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Australian healthcare: a smart card for a clever country

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Abstract

In this paper we give an overview of smart card technology how a smart card could be used as a healthcare card and the benefits that would most likely result from doing so. The smart card memory can be zoned into different security levels. The top security zone may contain an individual's full medical history while the lowest security zone may contain the cardholders name and address. Access to the different zones depends on the level of security of the zone. The higher the security level the more restrictive the access method. Were smart cards adopted for the storage of medical histories it would change the form of medical information recorded, not merely convert paper files to electronic ones. Storage of an individual's medical history on a smart card raises important privacy issues. These privacy issues are discussed particularly as they relate to the Australian community.

Keywords: Smart card; Security; Medical database; Privacy; ID number; Healthcare

1. Introduction

Australia is a vast country with a comparatively small population. It has a population of 18 million and an area of 3 million square miles. At fewer than six people per square mile not only is it sparsely populated compared with countries in its region, such as Thailand and Vietnam which, have, respectively 280 and 560 people per square mile, but also compared with western countries such as France which has 280 people per square mile and even the USA which has 62 per square mile. Therefore it has peculiar difficulties in providing high quality healthcare to the entire population. Historically, Australia has been at the forefront of using technology to provide this healthcare to its remote region known as the 'outback'. For almost 50 years the Royal Flying Doctor Service has provided medical advice and help to those living in remote regions of the outback. For many years this advice was provided via pedal radio and radiotelephone; today Australia has one of the most modern telecommunication systems in the world and this communication is provided to the remote areas by satellite. When the health incident cannot be dealt with via telephone, a doctor is flown in by a light plane, often it lands on a make shift runways.

Not only is Australia vast but also it is rich in natural resources. For many years Australia was referred to as 'A Lucky Country', because it thrived on the income from the export of these primary products. At the same time inefficient industries in Australia were protected by high

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import duties. Over the last fifteen years these import duties have had to be reduced in line with world trade policies and the export income from primary products has declined, resulting in a large annual trade deficit. The former Prime Minister Robert J. Hawke promoted the idea that for Australia to flourish it had to become 'A Clever Country'.

And indeed Australia is becoming a clever country. Australia is one of the leading countries in the adoption of computer and communication technology. Not only are computers common place in business, industry and the home but also the adoption rate of analogue and digital mobile phones is one of the highest in the world. The smart card usage in digital phones is but one aspect of what is becoming widespread adoption of smart card technology in Australia. They are also used as multipurpose cards, transport cards, cash cards and for secure access to facilities. Australia is exporting smart card technology to Europe. But at present they are not used in the healthcare industry in Australia. Given that Australia has adopted other technologies with great fervour, it appears surprising that smart cards have not been adopted by the healthcare industry.

In this paper we describe smart cards, discuss how they could be used in the healthcare industry, how doing so would improve the quality of healthcare and the obstacles to the introduction of smart cards in Australia for healthcare purposes.

2. Smart Card Technology

A Smart Card is a plastic card the size of a credit card which contains a microprocessor, memory and an interface to the outside world. In 1974 Roland Moreno developed the fundamental notion of imbedding electronic memory in a plastic card and in 1977 Michael Ugon included a processor as well as memory [1].

Today's Smart Cards have the memory and compute power of the first PCs. There have been enormous advances in microchip technology. The number of transistors in a chip increased by a factor of 10,000 between 1970 and 1990. Memory size performance, power consumption and cost have improved dramatically [2]. Smart card technology is benefiting from these advances.

