Information Technology and the Revolution in Healthcare

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John Houghton

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Centre for Strategic Economic Studies
Victoria University of Technology
PO Box 14428 Melbourne City MC VIC 8001   Australia
Telephone   +613 9248 1340
Fax +613 9248 1350

Email: csesinfo@vu.edu.au
Website: http://www.cfses.com

Executive Summary

Understanding the potential of information and communication technologies (ICTs) to transform cost and control structures is essential for those seeking to benefit from their application. This study examines the impacts of ICTs on the pharmaceutical and healthcare industries. It includes a brief exploration of ICT developments, a discussion of their impacts on pharmaceuticals and healthcare, and an assessment of the implications for healthcare costs, health outcomes and pharmaceutical industry development.

ICT developments

The big stories in ICT development are not of particular breakthrough technologies, but rather those of rapid and continuous improvement in price–performance of both computing and communications, the explosion of bandwidth capacity in fixed and mobile networks, and the emergence and development of the internet and internet-based applications. Perhaps the most important development is the convergence of technologies, which is opening up new possibilities in a number of fields (eg. bioinformatics).

Impact of ICTs on the pharmaceutical industry

Over recent years the drug discovery pipeline has been a concern for many in the pharmaceutical industry. Escalating costs, increasing complexity and a dwindling population of drug candidates suggest that traditional R&D methods are unlikely to produce enough breakthrough drugs to ensure industry growth. The convergence of information and bio-technologies is already revolutionising drug discovery and design, and may radically alter the economics of the drug discovery over the coming years.

In a detailed analysis of the potential economic impacts of genomics and genetics on the pharmaceutical industry's R&D pipeline, Tollerman et al (2001) stressed the importance of ICTs. They suggested that prior to the genomics 'revolution' developing a new drug cost an average of around USD 880 million and took 15 years from start to finish. By applying genomics technologies, they suggested that companies could realise average savings of around USD 300 million and 2 years on drug development. Longer term, genetics technologies could save up to USD 420 million per drug and between 0.7 and 1.6 years.[1] None of this would be possible without ICTs.

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1 Tollerman, P. et al (2001) *A Revolution in R&D: The Impact of Genomics*, Boston Consulting Group, pp3-5; and Tollerman, P. et al (2001) *A Revolution in R&D: Part II The Impact of Genetics*, Boston Consulting Group, p5. Both available www.bcg.com

Less revolutionary, but nonetheless significant impacts for the pharmaceutical industry are available from the further application of ICTs to the:

- substitution of *in silico* for *in vitro* and *in vivo* testing;
- operation and management of clinical trials (eg. e-recruitment);
- monitoring post-launch usage and outcomes;
- marketing and distribution of pharmaceuticals (eg. 'cyber-detailing');
- implementation of integrated e-commerce and supply chain management systems in healthcare supplies;
- development of internet health 'portals' and healthcare information for both medical practitioners and patients; and
- further development of electronic prescription and clinical decision support systems.

Impact of ICTs on the healthcare industry

There is an enormous range of opportunities for significant cost reductions, service enhancements and behavioural change through what is often broadly referred to as 'e-health'.

Payers: The major impact of ICTs on payers will be the ability to manage the system in order to better account for expenditures, to manage the flow of funds and contain costs. There will be strong motivation to adopt systems which enable payers to track expenditures and exercise control over the processes of referral and prescription – the initiators of health services. From the payers' perspective, ICTs are tools for demand management and cost containment.

Providers: It is clear that the entire healthcare system could reap significant gains from an integrated approach to supply chain management that includes the entire range of hospital and medical supplies and linkages to other players in the healthcare system. Electronic scheduling and patient management systems could improve scheduling of tests and procedures, and thereby reduce the length of hospital stays and reduce the need for multiple visits. Linking insurers, healthcare providers, financial institutions and consumers into claiming and payments systems also has the potential to reduce significantly administrative costs and improve quality of service. There are already some examples of leading-edge activities, but for many progress towards realising these benefits has been relatively slow.

Practitioners: From the perspective of individual medical practitioners, knowledge enrichment or education, practice administration, and clinical tools are among the most important ICT applications. Knowledge enrichment and practice administration systems are widely used, but the adoption of clinical tools has been relatively slow because of the complexity of such applications and a range of doctor concerns (eg. patient privacy and security of patient records, the possibility that the tools will generate activities that are not billable and/or reimbursable, the cost of integrating clinical tools with current systems, the difficulty of use and possible interruptions to workflow and doctor patient interactions, and the time needed for training to effectively use the new tools). Nevertheless, clinical tools hold significant promise, both in terms of direct efficiency and cost savings and in terms of influencing the behaviour and practices of doctors. Ultimately, Clinical Decision Support Systems (CDSS) will provide a key component for evidence-based care. The use of CDSS in prevention and monitoring has been shown to improve compliance with guidelines in many clinical areas. CDSS drug prescribing is particularly useful in such areas as drug selection, dosing calculations and scheduling, screening for interactions and monitoring and documentation of adverse reactions. Computer assisted diagnosis and management aids are at an earlier stage of development, due to the complexities involved, but their potential to enhance healthcare outcomes is enormous. The potential for such applications to enable a range of care management and funding agencies to monitor and influence the behaviour of doctors at the critical point of prescription and referral is of great significance for all stakeholders.

Patients: ICTs are altering the relationship and balance of power between patients and providers, leading to more empowered consumers and enhanced self, home and community care capabilities. Perhaps the greatest change in the patient-provider relationship will be brought about by the use of internet by patients. Broshy et al (1998) suggested that two types of information will be particularly important – information about managing health and chronic disease, and information about provider quality and cost.[2] With the rise of more informed consumers, there will be increasing scope for stakeholders to influence healthcare behaviour, prescription, treatment and referral decisions and compliance through patients, as well as through doctors.

Assessing the implications

In the pharmaceuticals industry there is a convergence of leading-edge information and bio-technologies which looks set to transform the drug development pipeline. The demand for new biotechnology and informatics capabilities within established pharmaceutical companies, and the emergence of new players into the industry with specialist skills in biotechnology and/or informatics, experience in using bioinformatics in genomics and genetics, and much sort after proprietary databases presents many new challenges. There are likely to be rapid changes and developments, requiring immediate responses involving significant, even (corporate) life-and-death decisions. It is a high stakes game, but there are significant rewards available to those who can successfully navigate the risks.

These same developments present both threats and opportunities for pharmaceutical industry development, with changes in core skills likely to effect the relative attractiveness of different locations, the viability of some traditional locations and the mobility of investment within the industry. Governments and locations tuned to the opportunities and threats stand to gain from these changes, while others may lose.

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2 Broshy, E. et al (1998) *Managing for a Wired Health Care Industry*, Boston Consulting Group. Available www.bcg.com

The interface between the pharmaceutical industry and the healthcare industry is also being changed by ICT applications, with many opportunities for cost savings and efficiency gains. The potential for e-commerce and internet-based technologies to enhance drug marketing and distribution has only just begun to be tapped, and the scope for further innovation is enormous. The potential for gathering information from drug trials and from post-launch usage opens up the possibility of closing the loop on evidence-based care, right through from drug design and development to consumption. The potential for pharmaceuticals manufacturers and suppliers to integrate more fully into clinical systems, opens up enormous possibilities (and risks) in terms of influencing drug selection and usage at the critical point of care.

Use of online health information by patients increasingly pro-active in the diagnosis, treatment and management of their conditions provides an entirely new window of opportunity to 'market' health, healthcare products and healthcare services directly to the consumers in such ways as to influence purchasing, prescribing and referral practices. The critical barrier facing pharmaceutical companies in navigating these possibilities and realising potential opportunities appears to be that of maintaining credibility while gaining advantage. Much cautious and well thought through partnering is likely to be required.

In the healthcare industry there are some areas where leading-edge ICT developments are employed and developments at the leading-edge will be important. In other areas the health system is some way behind other industries in the adoption and application of information management and information systems. In general, the situation seems to be one of relatively slow progress through the evolving computing paradigms of functional computing, enterprise computing and network computing. Some functions are highly automated, but integrated enterprise computing in hospitals and clinics is still rather rare. As a result, linking and integrating the healthcare system (network computing) remains a major challenge.

The healthcare sector's fragmented constituencies and complex transactions present a major barrier, making the application of ICT enabled information management systems extremely difficult. It is too early to right-off the potential impact of ICTs as mere hype, but it is clear that progress is slow and there are many hurdles to overcome. Consequently, at the system level, the impacts of ICTs are likely to be in overall management and cost control, and in influencing decisions at the point of care. In terms of care, the impacts are likely to be in such areas as quality control, patient safety and general improvements in services, outcomes and performance.

Given the difficulties of realising the savings, where difficulties translate into time and money, they may prove to be more marginal than many expect. When Goldsmith (2000) explored how the internet would change the US health system he concluded that:

> *"The Internet has a greater potential to fundamentally transform both the structure and the core processes of medicine than any new technology we have seen in the past fifty years. Professional resistance to adoption of the technology and political problems associated with protecting the confidentiality of patient*

> *records pose the two biggest hurdles to fully realizing this potential. I see the Internet generating some demand for new products and services. However, that demand is likely to be counterbalanced by a more careful weighing of potential benefits, reduction in medical errors, and the elevation of less expensive substitute therapies to parity with traditional invasive medicine, as well as savings from improved disease management…* ***As a consequence, the… impact on health care costs may be surprisingly benign****."* [3]

The impacts at the point-of-care are likely to be more significant in the near to medium term. Clinical tools hold more promise that do others, both in terms of direct efficiency and cost savings and in terms of influencing the behaviour of doctors. It is this latter that is likely to see major players in the healthcare system driving the adoption of e-health, and especially of clinical tools, because they impact so directly on prescription practices, and thereby upon the choice of drugs and management of drug expenditures, and on referrals to pathology, diagnostic, specialist and hospital services, and thereby upon the management of healthcare expenditures. As Martin (2000) wrote:

> *Money is tied to doctors signatures. They authorise the treatment and everything else that happens to citizens who are ill. A government which can control doctors signatures can control costs. A corporation which controls doctors can make a profit. Other professionals who can wrest control of treatment from doctors can increase control over their own activities.*[4]

Longer term, the major challenge for both pharmaceuticals and healthcare may be surviving the transformation to an individualised care paradigm, and adopting strategies to cope with the transformation and thrive in the emerging environment. ICTs, in the form of both information systems and information management, will play an important role in enabling stakeholders throughout the healthcare system to adjust and prosper, but there will inevitably be failures along the way.

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3 Goldsmith, J. (2000) 'How Will the Internet Change Our Health System?,' *Health Affairs* 19(1). Emphasis added.

4 Martin, B. (2000) *The Corporatisation of Health Care in Australia*, p1. Available www.uow.edu.au/arts/sts/bmartin/dissent/documents/health/corp_austral.html

Contents

Figures & Tables

1 Introduction

The information and communication technology (ICT) revolution is having dramatic effects on practices within the pharmaceutical industry and on the delivery of health services. Flower (1999) wrote: "health care has not essentially changed in at least half a century, but in one generation or less, every element of it, every assumption behind it, will be changed or gone."[5] He identified three forces for transformation: biology (particularly genetic and immunological developments); technology (particularly ICTs); and health management. Clearly, ICTs impact all three of these areas in fundamental ways and will, therefore, play a major role in the anticipated transformation.

1.1 Report Outline

There are three major elements to the report: an exploration of ICT developments; a discussion of their impacts on the pharmaceutical and healthcare industries; and an assessment of the implications and barriers. In examining the impacts and implications the various interests and motivations of all major stakeholders are considered, including pharmaceuticals companies, and healthcare's payers, providers, practitioners and patients.

Chapter 2 focuses on major ICT developments and how they might be used in the pharmaceutical industry and healthcare system. It includes an examination of recent developments and projections of likely futures.

Chapter 3 outlines a framework for assessing the impacts of ICTs in the healthcare system, then briefly looks at the scope of healthcare in Australia, the level of adoption of ICTs in the industry and at some of the drivers of e-health developments.

Chapter 4 explores the potential pharmaceutical industry impacts of ICTs, looking at the areas of drug discovery and design, marketing and distribution, e-commerce and health care system supply chain linkages.

