Title: Developing an In Interactive Electronic Maternity Record: A future concept for maternity care?

Abstract

Women have a strong need to be involved in their own maternity care. Pregnancy hand-held records encourage women's participation in their maternity care; gives them an increased sense of control and improves communication amongst care providers. They have been successfully used in the United Kingdom and New Zealand for almost 20 years. Despite evidence that supports the use of handheld records, widespread introduction has not occurred in Australia.

The need for an electronic version of pregnancy handheld records has become apparent, especially after the introduction of the Electronic Medical Record in Australia. We developed a personal digital assistant (PDA) as an interactive antenatal electronic maternity record that health care providers could use in any setting and women could access using the internet. This paper will describe the testing of the antenatal electronic maternity record.

Key words Electronic Maternity Record, Personal Digital Assistant, Interactive, Pregnancy handheld records

Key Phrases – The use of pregnancy handheld records hold many advantages for women and clinicians, but are not in widespread use in Australia. An antenatal electronic maternity record (the Obi-MATE) was developed that women and midwives could access using the internet and/or Personal Digital Assistant. The testing of the Obi-MATE provided excellent interdepartmental collaboration between midwifery and information technology disciplines. The Obi-MATE will soon be tested within a hospital setting. The next generation are ready to appreciate the use of innovative interactive technology during pregnancy.

Cover letter- re conflict of interest: This paper was undertaken with a challenge grant made available by University of Technology, Sydney (UTS) specifically for interfaculty collaboration; although this paper promotes the use of ' a personal digital assistant or smart phone' it is not the author's intention to gain commercially from these information technology products.

Introduction

There are no nationwide standards and format for maternity records in Australia and in many other developed countries. Record systems often consist of comprehensive hospital-based maternity notes with women carrying their own smaller card containing similar information about the current and past pregnancies. Australia has been slow to introduce pregnancy handheld records (PHR), despite recommendations from the World Health Organisation and our Australian National Health and Medical Research Council (NHMRC, 1996; World Health Organisation, 1994). Presently only two states in Australia (South Australia and Victoria) have successfully introduced the PHR (Government of South Australia, 2004). In the Australian state of New South Wales, a randomised controlled trial conducted on the introduction of the PHR had favourable outcomes (Homer *et al.*, 1999), but the state has as yet to introduce PHRs. Overseas, particularly in the UK, the PHR has been in use for many years.

We developed an antenatal electronic maternity record that women and midwives could access using the internet and/or Personal Digital Assistant (PDA) (Hoang *et al.*, 2008). We have called this concept Obi-MATE. This paper uses a case study approach to describe the development and pilot testing of the Obi-MATE. Ethical approval was granted for the study from the University of Technology, Sydney.

Women-held records in antenatal care

There are advantages to women carrying their own PHR (Brown and Smith, 2004; Homer *et al.*, 1999). Holding their own records allows women to refer to their personal information outside the clinical setting which encourages family support and involvement, communication with carers, continuity of information across different providers and settings, and personal control of health. This enhances women's control and confidence in their interactions with doctors and midwives, and increases women's satisfaction with their care (Brown and Smith, 2004). Brown and Smith (Brown and Smith, 2004) evaluated the effects of giving women their own antenatal records (a paper-based record) to carry during pregnancy in a systematic review published by the Cochrane Collaboration. Three trials were included (n = 675 women). The findings highlighted some potential benefits (increased maternal control and satisfaction during pregnancy, increased availability of antenatal records during hospital attendance) but also suggested there were possible harms (more operative births). Women in the group who held their own records would prefer to hold their antenatal records in another pregnancy. The authors concluded that "there is insufficient evidence on health related behaviours (smoking and breastfeeding) and clinical outcomes. It is important to emphasise that this review shows a lack of evidence of benefit rather than evidence of no benefit."

There are savings associated with decreased clerical time and storage space and no evidence of an increase in the rate of lost records (Elbourne *et al.*, 1987; Lovell *et al.*, 1987; Homer *et al.*, 1999). In addition, qualitative research (Phipps, 2001) suggests that PHRs have the potential to positively influence psychological and behavioural factors, and help eliminate inconsistent and conflicting content often present in other written educational material and on the internet.

The Electronic Medical Record
Today, most industrialised nations are implementing electronic medical records, and are working towards linking up community and hospital services within one efficient nationwide health system. This technology improves efficiency and quality (Chaudhry *et al.*, 2006), and has the ability to enhance patients' experiences wherever they present for care. In 2008, implementation of the Electronic Medical Record (eMR) began in NSW, Australia. This initiative aimed to replace the paper medical record with an online record which tracks and details a patient's care during the time spent in hospital. The eMR plans to significantly improve the delivery and quality of patient care as well as streamline clinical workflow. It also aims to improve efficiency, reduce errors of omission, duplication, transcription and interpretation, thus reducing adverse incidents caused by poor, illegible, absent and lost information. However, the eMR in its present format does not have scope for patient access and interaction. It is also designed for in-hospital setting which often does not work for maternity care providers as care is often provided in community settings rather than acute care ones.

