Original Article

Indian Journal of Anaesthesia and Analgesia
Volume 2 Number 1, January - June 2015
DOI: https://dx.doi.org/10.21088/ijaa.2349.8471.2115.3

Handheld devices and Informatics in Anaesthesia

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Abstract

Handheld devices like smart phones, once viewed as a diversion and interference have become an integral part of healthcare. Medical informatics helps us by analysing complex data in making clinical decisions and knowing recent advances at the point of patient care. Together handheld devices and Informatics is changing the way medicine is being practised. The anaesthesia and critical care related applications are discussed and possible drawbacks are also discussed.

Keywords: Informatics; Anesthesia informatics; Anaesthesia; Critical care; Devices; Smart phones.

Indroduction

The integration of technology into medicine has made the entire process of patient management more efficient, accurate and safer. Complex medical devices are becoming smaller and robust, and hand held devices have an increasing role to play in day to day patient management. Hand held devices like smart phones, personal digital assistants (PDA), and other informatics devices can and is changing the way medicine is practiced now.

Information overload

The need to stay up to date in treatment modalities is being felt more than ever before, in this era of evidence based medicine. Compared to text books and knowledge of teachers being the only source of information a few decades back, today we have several.

Sources of medical information

1. Peer reviewed Journals
2. Text books with editions every few years
3. Conferences and seminars
4. Association Guidelines
5. National and institutional protocols
6. Pharmaceuticals Monographs
7. Expert opinions, best practice guidelines
8. Web based resources

Can we know them all?

Since 2005, between 2000 to 4000 completed references are added each day Tuesday to Saturday, amounting to more than 700,000 articles in 2013, according to medline.[1] Even within a narrow speciality, it is close to impossible to keep up with all the published medical reports.[2] The authors mention with the ever increasing number of medical publications, however narrow the field may be, it is impossible to be up to date and be an expert.

Considering if a cardiac imaging trainee reads 40

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papers a day five days a week, it will take them 11 years to read all the published articles, by that time another 82,000 papers would have come out.[2,3]

Various strategies to keep with the information overload has been suggested, but computers and informatics can help us tremendously in filtering huge loads of information and provide us what exactly we need.

Clinical Parameters and interpretation

As monitoring and laboratory parameters are increasing it becomes difficult for the human mind to process them and arrive at a clinically relevant diagnosis. Human mind can process only 4 variables at a time, adequately.[4] Considering a patient in an intensive care unit can generate upto 236 variables,[5] it is possible to miss relevant data that can help in diagnosis and management. On the other hand, such excess of information can even lead to diagnostic errors and neglect of relevant data. So we need not just variables, but intelligent informatics systems that process these variables and give us clinical hypotheses that best explain the data.[6]

Hand held devices equipped with medical informatics systems can help us to arrive at accurate diagnoses and in better management of the patient. Another human factor is fatigue and mood of the physician can lead to errors and deviations from protocols. Emotion can play a role in decision making, and studies in both psychology and economics have demonstrated human fallibility in everyday decision making.[7] This is not possible with computers. Also when hand held devices are used in critical care units, it has been shown there is a significant reduction in patient length of stay and antibiotic prescribing in a critical care unit.[8] In other words, a handheld informatics system will serve as an invaluable assistant to the physician and help them in taking rational and evidence based decisions.

Medical informatics

Medical informatics can be defined as a Complex science that integrates relevant theories, design methodologies, and knowledge of best practices drawn from various cognitive, computational, informational, organizational, and other expert knowledge domains.[9] It involves synergistically collecting, storing, organizing, manipulating, using, and disseminating clinical-based and health-related information.

How can Informatics help Anaesthesia?

There are three major areas where informatics is used in medicine.

1. as a tool of electronic record keeping and retrieval. This is a valuable tool for practitioners and researchers.
2. It can help us in making decisions based on patients' clinical parameters and a database of best practices from reliable sources. This is called HDSS or Health decision support systems. Intelligent medical informatics, should be able to mimic the thought process of an expert physician.[9]
3. Telemedicine-the ability to diagnose and treat diseases remotely. This is the basis of tele-ICU and tele-surgery.