Chapter 5 explores the potential healthcare industry impacts of ICTs, looking at four key areas:[6]

1. *Payer applications* – including management of government funding and delivery programs, health insurance and the use of e-commerce and electronic

5 Flower, J. (1999) 'The End of Health Care as We Know It', *Health Forum Journal*, July/August 1999.

6 Biomedical applications – including, for example, imaging, sensors and robotics – make an important contribution to healthcare, but they are not dealt with in this study as they are ICT assisted medical tools rather than ICT systems enabling the delivery of healthcare services. See Box 5.1.

communication to coordinate healthcare organizations and activities throughout the system;

2. *Provider applications* – including the applications of e-health in private for-profit, not-for-profit and public hospitals and clinics, the use of e-commerce and internet-based systems linking and integrating health services;
3. *Practitioner applications* – including the adoption of practice management tools, clinical tools and online communication systems, telemedicine and remote diagnostics, the use of clinical decision support systems (CDSS) and evidence-based care in diagnosis and treatment; and
4. *Patient applications* – including new forms and locations of care delivery, the emergence of the internet and of informed consumers and new information and health intermediaries, and the use of online pharmacies.

Throughout the analysis we attempt to separate what is real from the hyperbole, remaining cognisant of the dangers of overstating the potential impacts of ICTs – which were, for example, set to give us the ‘paperless office’ a decade ago and to make travel unnecessary soon after the development of the telegraph in the 19th century.

Chapter 6 explores the implications of the various ICT developments and applications identified. The focus is on potential positive and negative impacts for all the stakeholders and for the system as a whole. We examine the opportunities and threats that ICT applications present to the pharmaceutical and healthcare industries, and attempt to identify the critical barriers to the full realisation of potential benefits. The implications for national health systems vary to some extent with variations in those national systems. This study focuses on drawing out the implications for the evolving Australian system.

2 Major trends and developments in ICTs

This chapter explores some of the developments within ICTs that impact the kinds of information systems and management applications that are found in the pharmaceutical and healthcare industries. From this 'application' perspective the big stories in the development of ICTs are not of particular breakthrough technologies, but rather those of fast and continuous improvement in price–performance of both computing and communications, the explosion of bandwidth capacity in fixed and mobile networks, the emergence and development of the internet, and continuing miniaturisation. Underlying some of the major opportunities is the convergence of technologies, which is opening up new possibilities for synergistic developments in a number of fields – developments that could fundamentally transform the pharmaceutical and healthcare industries.

2.1 Price–performance

In the 1960s, Gordon Moore, noted that the density of transistors on chips was doubling every year, and he predicted a continued doubling every 12 to 18 months. This prediction became known as 'Moore's Law', and it has held for more than 25 years. Moravec (1998) suggested that the power of computers (ie. their information processing capacity measured in machine instructions per second) doubled every two years during the 1950s, 1960s and 1970s, every 18 months during the 1980s and every year during the 1990s.[7] At the same time prices have been falling. During the 1990s, the price of computer equipment in the United States declined by more than 17 per cent a year, or by 87 per cent. In Australia, audiovisual and computing equipment prices fell by more than than 48 per cent between 1989-90 and the September quarter 2001.[8]

In 1997, the Information Industries Taskforce noted that: "A 1975 mainframe computer could carry out 10 million instructions per second and cost about $10 million. By 1995 the ordinary desktop computer could compute nearly 70 million instructions per second and cost only $3,000. In cost/performance terms, the capital cost of performing one million instructions had dropped from $1 million in 1975 to $45 in 1995, a decline of more than 99.99 per cent in 20 years.[9] If the price of trucks had dropped at a corresponding rate, a 1975 $200,000 semi-trailer would have cost $9 in 1995! Imagine how that would have revolutionised the transportation of goods to market and you can begin to appreciate

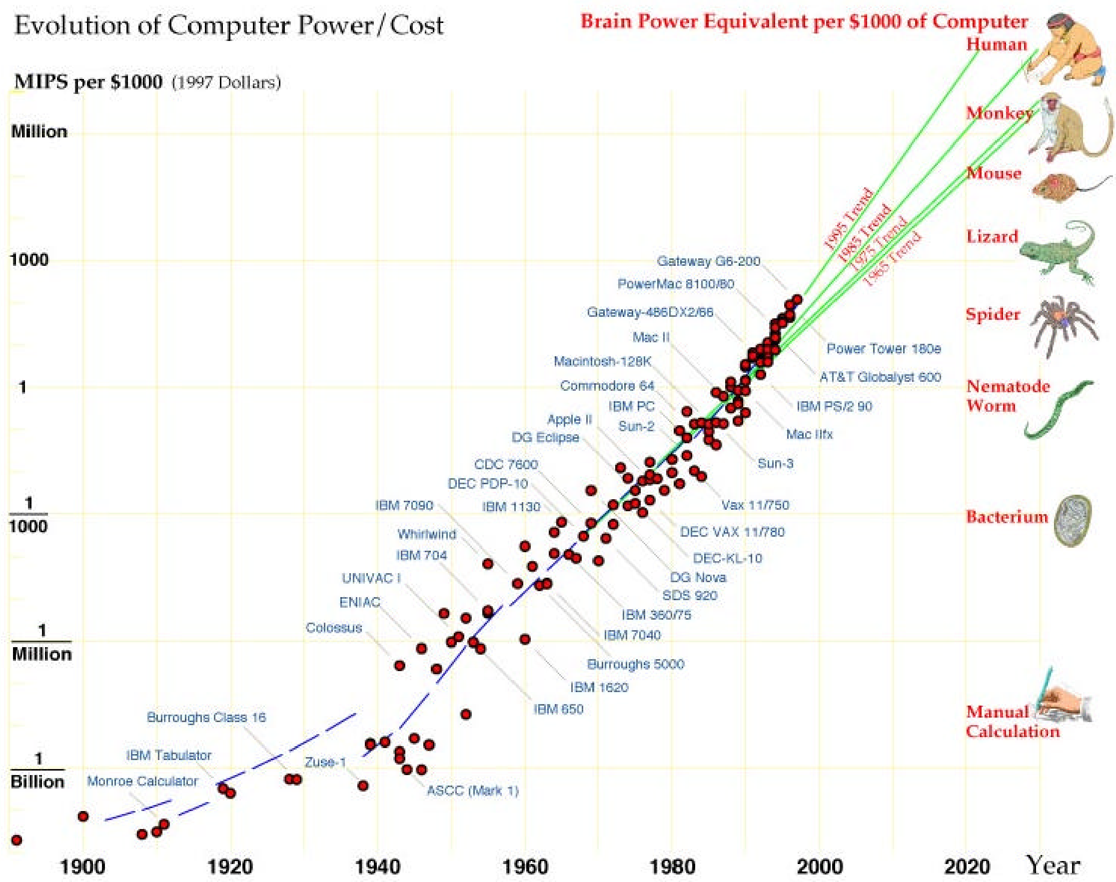
7 Moravec, H. (1998) *Robot: Mere machine to transcendent mind*, Oxford University Press, Oxford. Available http://cart.frc.ri.cmu.edu/users/hpm/book97/

8 ABS (2001) *Consumer Price Index: Australia*, Cat No 6401.0, ABS, Canberra, p20. Including all audio, visual and computing equipment.

9 Hudson Institute (1997) *Workforce 2010*, cited in Ryan, C. 'How the US has licked unemployment,' *Australian Financial Review*, June 20th 1997, p32.

the potential of information and communication technologies to revolutionise commerce."[10]

Figure 2.1 Increasing computer power



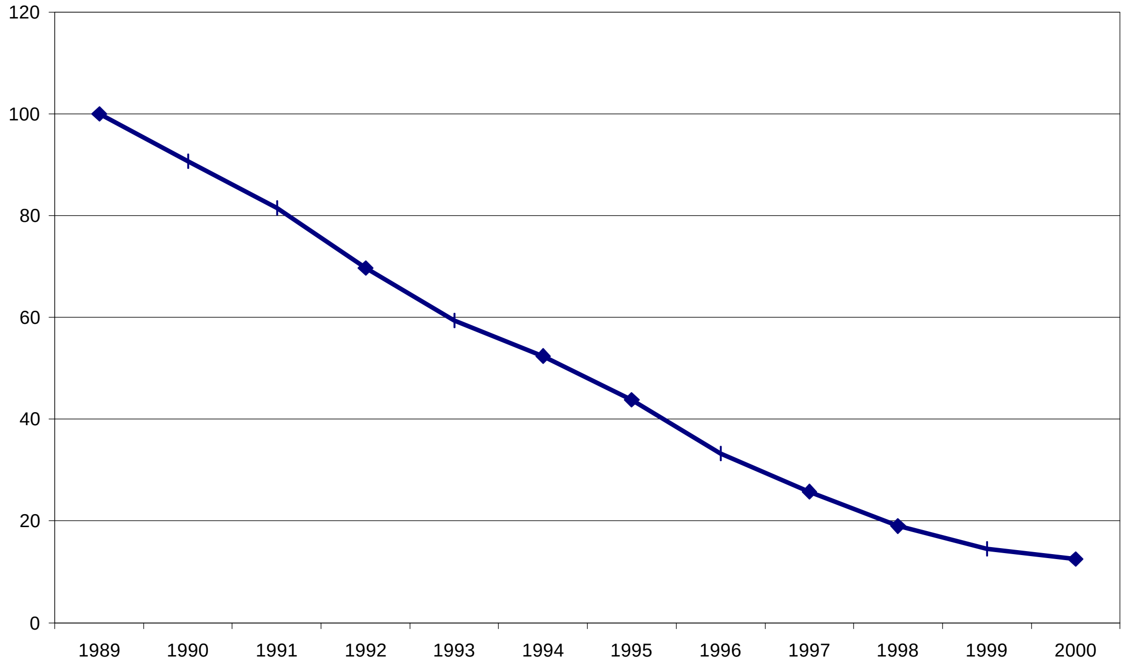
Source: Moravec, H. (1998) *Robot: Mere machine to transcendent mind*, Oxford University Press.

Many have predicted the end of the exponential growth in computer capacity as we near the physical limits of lithographic processes for the manufacture of silicon chips. Others are less Malthusian. "As we rush towards the limits of traditional chip manufacturing technologies, entirely new approaches are beginning to bear fruit in the laboratories. 3D chip arrays will bring another dimension to circuit layout. DNA computing could be an immensely powerful form of parallel processing, though it may have a limited range of applications. Quantum computing, until recently dismissed by many scientists as science fiction, is showing real results and could eventually lead to computers many orders of magnitude more powerful than today's supercomputers. These and other emerging computing technologies suggest that the exponential growth in computer

10 The Information Industries Taskforce (1997) *The Global Information Economy: The Way Ahead*, ('Goldsworthy Report'), DIST, Canberra, July 1997, p1.

power could continue for decades to come."[11] There are a number of potential and emerging technologies which look set to underpin further development.[12]

Figure 2.2 U.S. computing equipment prices, 1989-2000 (Indexed 1989=100)



Source: U.S. Bureau of Labor Statistics. Available www.bla.gov

2.2 Bandwidth and mobility

Increasingly this power is networked, with bandwidth capacity and communications traffic also growing rapidly. Broadband and networking technologies have received a large share of development interest and funding in recent years. Fibre optics have been around for some time, but still contain newly emerging sub-fields and technologies that are likely to continue to evolve. For example, dense wave division multiplexing is greatly increasing the capacity of existing optical fibre infrastructure, and an ever increasing range of photonic devices is available to harness that capacity.

11 Manyworlds (2001) *Tracking Emerging Technologies and Trends: Taking Advantage of Technological Acceleration*, Manyworlds, Houston, Texas, p7. Available www.manyworlds.com.

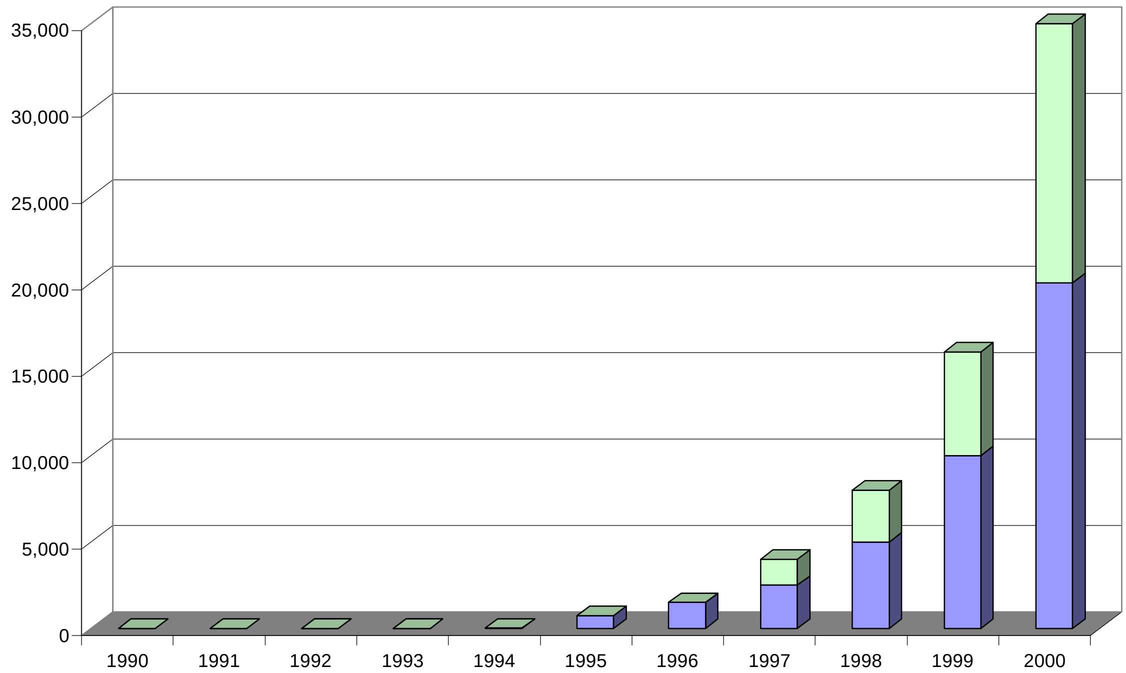
12 See, for example, Economist (2002) 'Stamping on tradition: A new way of making silicon chips has been invented,' *The Economist* 20 June 2002 on the development of LADI.

