Author's response to reviews

Title: Handheld Computers and the 21st Century Surgical Team: A Pilot Study

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Author's response to reviews: see over
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Editorial Team, *BMC Surgery*

Dear Sir,

Re: MS: 1748906694566283 - Handheld Computers and the 21st Century Surgical Team: A Pilot Study

Thank you considering the above manuscript for publication in BMC Surgery. We have carefully addressed the reviewers' comments, and have made the suggested changes and attach with this letter the following:

1. A reply to the reviewers outlining the changes to the manuscript
2. The revised manuscript

I greatly look forward to your reply. Please do not hesitate to contact me if there is any further information that you may require.

Kind Regards

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Author Reply

Reviewer #1: Elske Ammenwerth

Major compulsory revisions:

Comment 1: “It seems that the first part of the study (that is to assess improvements in communication by PDA) does not, as the authors state, compare Pager vs. PDA, but only pager vs. mobile phone. Here, it is not very surprising that the mobile phone as bi-directional communication device is answered more quickly (as the authors state, with a page, the doctors first have to search for a phone). This should be made more clear both in the methods as well as in the discussion section.”

Reply 1: We acknowledge this comment and have added it to both the methods (page 7) and discussion (page 10) sections:

“The main feature of this device being compared to the conventional pager was its use as a mobile phone, but other features such as access to the internet and reference data were also considered and evaluated.” (Page 7)

“The use of combined PDA-mobile phone devices in our pilot study suggests that this technology might reduce the time doctors take to respond to a call. This is not surprising as the PDA with a mobile phone is a bi-directional device and enables faster communication between the caller and the doctor. Furthermore, it highlights an important potential limitation of pagers. Doctors often find themselves on busy hospital wards where phones are often otherwise engaged, or lifts, corridors, and just outside the hospital, where the absence of a landline makes the pager an ineffective communication device.” (Page 10)

Comment 2: “The interpretation of the second part of the study (that is to assess the perceptions of the 9 users to PDA) is difficult to judge for the reader, as the offered functionality is only described very shortly - was it really only two textbooks? Isn’t this rather little functionality for a PDA? Did they e.g. not use other functions built-in in PDAs such as address books? Aren’t there any logfiles that could describe in detail which PDA functionality was used how often during the study?”

Reply 2: We also acknowledge the above comment and have added the necessary information (pages 6–7).

“Other reference software available on this card included a drug interactions compendium, and anatomy atlas, International Classification of Disease-10 guidelines, and medical calculators. Some users also chose to make use of the address book and
diary functions of the PDA. However, detailed use of the various functions of the PDA was not monitored.”

Comment 3: “The results of the study are not strongly put into context of other comparable research. There are so many evaluation of mobile computers (see also [http://evaldb.umit.at](http://evaldb.umit.at)). How do the results of this study differ from other studies, what could be the reason? What does this study bring as new insight to the reader? What can a doctor, what can a researcher learn from this study?”

Reply 3: As far as we are aware, no other field trials in uncontrolled conditions have been carried out in the manner we have done so. However, we have expanded our paragraph in the conclusion to show what new information can be gained from this study. (pages 12 - 13)

“PDAs have been increasingly used in clinical medicine for the delivery of information at the point of care, the collection of patient information, updating of clinical records, electronic prescribing and medical education. Recently, PDAs have even successfully been used in a trial involving doctors offering on-call services in health protection. [11] A major limitation of most research involving PDAs in healthcare is however that this has been carried out under controlled conditions. [12] This pilot study integrated a combined PDA and mobile phone device into the daily schedule of a team of general surgeons, showing its usefulness primarily as a communication tool. Although we were unable measure a direct patient benefit from the use of these devices, the majority of doctors in the trial felt that having a PDA with a mobile phone as an in-built feature did help them to deliver better health care, and found this technology easy to adopt.” (Page 12)

“In light of these promising initial findings, we now propose a large-scale clinical trial of the use of PDAs with built-in mobile telephones in the hospital setting. This may be a first step in developing the evidence base for a new hospital communication system that may eventually replace the quaint, but hopelessly outdated hospital pager. Other wireless technologies such as blue-tooth and wireless local area networks must also be considered in any communication system proposed for use in hospitals.” (Page 12)

Minor essential revisions

Comment 4: “Please add the following information to the methods section:
- when did the study took place? (exact date)

- how were the physicians/the unit be selected? Were they perhaps rather enthusiastic PDA users, or more IT critical?