The anaesthesia related informatics systems are known as Anaesthesia information management system or AIMS. Most of the features of the AIMS can be accessed via hand held devices. Companies like McKessons, Stanford Anesthesia informatics provide integration of the informatics systems with hand held devices.

Storing and accessing patient data, automatic recording of intra-operative

vitals and events, calculating drug dosages and predicting possible drug interactions based on the patients history, diagnosing light anaesthesia and unstable blood pressures, reminders for drugs that has to administered (like insulin, DVT prophylaxis, antibiotics), Scheduling surgeries, tracking post operative patients are only some of the possibilities of anaesthesia informatics systems. The decision support system can help in making prompt decisions after analysing multiple variables.

Internet in Handheld devices

Another major application of handheld devices is accessing internet for information. Most AIMS devices provide integrated internet access.

e-Learning is a concept where computers and networks are used to provide online educational materials and communication. Modules rich in multimedia teaching files and discussions and feedback create a virtual classroom. It is also referred to by other terms: online learning, computer-assisted-learning, or Web-based learning. e Learners have demonstrated increased retention rates and better utilization of content.[10] Other advantages include the learner can control the pace, timeliness content and sequence of learning. Interactive learning enables users to manipulate variables and observe outcomes, for example drug kinetics. Several societies and associations offer eLearning modules on various topics, which can be accessed from handheld computers also.

For the practicing anaesthesiologist, the need to stay upto date in current concepts and guidelines is being felt like never before. The need to retrieve reliable and clinically relevant data rapidly at the point of care has made few institutions to employ perioperative librarians dedicated solely to this purpose.

While accessing information from the internet, the pitfalls should be borne in mind. The source, reliability, and time of publishing should be noted. Most patients and even some health care professionals believe any information from the world wide web is reliable. For example, the quality of drug information from Wikipedia continues to be inconsistent, and clinicians may inappropriately rely upon it.[11] Like all other medical literature, information from Web sites should be evaluated and compared to prior knowledge, new studies, and current recommendations.[12]

Devices that became handheld

As technology advances, we have smaller devices capable of doing more and more. Remote monitoring via a hand held devices in real time is possible. The hand held device communicates with the server wirelessly via Bluetooth(range- 10 -20m), w-Lan(70-100m), Internet, or newer protocols like zigbee.

Ultrasound devices have become hand held, enabling greater mobility and ease of use. Most requires the image to be transferred to a computer for proper processing and reporting. At least three manufacturers are currently marketing handheld USG devices. Vscan by General Electricals, mobisante US and Signostics.

The smart phone as a medical device

Apart from accessing internet and AIMS, the smart phone has found several uses in our day to day practice. Since 2010, smart phones have virtually replaced personal digital assistants or PDAs. Today the major operating systems used in smart phones are windows, iOs and android. Most smart phone apps provide cross platform compatibility.

Today, a smart phone has the ability that a personal computer had few years back. The huge storage capacity, fast processing speed and memory enables them to store entire textbooks or rather libraries. Most journal articles can be accessed anytime and social media sites like facebook are providing a platform where case discussions can be carried out with peers. Videos of procedures can be watched, and calculation of drug dosages and infusion rates have never been easier. Podcasts, where digital media files can be downloaded and watched later helps in understanding complex concepts with ease. Podcasting uses RSS (Rich site summary) format to broadcast audio or video files from Web sites to portable players, allowing physicians to access educational materials at the point of care. AIMS manufacturers like McKessons and Metavision provide apps meant for smart phones connectivity.

Other out of the box usages of smart phones have been reported. Age appropriate videos shown to children before induction has been shown to allay anxiety, a technique nicknamed iphone induction.[13]

The high definition cameras of iPod touch have been used as a low cost remote monitor.[14] The accelerometer (the hardware that senses orientation and motion of the device) has been used to accurately measure 15 degree tilt during caesarean sections [13] and as a monitor for neuromuscular junction,[16] where the fade can be demonstrated accurately as a graph.

iStethoscope is an iphone app, which enables the user to record heart sounds and create a wave form display. The sound files can be sent to another user, and opinion obtained. The app uses a proper stethoscope that needs to be attached to the microphone socket of the phone.

