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To *TPJ:*

Why the current generation of handheld computing devices will not have a significant impact on clinical computing

I am not a neo-Luddite.[1] I am a true fan and user of the current generation of handheld computers. Because clinical computing is about communication among members of the clinical team, I do not think that this generation of handheld computing devices will have any significant impact on the field of clinical computing. To achieve this seemingly simple goal of clinical communication requires a tremendous amount of data input and output. Any hardware designed to facilitate this goal should be easy to use (ie, easy to enter data as well as retrieve and review it) and able to send and receive information throughout the health care delivery network. Because very few health care providers have ever seen such extensive networks (ie, the Latter Day Saints Hospital in Salt Lake City, UT or the Brigham & Women's Hospital in Boston, MA) in operation, many are now assuming that the current generation of handheld computers is capable of performing these tasks and hence transforming the field of clinical computing. They are wrong!

The current generation of handheld computing devices is best suited to replace the small reference books (eg, drug dosage and interaction guides and therapeutic guidelines) and index cards containing current patient lists which clinicians routinely carry in their pockets. Consolidating all of these paper-based information resources into a small, searchable, and upgradable device is a great idea, but such a device cannot make the leap from a single user information resource to an integrated clinical computing device for all of the following reasons:

1. Difficulties in entering data

Over the past 50 years data input has consistently been the most difficult obstacle for all clinical computing system developers. The ease and accuracy with which the user can enter data often decide whether an application will be used or not. Even though the "graffiti" interface was a significant improvement over previous character recognition solutions, it is still much slower than using a keyboard to enter anything more than a few characters. In addition, the extremely small screen space available for data display makes the use of checklists or any other kind of list subject to extensive vertical scrolling, a known thorn in the side of any user interface designer. While portable keyboards exist, if the user is going to take the time and space to connect such a device, I believe that a small laptop computer with a larger display screen and normal keyboard is more useful. For specific applications with low data entry requirements like the error prone medication administration process in hospitals, a dedicated device with a wireless connection to a LAN and a barcode reader could be developed to help nurses keep an automated medication administration record.

2. Difficulties in reviewing data

When asked what data they need to make clinical decisions, most clinicians say, "I want to see EVERYTHING on ONE SCREEN." It is unthinkable that one could design an acceptable clinical data display for the 160x160-pixel displays currently available. The extremely limited space available for data entry and the difficulties in entering more than a few characters make looking up information from a list of 50 or more entries very difficult. On the other hand, if someone were to develop an ultra micro LCD projector that could be incorporated into the handheld (perhaps as a "springboard" accessory to a Handspring computer), allowing the device to project a large image on any flat surface, then the data review problems could be solved.

3. Lack of security of data on the device

If one of these handheld devices is lost or stolen, the data can often be read by whomever obtains the device. Although it is possible to protect the "desktop" of the device with a password, such a password significantly reduces the utility of the device for rapid "lookup" of information and is therefore not routinely used by clinicians. In addition to password protection, the PalmOS offers a "private" designator for files stored on the handheld. This rudimentary password protection scheme offers little protection against savvy

thieves because most private data can be simply uploaded to a PC and then read using any standard text reader. Finally, although there are many contenders, there is no cryptographic standard for the transmission of handheld computer data to a central network. Therefore, applications that transmit data (via LAN or WAN) as unencrypted packets of information are vulnerable to "sniffers" that can capture these packets and expose their contents. Additionally, system administrators, who may not be authorized to view sensitive patient data, can access data stored on the local servers.

4. Difficulties in connecting to a central data repository

Because the key concept in clinical computing is communication of information among the members of the clinical team, a handheld device that is not in real-time contact with a central data repository is by definition not capable of displaying the most recent clinical data available (eg, lab results or the current medication list). Therefore, any solution based on the idea that clinicians will "sync" their devices with a central data repository is doomed to failure. Although there exist several "wireless" networking solutions for handheld devices, these are still in relative infancy and do not meet the complex needs (ie, bandwidth, security, reliability) of the clinical computing environment. On the other hand, if a clinician is out of the office and answering a patient-related call, having to wait 10-15 seconds for each screen of data to appear and then slowly scrolling through it before answering the question could save both the patient's life and the family outing.

5. Basic hardware constraints

a. Limited battery life

A clinician using a handheld device with a color display and a wireless networking solution would need to recharge or replace the batteries more than once a week.

b. Subject to breakage

Most commercially available handheld devices have not been toughened for routine use in the somewhat hostile clinical environment. Although there are handheld devices capable of withstanding drops of up to 4 ft (1.2 m) onto concrete, they are not the ones routinely seen in the hands, and certainly not in the shirt pockets, of clinicians. In addition, very few of the current handheld devices meet the IP54 standards (International Protection) for protection against water splashes and dust.

c. Expense and challenges associated with implementing robust wireless networks

Setting up structured wireless LANs is a challenge. These networks consist of access points (AP) spread around a building, and connected to each other or onto the wired LAN using copper cable. Mobile users in range of an AP can connect to other wireless users or to network resources. As a user moves around the building, the AP hands off responsibility for that user to the next AP. Ensuring elimination of collisions, which occur when two or more nodes sharing a communication medium transmit data together, is difficult.

Conclusion

Although the current generation of handheld computing devices is appealing for a variety of reasons (eg, low cost, small size, portability, "instant on") and useful in limited ways, these devices are not capable of facing the challenges posed by the current clinical computing environment. ❖

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Reference

1. Ned Ludd was a workman in 19th-century England. He and others destroyed labor-saving machinery as protest. Hence the term Luddite has come to represent anyone who is opposed to technological progress, especially those who resort to violence to illustrate their point. Those who are against the most recent advances have been referred to as Neo-Luddites.