Smartphones in Medical ICU

DM SEMINAR

Inderpaul Singh Sehgal

What is a PDA?

P

- ✓ Personal
- ✓ Portable
- ✓ Powerful

D

- ✓ Digital
- ✓ Diverse Applications

A

- ✓ Assistant
- ✓ Affordable

- **1990 (concept)**
- **Small Size**: like a notebook computer
- **Light Weight**: 4-6 pounds
- **Low Cost**: <$4000
- **Long Battery Life**: 3-4 hours

Why PDA's?

Isn't paper good enough?

- Advantages
  - Portability
  - Easy access
  - Fast data entry
  - Persistence
  - Low cost
  - No training required
- Disadvantages
  - Limited space
  - Personal shorthand
  - No backup
  - Static view
  - Volatility

Why PDA's?

Forces driving adoption of PDA's in Healthcare

- Rapidly rising cost of healthcare
- Greater awareness of medical errors
- Increased physician demand
- Increased demands on physicians
- Advances in technology

Why PDA's?

Increased Physician Demand

- Many **medical students** and **residents** being issued PDA's and *required* to use them
- Increasing complexity of disease management driving physicians to better methods of information management
- Increasing number of medical graduates computer literate

Advantages: Hardware

- Size: Palm
- However, we haven't seen real innovation in a long time
- Weight: Palm
- Battery Life: Palm
- Screen Size/Resolution: PocketPC
- Processor Speed/Memory: PocketPC
  (but may not be reflected in end user experience)

Available medical references

- Epocrates
  - Rx and ID guide in use by 25% of all physicians
  - Free !!!
  - Autoupdate via IP based syncing
- PocketMedicine
  - New company creating PDA specific content by known authors
- Handheldmed
  - Porting of popular medical handbooks to PDA format

Handheld Applications

Administrative

- ✓ Charge Capture
- ✓ Email
- ✓ Contacts
- ✓ File Cabinet
- ✓ Procedure Logs

Clinical Information

- ✓ Results
- ✓ Orders
- ✓ Medications
- ✓ Problem Lists
- ✓ Consults

Reference and Tools

- ✓ Drug Reference
- ✓ Formularies
- ✓ EBM Tools and Calculators
- ✓ Literature
- ✓ Research

Solution Architecture

Always Connected: PDA as a thin-client

- Requires always active wireless connectivity
- Useful Applications:
  - Order Entry
  - Real time monitoring
  - Lab Results viewing
  - Radiology Results viewing

Solution Architecture

Often Connected

- Frequently synchronized applications that can operate in a connected and disconnected modes
- Typically exist within the firewall of an enterprise
- Useful Applications:
  - Charge Capture
  - Lab Results
  - Medication Lists

Often-Connected Solutions

AvantGo: *The Internet on your handheld*

- Provides Palm, PocketPC and WAP Phone support for http based content and forms
- Free avantgo.com site allows configuration of public channels
- Enterprise server available for custom applications requiring security
- Advantage in leveraging existing http based infrastructure

Solution Architecture

Occasionally Connected

- Connected once a day or less, typically via internet
- Used for information management tasks that don't change much in a day
- Useful Applications:
  - Charge Capture--MDEverywhere
  - Electronic Prescription Pads--AllScripts, ePhysician
  - References with update features (ePocrates)

Occasionally Connected Solutions

Automatically Updating Reference Companies

- 500,000 user network including 25% of all physicians
- "DocAlerts" push information to users PDA's
- Free drug and infectious disease reference
- Will be providing automated Rx refill capability
- Users to earn honoraria ($$$) by participating in marketing

- Subscription-based access to text-book references (e.g. The Merck Manual)

Solution Architecture

Rarely Connected

- Connected less than once per day, typically just for backup to PC or periodic upgrades
- Many freeware or shareware examples available online
- Examples:
  - References
  - EBM Tools
  - Medical Calculators
  - Stand-alone patient management applications