Smart phone medical Apps

A lot of anaesthesia related applications are available for smart phones. Ready reckoner for calculating drug doses, endotracheal tube sizes, normal laboratory values are available. Pharmacokinetic models and pro-calculator are some of the apps worth mentioning. All said and done, the accuracy of data cannot be guaranteed and should not be relied upon to replace our knowledge. Several drug databases are also available. A review of the smart phone apps for paediatric anaesthesia was published in 2012.[17]

A survey after 4 weeks of physician use of a clinical reference application (including a pharmacopeia, infectious disease reference, diagnostic and therapeutic data) found that 39% of participants reported using the software during more than half of their patient encounters and 61% believed that use of the clinical reference prevented adverse drug events or medication errors three or more times during the 4-week study period. They also believed that using the application helped them to improve patient care and was valuable in learning about recent alerts.[18]

FDA's take on smartphone as a medical device

It is estimated that more than 500 million smart phone users will be using a medical application by 2015. Epocrates, a leading software for health professionals is being used by more than half of US doctors for accessing information on drug dosing, interactions and insurance information, according to the company. On July 21, 2011, the U.S FDA issued a "draft guidance" discussing how it intends to regulate mobile medical apps. Soon we will have FDA approved medical apps, subjected to regulations.

Hazards of handheld devices

1. *Distraction:* Handheld devices especially smart phones can distract health care providers especially when used in operation theatres and critical care units. Slagle and Weinger[19] note that with the introduction of electronic patient care information, the opportunities and allure of electronic non-patient care activities, e.g., web surfing, are increasing.

   A study presented in 2011 ASA annual meeting found that nurse anaesthetists and residents were distracted by something other than patient care in 54% of the cases, even when they knew they were being watched.[20] A 'no personal internet use policy' and restricted use by personnel can be the only solution. Most anaesthesiologists view their mobile phone as a life saving device rather than a life threatening one.

2. *Interference:* Can handheld devices cause electromagnetic or radio frequency interference with sensitive medical equipment like ventilators and pace makers? Most of the anecdotal reports were seen with cardiac monitors[21] and pacemakers. Initially a one meter rule was proposed by Irnich *et al*[22], which suggested restriction of mobile phone use to greater than 1 meter from equipment, and it still holds good. However, such interference are not seen with modern mobile devices with low electromagnetic interference, and medical equipment which by FDA regulations, should be immune from interference in fields of up to 7 V/m within the frequency range of 450–1000 MHz.[23]

3. *Infection:* Mobile devices have been shown to harbour numerous pathogens, including MRSA, Coagulase negative Staphylococcus aureus and kleibsella. After the use of mobile phones, 38 out of 40 anaesthetists had bacterial contamination in their hands, 4/40 were human pathogens.[24] Frequent wiping of mobile surfaces with antiseptics and using antiseptic covers has been recommended. Avoidance in sensitive areas seems to be prudent. (ICU,transplant theatres etc.)

Future

As technology improves, devices will get small, robust and versatile. Remote anaesthesia is now a possibility. A remote intubation system, Keplar Intubation system has been developed by Thomas Hemmerling, McGill University (2011).[25] Similarly a remote anaesthesia maintenance system McSleepy[26], (developed by Intelligent technologies in Anaesthesia) can maintain anaesthesia by automatically adjusting the infusion rates of drugs bases on three patient parameters (Depth of hypnosis via EEG, Analgascore for pain, and muscle relaxation via phonomyography).

Google glass, with real time video streaming can prove invaluable in scenarios like difficult intubation and out of the hospital activities where the user can get guidance from an expert in real time. The future of handheld devices hold much promise, and judicious usage helps us in early and accurate diagnoses, evidence based management of patients and accessing reliable information from our finger tips. Like all technology, the ultimate result lies in the way it is used.

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