- the significance of the last point for the interpretation of the results should be discussed in the discussion section.”
**Reply 4:** All necessary information added:

- “The crossover study was carried out for 6 weeks (17th May to 25th June 2004), with the team having access to the PDA every alternate week.” (Page 7)

- “The study group consisted of a heterogeneous team of doctors (n=9) working in a busy surgical setting at the Academic Surgical Unit at St. Mary’s Hospital (London). This unit was selected because it was a general surgical team with all members having a clinical commitment. There were varied levels of enthusiasm about the PDA, with some clinicians more critical and others more enthusiastic. All members of the team had a similar basic knowledge of computers and mobile telephones.” (page 5)

- “In addition, it is important to note that the members of the study group were not all ‘PDA enthusiasts’, but a rather diverse group consisting of pro-PDA users as well as sceptics even though it is often felt that resident physicians or surgeons are more likely to use newer technology and are more receptive to change. The group on the whole was largely heterogeneous in this respect.” (Pages 10-11)
Reviewer #2: Aaron E Carroll

Major compulsory revisions:

Comment 1: “There are major limitation to this study. They must be addressed. You only used resident physicians who are more likely to use PDA technology and are generally more receptive to changes. You show nothing that convinces me that it is the PDA component of the phone, rather than providing a cell phone in general, that makes a difference.”

Reply 1: Highlighted in article:

“In addition, it is important to note that the members of the study group were not all ‘PDA enthusiasts’, but a rather diverse group consisting of pro-PDA users as well as sceptics even though it is often felt that resident physicians or surgeons are more likely to use newer technology and are more receptive to change. The group on the whole was largely heterogeneous in this respect. Only 2/9 (22%) participants in the study had prior experience with a PDA (1 using a Palm device and 1 using a Pocket PC device).” (Pages 10-11)

“Detailed usage of the various functions of the PDA and the software were not assessed, except that the favourite reference texts for most users were the British National Formulary, the Oxford Handbook of Clinical Medicine and the Evidence-based medicine (EBM) guidelines. In addition, 7/9 (78%) of the staff preferred electronic-based reference material compared to paper-based material. 6/9 (67%) members of the team found the PDA to be user-friendly and easy to learn (67% and 56% respectively). 4/9 (44%) team members thought that it decreased their work load while 7/9 (78%) agreed that it enhanced the efficacy of communication between each other.” (Pages 9-10)

Minor essential revisions:

Comment: “Your literature review could be much more thorough.”

Reply 1: More information added by looking at trials with PDAs in PubMed and http://evaldb.umit.at:

“PDAs have been increasingly used in clinical medicine for the delivery of information at the point of care, the collection of patient information, updating of clinical records, electronic prescribing and medical education. Recently, PDAs have even successfully been used in a trial involving doctors offering on-call services in health protection. [11] A major limitation of most research involving PDAs in healthcare is however that this has been carried out under controlled conditions. [12]” (Page 12)
Reviewer #3: Richard H Wiggins

General revisions:

Comment 1: “The methods are appropriate but not well described, further details should be provided to replicate the work, in reference to the hardware used (both the specifications of the Palm W devices, pager used (text pagers? Alphanumeric text capabilities? Web paging capable? and specifics as to the prior PDA experience of the physicians.”

Reply 1: All additions made – please refer to major revisions

Comment 2: “The data may be as sound and well controlled as is possible in such a project. It may be helpful to include the normal workload and schedules of these physicians during the study, such as one physician may be more likely to call back in time when on rounds on the patient floors, but not when in a clinic seeing a patient or in the OR during a case.”