The United States (US) is actively moving towards adopting electronic medical records nationwide. Recently, the federal government's health plan pledged 50 billion dollars over five years to achieve a comprehensive electronic health information system, including electronic medical records. This will incorporate the whole health spectrum, and include pregnancy. However, Jha et al. (2009) found that only 1.5% American Hospital Association members had a fully integrated computerised system in operation, and only 17% of doctors used an electronic medical records system.

In the UK, the NHS Care Records Service has begun implementation of a nationwide electronic system to create Summary Care Records through an integrated system involving GPs and Primary Care Trusts (National Health Service, 2009). The Summary Care Record is a centrally stored record of health information initially created from GP records, with controlled access. Also offered is the more interactive personal online health care record called HealthSpace (National Health Service, 2008; National Health Service Connecting for Health 2008). Uptake and widespread use of these initiatives is expected to take several years.

PHRs and electronic antenatal records are not in widespread use in the US, despite positive reviews of trials. For example, Bernstein et al. (2005) in their review of the use of a network-based computerised antenatal record in a busy metropolitan medical centre found that compared to a previous paper system, there were improvements in communication, availability of records and currency of data. In other parts of the US, electronic antenatal records such eNATAL™ (Miller, 2007a) are used, although its ability for patient access and interaction is uncertain.

Personal Digital Assistants
Personal Digital Assistant (PDA) devices have been successfully used to record clinical events (for example, to accurate dietary intake (Fowles and Gentry, 2008), respiratory system performance (Fong and Doyle, 1997); to assist clinicians to reflect on practice (Ranson *et al.*, 2007); to provide education in clinical settings (Brock and Smith, 2007); and have the ability to help maintain medical staff's currency of practice (Larkin, 2001; Platt, 2009). This has been highlighted in resource-rich as well as resource-poor settings. In rural India, Anantraman et al., (2002) describe the introduction of PDAs to help enhance the practice of

staff working in child and maternal health. This initiative not only provided health alerts pertinent to patient care, but eliminated the need to carry paper notes for up to 40 patient visits per day (Anantraman *et al.*, 2002). Despite these advances and initiatives, there are no known initiatives that use a web-based, live, active version of a pregnancy record particularly one that can be accessed by clinicians and women. It is for this reason that we developed the Obi-MATE concept of care.

It is hypothesised that the Obi-MATE will enhance women's involvement in their antenatal care and decision making, which has been described in the literature as desirable (Young, 1991; Fawdry, 1994a, b; Holmes *et al.*, 2005; Homer *et al.*, 1999).

This project
The concept for this project was to develop a system where women could access their information as well as obstetricians and midwives, even when care was not based in the hospital setting. The evidence around woman-held records is clear that women and their partners benefit from having access to all their information (Brown and Smith, 2004). Equally, clinicians need effective communication systems so that information can be more readily shared between providers and between settings (that is, hospital and community). This information needs to be retrievable in accessible forms and have the capacity to be synchronized with main frame record systems so that one accurate record exists. It was envisioned that the electronic version would be available to women via the internet through a secure site and to clinicians through a PDA and/or website. The aim of this project was to pilot test these two processes for antenatal records and to see whether the concept (that is, Obi-MATE) had enough value for further testing.

Development of Obi-MATE
Obi-MATE was based on a new paper-based PHR that had been tested and audited in one area health service in Australia. A multidisciplinary working party developed the proposed new record from 2002-2006. The long time period was to enable widespread consultation and discussion as there was a reasonable amount of contention as to the benefits of giving women access to their antenatal records. The woman-held record included information about past medical, obstetric, social and emotional history as well as laboratory results for the current pregnancy. The record also included space to record information at each antenatal visit.

A template was designed on both PDA and PC format in collaboration with staff from the iNEXT Centre for Innovation in IT Services and Applications at the University of Technology, Sydney. This process took a number of months as the format for both these visual options was different. Mapping all the information from several A4 pages onto the PDA presented challenges for the IT department as the display area of the PDA was limited (see Figures 1 and 2). Developing the exact specifications and learning one another's 'language' (information technology and midwifery) was both challenging and rewarding. A number of meetings were held between IT and midwifery to inform one another of the terminology and language that needed to be used. Both disciplines leant from each other in this process. In addition, two of the authors spent a considerable amount of time together to develop the template.