Learnings over the last 5 years

- PDA's are here to stay
- Size Matters--The Newton had everything Palm does and more but it took the Palm Pilot to jump start the market and the Palm V to make it really take off.
- People will adopt their style for the right device/functionality--Grafitti

WIKIPEDIA
The Free Encyclopedia

Smartphone

From Wikipedia, the free encyclopedia

This article **needs additional citations for verification**. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed. *(August 2013)*

A **smartphone**, or **smart phone**, is a mobile phone built on a mobile operating system, with more advanced computing capability and connectivity than a feature phone.[1][2][3] The combined the functions of a personal digital assistant (PDA) with a mobile phone. Later models added the functionality of portable media players, low-end compact digital cameras, cameras, and GPS navigation units to form one multi-use device. Many modern smartphones also include high-resolution touchscreens and web browsers that display standard wel as mobile-optimized sites. High-speed data access is provided by Wi-Fi and mobile broadband. In recent years, the rapid development of mobile app markets and of mobile comme drivers of smartphone adoption.

The mobile operating systems (OS) used by modern smartphones include Google's Android, Apple's iOS, Nokia's Symbian, RIM's BlackBerry OS, Samsung's Bada, Microsoft's Wi Hewlett-Packard's webOS, and embedded Linux distributions such as Maemo and MeeGo. Such operating systems can be installed on many different phone models, and typically receive multiple OS software updates over its lifetime. A few other upcoming operating systems are Mozilla's Firefox OS, Canonical Ltd.'s Ubuntu Phone, and Tizen.

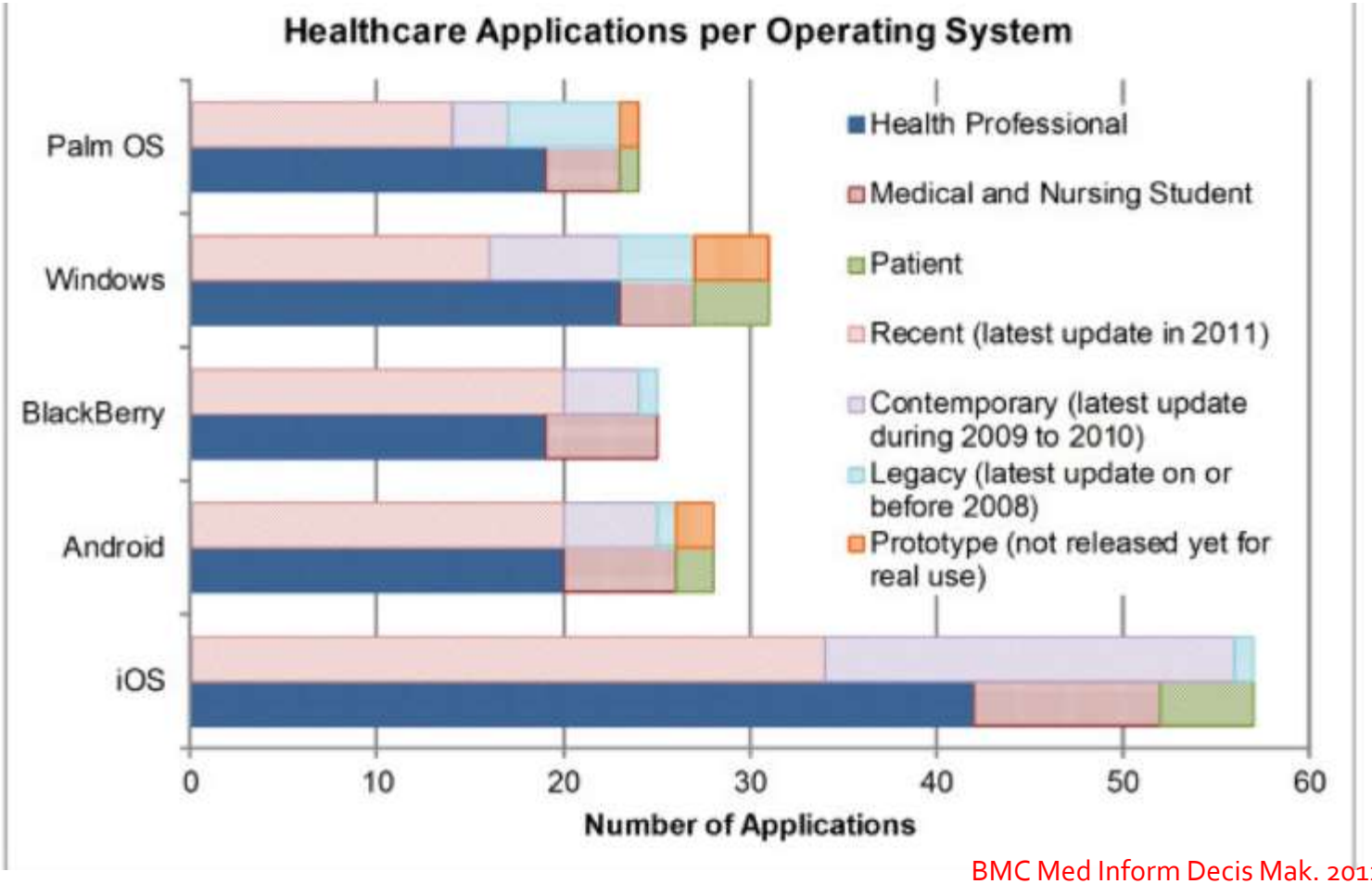
Worldwide sales of smartphones exceeded those of feature phones in early 2013.[4] As of July 18, 2013, 90 percent of global handset sales are attributed to the purchase of iPhone smartphones.[5]