Reply 2: All additions made – please refer to major revisions

Major compulsory revisions:

Comment 1: “â€œPalm W Tungsten PDA” (you might want to mention here that these devices are not actually still on the market, as Palm is moving back to the Treo handheld devices). It is also important with these devices to include specifications, such as: the Tungsten W's screen is a 320x320, with a 16-bit color TFT display, and a 1-cm long rounded antenna for a Class 10 GSM/GPRS radio, and it runs on a 33 MHz DragonBall VZ processor. The Tungsten W comes with 16 MB of RAM, with Palm OS 4.1. Are you planning on upgrading to the PalmOne Treo in future projects? You should also mention the specifics of the cellular technology if you are discussing data transfer. Are you using the Vodafone 3G GSM/GPRS network? It may be helpful to many readers to give a brief description of what Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS) is, and if you are using Enhanced Data Rates for Global Evolution (EDGE) technology for the network. EDGE is a 3G technology that delivers broadband-like data speeds to mobile devices. It allows subscribers to send and receive data, such as digital images, web pages and photographs, up to three times faster than with an ordinary GSM/GPRS network. GPRS speed rates are from 100kbps to 125kbps but with implementation of EDGE this may approach 300kbps to 400kbps. Were the digital reference materials the only other uses of the PDA device, or was Internet access also utilized for â€œlate nightâ€ decision-making? In waiting for 5 minutes for a return call, you should...
mention here the schedules of the 8 junior team members. Are these all general surgeons? Are they on the schedule similarly, such that they are all in the OR at the same time, or all in clinical or on rounds? This could make a significance difference in the call back times.”

Reply 1: We have made all the necessary additions and acknowledge these invaluable comments:

“All members of the team were given a Palm Tungsten W™ PDA with mobile phone and web-browsing facilities, connected to a Vodafone UK network. In is important to note that these palm devices are no longer on the market and have been replaced by Treo™ smartphones. The Palm Tungsten W™ measures 12.1 x 7.79 x 1.65 cm, and weighs 184 grams, and has a 320x320 16-bit colour TFT display screen. The biggest connectivity feature of the Tungsten W (provided via a 1-cm long rounded Antenna) is the Class 10 GSM/GPRS radio. [7]

This GSM/GPRS enabled PDA was connected to a Vodafone network. GPRS stands for General Packet Radio Service. It keeps you permanently connected to the Internet but only charges you when your phone is sending or receiving data. It is also fast - GPRS works at similar speeds to a dial-up modem on your home PC, 100kbps – 125kbps. [8] However, in this study, the GPRS facilities were not used. GSM (Global system for mobile communications) is an open, non-proprietary system that is constantly evolving. Voice is digitally encoded via a unique encoder, which emulates the characteristics of human speech. This method of transmission permits a very efficient data rate/information content ratio. [9]

The Tungsten W is intended primarily as a data-centric device using the GPRS network. Any application that requires an Internet connection will automatically causes the device to establish a GPRS connection, which takes anywhere from 20-40 seconds depending on the signal strength, and the connection automatically shuts itself off after a period of inactivity. The device runs on a 33 MHz Dragonball VZ processor and includes 16 MB of RAM, of which 15 is available to the user. The manufacturer’s specifications state that the lithium ion battery provides up to 10 hours of talk time. [7]” (pages 5 - 6)

Undoubtedly, not all members of the team would be in the same place; some were in the operating theatre, some on the wards and some in clinic. Whether this affected the response times is beyond the scope of this pilot-study. However, the aim was to determine the response times at a randomly allocated point in time as in a real-life situation.” (Page 8)

Comment 2: “â€œPagers and landline telephonesâ€¦â€œ. Vodafone UK began GPRS Internet access and voice 3G call in 2001, and surpassed 100 million customers in 2003, if cellular phone use is widespread in the UK, and acceptable within medical institutions, are they really not being used at all? What kind of pagers are these? Are these alphanumeric text pagers? Is Internet text paging available? Are they alphanumeric 2-way communication devices? Who is the service provider for these devices? It is important to address issues such as battery life and signal strength in
such articles. You should include some information about the battery life of the Tungsten W devices: were they charged nightly? Was the internal battery acceptable for use throughout the day? How much actually were the devices actually used throughout the day? In terms of signal strength, were there areas in the institution where signal strength with the devices was an important issue, such as leaded walls in the Radiology department?”