Seeing communication as the new revolution, futurist George Gilder has declared the computer age over, writing:

> *"After a cataclysmic global run of thirty years, it has given birth to the age of the telecosm - the world enabled and defined by new communications technology. Chips and software will continue to make great contributions to our lives, but the action is elsewhere. To seek the key to great wealth and to understand the bewildering ways that high tech is restructuring our lives, look not to chip speed but to communication power, or bandwidth. Bandwidth is exploding, and its abundance is the most important social and economic fact of our time."*[13]

Gilder's 'Twenty Laws of the Telecosm' include one that states that bandwidth grows at least three times faster than computer power. Manyworlds noted that the doubling time for computer capacity (ie. machine instructions per second per dollar) has fallen from two years to 1 year, but bandwidth capacity is doubling every nine months.[14]

Figure 2.3 Traffic on internet backbones in the United States, 1990-2000 (Terabytes per month as at December of that year)



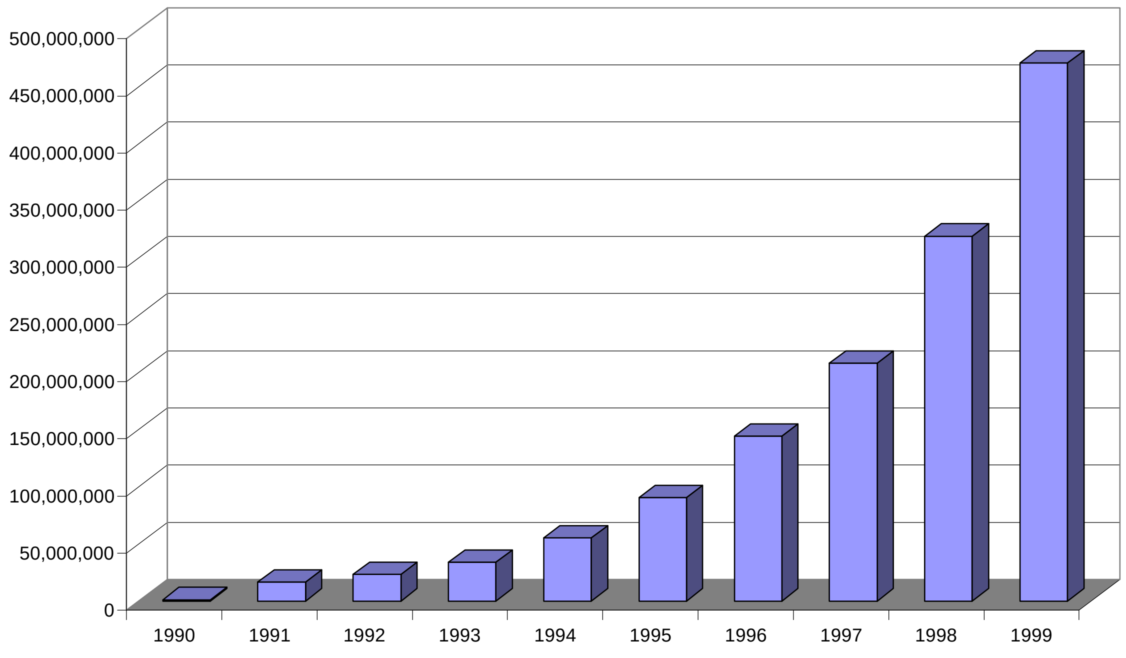
Note: Bars show base and upper estimates of backbone traffic.
Source: Coffman, K.G. and Odlyzko, A.M. (2001) *Internet Growth: Is there a Moore's Law for data traffic*? AT&T Labs, p4.

13 Gilder, G. (2000) *Telecosm: How Infinite Bandwidth Will Revolutionize Our World*, Free Press, New York. Available http://www1.fatbrain.com/asp/bookinfo/

14 Manyworlds (2001) *Tracking Emerging Technologies and Trends: Taking Advantage of Technological Acceleration*, Manyworlds, Houston, Texas, p3. Available www.manyworlds.com.

In addition to the massive amount of capacity being installed the impact of successive waves of technological development are dramatically increasing the amount of traffic each fibre is able to carry.[15] Coffman and Odlyzko (2001) estimated that by the end of 2000 there was between 20,000 and 35,000 terabytes of traffic on US internet backbones per month – up from around 1,500 terabytes at the end of 1996.[16] International submarine and satellite capacity has also grown rapidly. Capacity between Australia and other countries was predicted to increase twenty-fold between 2001 and 2003, on the back of a ten-fold increase in the previous two years.[17] As a result, the cost of broadband transmission capacity has fallen by an average of 30 per cent a year for the past 25 years.[18] Telephone call prices are falling too. The average international call charge per minute for OECD countries fell from USD 1.07 in 1995 to USD 0.52 in 2000, with the largest declines occurring since 1998 – an overall reduction of 32 per cent in the OECD average price between 1998 and 2000.[19]

Figure 2.4 Cellular mobile subscribers in OECD countries, 1990-99



Source: OECD (2001) *Communications Outlook 2001,* Paris: OECD, p85.

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15 Especially through the development of dense wave division multiplexing.

16 Coffman, K.G. and Odlyzko, A.M. (2001) *Internet Growth: Is there a Moore's Law for data traffic*? AT&T Labs, p4.

17 Huston, G. (2001) *The Changing Structure of the Internet*, presentation to APEC Tel 23, Canberra, March 2001.

18 Ovum (1999) *Future Pricing Trends for Bandwidth*, DCITA, Canberra.

19 OECD (2001) *Communications Outlook 2001*, OECD, Paris, p180.

In terms of useability, perhaps the most important development is that of mobility, with rapid technical developments occurring in the areas of mobile voice and data. While they are far from mature, some interesting applications are emerging.[20] These include: two-and-a-half generation mobile technologies like Wireless Access Protocol (WAP), the SIM Application Toolkit, General Packet Radio Service (GPRS), technologies like Bluetooth and, of course, the introduction of 3rd generation (3G) mobile. Predictions about the importance of wireless data and these technologies vary considerably, but Telstra has stated that it expects mobile data volumes to equal mobile voice traffic by 2005.[21] The global 3G market is estimated to grow from USD 1.5 billion in 2001 to USD 9.2 billion in 2005; with investment in infrastructure to support 3G services of USD 1 billion in 2001, increasing to over USD 5 billion in 2003.[22] There are around 8 million mobile phone subscribers in Australia, and IDC reported that there were already up to 100 000 mobile internet subscribers at the end of 2000.[23]

2.3 Internet

The internet is both simple and revolutionary. The number of internet users is difficult to gauge, but the number of hosts (ie. unique addresses advertised to internet) has increased rapidly in recent years. From a little over 200 in 1981, the number of hosts increased to more than 300 000 by 1990 and reached 147 million in January 2002 – growing at a compound annual rate of 90 per cent over 21 years.[24] In Australia, there was an estimated 4.3 million internet subscribers at the end of 2001.[25] Moreover, internet access prices are falling rapidly. The average cost to OECD users of access to the internet for 20 hours per month at peak times fell by 25 per cent between October 1999 and September 2000, and by 22 per cent at off-peak times.[26]

The internet will continue to evolve rapidly.

> *"Middleware and enterprise application integration (EAI) software is bridging disparate systems in increasingly powerful ways. Web-enabling application platforms are beginning to form the fabric for the next generation of eBusiness*

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20 See Houghton, J.W. and Morris, P. (2001) *Broadband Networks and Services: Regulatory issues - Australia*, International Telecommunications Union, United Nations, Geneva (www.itu.int/osg/spu/ni/broadband) for a summary of Australia's fixed and mobile broadband network capacity.

21 This discussion of mobile data developments is derived from ACA (2000) *Telecommunication Performance Report 1999-2000*, ACA, Canberra, pp104-106.

22 ITU (2000) *Media Release*, May 8th, 2000, International Telecommunications Union, Geneva. Available www.itu.int

23 Kennedy, D. (2001) 'New message system still over the horizon,' *Australian Financial Review*, World without wires (special report) 28th February 2001, p13.

24 See Network Wizards (www.mw.com), and Netsizer (www.netsizer.com).

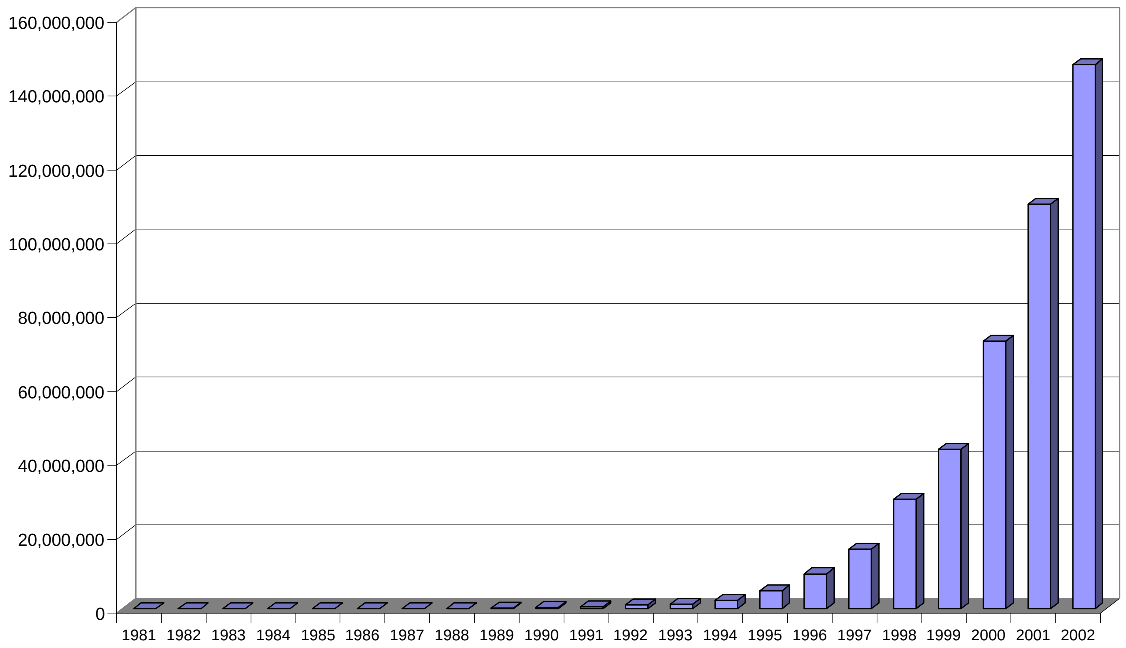
25 ABS (2002) *Internet Activity Australia*, Cat No 8153.0, ABS, Canberra.

26 OECD (2001) *Communications Outlook 2001*, OECD, Paris, p178.

applications. Web-enabled supply chains will push further the trend towards the virtualization of enterprises and the optimization of supply chains. The proliferation of languages, standards, directories and protocols… is enabling the building of Web services. The numerous initiatives in the area of metadata creation and processing will enable entirely new forms of on-line interaction."[27]

The great contribution of the internet is that it can provide the basis for very low cost, universal, worldwide access to data by spanning across and being able to reach down into proprietary 'silos'.

Figure 2.5 Number of internet hosts, 1981 to 2002



Note: Number of internet hosts as at July for 1981 to 1992, and as at January 1993 to 2002.
Source: Internet Software Consortium (http://www.isc.org/).