Advantages of a smartphone

- Simplifies the life of a physician
- Rapid data entry
- Synchronization of data on various devices
- Better communication & expert opinion
- Newer devices with better memory
- Smartphones as 2 way pagers

The operating system! How does it work?

- 7 primary operating system (OS)
  - Windows mobile 6.0
  - Symbian
  - Blackberry
  - Palm OS
  - Pocket PC
  - IPhone
  - Android



BMC Med Inform Decis Mak. 2012; 12: 67

BMC Med Inform Decis Mak. 2012; 12: 121.
Published online 2012 October 30. doi: 10.1186/1472-6947-12-121
PMCID: PMC3504572

Smartphone and medical related App use among medical students and junior doctors in the United Kingdom (UK): a regional survey

Karl Frederick Braekkan Payne,[1] Heather Wharrad,[2] and Kim Watts[2]

Percentage of medical students and junior doctors owning medical related smartphone apps

Question response	Medical student cohort (n=203)	Junior doctor cohort (n=98)
No	20.2% (41)	24.5% (24)
Yes – 1–5 apps	52.2% (106)	51.0% (50)
Yes – 6–10 apps	16.7% (34)	20.4% (20)
Yes – 11–15 apps	5.9% (12)	3.1% (3)
Yes – 16–20 apps	1.5% (3)	1.0% (1)
Yes – 21–25 apps	1.5% (3)	0.0% (0)
Yes – 26–30 apps	1.0% (2)	0.0% (0)
Yes – 30+ apps	1.0% (2)	0.0% (0)

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Frequency of use of medical related apps within medical student and junior doctor groups

Question response	Medical student cohort		Junior doctor cohort (n=98)
	Clinical attachment (n=137/203)	Medical school education (n=160/203)	
Several times a day	22.6% (31)	14.4% (23)	14.3% (14)
Once or twice a day	19.0% (26)	20.0% (32)	15.3% (15)
2-3 times a week	19.7% (27)	17.5% (28)	20.4% (20)
Once a week	13.1% (18)	14.4% (23)	6.1% (6)
Rarely used	8.8% (12)	18.1% (29)	16.3% (16)