The Obi-MATE was developed as an 'active' system which means that the features allow the initiation of dynamically and automatically appropriate actions, for example, data collection

or care alerts and advice for women. Particular technological aspects of the development process of the Obi-MATE have been documented by Hoang et al. (2008).

All users required authentication and received the level of access appropriate to their status. Women were able to access certain areas of the program, whereas clinicians received a more comprehensive level of access, for example to update results. It was also ensured that women only had the ability to access their own data and not that of other women using the network. Figure 1 demonstrates the user interface that was available for women using a desktop or laptop computer.

Figure 1: Desktop interface for woman - Main Page
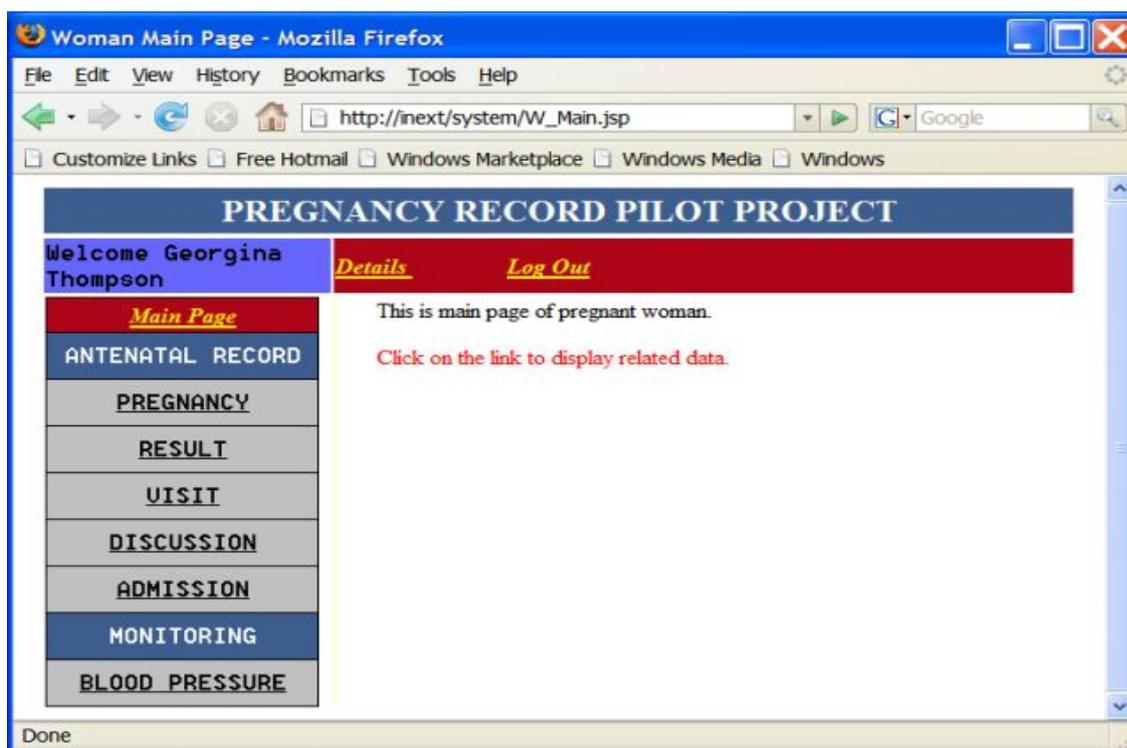
Figure 2: Desktop interface for woman - Details of visits

Figure 3: PDA interfaces for clinicians: (a) Homepage, (b) clinician login, (c) woman login, (d) drop-down menu for viewing selection, (e) woman's details, (f) details of visits

(a)　　　　　　　　　　　(b)　　　　　　　　　　　(c)