Rather than relying on search engines and bookmarks, or even gateways and portals, it is likely that 'agents' or 'bots' will provide customised and specialised retrieval and notification services – despite a somewhat over-hyped beginning.[28]

"Software agents or bots may have suffered from the same premature enthusiasm as virtual reality, but should still become an integral part of the

27 Manyworlds (2001) *Tracking Emerging Technologies and Trends: Taking Advantage of Technological Acceleration*, Manyworlds, Houston, Texas, p10. Available www.manyworlds.com.

28 See, for example, Shirky, C. (2001) *Why Smart Agents are a Dumb Idea*. Available www.shirky.com/writings/bots.html

future Internet, assisting individuals and businesses make transactions, gather information according to personal preferences, and act as surrogates in a growing range of applications as their sophistication grows. Agents will be only part of a growing trend towards personalized or customized content and knowledge management. More intelligent software agents, Internet ontologies, metadata, and semantically-aware software will bring an ever better fit between information flows and individuals and corporations. On-line business will benefit from this heightened personalization and we can expect to see a continuation of recent trends in Web-enabled customer relationship management (eCRM), along with the improvement of electronic payment."[29]

Such applications have the potential to contribute to patient care and management as well as patient and doctor education through the use of specialised, perhaps disease specific, agents or bots.

2.4 Miniaturisation

Miniaturisation continues, with the development and proliferation of microelectrical mechanical systems (MEMS) – including sensors, actuators, and monitors.

"MEMS form just part of the large field of micromachines which includes all devices operating on a microscopic level such as micromirrors used in optical switches and tiny accelerometers which deploy airbags. At a level one thousand times smaller than that of micromachines, we are beginning to see the field of molecular nanotechnology move from pure theory to practical applications. Although definitions vary, the strongest form of nanotechnology involves complete control of matter by the direct positioning of individual atoms. Some components of nanomachines (such as nanotubes and buckyballs) have already been created. Eventually we may achieve molecular-scale nanobots working with nanocomputers (with the power of today's supercomputers packed into a device small enough to move easily inside a human cell). Carefully programmed nanobots, multiplying themselves into numbers sufficient to reach every cell in the human body, could lead to a mature nanomedicine capable of eliminating all disease and augmenting the immune system (among the more modest possibilities)."[30]

The potential healthcare applications of these developments, and of more readily available miniaturisation of existing medical equipment and tools are likely to see

29 Manyworlds (2001) *Tracking Emerging Technologies and Trends: Taking Advantage of Technological Acceleration*, Manyworlds, Houston, Texas, p11. Available www.manyworlds.com.

30 Manyworlds (2001) *Tracking Emerging Technologies and Trends: Taking Advantage of Technological Acceleration*, Manyworlds, Houston, Texas, p7. Available www.manyworlds.com.

improved health outcomes, greater mobility and a consequent growth in community and home-based care possibilities.

2.5 Imaging technologies

Materials science is feeding a number of emerging trends with potential application in ICTs, medical instruments and healthcare.

> *"New battery technologies (including fuel cells), new polymers, and more precise ways of arranging matter are allowing the fabrication of previously impossible products: inexpensive, high resolution flat-screen displays, foldable computer screens, and high contrast monitors for e-books and portable devices. Materials science is combining with other advances such as in optics to produce other innovations in display technology. The popularity of cellphones, PDAs, and other portable computing devices is driving improvements in microdisplays.*
>
> *Although over-hyped in the short term, virtual reality technologies (VR) continue to improve and will find at least limited uses such as in remote surgery, remote exploration of extreme environments, and perhaps the wider applications of personal interaction. Truly useful VR will require considerable advances in haptic interfaces so as to involve more than visual interaction, as well as greater bandwidth."*[31]

Clearly, these kinds of developments could improve and make more affordable a wide range of medical imaging, remote diagnostic and even treatment technologies.

2.6 Data handling

Rapidly advancing data storage capacity is far from a new trend, but within this long-term growth are some newly emerging technologies that promise to keep alive the explosive growth in storage capacity.

The density of magnetic disk storage increased around 30 per cent a year from 1956 to 1991, doubling every two and a half years.[32] In the 1990s the growth rate accelerated, and in the late 1990s increased yet again. By some accounts, the density of disk drives is now doubling each year. The total deployed storage capacity has increased even faster, as the number of disks shipped has grown. It is estimated that installed magnetic disk drive capacity alone reached over 3 million terabytes in 2000, and is likely to be in

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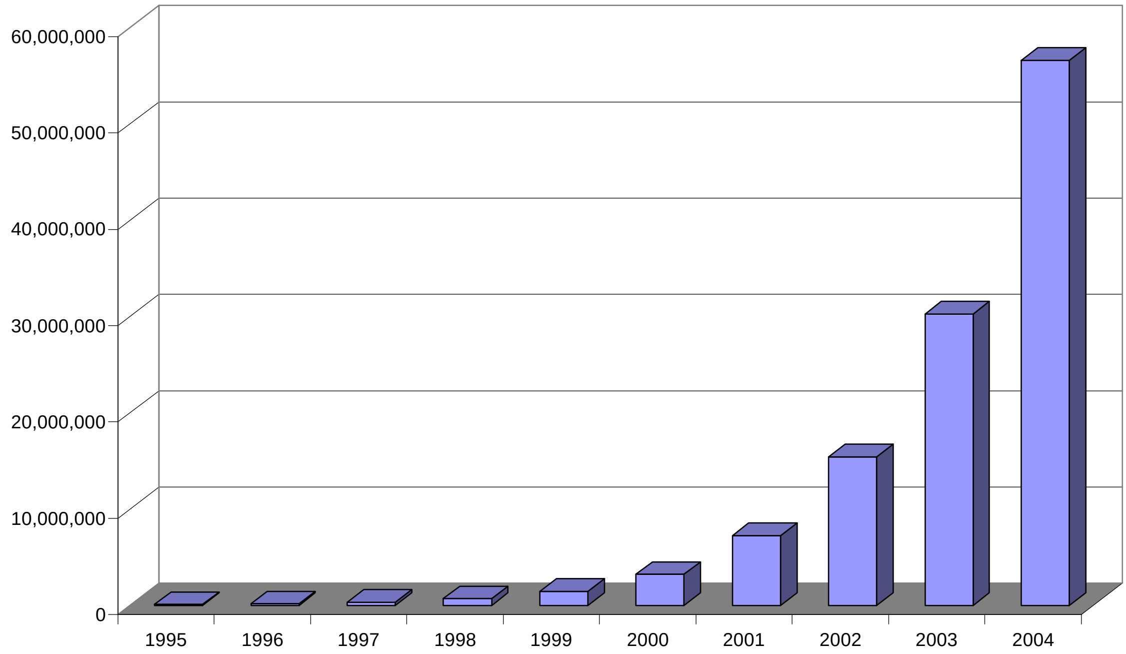
31 Manyworlds (2001) *Tracking Emerging Technologies and Trends: Taking Advantage of Technological Acceleration*, Manyworlds, Houston, Texas, p9. Available www.manyworlds.com.

32 Economist (1997) Not Moore's Law, *The Economist*, July 12, 1997.

excess of 30 million terabytes by the end of 2003.[33] The boom in optical storage is at least as impressive.

Figure 2.6 Worldwide hard disk storage capacity in terabytes, 1995-2004



Note: 2000 to 2004 estimated.
Source: Coffman, K.G. and Odlyzko, A.M. (2001) *Internet Growth: Is there a Moore's Law for data traffic*? AT&T Labs, p36.

New materials for hard discs, optical storage, and now molecular-scale memory are being developed. Microprocessor companies continue to develop new processor architectures, often using computer-aided design to handle otherwise intractable difficulties in optimising data flows. Data warehousing and data mining technologies are maturing, keeping pace with the explosion of information and making it increasingly usable and useful. Artificial intelligence (AI) and, perhaps to a lesser extent, expert systems have yet to live up to their promise. Nevertheless, there are significant developments which could see the more widespread use of increasingly sophisticated decisions support systems in such areas as diagnostics.

2.7 Converging technologies

In a recent summary of emerging technologies, Manyworlds (2001) suggested that convergence is the 'mega-trend'.

33 Coffman, K.G. and Odlyzko, A.M. (2001) *Internet Growth: Is there a Moore's Law for data traffic*? AT&T Labs, p36. Available research.att.com

> *"Looking through the technologies noted above, it will become obvious that numerous technological convergences are occurring. These convergences are bringing together trends to form megatrends. The biotech revolution has highlighted the deep interrelationships between the biological sciences and information technology. Materials science, human-computer interfaces, and knowledge and content management are coming together in novel combinations to deliver solutions. The once-separate worlds of hardware and software are beginning to blur together to some degree. As matter grows in intelligence with the spread of embedded processors, wireless tracking, and ubiquitous computing, it becomes responsive to human desires and commands. Matter is increasingly becoming programmable like software. If the promises of molecular nanotechnology are realized, this process will be completed."*[34]

The meeting of biological and information sciences is, perhaps, among the most significant of these mega-trends for the pharmaceutical and healthcare industries. Anton et al (2001) suggested that: "The revolution of biology relies heavily on technological trends not only in the biological sciences and technology but also in microelectromechanical systems, materials, imaging, sensor, and information technology. …advances in genomic profiling, cloning, genetic modification, biomedical engineering, disease therapy, and drug developments are accelerating."[35] Manyworlds (2001) suggested that:

> *"Medicine and biotechnology are being transformed by numerous simultaneous revolutions. Bioinformatics uses mathematical techniques to uncover information in several areas including the gene sequences studied in genomics and the newer field of proteomics which reveals the structure and function of proteins. DNA chips can be used to quickly identify genetic differences between people. Rational drug design uses bioinformatics to more precisely identify drug targets, while directed evolution methods generate numerous potential substances from which the most promising can be culled and recombined leading to better drugs. Both supercomputers (eg. IBM's Blue Gene) and distributed computers (eg. folding@home) are being brought to bear in protein folding computation, which attempts to model the massive complexity of protein structure to precisely design effective treatments. These trends are moving us towards* in silico *biology - computer modelling of biological processes that obviates the need for slow biological trials and tests.*
>
> *Many of these new biotechnologies are drawing us closer to an era of truly personalized medicine, where patients will take only drugs known to be safe and*

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34 Manyworlds (2001) *Tracking Emerging Technologies and Trends: Taking Advantage of Technological Acceleration,* Manyworlds, Houston, Texas, p12. Available www.manyworlds.com.

35 Anton, P.S., Silberglitt, R. and Schneider, J. (2001) *The Global Technology Revolution: Bio/Nano/Materials trends and their synergies with information technology by 2015,* Rand National Defence Research Institute, Santa Monica and Arlington.

effective for them as individuals. Stem cells, gene therapy, tissue engineering, transgenesis, anti-aging research, and other emerging fields will open new possibilities for powerful medical therapies and a transformation of the medical and insurance industries. Further in the future, nanomedicine offers the potential to alter biological function at the deepest level possible."[36]

Box 2.1 Virtual health agents?

Developments that are likely to dominate healthcare in the first two decades of the next century include: evidence-based medicine; comprehensive electronic medical records; and an Internet conduit linking providers, patients, and payers. Add new medical instruments and diagnostic devices – increasingly small, sensitive, and non-invasive – to this mix and the practice of healthcare will change dramatically.

Meet Elliot Carter, a 40-year- old professional living in the year 2015. He starts each day with an at-home medical scan and a consultation with his virtual on-line physician, Dr. Franklin Thomas. The encounter goes like this:

The medical scan. Elliot inserts his left forefinger into a digital terminal to measure his blood pressure and circulation. He places a lightweight, oral probe under his tongue for an instant temperature and viral antibody reading. His saliva is sampled for a rapid nutritional analysis of yesterday's food and liquid intake.

The virtual consultation. The measurements are transmitted to Elliot's health agent, a successor to today's health plan, which has the information technology to assess the data instantly, store it, and compare it to Elliot's medical history, stowed in a vast medical records data warehouse. Dr. Thomas, an on-screen personification of the health agent, tells Elliot that he has a slight cold and overindulged in food and drink the day before. Dr. Thomas prescribes a medicine to treat the cold and proposes a meal plan to maximize Elliot's limited energy over the next 24 hours.

Healthcare delivery. Unless Elliot is acutely sick, he rarely needs to see a physician face-to-face. Dr. Thomas uses two-way technology to "observe" him. A speedy one-hour delivery service rushes any necessary prescriptions to his home or office. On the few occasions when Elliot must make an out-patient visit, his health agent puts the business out to bid, combing through extensive provider records to see which providers have the best proven outcomes. They are invited to submit their bids. The health agent then determines which is the best provider (based on the best outcome at the best price) and schedules an appointment.