The chip consists of a CPU, memory and an operating system. It may also contain a cryptographic unit and even a coil antenna in the case of a contactless chip [3]. The memory consists of Read Only Memory (ROM), where the fixed program can be held; Random Access Memory (RAM), used as a scratch-pad for computations; and Erasable (by user) programmable read only memory (EPROM) or electrically erasable (by user) programmable read only memory (EEPROM) for storing non-volatile application data. Currently the typical memory size is 512 bytes of RAM, 16 Kbytes of ROM, up to 8 Kbytes of EPROM, and up to 8 Kbytes of EEPROM [2]. Smart cards are required to conform to a number of international standards [2]. The key ones are:

- ISO 7816-1 Physical characteristics
- ISO 7816-2 Dimensions and location of the contacts
- ISO 7816-3 Electronic signals and transmission protocols
- ISO 7816-4 Security architecture

Smart cards by their very design are optimized for security. Unlike magnetic striped cards they are not very susceptible to probing, reverse engineering or duplication. Having a single chip embedded within the plastic makes it difficult to probe.

The memory of a smart card can be zoned for security with different levels of user access. One example might be: a secret zone which is unreadable and is used for passwords and encryption algorithms; a confidential zone which is read only and requires password access and is used for audit trail of transactions; a usage zone with read/write access by password and is used for storage of information actively used in transactions; and a public zone which is read only, without a password, and is used for storage of non-sensitive information such as names and addresses.

An important security feature of a smart card is its ability to carry its own PIN number. This can be verified by any reader with a PIN pad, rather than requiring an on-line system as is the case for magnetic strip cards. Further the card can be programmed to lock itself after a prescribed number of failed attempts at the PIN [4].

The typical cost of a smart card is between $5 and $40 depending on its capabilities and on the volume being produced.

3. Smart Card Usage

According to Elsbeth Monod [5], "French people love smart cards and have taken to them with enthusiasm!' France has been the theatre of a creative explosion and smart cards have developed in several fields: banking, shop credit, telecommunications, parking, car washing, education, city services, road tolls, leisure, even Olympic games. And now, for nearly 10 years smart cards for health and social purposes have joined the club! They are now in use in many areas: cards linked with specific medical problems such as diabetes, dialysis, and blood transfusion basic medical information and emergency, homecare and telesurveillance, insurance administrative data sometimes combined with other functions; cards giving access to medical (data)bases, and last of all, those designed for confidentiality and privacy and to give identification of health professionals. About 15 card systems using microprocessor technology are in use." Many other countries have adopted smart cards for these and related purposes, although their usage in Europe is the greatest. Germany is the largest user of smart cards — they are especially used for phone cards and health insurance cards [6,7]. Indeed about 70% of the usage is in Western Europe, 10% in South America, 8% in Asia and about 2% in the USA and Canada.

4. Smart Cards in Healthcare

In many counties doctors keep their financial records on computers, but the practice of keeping patient medical histories on computer varies greatly from country to country. For example in Sweden over 80% of doctors in general practice have computerized medical records while in Australia fewer than 5% do. Smart card technology allows very portable computerized medical records. A key feature of health data and information is that it be timely, reliable and complete [8]. Smart card technology is one way of achieving this.

There are at least three distinct approaches to the use of smart card technology for storing and accessing patient medical histories. One approach is for the smart card to contain key medical information (a minimum data set) about an individual and no medical information is held on a central register. This provides complete privacy for the individual, but results in no medical data being able for research purposes or to identify disease trends or to be used to improve the provision of health care.

A second approach is to have a central registry of medical information on individuals and to have the smart card being the key for access to the information. This provides a high level of security and hence privacy for the individual but would allow the central medical database to be used as a statistical database for research. (Statistical databases permit only those queries that do not allow individual records to be identified.) This approach has all the inherent security problems associated with networks [9].

A third approach is to have the patient's complete medical history on the smart card. However, the basis of any disaster recovery plan necessitates a centralized database to allow for recovery of the record if the card is lost or destroyed. This has fewer security problems as the detailed medical records do not need to be continuously on line. However, as above, the central database can still be used for research purposes.
A possible zoning for a healthcare card is:

Zone 1: Card holder's identifying information
Zone 2: Emergency information
Zone 3: Vaccination history
Zone 4: Medications
Zone 5: Medical history

Different healthcare providers could then have access to different zones based on a need-to-know basis.