(d) (e) (f)
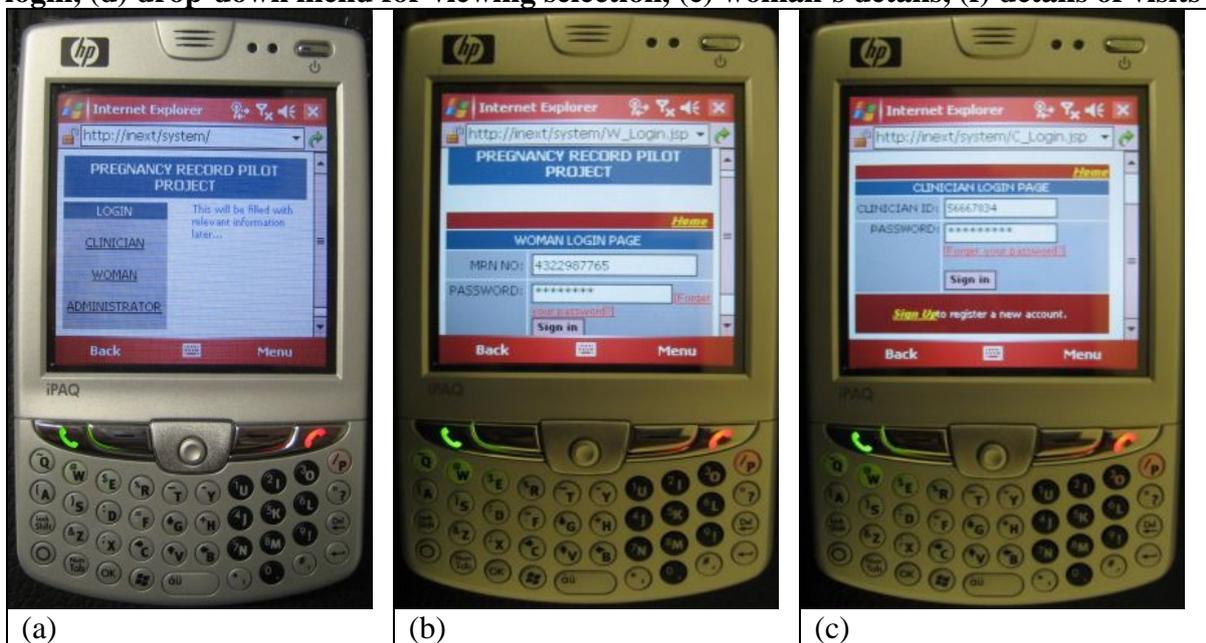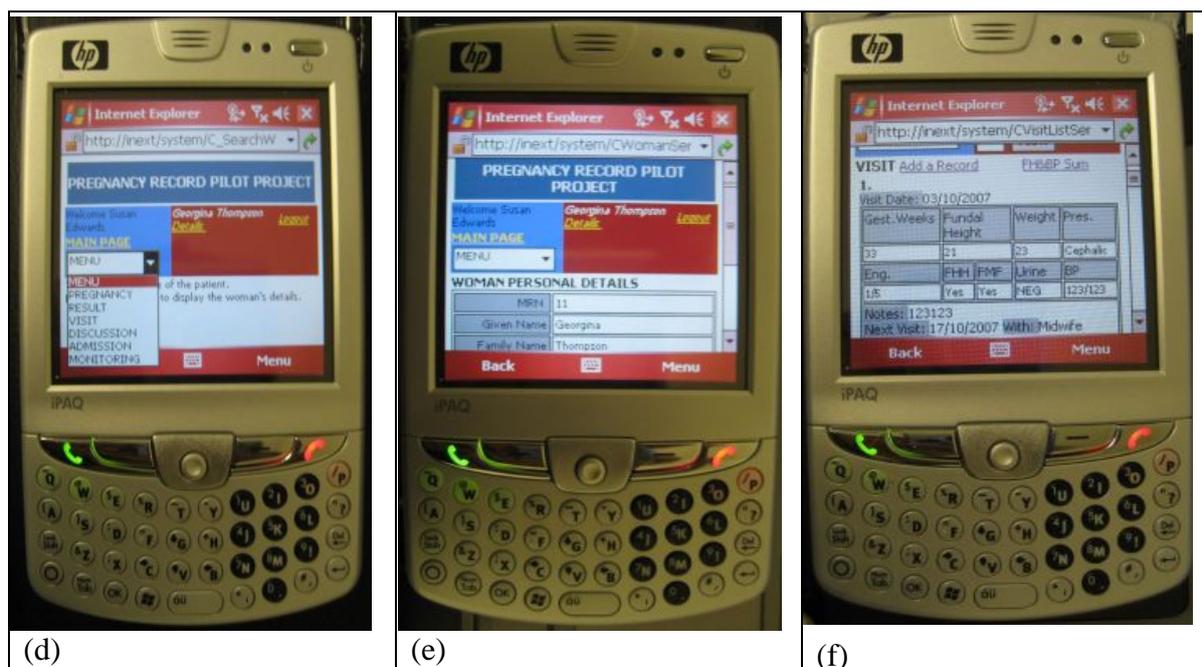
Testing the Obi-MATE

A two day workshop was arranged at UTS in February 2008 with staff from the Nursing, Midwifery and Health and IT faculties. Eight paid volunteers attended the workshop with four assuming the role of a midwife, and four took the role of pregnant women. All the workshop volunteers were either registered or student midwives.