Elliot no longer sees one real practitioner regularly, but he relates to Dr. Thomas – with whom he "talks" daily – in a similar way. Besides, Elliot is pleased at how responsive his service is. No medical question is too big or too small for this virtual health agent, which is available 24 hours a day, seven days a week. What he has is health advocacy at its best.

Source: PriceWaterhouseCoopers (1999) *Pharma 2005: Marketing to the Individual*, PriceWaterhouseCoopers, p16. Available http://www.pwcglobal.com/

36 Manyworlds (2001) *Tracking Emerging Technologies and Trends: Taking Advantage of Technological Acceleration*, Manyworlds, Houston, Texas, p6. Available www.manyworlds.com.

In a similar vein, under the heading '*Converging Forces and a New Form of Healthcare*' PriceWaterhouseCoopers (1999) noted that:

> *"Huge forces are changing the world in which we live and – with it – the world of healthcare. A global shift in consumer attitudes is taking place. Empowered by better access to higher education, information sources like the Internet, and greater personal wealth, consumers want a much bigger say in their own medical treatment. Their expectations are rising, too. They increasingly regard healthcare as a right, not the privilege it was considered by former generations. And the way in which they define health is expanding to encompass quality of life, not just the absence of illness.*
>
> *Consumer empowerment is only one of the forces transforming our world. Massive advances in information management, technology, and science are also taking place. Improvements in information management are forging the tools that connect people across the globe. They are likewise providing the means with which to manage a growing mountain of data and maximize its value. Meanwhile, new diagnostic tools are providing ever more accurate pictures of man's internal organs; miniaturization is paving the way for tiny surgical devices such as intelligent pacemakers; and the code that makes up the human genome is being deciphered…*
>
> *The convergence of all four forces – consumer empowerment, information management, technology, and science – is not just accelerating the rate of change, it is also magnifying the impact of each change. In isolation, they would be dramatic. Collectively, they will alter the very way in which we think, interact and move. They will reshape life itself.*
>
> *Or, rather, they will reshape lives, for they all have the same focal point: the individual. Consumerism has created the "me" generation; the revolution in information systems has resulted in the personal computer; technology has produced the pocket-sized mobile phone and the CD Walkman; and the study of genomics is unravelling the single nucleotide polymorphisms that account for the genetic differences between one human being and another.*
>
> *This individual-centric environment opens the way for a totally different form of healthcare – one that provides individualized, informed, interactive, immediate, and integrated health management."*[37]

Such visions highlight the significance of ICTs for the pharmaceutical and healthcare industries – not least as an integral part of a fundamental convergence of forces both enabling and propelling the transition from a mass production paradigm to an individual paradigm. *HealthCast 2010* identified three forces for change: informed consumers, e-

[37] PriceWaterhouseCoopers (1999) *Pharma 2005: Marketing to the Individual*, PriceWaterhouseCoopers, p2. Available http://www.pwcglobal.com/

commerce or e-health, and the genomics revolution.[38] ICTs are the common thread. Their impacts on the pharmaceutical and healthcare industries are the subject of the remainder of this report.

[38] PriceWaterhouseCoopers (1999) *HealthCast 2010: Smaller World, Bigger Expectations*, PriceWaterhouseCoopers, p3. Available http://www.pwcglobal.com/

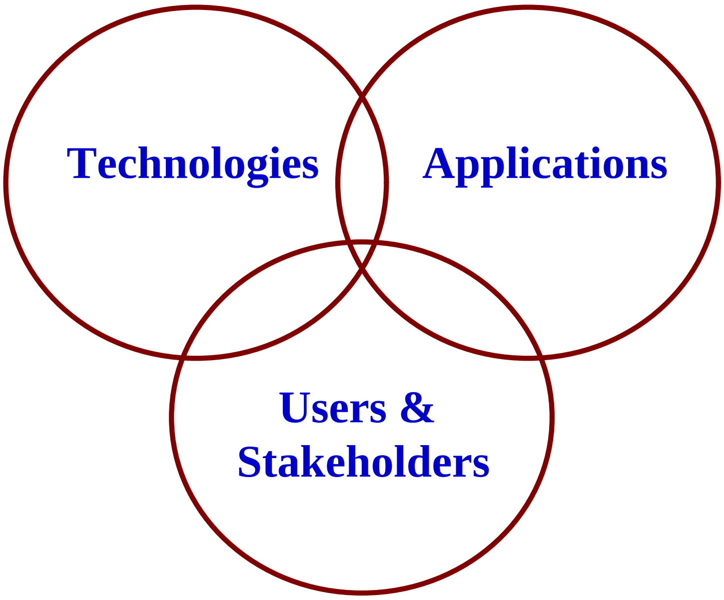
3 Healthcare and ICTs in Australia

This chapter outlines a framework for assessing the impacts of ICTs in the healthcare system, then briefly looks at the scope of healthcare in Australia, the level of adoption of ICTs in the industry and at some of the drivers of e-health developments.

3.1 A framework for assessing the impact of ICTs

Barron and Curnow (1979) pointed out that: "The technology available within the next five years will be more than adequate to generate great changes in the economic and social order. The sequence and timing of these changes will be determined not by technological factors, but by social and economic factors, and to establish a view of the future it is these that need to be studied rather than technological developments."[39] Hence, our framework for assessing the impacts of ICTs includes the technologies, their applications and the stakeholders involved. We looked at some of the technologies in chapter 2, the remainder of this report focuses on stakeholders and applications (actors and activities).

Figure 3.1 Framework for exploring technology impacts



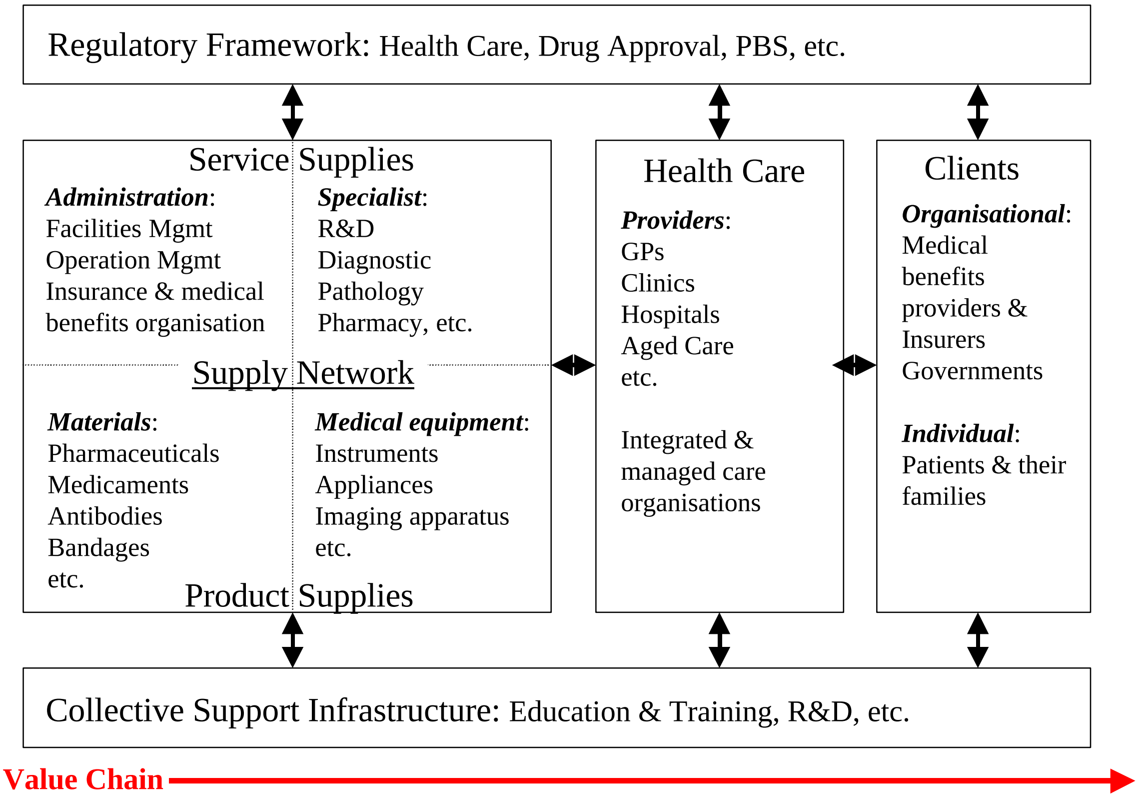
Source: Derived from Mitchell, J. (1998) *Fragmentation to Integration: National scoping study of the telemedicine industry in Australia*, DIST, Canberra.

39 Barron, I. and Curnow, R. (1979) *The Future with Micro Electronics: Forecasting the effects of Information Technology*, Frances Pinter, London. Cited by Hancock, T. and Groff, P. (2000) *Information Technology, Health and Healthcare: A view to the Future*, CPRN Discussion Paper No H/02, June 2000, Ottawa, p7.

3.2 The healthcare system

The healthcare system involves a wide range of actors and activities, linked together in a complex web of relationships between each other and with the technologies they use in order to produce the complex product/service we call healthcare. The notion of 'product systems' has developed in recognition that many of the social and institutional interactions vital to an understanding of innovation fall outside the scope of traditional industry analyses. The idea emerged more than 20 years ago, but owns much to the work of David Gann in the United Kingdom and to adopters of the approach around the world.[40] The key purpose of a product system approach is to bring to light all the major elements of the overall system, including all the activities and actors (or stakeholders) contributing to the development, production and delivery of healthcare services.

Figure 3.2 A schematic healthcare product system



40 See Gann, D. and Slater, A. (1998) *Learning and Innovation Management in Project-based Firms*, Paper for the 2nd International Conference on Technology Policy and Innovation, Lisbon, August 3-5, 1998; AEGIS (1998) *Mapping the Building and Construction Product System*, Department of Industry, Science and Resources, Canberra; AEGIS (1999) *Mapping the Textile, leather, Clothing and Footwear Product System*, Department of Industry, Science and Resources, Canberra; AEGIS (2000) *The Health Product and Services System in Australia*, University of Western Sydney; and Houghton, J.W. (2000), *Economics of Scholarly Communication*, Report prepared for the Coalition for Innovation in Scholarly Communication, Canberra. Available www.caul.edu.au/cisc.

The healthcare product system includes healthcare services providers at the centre, their supply network (including suppliers of generalist and specialist services, materials and equipment) to the left, and their various clients and users to the right. These key players make up the core value chain. They are supported by a collective support infrastructure (including, for example, education and training institutions, and R&D providers), and operate within the purview of an overarching regulatory framework (including such things as drug approval processes and various government formularies). In exploring the possible impacts of ICTs these stakeholders and their interrelations will be considered – providing the framework for, and scope of, the study.

3.3 Australian healthcare and ICTs

Health represents a significant sector of the Australian economy, with annual expenditure by the public and private sectors in the order of AUD 55 billion. The Commonwealth finances around 47 per cent of this expenditure through grants to the States and Territories for public hospital services (via Australian Health Care Agreements) and through rebates for medical services (under the Medicare Benefits Schedule) and pharmaceuticals (through the Pharmaceuticals Benefits Scheme). State and Territory governments finance approximately 23 per cent of health spending, while the remaining 30 per cent is financed privately (via private health insurance premiums and out-of-pocket expenses).[41] Health and medical services account for close to 5 per cent of total household expenditure on goods and services.

During 1999-2000, 14 per cent of health and community services enterprises staff were IT staff, compared to an all industry average of 17 per cent.[42] During 2000-2001, 89 per cent of health and community services enterprises used computers, compared to an all industry average of 84 per cent; 72 per cent of them had internet access, compared to an all industry average of 69 per cent; 14 per cent had a website, compared to an all industry average of 22 per cent; 21 per cent used e-commerce for purchasing, compared to an all industry average of 20 per cent; and 2 per cent reported using internet purchasing, compared to an all industry average of 9 per cent.[43]

IT expenditure by healthcare organizations varies considerably, but is rather low compared to some other service industries. In 2000, CHIC reported that the average IT budget across all health organization types in its survey of the Australian health IT market amounted to 2.4 per cent of the total health budget – ranging from 1 to 10 per

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41 NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, p2.