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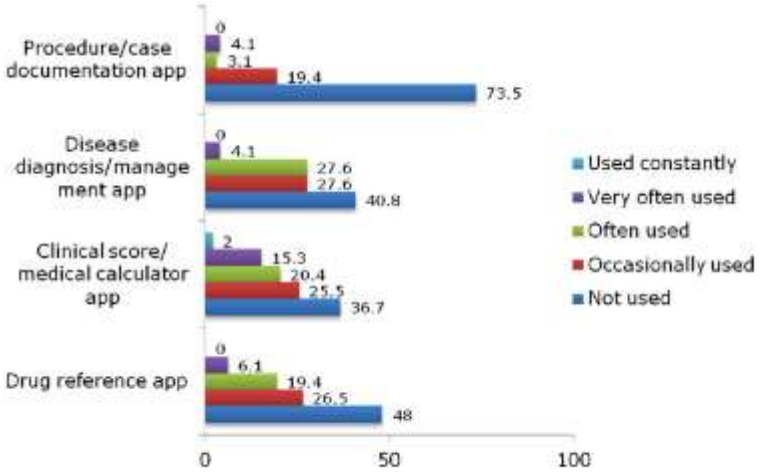
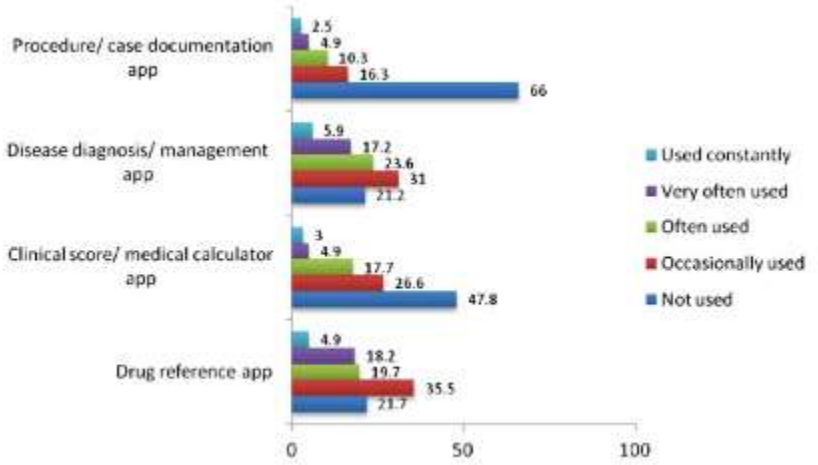


Percentage frequency of use of different categories of medical apps within the junior doctor group (n=98).



Percentage frequency of use of different categories of medical apps within the medical student group (n=203).

Do they really help in ICU?

- Administrative support (billing & scheduling)
- Patient tracking & electronic prescription
- Documentation
- Decision support (clinical & drug references)
- Education & research tool

J Med Syst 2005;29(4):335-342
Int J Med Inform 2005;74(5):409-422
Health Inform J 2005;11(2):123- 134

Research article

Handheld computers in critical care

Stephen E Lapinsky, Jason Weshler, Sangeeta Mehta, Mark Varkul, Dave Hallett and Thomas E Stewart

Background Computing technology has the potential to improve health care management but is often underutilized. Handheld computers are versatile and relatively inexpensive, bringing the benefits of computers to the bedside. We evaluated the role of this technology for managing patient data and accessing medical reference information, in an academic intensive-care unit (ICU).

Methods Palm III series handheld devices were given to the ICU team, each installed with medical reference information, schedules, and contact numbers. Users underwent a 1-hour training session introducing the hardware and software. Various patient data management applications were assessed during the study period. Qualitative assessment of the benefits, drawbacks, and suggestions was performed by an independent company, using focus groups. An objective comparison between a paper and electronic handheld textbook was achieved using clinical scenario tests.

Results During the 6-month study period, the 20 physicians and 6 paramedical staff who used the handheld devices found them convenient and functional but suggested more comprehensive training and improved search facilities. Comparison of the handheld computer with the conventional paper text revealed equivalence. Access to computerized patient information improved communication, particularly with regard to long-stay patients, but changes to the software and the process were suggested.