Under the guidance of IT staff, the 'midwives' undertook a structured role play scenario of taking antenatal booking histories from four fictitious case histories on the PDA. Staff gained experience downloading data onto the PDAs, and undertook mock 'follow up' visits. SMS alerts were sent by the IT staff overnight. These included 'dummy' information from women about clinical events such as blood pressure recordings. The project team devised a series of scenarios including recording high blood pressure readings that meant alerts were sent to the midwives in the morning.

The project midwife collected data through observations throughout the workshop and comprehensive note taking during focus groups held at the end of each day, facilitated by the faculty leaders. Data were analysed in three major categories. These were: aesthetics of the equipment, database fields and clinical information format, and security and confidentiality.

Overall, the response was very positive and the aesthetics of the PDAs were favourable; it was easy to navigate and use. However, a number of recommendations were given for improvement. These included the addition of a fold-out keyboard to facilitate more space and the option to add details to the discussion fields. The logistics of having the test results added to one field screen were suggested and overall, more space to add details was thought necessary. In addition, the inclusion of educational website links for women was recommended.

Staff stated a number of issues for improvement related to clinical information. For example, there were suggestions to include an obstetric calculator, blood group data, and a final due date by ultrasound scan or last menstrual period. There was also a need for more woman-friendly terminology on the PC screens that women could access.

There was a necessity to ensure sensitive information such as blood tests for Hepatitis, HIV, and issues relating to domestic violence recorded on the PDAs were not accessible to women. This was thought to pose confidentiality problems should women access their information from home and have third parties present. It was also necessary to ensure that women did not have the ability to alter information without discussing this with their care provider.

Further development
Further developments include the possibility of an inbuilt language translator so that staff could type in English, and the PDA would translate it into the woman's first language. This has the potential to reduce the need for interpreters and would have positive cost implications. Other suggestions included those of installing a voice recognition facility for use in emergency situations, and in the event of a woman not attending an appointment, the automatic sending of an SMS to the woman with another appointment date.

Current maternity software providers that provide a PDA version of an antenatal maternity record could be an attractive option for stakeholders as well as midwives, similar to the eNATAL™ used in the US. Data entered at the first booking visit, for example, regarding tests performed or discussed, would save midwifery time at subsequent appointments and avoid duplication. The most current version of the record would be available wherever there was an internet connection, and it would be tailored to a woman's individual needs.

This is a new, innovative and exciting concept. The use of the Obi-MATE has enormous potential to avoid duplication and error, enhance consistency of information and multidisciplinary communication. It could be utilised across all areas of maternity care provision and could prove particularly useful in rural and remote areas. Chaudry et al., (2006) in a systematic review, found health information technology systems in the US improve health practitioner adherence to policy, enhance surveillance of disease, decrease medication errors and lower lengths of stay in hospital.

Limitations
The cost of the PDAs was not thought to be prohibitive for an entire service, although widespread rollout would involve an initial substantial cost. This may, however, be offset by workload savings through staff having to spend less time on duplication of documentation, less error, and fragmentation of care.

Privacy and confidentiality issues would need to be carefully worked through to ensure breeches did not occur. It was thought any security issues could be tackled appropriately, and sensitive information protected, with systems similar to those used by online banking sites.

The ability of staff to be able to negotiate the Obi-MATE technology was also a limitation. Access for women was also considered a limitation. However, in Australia in 2007-08, 67% of households had home internet access and 75% of households had access to a computer (Australian Bureau of Statistics, 2008). It can be predicted that computer and internet access, and computer literacy will rise steeply in future years. The next generation are already managing much of their working and personal lives online by currently controlling their bank accounts, purchases, and investments via the internet. It naturally follows that this be extended to their medical and maternity portfolio.

Another limitation may be a lack of consistency and poor uptake of an antenatal electronic record by private hospitals/obstetricians. Equally, many systems in the public sector in both Australia and other countries like the UK and the US, are inconsistent which makes widespread implementation challenging. For a seamless interface between public or private hospitals and the community, it may seem preferable to introduce the records across all settings simultaneously. However, a gradual introduction may also be effective, and possibly more realistic (Miller, 2007b). These barriers should not deter systems and providers. Moving to an integrated and universal or, at least, consistent within countries, system should be an aim that we all should be working towards.

Conclusion
The development and testing of the Obi-MATE concept was a positive experience with excellent inter departmental collaboration. The workshop was successful in identifying the strengths and potential of the Obi-MATE, and adjustments for widespread use have been acknowledged by the IT department. The next phase for Obi-MATE will be to test the concept with women and health care professionals within the hospital and community setting.

Acknowledgements

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