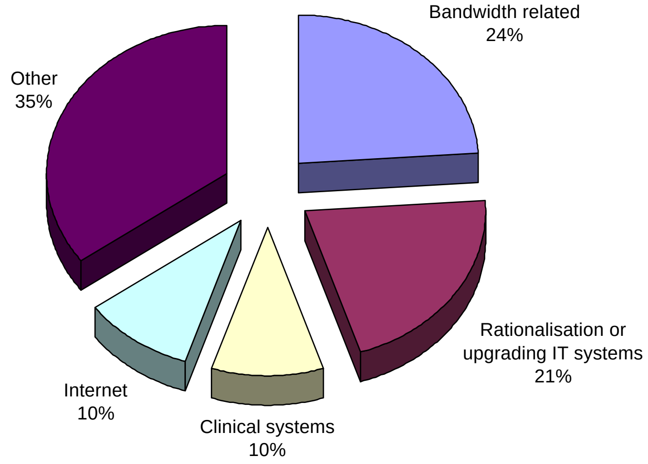
42 ABS (2000) *Business Use of Information Technology, Australia: 1999-2000*, ABS Cat No 8129.0, ABS, Canberra.

43 ABS (2001) *Business Use of Information Technology, Australia: 2000-2001*, ABS Cat No 8129.0, ABS, Canberra.

cent. Public hospitals spend an average of around 1 per cent of their total budget on IT.[44] Nevertheless, there are signs of considerable growth. Between 1996 and 2000, health and community services recorded the highest rate of growth in ICT jobs of all industries – with ICT jobs growing at a compound annual rate of 47 per cent to more than 14 000 by the end of 2000.[45]

Australia's e-health market was estimated to have been worth AUD 1.76 billion in 2000, and is predicted to grow at a compound annual rate of 15 per cent to reach AUD 2.79 billion by 2004. ICT priorities for Australian healthcare organizations during 2001 included: communications and bandwidth (24 per cent), rationalising or upgrading IT systems (21 per cent), the implementation of clinical systems (10 per cent), and the internet (10 per cent).[46]

Figure 3.3 ICT priorities for healthcare organizations, 2001



Source: CHIC (2001) *Australian E-Health Market, 2000 - 2004*, Collaborative Health Information Centre. Available www.chic.org.au

Australian healthcare organizations surveyed in 2000 reported that a wide range of ICTs were being considered for future deployment. Among the more widely cited were:

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44 CHIC (2001) *Australian E-Health Market 2001 - 2004*, Collaborative Health Informatics Centre. Available www.chic.org.au

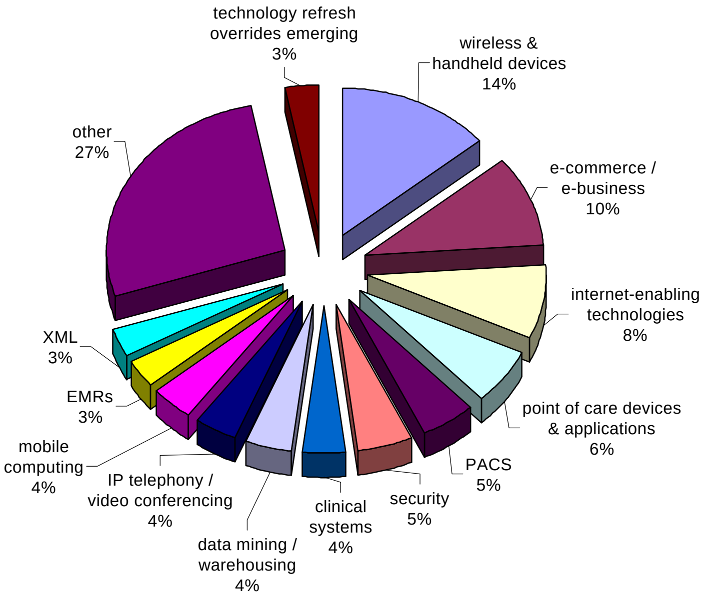
45 Houghton, J.W. (2001) *Impact of the ICT Industry in Australia*, Australian Computer Society, Sydney, p8. Available www.cfses.com

46 CHIC (2001) *Australian E-Health Market 2001 - 2004*, Collaborative Health Informatics Centre. Available www.chic.org.au

- wireless and handheld devices (14 per cent);
- e-commerce or e-business systems (10 per cent);
- internet enabling technologies (8 per cent); and
- point-of-care devices (6 per cent).

Only 3 per cent of respondents suggested that the need to upgrade existing technology would override their ability to consider new technologies.[47]

Figure 3.4 Emerging technologies under consideration by Australian healthcare organizations, 2000 (percentage of respondents)



Source: CHIC (2001) *Australian E-Health Market, 2000 - 2004*, Collaborative Health Information Centre. Available www.chic.org.au

47 CHIC (2001) *Australian E-Health Market, 2000 - 2004*, Collaborative Health Information Centre. Available www.chic.org.au

Box 3.1 Drivers of E-Health in Australia

An ageing population: A gradual, long-term increase in life expectancy has increased both the overall number of older people and the proportion of the population comprising older people.

A paradigm shift from treatment to prevention and care: Health care in the future will probably be more about managing chronic conditions than responding to acute illness. In 1995, for the first time, more people died of chronic illness than from an acute illness. Increasing numbers of people are living for longer periods with severe disability. This is the result of better survival rates in infancy and after major trauma, as well as living longer with chronic health conditions or progressive and terminal illness.

Changing models of care: Future health-related services and their models of delivery will reflect the shift from treatment to prevention and care. It is predicted that the number of people going into hospital and their length of stay will continue to decline. Over time, healthcare is likely to be delivered in the home or at the workplace.

Expanding diagnosis and treatment options: Improved imaging, increased capacity for care and monitoring in the home and community.

Improved information technology and communication: dramatic improvements in the performance of information technology and communications technologies, accompanied by declining costs, and expanding applications.

Market forces: Strong perception within industry that the health sector is a major market sector for generic information technology and communications applications.

Pressures to reduce healthcare costs: healthcare spending is on an upward track, with increasing capacity to diagnose and treat resulting in growing levels of service provision.

Consumer demands: Individuals are better educated, and know more about health and healthcare; and consumers are increasingly empowered and make informed choices about their own healthcare, and expect to be part of the decision process.

Urbanisation and globalisation: Declining rural populations accompanied by increasing concern about service levels 'in the bush'; disappearing national boundaries; and a widening gap between rich and poor nations, regions and economies.

Source: Australian New Zealand Telehealth Committee.

4 Pharmaceutical industry impacts

Pharmaceutical industry applications include: the increasing use of ICTs in drug discovery and design; new and more targeted marketing and modes of distribution; greater use of e-commerce and healthcare system supply chain management; and increasing opportunities to capture and process information collected in pre-clinical and clinical trials and subsequent drug usage, and to make use of that information in future drug design and development.

4.1 Drug discovery and design

As noted above, there is a convergence of information and bio-technologies that is already revolutionising drug discovery and design, and is likely to radically alter the economics of the drug discovery pipeline. Over recent years the drug discovery pipeline has been a concern for many in the pharmaceutical industry. Escalating costs, increasing complexity and a dwindling population of drug candidates suggest that traditional R&D methods are unlikely to produce enough breakthrough drugs to ensure growth. As one analyst reported recently: "Sticking to the present course of action is simply not possible… Those companies which cannot dramatically increase both the number and quality of the drugs they produce will go the way of the dinosaurs."[48]

An immediate response to this has been to scale up – one of the drivers of recent mergers and acquisition in the industry. Scale might increase the odds of success on a pure numbers basis, and may help commercialisation, global development, marketing and distribution, but it does not really solve the R&D problem. In manufacturing, increasing inputs leads to an approximately proportional increase in outputs at the margin – depending upon whether the manufacturer is facing increasing or decreasing economies of scale. But knowledge is fundamentally different, it is non-additive. Putting five scientists onto the job would not necessarily give you the theory of relativity in 20 per cent of the time it took Einstein. Consequently, simply increasing scale may not help. The other standard response to the R&D problem has been to buy in drug candidates, through mergers and acquisitions – especially of smaller biotechnology and specialist R&D firms. However, the demand for such candidates is high, hence the prices demanded for them can be high. Moreover, the risks remain. The only sure way to address the problem is to increase the productivity of R&D – by increasing efficiency (lower cost and/or higher speed) and/or by reducing failure rates along the value chain.[49]

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48 PriceWaterhouseCoopers (1998) *Pharma 2005: An Industrial Revolution in R&D*, PriceWaterhouseCoopers, p2. Available http://www.pwcglobal.com/

49 Tollerman, P. et al (2001) *A Revolution in R&D: The Impact of Genomics*, Boston Consulting Group, p1. Available www.bcg.com

Guy and Gartenmann (2001) suggested that ICTs offer the greatest value for pharmaceutical companies when they are paired with the scientific advances already revolutionising drug discovery. Genomics, bioinformatics, and advances in drug discovery technologies unleash the power of innovation by greatly increasing the number of new drug targets and chemical compounds, as well as accelerating the speed with which they can be matched. ICTs provide the tools to harness and navigate the flood of data, identify promising prospects for targets and compounds, and assess which are most likely to produce results.[50]

Tollerman et al (2001) suggested that: "There are two relevant approaches to consider when assessing the economic impact of genetics on R&D: disease genetics and pharmacogenetics. They operate at different stages of the [R&D] value chain. Disease genetics is invoked earlier, during the discovery phase: it involves the search for genes that make people susceptible to particular diseases, with the aim of then finding targets. Pharmacogenetics… comes into play later, in the development phase: it involves predicting the efficiency and side effects of candidate drugs."[51] Both genomics and genetics depend in no small part upon developments in ICTs. Tollerman et al (2001) went on to say that:

> *"The genomics wave is technology-driven, formed by the integration of new high throughput techniques with powerful new computing capabilities. It is active throughout R&D, most immediately at the drug discovery stage, and promises to enhance productivity greatly, without jeopardizing downstream success rates. The genetics wave is data-driven, exploiting the details of individuals' genetic variation that are emerging from the oceans of genomic data… The impact of genetics will be greatest at later phases of the [R&D] value chain, where it will enhance productivity mainly by boosting success rates.*
>
> *We characterize genomics… as the confluence of two interdependent trends that are fundamentally changing the way R&D is conducted:* industrialization *(creating vastly higher throughputs, and hence a huge increase in data), and* informatics *(computerized techniques for managing and analyzing those data). The surge of data - generated by the former, and processed by the latter - is of a different order from the data yields of the pre-genomics era."*[52]

Looking somewhat further ahead it seems likely that very much the same kind of 'industrialisation' of the processes through the application of ICTs (informatics/bio-informatics) can be achieved in the area of proteomics (eg. in the identification of target substances) and structural biology (eg. in screening and design). Cohen (2001) noted

50 Guy, P. and Gartenmann, T. (2001) *Big Pharma can still find big value in E-health*, Boston Consulting Group. Available www.bcg.com

51 Tollerman, P. et al (2001) *A Revolution in R&D: Part II The Impact of Genetics*, Boston Consulting Group, p2. Available www.bcg.com

52 Tollerman, P. et al (2001) *A Revolution in R&D: The Impact of Genomics*, Boston Consulting Group, pp1-2. Available www.bcg.com

that: “Just as genomics is the attempt to decipher all of the genes in an organism, proteomics, in its simplest definition, aims to uncover all of the proteins and their functions. Since genes are simply the blueprints for proteins, which in turn are the main players in most of the body's functions, it's a logical progression. Indeed, there is no mistaking what proteomics promises: a revolution in medical science with implications that far surpass those of genomics.”[53] Thus the ability to handle vast amounts of data, and to process and make sense of those data are critical to realising potential increases in pharmaceutical R&D pipeline productivity.

A recent report in *The Economist* outlined examples of some current developments.[54] It began by suggesting that in terms of both ICTs and the potential revolution in drug discovery and design, sequencing the human genome was just the beginning. A parallel requirement for structure-based drug design is the availability of databases of protein structures. It is their combination that opens up the possibility of virtual, computer-based screening (ie. *in silico*, rather than *in vitro* testing). But determining protein structures is proving to be more difficult than some had hoped. Since it began gathering structures in 1972, the Protein Data Bank, run by the Research Collaboratory for Structural Informatics, has added around 15 000 structures to its database, and it is estimated that a typical pharmaceutical company may solve five to ten structures a year. However, that could be about to change. Companies like Syrrx Pharmaceuticals and Structural Genomix claim that within the next few years they will automate protein-solving and accumulate hundreds of structures.