The benefits are greatest with the second or third approach. In Australia, for example, patients have the right to choose any doctor and to change as often as they wish. This means that a patient's medical record can be distributed across numerous healthcare providers, sometimes spread across the country, with no linking of this infor-

mation [10]. If the patient's complete medical history were accessible in the one place then the doctor would be better informed and so able to deliver a much better quality service. For example, if the third approach were used the one card could contain entries from General Practitioners Specialists and Consultants, Radiologists, hospitals, etc. It could also assist in preventative medicine by keeping the date of the last test and so provide a reminder that a test (e.g., a pap smear) is overdue; keep a record of trends in, say, blood pressure counts, etc. It could also save resources by avoiding unnecessary repetition of investigations. In emergency situations it may help save lives. Record keeping would also be greatly improved. As already experienced with computerized medical records, were smart cards adopted for the storage of medical histories it would change the form of medical information recorded, not merely convert paper files to electronic ones. The records become more systematic and precise.

5. Privacy

A major problem with the introduction of computerized medical records is privacy.

Suppose a test shows that a person has a sexually transmitted disease — does this go on his/her smart card record? If it does not, does the medical-record card fail to record vital information? If it does, will the owner of the card know who will have access to this very sensitive information? But it gets worse. What happens if I lose my card with all my medical records? Obviously there must be a back-up system of some sort and somebody must keep this. Can this body, whether it be government or private, be trusted [11]?

A centralized back-up database will need to identify uniquely each person — date of birth, name, address, etc is not sufficient. To guarantee identification each person will need to be assigned a unique identification number. This has been done in a number of countries — most recently in New Zealand. But in Australia this would cause an uproar.

In every country privacy is regarded as important, but the amount of importance varies dramatically from country to country. In Australia great weight is put on privacy. This was evidenced most clearly when there was a debate about the introduction of the stalled Australia Card.

In 1986 the Australian government produced a paper called 'Towards fairness and equity: the Australia Card Program'. It was to overcome tax evasion by assigning every Australian a unique ID. The then Treasurer (and now Prime Minister) the Hon. Paul Keating said in 1985 'the Australia Card is designed to provide a substantially effective and long overdue means of ensuring that everybody in the community provides a fair share of the costs of providing Government services to the community'.

The civil libertarians campaigned strongly against a unique ID because it was seen to be an invasion of individual privacy. Amongst these voices was the influential and highly respected Mr Justice Michael Kirby. The civil libertarians won public support for the notion that Australians should not have a unique identification number. In the end, the Government decided against the Australia Card [12]. Notwithstanding this, Australia has introduced a Tax File Number and a Medicare number (for government medical insurance). However there is strong legislation which purports to prevent data matching across government databases [13].

Therefore, there is a great resistance in Australia from many quarters to the introduction of smart card technology for healthcare use as this would necessitate a unique identification number for each individual. The strength of the feeling in Australia against a unique ID is summed up by Davies [14] oft quoted comment: 'Australia is now leading the world in technological surveillance. The computer databases of dozens of government agencies and commercial institutions are being linked. Restrictive laws are being passed on almost a daily basis. Government is intruding into areas of private life once considered off limits. It is no exaggeration to warn that the extent of mass surveillance in Australia will soon rival those of the most authoritarian countries in the world'.

6. Conclusions

It is difficult to envisage an Australian government being sufficiently courageous to introduce a Healthcare Card which requires a unique ID. But eventually the fact that healthcare costs are rising and are already 8% of GDP as well as overseas trends may force it to do so. Indeed the public is demanding a more efficient and effective healthcare system. Around the world Health Informatics is seen as offering the only glimmer of hope in reducing costs while providing a better quality service. Smart cards are just one of the health informatics' technologies that may contribute to providing more cost effective and improved healthcare.

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