Conclusions The introduction of this technology was well received despite differences in users' familiarity with the devices. Handheld computers have potential in the ICU, but systems need to be developed specifically for the critical-care environment.

Critical Care 2001, 5:227–231

JAMIA
Journal of the American Medical Informatics Association
Current TOC | Instructions for authors

J Am Med Inform Assoc. 2005 Jul-Aug; 12(4): 398–402.
doi: 10.1197/jamia.M1798
PMCID: PMC1174884

Handheld Computer-based Decision Support Reduces Patient Length of Stay and Antibiotic Prescribing in Critical Care

Abstract

Objective: This study assessed the effect of a handheld computer-based decision support system (DSS) on antibiotic use and patient outcomes in a critical care unit.

Design: A DSS containing four types of evidence (patient microbiology reports, local antibiotic guidelines, unit-specific antibiotic susceptibility data for common bacterial pathogens, and a clinical pulmonary infection score calculator) was developed and implemented on a handheld computer for use in the intensive care unit at a tertiary referral hospital. System impact was assessed in a prospective "before/after" cohort trial lasting 12 months. Outcome measures were defined daily doses (DDDs) of antibiotics per 1,000 patient-days, patient length of stay, and mortality.

Results: The number of admissions, APACHE (Acute Physiology, Age, and Chronic Health Evaluation) II and SAPS (Simplified Acute Physiology Score) II for patients in preintervention, and intervention (DSS use) periods were statistically comparable. The mean patient length of stay and the use of antibiotics in the unit during six months of the DSS use decreased from 7.15 to 6.22 bed-days ($p = 0.02$) and from 1,767 DDD to 1,458 DDD per 1,000 patient-days ($p = 0.04$), respectively, with no change in mortality. The DSS was accessed 674 times during 168 days of the trial. Microbiology reports and antibiotic guidelines were the two most commonly used (53% and 22.5%, respectively) types of evidence. The greatest reduction was observed in the use of β-lactamase–resistant penicillins and vancomycin.

Conclusion: Handheld computer-based decision support contributed to a significant reduction in patient length of stay and antibiotic prescribing in a critical care unit.