The Economist report went on to suggest that:

> *"Typically, a single screening process, either* in vitro *or* in silico, *produces millions of data points. Once, 99% of such data had to be discarded, leaving a chemist with “only” 10 000 or so data points to mull over, with ordinary spreadsheet software and weeks of patience.*
>
> *No longer. Software produced by a company called Leadscope of Columbus, Ohio, now lets chemists analyse all the data from high-throughput screens immediately. If need be, all the data from all the screenings that a company has performed can be visualised and mined simultaneously. All a pharmaceutical company needs to do is to link Leadscope's software to its own database of chemical structures and their biological activity. The software then compares the company's database with the program's catalogue of 27 000 chemical substructures. By correlating classes of chemicals with biological activity, the program can tell researchers which features of a test compound are important. Given that, researchers can pluck out and refine promising leads far more quickly.*

[53] Cohen, J. (2001) ‘The Proteomics Payoff,’ *Technology Review,* October 2001. Available http://www.technologyreview.com/articles/cohen_pro1001.asp

[54] The following discussion and examples are taken from Economist (2001) 'Drugs ex machina', *The Economist*, 20th September, 2001. Available www.economist.com

Leadscope has also just launched a piece of equipment that screens compounds for their toxicity. For the past two years, the company's researchers have scoured public information sources to compile toxicity profiles of 150 000 chemicals. By searching this new database, dubbed Toxscope, with the chemical fingerprint of a promising lead compound, researchers can get an early warning of whether it is going to be too toxic for people to take.

Predicting other chemical characteristics of a drug would be useful, too. Once a drug is swallowed, it has to be absorbed into the bloodstream and circulated to the tissues of the body. As the drug does its work, it is attacked and gradually destroyed ("metabolised") by various enzymes. Eventually, these breakdown products are eliminated from the blood through urine or bile. Up to now, drugs companies have found it difficult to model the way a compound goes through the various processes of absorption, distribution, metabolisation and elimination (what the industry labels a drug's "ADME profile"). This ignorance is costly. Bad ADME characteristics account for the majority of failures of new drug candidates during development.

Using a combination of empirical data and molecular modelling, Camitro, a chemical genomics firm based in Menlo Park, California, has developed software that tries to predict a compound's ADME characteristics. If the characteristics are undesirable, the compound can be discarded before too much money is spent developing it, or redesigned to have better properties… Camitro's software also has the potential to provide information on another subject of growing interest to pharmaceutical firms - the interactions that can take place between two different drugs that a patient may be taking for different ailments."[55]

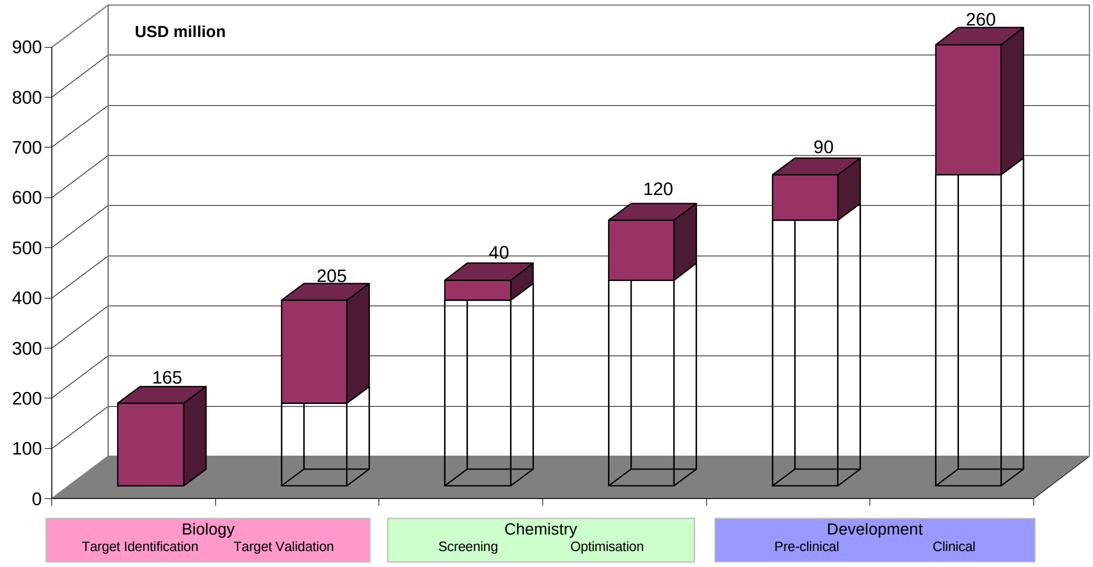
The Economist feature and a derivative article in *The Australian* presented further evidence of current and potential developments.[56] They suggested that: since the merger of Hoechst and Rhone-Poulenc, Aventis has established a specialist informatics group to underpin its structure-based drug design program, and expects it to accelerate the progress of potential drugs through the company's development pipeline by 15 to 20 per cent, and to lower the attrition rate among prospective compounds. Vertex Pharmaceuticals has been a pioneer of many of the techniques now entering the mainstream – including molecular modelling, structure-based design, virtual screening and efficient data mining, as well as ADME and toxicity prediction. These innovations have made Vertex's drug pipeline more efficient. Normally, a prospective compound

55 Economist (2001) 'Drugs ex machina', *The Economist*, 20th September, 2001. Available www.economist.com

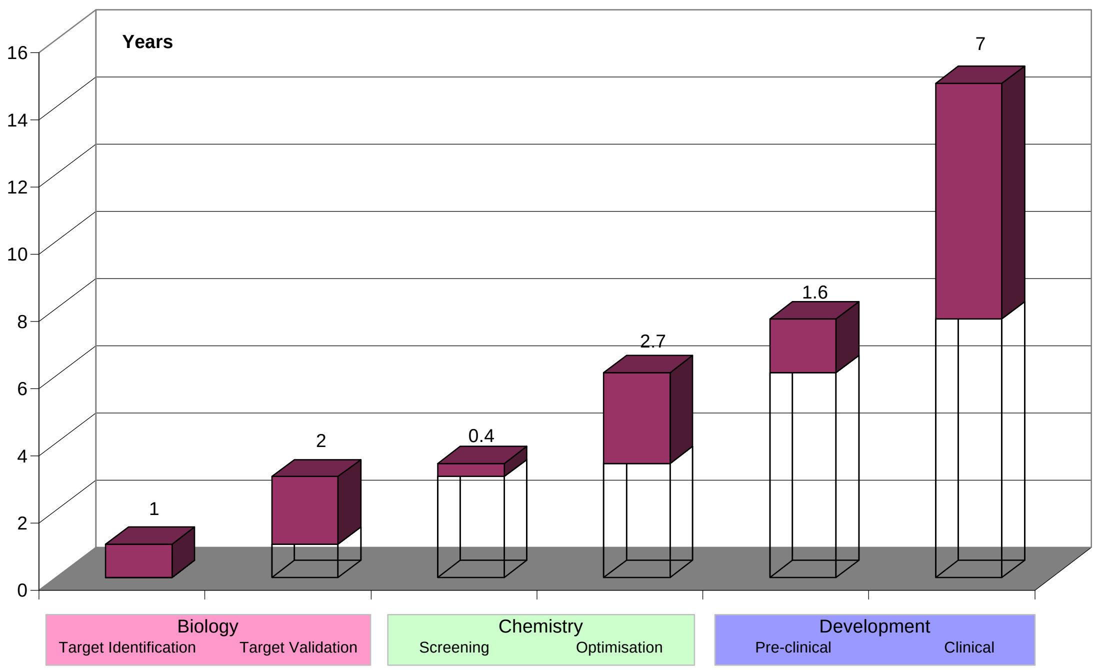
56 Discussion and examples taken from Economist (2001) 'Drugs ex machina', *The Economist*, 20th September 2001, Available www.economist.com; and The Australian (2001) 'Digital Druggists: Drug companies are closing on the rewards of genomics, thanks to automation, miniaturisation and information technology,' *The Australian*, 6th November, 2001.

Figure 4.1 Drug R&D: Currently expensive and time consuming

Development cost USD 880 million



Development time 14.7 years



Source: Tollerman, P. et al (2001) *A Revolution in R&D: The Impact of Genomics,* Boston Consulting Group, p3.

picked for development had only a 10 per cent chance of making it through to clinical testing. Vertex has been able to increase that chance to 80 per cent, but they admit that it may fall once the easier targets have been exploited.

In the discovery phase of the pipeline, DoubleTwist touts itself as a portal to genomic information and bioinformatics analysis. Its software interface allows scientists to apply automated algorithms to public, proprietary, and third-party databases so that they can access genetic information and perform analyses online. Scientists researching a genetic sequence can run online searches to locate similar sequences, identify associations with protein families, and determine protein interactions – details that suggest whether the genetic sequence is a likely drug target. After researchers conduct an initial analysis, DoubleTwist can automatically monitor further developments, e-mailing updates when related discoveries are unveiled. Celera and CuraGen offer similar access, delivering complex analyses that scientists might not otherwise be able to perform. The technology offers these advantages at low cost and at an accelerated pace, which could ultimately allow pharmaceutical companies to explore many more potential targets in much richer detail.[57]

While the risks are high, the gains can be significant. In a detailed analysis of the potential economic impacts of genomics and genetics on the pharmaceutical industry's R&D pipeline, Tollerman et al (2001) stressed the importance of ICTs. They suggested that prior to the genomics 'revolution' developing a new drug cost an average of around USD 880 million and took 15 years from start to finish – of which about 75 per cent was attributable to failures along the way. By applying genomics technologies, they suggested that companies could realise average savings of around USD 300 million and 2 years on drug development – 35 per cent on costs and 15 per cent on time. The time saving would be worth around USD 180 million per drug.[58] Longer term, genetics technologies could save up to USD 420 million per drug and between 0.7 and 1.6 years – with the time saving estimated to be worth around USD 290 million per drug.[59]

Looking further ahead, the outcome of these developments may prove even more revolutionary. It has been noted that, long term, the approach has two drawbacks:

> *"First, as pharmacogenomics provides the means with which to customize pharmaceuticals for sub-populations (and ultimately individual patients) with particular genetic polymorphisms, so demand for products that are aimed at the*

57 Guy, P. and Gartenmann, T. (2001) *Big Pharma can still find big value in E-health*, Boston Consulting Group. Available www.bcg.com

58 Tollerman, P. et al (2001) *A Revolution in R&D: The Impact of Genomics*, Boston Consulting Group, pp3-4. Available www.bcg.com It should be noted that the cost of drug development varies widely and that these estimates of the cost of drug development are on the high side – see Sweeny, K. (2002) *Technology Trends in Drug Discovery and Development: Implications for the development of the pharmaceutical industry in Australia*, Centre for Strategic Economic Studies, Melbourne.

59 Tollerman, P. et al (2001) *A Revolution in R&D: Part II The Impact of Genetics*, Boston Consulting Group, p5. Available www.bcg.com The same caveat applies.

> *population in general will fall. Second, a customized medicine should, by definition, produce better results (or have fewer side effects) than a medicine for the masses – and medicines that produce inferior outcomes may eventually attract lower rates of reimbursement. For both these reasons, one-size-fits-all products will generate smaller revenues in the age of individual health management…"*[60]

As a result, these developments are likely to entail a shift in the underlying strategy of pharmaceuticals manufacturers – from the mass production/mass marketed 'blockbuster' approach to a customised, even individualised approach targeting specific groups and even individual patients. A shift that will depend upon the further adoption and application of ICTs in drug discovery and design.[61]

4.2 Trials: using internet and computer modelling

Reduced development times and higher success rates in discovery and pre-clinical testing are likely to significantly increase the demand for investigators and patients for clinical trials. Most patients in Phase II or III trials are currently recruited at specialist referral centres. This pool is not big enough to meet the industry's growing needs, and an increasing number of companies are now recruiting patients through primary care providers, the internet and even television. E-recruitment can help companies address this short-term shortfall (although they would then have to screen many more patients). It could also enable them to eliminate some of the administrative pain involved in searching for, and managing, large numbers of trial personnel.[62] A number of companies are currently developing ways to inform, recruit and manage trial data using internet-based tools.[63]

Guy and Gartenmann (2001) suggested that: during the development phase, there are many opportunities to get closer to and more familiar with trials and trial data. Online enrolment, communication and monitoring can enhance trial speed and accuracy, which in the short term could translate into major cycle-time advantages, particularly for those who use the technology to achieve real-time syntheses of results. The next step might be to develop online connections with trial participants and investigators, bringing closer

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60 PriceWaterhouseCoopers (1999) *Pharma 2005: Marketing to the Individual*, PriceWaterhouseCoopers, p19. Available http://www.pwcglobal.com/

61 More detailed analyses of the impacts of technology on drug development and corporate strategies can be found in the companion papers Sweeny, K. (2002) *Technology Trends in Drug Discovery and Development: Implications for the development of the pharmaceutical industry in Australia*, Centre for Strategic Economic Studies, Melbourne, and Rasmussen, B. (2002) *Implications of the Business Strategies of Pharmaceutical Companies*, Centre for Strategic Economic Studies, Melbourne.