**Reply 2:** We have made all the necessary additions and acknowledge these invaluable comments:

> “Hospital communication in the UK currently consists of pagers and landline telephones, and although they have had a ban on mobile phone use on their premises since the early 1990s (prompted by a warning issued by the UK Medical Devices Agency), many doctors ignore this, using their personal mobile phones for convenience at work.

> With a greater appreciation that mobile phone and other wireless technologies are on the whole safe to use in the proximity of medical equipment, [6] it is conceivable that devices combining the PDA and mobile phone could soon become the standard means for communication between hospital practitioners.” (Page 5)

> “The pagers used by the hospital were alpha-numeric with no internet text paging, and no two-way communication ability.” (Page 7)

> “The manufacturer’s specifications state that the lithium ion battery provides up to 10 hours of talk time. [7]” (Page 6)

> “Issues about battery life were raised by some members. Some participants charged their PDAs on a daily basis, others did not. Comments on battery life and poor signal strength in certain areas of the hospital such as the lifts were not explored in any further detail.” (Page 10)

**Minor essential revisions:**

**Comment 1:** “â€œhas lead to the creation of many combined mobile phonesâ€””

**Reply 1:** Corrected

> “The commercial development and expansion of mobile phone networks has led to the creation of devices combining mobile phones and personal digital assistants, which could prove invaluable in a clinical setting.” (Page 2)
Comment 2: “â€œsuggests that personal digital assistant and mobile phone combined devices may improveâ€”" 

Reply 2: Corrected 

“The results of this pilot study show the possible effects of replacing the current hospital pager with a newer, more technologically advanced device, and suggest that a combined personal digital assistant and mobile phone device may improve communication between doctors.” (Page 3) 

Comment 3: “â€œhas lead to many combinedâ€¦ 
â€œinformation access, making itâ€¦â€” 
â€œinclude easy access to hospital addressesâ€¦â€” 
â€œtextbooks, and electronic patientâ€¦â€” 

“As an international journal, you should include a short description here of the NHS, so that those â€œacross the pondâ€”and elsewhere will have a basic understanding of your health care circumstances, such as: â€œThe National Health Service (NHS) was set up on the 5th July 1948 to provide healthcare for all citizens in the United Kingdom, based on need, instead of the ability to pay. With the NHS now investing 
â€Œâ€Œâ€Œâ€Œit is conceivable that PDA technologyâ€Œâ€Œâ€Œmeaningful outcome.â€Œ” 

Reply 3: Corrected and additions made. 

“The commercial development and expansion of mobile phone networks has led to the creation of many combined mobile phone and PDA devices, which could prove invaluable in a clinical setting. This is because these devices have the advantage of providing mobile information access, making it possible to retrieve clinically important information at any time of day and in any location. Information resources that doctors may benefit from include easy access to hospital addresses, protocols, evidence-based guidelines, textbooks, electronic patient records and drug formularies, to mention but a few.[3]” (Page 4) 

“Since being first introduced in 1948, the United Kingdom National Health Service (NHS) faces increasing costs as it attempts to provide free healthcare to all citizens of the United Kingdom, based on need rather than the ability to pay. Investment in information technology (IT) and communication infrastructure is an important part of healthcare expenditure as hospitals in the NHS aim to provide efficient and standardised healthcare delivery to a large patient population. [4] Nevertheless, a recent report by a parliamentary advice committee recommended that the NHS must overcome its preference for short term savings and develop strategies to stop the current underuse of new medical
technologies. Currently, the UK only spends 0.36% of its gross domestic product (GDP) on medical technology, unlike Europe which spends 0.55%. [5]

Comment 4: “â€œresponse times to pagingâ€Ÿ. Were you using the paging function of both the pagers and PDA/cell phones here? Were you actually calling the cell phones directly, or using their paging function?”