Rapid response & communication

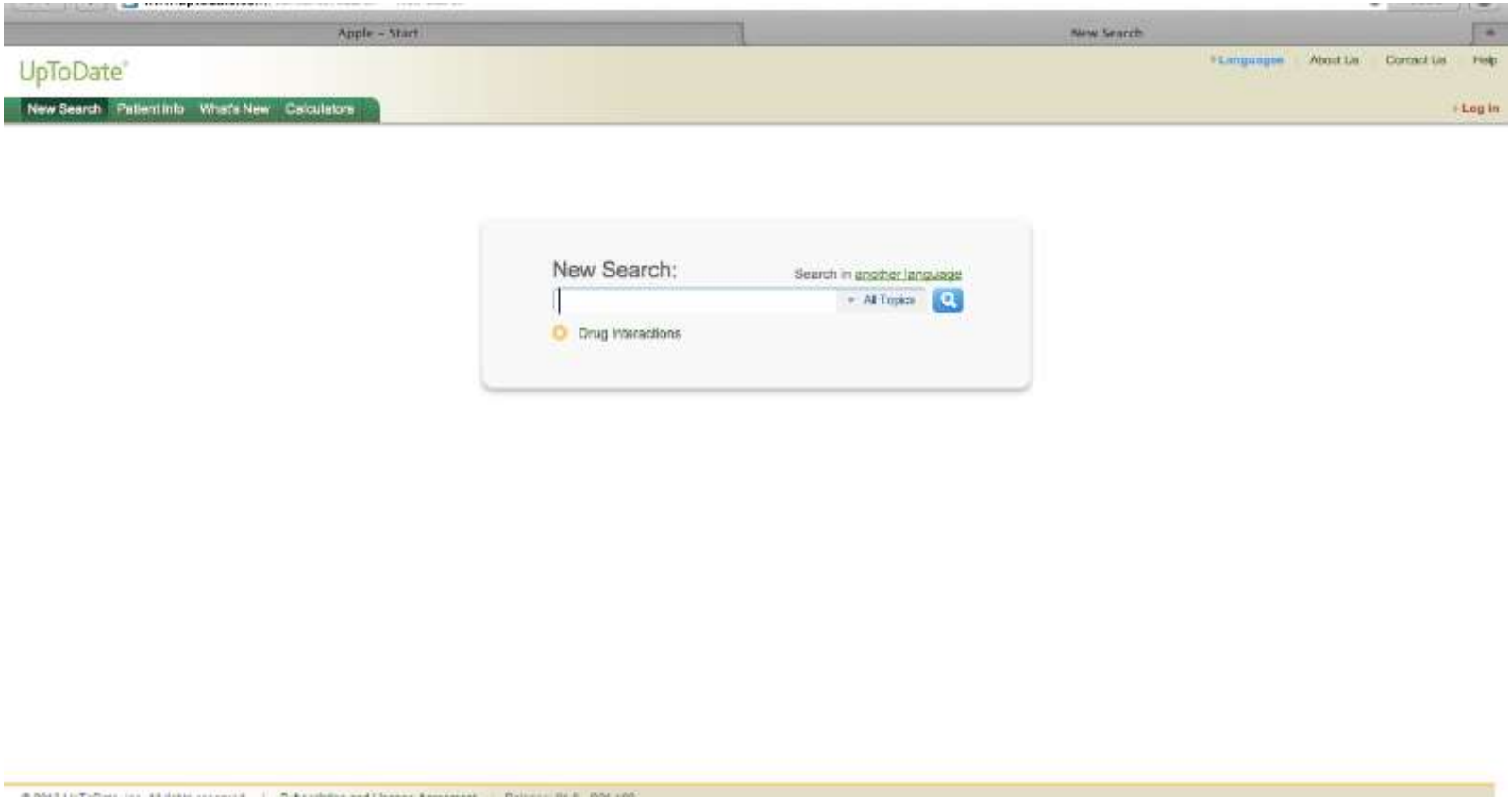
Authors	Study type	Speciality area	Aim	Outcomes	Impact
Adams et al (2006)	Pre-post intervention	emergency	To investigate whether prehospital ECG transmission to cardiologist hand held device could decrease door to treatment time	Median time from ED arrival to reperfusion time	Allowed earlier intervention 50 min v/s 101 min
Clemmensen et al (2005)	Prospective study	Emergency	Evaluate safety and feasibility of pre hospital ECG transmission	Mean time from ED arrival to reperfusion	40 mins v/s 94 min
Reponen et al (2000)	Case control study	Emergency	To explore the accuracy of present technology in emergency teleradiology	Image quality for reporting	Present PDA technology is feasible for preliminary interpretations and may speed up treatment initiation by providing images directly to the responsible physician
Aziz et al (2005)	Cross over study	Surgical	Whether PDA is more efficient than pager in communication	Mean call response time	PDA, with mobile phone capabilities, enables faster inter-professional communication and overcomes

Decision support

Authors	Study type	Aim	Outcome measures	Outcome
Rudkin et al (2006)	Crossover study; Emergency	To assess the feasibility of PDAs and determine the rate of patient management changes	Rate of patient management change	Changes in patient management were higher using PDA (29.8% compared with 17.6%), particularly for changes in drug type
Sintchenko et al (2005)	Prospective; ICU	Effect of PDA on antibiotic use	Total antibiotic use Mean ICU stay	Antibiotic use decreased from 1925 daily doses per 1000 patient days to 1606 (p=0.04); Icu stay also decreased (6.22 v/s 7.15 bed days;p=0.02)

Health care applications

- 900,000 applications on apple store June 2013; 20,000 medical applications (July 2013)
- 1 million applications in android market July 2013; 8861 medical applications(August 2013)
- 7 categories of medical applications
    1. Disease diagnosis
    2. Drug reference
    3. Medical calculators
    4. Literature search
    5. Clinical communication
    6. Hospital information system
    7. Medical training


Apple – Start
New Search
UpToDate
Language
About Us
Contact Us
Help
New Search
Patient Info
What's New
Calculators
Log In
New Search:
Search in another language
All Topics
Drug Interactions

Journal of HOSPITAL MEDICINE www.journalofhospitalmedicine.com

ORIGINAL RESEARCH

Use of *UpToDate* and Outcomes in US Hospitals

Thomas Isaac, MD, MBA, MPH[1], Jie Zheng, PhD[2], Ashish Jha, MD, MPH[2,3,4]*

BACKGROUND: Computerized clinical knowledge management systems hold enormous potential for improving quality and efficiency. However, their impact on clinical practice is not well known.

OBJECTIVE: To examine the impact of *UpToDate* on outcomes of care.

DESIGN: Retrospective study.

SETTING: National sample of US inpatient hospitals.

PATIENTS: Fee-for-service Medicare beneficiaries.

INTERVENTION: Adoption of *UpToDate* in US hospitals.

MEASUREMENT: Risk-adjusted lengths of stay, mortality rates, and quality performance.

RESULTS: We found that patients admitted to hospitals using *UpToDate* had shorter lengths of stay than patients admitted to non-*UpToDate* hospitals overall (5.6 days vs 5.7 days; $P < 0.001$) and among 6 prespecified conditions (range, −0.1 to −0.3 days; $P < 0.001$ for each). Further, patients admitted to *UpToDate* hospitals had lower risk-adjusted mortality rate for 3 of the 6 conditions (range, −0.1% to −0.6% mortality reduction; $P < 0.05$). Finally, hospitals with *UpToDate* had better quality performance for every condition on the Hospital Quality Alliance metrics. In subgroup analyses, we found that it was the smaller hospitals and the non-teaching hospitals where the benefits of the *UpToDate* seemed most pronounced, compared to the larger, teaching institutions where the benefits of *UpToDate* seemed small or nonexistent.

CONCLUSIONS: We found a very small but consistent association between use of *UpToDate* and reduced length of stay, lower risk-adjusted mortality rates, and better quality performance, at least in the smaller, non-teaching institutions. These findings may suggest that computerized tools such as *UpToDate* could be helpful in improving care. *Journal of Hospital Medicine* 2012;7:85–90 © 2011 Society of Hospital Medicine

Original Article

Singapore Med J 2012; 53(2) : 116

Utility of the electronic information resource UpToDate for clinical decision-making at bedside rounds

Phua J[1], MBBS, MRCP, *See KC*[1], MBBS, MRCP, *Khalizah HJ*[1], MBChB MMed, MRCP, *Low SP*[1], MBBS, MRCP, *Lim TK*[1], MBBS, FRCPE

INTRODUCTION Clinical questions often arise at daily hospital bedside rounds. Yet, little information exists on how the search for answers may be facilitated. The aim of this prospective study was, therefore, to evaluate the overall utility, including the feasibility and usefulness of incorporating searches of UpToDate, a popular online information resource, into rounds.

METHODS Doctors searched UpToDate for any unresolved clinical questions during rounds for patients in general medicine and respiratory wards, and in the medical intensive care unit of a tertiary teaching hospital. The nature of the questions and the results of the searches were recorded. Searches were deemed feasible if they were completed during the rounds and useful if they provided a satisfactory answer.

RESULTS A total of 157 UpToDate searches were performed during the study period. Questions were raised by all ranks of clinicians from junior doctors to consultants. The searches were feasible and performed immediately during rounds 44% of the time. Each search took a median of three minutes (first quartile: two minutes, third quartile: five minutes). UpToDate provided a useful and satisfactory answer 75% of the time, a partial answer 17% of the time and no answer 9% of the time. It led to a change in investigations, diagnosis or management 37% of the time, confirmed what was originally known or planned 38% of the time and had no effect 25% of the time.

CONCLUSION Incorporating UpToDate searches into daily bedside rounds was feasible and useful in clinical decision-making.