“â€œdisagreement regarding PDAsâ€Ÿ. Is this a general unwillingness to use technology? What does â€œdisagreementâ€Ÿ mean exactly in this sentence?

In the percentages listed, you should include information about how many of the junior doctors had previous PDA experience/ownership, and which OS (Palm vs PocketPC). You should expand this beyond stating that it was a â€œdiverse groupâ€Ÿ.”

Reply 4: Queries answered as below:

“The primary outcome measure of interest for assessing efficiency of communication was the length of time it took for clinicians to respond to a call. To test this, one investigator, on a randomly selected day of the week, called all the junior team (n=8 i.e. excluding the consultant) and measured the time taken for doctors to respond to the call. If after 5 minutes, there was no reply, it was noted that the doctor had ‘failed to respond’. We used this measurement of ’response time’ to measure efficiency of communication with the respective devices. The mobile phones were called directly and the paging was done via the standard paging system of using the hospital extension. In order to minimise the risk of bias we ensured that doctors could not differentiate a test call from regular communication traffic by making calls from different hospital extensions on each occasion. For the purpose of computing mean response time for each period of the study, the failure to respond was given a value of 301 seconds (5minutes + 1 second). Undoubtedly, not all members of the team would be in the same place; some were in the operating theatre, some on the wards and some in clinic. Whether this affected the response times is beyond the scope of this pilot-study. However, the aim was to determine the response times at a randomly allocated point in time as in a real-life situation. We determined the rate ratios of those failing to respond for each pair of adjacent Pager/PDA periods and pooled the results using a fixed effects model to produce an overall rate ratio for failure to respond. This method was chosen so as to take into account the clustering of responses within individuals and the small sample size.” (Pages 7 -8)

“Perceptions of nervousness associated with PDA use dropped significantly (p=0.04) during the study, suggesting positive uptake of new technology by the team. Negative perceptions and disagreement (as measured by the validated questionnaires) regarding PDAs also decreased, albeit non- significantly. [10]” (page 9)
“In addition, it is important to note that the members of the study group were not all ‘PDA enthusiasts’, but a rather diverse group consisting of pro-PDA users as well as sceptics even though it is often felt that resident physicians or surgeons are more likely to use newer technology and are more receptive to change. The group on the whole was largely heterogeneous in this respect. Only 2/9 (22%) participants in the study had prior experience with a PDA (1 using a Palm device and 1 using a Pocket PC device).” (Page 11)

Comment 5: “Although this may be expected..”

Reply 5: Corrected

“This is not surprising as the PDA with a mobile phone is a bi-directional device and enables faster communication between the caller and the doctor.” (Page 10)

Comment 6: “Suggesting that PDA and mobile telephone combined devices... You need to focus the discussion on comparing pagers to combination PDA and cell phone devices, unless you want to expand this study to compare pagers, PDAs, cell phones, and combination devices. Although we were unable to measure...”

Reply 6: We acknowledge the above change

“The use of combined PDA-mobile phone devices in our pilot study suggests that this technology might reduce the time doctors take to respond to a call. This is not surprising as the PDA with a mobile phone is a bi-directional device and enables faster communication between the caller and the doctor.” (Page 10)

Discretionary revisions: “You should include information in your future plans as to what they are: hardware, software, scope, multi-institutional, etc. The next logical step from your paper seems to be replacing all pagers with cell phones, for communication, and PDAs for portable reference material, and combined devices when possible. If all types of wireless communication (3G/GSM/GPRS/802.11b/Bluetooth) have been cleared for use around medical devices, this should obviously be the next step for the NHS.”

Reply: We have added the above points

“In light of these promising initial findings, we now propose a large-scale clinical trial of the use of PDAs with built-in mobile telephones in the hospital setting. This may be a first step in developing the evidence base for a new hospital communication system that may eventually replace the quaint, but hopelessly outdated hospital pager. Other wireless technologies such as blue-tooth and wireless local area networks must also be considered in any communication system proposed for use in hospitals.” (Page 13).