SURFING THE WEB INVITED ARTICLE
Victor L. Yu, Section Editor

Mobile Infectious Disease References: From the Bedside to the Beach

Steven D. Burdette,[1] Robin Trotman,[2] and John Cmar[3]

[1]Department of Medicine, Wright State University Boonshoft School of Medicine, Dayton, Ohio; [2]Cox Health Infectious Diseases Specialty Clinic, Springfield, Missouri; and [3]Department of Medicine, Sinai Hospital of Baltimore, Maryland

Point-of-care access to current medical information is easily available to the practitioner through the use of smartphones, iPads, and other personal digital assistants. There are numerous mobile applications (apps) that provide easy-to-use and often well-referenced medical guidance for the infectious diseases practitioner. We reviewed 6 commonly utilized mobile apps available for handheld devices: the Emergency Medicine Residents' Association's (EMRA's) Antibiotic Guide, Epocrates Deluxe, Johns Hopkins Antibiotic Guide, Sanford Guide, the Medscape mobile app, and the Infectious Diseases Compendium. We evaluated several basic infectious diseases topics (including but not limited to endocarditis, vancomycin, and *Acinetobacter* infection) and attempted to objectively score them for metrics that would help the provider determine which mobile app would be most useful for his or her practice. The Johns Hopkins Antibiotic Guide and the Sanford Guide had the highest cumulative scores, whereas EMRA scored the lowest. We found that no single app will meet all of the needs of an infectious diseases physician. Each app delivers content in a unique way and would meet divergent needs for all practitioners, from the experienced clinician to the trainee. The ability to rapidly access trusted medical knowledge at the point of care can help all healthcare providers better treat their patients' infections.

What' s next ?

Nursing Times.net

London hospitals pioneer video link for ICU monitoring

3 July, 2013 | By The Press Association

Some patients in intensive care will be monitored by video link from a remote location, it has been announced.

Two hospitals in London will become the first in Europe to use the system within the next 12 months.

Guy's and St Thomas' will install the Philips eICU Program to enable patients to be monitored by specialists using clinical software, high definition video cameras and two-way audio communication.

The system will provide care to a minimum of 65 patients, with the potential to expand to cover 120.

According to Philips the technology has cut death rates by 27% and reduced the length of hospital stays by 23% in the USA, where it is used in around 300 hospitals.

Dr Richard Beale, clinical director of perioperative, critical care and pain services at Guy's and St. Thomas', said: "ICU (intensive care unit) is one of the most challenging areas of the hospital - it is where doctors and nurses respond to the sickest, most vulnerable patients who can rapidly take a turn for the worse with little or no advance warning.

"With Philips' eICU Program, the bedside clinical staff will have immediate access to a team of highly skilled senior colleagues who provide an added layer of support to help save lives, reduce complications and decrease the length of ICU stays."

Brian Rosenfeld, chief medical officer for Telehealth at Philips Healthcare, said: "Improving patient care

Do we need a regulatory body ?

Should the FDA regulate mobile medical apps?

Bradley Merrill Thompson says regulation of certain medical apps is essential for patient safety, but **Ira Brodsky** believes unfettered development could see the reinvention of healthcare

Bradley Merrill Thompson *attorney*[1], Ira Brodsky *consultant* [2]

[1]Epstein Becker & Green, 1227 25th Street, NW, Washington, DC 20037, USA ; [2]Datacomm Research, St Louis, MO, USA

Too much of interference may hinder development
No regulation may lead to patient harm then benefit

BMJ 2013;347:f5211

What else we can do in future?

- Get medical reports of patients on the go via intranet
- Get radiology directly on our smartphones
- Institutional uptodate access round the clock in ICU
- Access to e journals
- Provision of telemedicine consults to other ICU s
- 24 hours monitoring of our patients even from home

Conclusion

- Smartphones are the need of the hour
- Revolutionized the current medical practice
- Brings state of the art care to bedside
- We all love gadgets, its time to use them for patient care
- Randomized trials to prove benefit of smartphone usage and medical applications in improving patient outcomes