62 PriceWaterhouseCoopers (1999) *Pharma 2005: Silicon Rally, The Race to e-R&D*, PriceWaterhouseCoopers, p11. Available http://www.pwcglobal.com/

63 Lutz, S. and Henkind, S.J. (2000) *Recruiting for Clinical Trials on the Web*, HealthPlan Sept/Oct 2000, PriceWaterhouseCoopers, p36. Available http://www.pwcglobal.com/

relationships with target customers. Online communication could help to accelerate drug launches if companies use the relationships to create a seamless transition from pre-launch trials to post-launch sales.[64] The potential for gathering information from trials and from post-launch usage, opens up the possibility of closing the loop on evidence-based care right through from drug design and development to consumption.

Looking further ahead, there is increasing potential to use *in silico* testing in place of both *in vitro* and *in vivo*. PriceWaterhouseCoopers (1998) suggested that: "Greater competition for patients and investigators, and the rising cost of clinical trials, have triggered one of the boldest experiments in the history of the pharmaceutical industry: an attempt to test products without any human exposure. Companies like Pharsight are using pre-clinical data to create populations of software "people" designed to behave like the real thing."[65] In a subsequent report they wrote:

> *"With* in silico *techniques like single cell differential gene expression and target searches in Expressed Sequence Tag libraries, the industry will soon be able to identify targets possessing the ideal physiological and pathological characteristics. It will then be able to design and test drug candidates using pharmacophore technology,* in silico *lead optimisation, scale-up and preclinical trials.*
>
> *Computer modelling will even provide the tools with which to perform* in silico *clinical trials based on whole organ body models that test for everything, including side-effect profiles and drug-drug interactions. One such example is the virtual heart developed by Denis Noble, Professor of Physiology at the University of Oxford – a model so lifelike that it behaves almost exactly like a living human heart. The issue thereafter will not be whether, but when, the regulators accept such evidence.*
>
> In silico *preclinical trials and simulations for the design – if not actual implementation – of clinical trials will transform the way in which development is conducted. Good portfolio management decisions on candidate selection and attrition require high-quality information about safety, efficacy, development costs and profitability. Under the current clinical development model, such information is only available late in the development cycle. But simulation will massively accelerate the development process, facilitate the selection of drug candidates and reduce the risk of failure. In short, it signals the shift from empirical to predictive science…*
>
> *Precisely how much money simulation – together with a better understanding of drug outcomes gained from advances in new discovery technologies – will save is difficult to quantify, since estimates of expenditure on Phase III trials vary*

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64 Guy, P. and Gartenmann, T. (2001) *Big Pharma can still find big value in E-health*, Boston Consulting Group. Available www.bcg.com

65 PriceWaterhouseCoopers (1998) *Pharma 2005: An Industrial Revolution in R&D*, PriceWaterhouseCoopers, p13. Available http://www.pwcglobal.com/

> *widely. Given average operating costs and the fact that the typical Phase III trial lasts between 6 and 12 months, we estimate that every flawed or unnecessary late-stage trial wastes between $5m and $10m.*
>
> *What is clear, however, is that simulation will help to reconfigure the financial basis of clinical development at precisely the time when the industry most needs it – although the speed of the transition from* in vivo *to* in silico *testing will vary according to the particular disease and therapeutic category. In total, we calculate that in silico technologies will enable the industry to bring products to market for 50% to 66% of today's average cost per drug."*[66]

Tollerman et al (2001) estimated that *in silico* chemistry could save up to USD 130 million, or around 15 per cent of drug development costs, and reduce development time by up to 10 months.[67] Developments within the context of the Physiome Project, which seeks to build computer models of organs, are already helping pharmaceutical companies develop drugs and better understand their operation. For example, Physiome Sciences' model of blood coagulation helped one drug company understand why flooding the body with a particular clotting factor had the unexpected effect of blocking coagulation rather than speeding it.[68] Notwithstanding the likely inertia and practical difficulties facing regulators, it seems inevitable that computer models will increasingly substitute for people in pre-clinical and clinical trials in order to reduce costs, shorten trial times, increase efficiency, reduce potential risks, and overcome the patient recruitment supply bottleneck.

4.3 Marketing and distribution

ICTs, especially internet-based technologies, could contribute a good deal to pharmaceutical industry marketing and distribution. Guy and Gartenmann (2001) pointed out that: online detailing, which allows companies to share medical information and stay in touch with doctors between sales visits is one area of opportunity. Online detailing ('cyber-detailing')[69] could let companies not only answer queries from physicians in real time and provide drug information on demand, but also gather data on doctors' behaviours and concerns. The pharmaceutical company sales force could use the information to segment physicians and customize messages during their sales visits. Moreover, online detailing could expand the reach of current marketing by giving

66 PriceWaterhouseCoopers (1999) *Pharma 2005: Silicon Rally, The Race to e-R&D*, PriceWaterhouseCoopers, pp8-9. Available http://www.pwcglobal.com/

67 Tollerman, P. et al (2001) *A Revolution in R&D: The Impact of Genomics*, Boston Consulting Group, p4. Available www.bcg.com

68 Economist (2001) 'The Heart of the Matter,' *The Economist*, 6th December 2001. Available www.economist.com

69 See also Chin, T. (2001) 'Online Detailing: The New Way to Sell,' *American Medical News*, July 9/16 2001. Available http://www.cyberdialogue.com/news/in_the_news/

companies the ability to contact remote physicians electronically and promote lower-margin drugs more economically.[70]

Guy and Gartenmann (2001) went on to suggest that: as wireless technologies develop, online prescribing through hand-held devices may present opportunities for the drug industry to influence medical decisions when they are made – during consultations with patients about symptoms, diagnoses, and treatments. Ideally, services such as *ePhysician* and *iScribe* would allow physicians to check medical records, drug interactions and formularies at the moment they write prescriptions. Pharmaceutical companies might partner with these service providers to position their drugs prominently or to distinguish their drugs' strengths at the point of prescription. Furthermore, by linking online detailing and prescribing tools, the pharmaceutical company's sales force could monitor prescribing patterns. When fully integrated with marketing and sales functions, online tools (including electronic communication during development) could serve as a comprehensive system for customer relationship management.[71]

There are an estimated 63 000 drug company sales representatives in the United States who visit doctors in an attempt to persuade them to prescribe their company's drugs. During 2000, this 'detailing' accounted for almost half of the USD 15.5 billion drug companies spent on product marketing. The cost is high, and the benefits questionable. But, increasingly, there are alternatives. For example, it was recently reported that:

> *"A dozen firms have sprung up to pitch drugs to doctors over the web and via other remote channels, giving them easy access to such information at times that are convenient. Some ventures, such as ePocrates, send brief product information on to the handheld devices that are now used by 130 000 American doctors, who can get more information about a drug made by, say, Eli Lilly, by sending a message requesting it.*
>
> *Another firm, RxCentric.com, based in New York, acts as an Internet service provider (ISP) for doctors, offering them access to product information on the web. The firm alerts doctors to new products by e-mail; they can then get more details by visiting drug companies' sites within the RxCentric ISP.*
>
> *Many doctors would welcome meetings with sales reps if only they could take place at a better moment. This is what iPhysicianNet, based in Arizona, hopes to facilitate. The firm has installed computers, with high-speed phone lines and video-conferencing equipment, in the offices of almost 7 000 of America's highest-prescribing doctors. In exchange for this free set-up, doctors agree to participate in one video-detailing session per month with each of the nine drug makers… that pay for the service.*

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[70] Guy, P. and Gartenmann, T. (2001) *Big Pharma can still find big value in E-health*, Boston Consulting Group. Available www.bcg.com

[71] Guy, P. and Gartenmann, T. (2001) *Big Pharma can still find big value in E-health*, Boston Consulting Group. Available www.bcg.com

> *Sales reps can use this system to request a session with a doctor, who can then respond at a more suitable time. Because the session takes place at the doctor's convenience, it lasts on average four times longer than typical sales visits. Moreover, the video format allows sales reps to show data and other visual aids that make the session more informative - something that a rushed meeting in the doctor's surgery rarely permits.*
>
> *iPhysicianNet claims that each video session costs $110, compared with almost $200 for a real-life encounter. It also says that pilot trials have shown that its service boosts new prescriptions by 14% compared with the knock-on-the-door approach. W.R. Hambrecht, an investment bank, predicts that drug companies will spend $600m on e-marketing by 2004."*[72]

The potential of e-commerce and internet-based technologies to enhance marketing and distribution (through cyber-detailing, e-sampling, etc.) has only just begun to be realised.

There are also significant savings to be made for pharmaceutical firms using the internet for direct to customer (DTC) sales, where such direct sales are permitted. Cyber Dialogue recently reported that: in the first half of 2000, pharmaceutical companies spent an estimated USD 833 million on TV advertising, USD 460 million on print campaigns and USD 47 million on Internet marketing in the United States; and that this translated to a cost of USD 54 per single specific drug request driven by the Internet, USD 152 per request using TV advertising and USD 318 per request using print advertising.[73] The scope for innovation and for realising both cost saving and better outcomes is enormous.

4.4 E-commerce and supply chain management

E-commerce and supply chain management are already transforming many businesses and contributing not only to realising savings, but also to improving quality of service and enabling customised services to particular groups of clients, even individual clients. Examples are many and varied, but in relation to the pharmaceutical industry Australia's Project Electronic Commerce and Communication for healthcare (PeCC) is as relevant as any.

PeCC began in 1996 in response to concern about the burgeoning cost of healthcare. It has been a multi-stage and multi-pronged project, but the central aim has been to introduce e-commerce and supply chain management into Australia's healthcare sector – with almost 700 suppliers automating pharmaceutical and other supplies to hospitals and retail pharmacies. Barcoding and internet-based e-commerce provide the basis for

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72 Economist (2001) 'Rebirth of a salesman,' *The Economist*, 12th April, 2001. Available www.economist.com

73 Cyber Dialogue (2001) reported in 'Online consumer advertising pays for US pharmas,' *Medexonline*, 15th May, 2001. Available http://www.cyberdialogue.com/news/in_the_news/

the project, which is expected to unlock in excess of AUD 340 million annually in supply chain process savings and allow for better patient care as funds previously invested in inventories can be shifted elsewhere. The Pharmaceutical Extranet Gateway (PEG) sub-project alone is expected to enable savings of the order of AUD 200 million a year. Moore and McGrath (2000) suggested that: "Analysts estimate that the cost of placing an order through the normal manual process would be around AUD 50–AUD 70. With full implementation of PEG, they suggest that this transaction cost will be reduced to merely AUD 2–AUD 5 per order. Given a current purchase order transaction volume of 3.8 million per year, this equates to annual savings of the order of AUD 200 million."[74] Clearly, there is potential for significant savings.

74 Moore, E. and McGrath, M. (2000) *health & industry collaboration: the PeCC story*, DCITA, Canberra.

5 Healthcare industry impacts

Looking at the impact of ICTs on healthcare reveals an enormous range of opportunities for significant cost reductions and service enhancements, through what is often broadly referred to as 'e-health'. This chapter explores just a few of these opportunities as an indication of what is possible. In so doing it focuses upon e-health applications in four key areas, namely:

1. *Payer applications* – including management of government funding and delivery programs, health insurance and the use of e-commerce and electronic communication to coordinate healthcare organizations and activities throughout the system;
2. *Provider applications* – including the applications of e-health in private for-profit, not-for-profit and public hospitals and clinics, the use of e-commerce and internet-based systems linking and integrating health services;
3. *Practitioner applications* – including the adoption of practice management tools, clinical tools and online communication systems, telemedicine and remote diagnostics, the use of clinical decision support systems (CDSS) and evidence-based care in diagnosis and treatment; and
4. *Patient applications* – including new forms and locations of care delivery, the emergence of the internet and of informed consumers and of new information and health intermediaries, and the use of online pharmacies.

Biomedical applications (eg. imaging, sensors and robotics) make an important contribution to healthcare, but they are not dealt with in this study as they are ICT assisted medical tools rather than ICT systems focused on enabling the delivery of healthcare services (See Box 5.1).

Over recent years a number of reports have suggested that the healthcare sector has been slow to adopt ICTs and to integrate them into their practices, institutions and the provision of healthcare services. They have pointed to both the potential benefits of ICT applications and the potential dangers of falling behind. In 2000, the National Office for the Information Economy (NOIE) suggested that in Australia, "the use of information technology in the health sector is very varied and overall rather primitive compared with other service industries. However, powerful drivers underlie a dramatic change in the way information is collected, managed and communicated in the health industry. These include:

- The explosion of knowledge in medicine and biotechnology resulting in an increasing focus on quality and evidence-based treatment;
- Shifts in demand from brief acute episodes of care to extended clinical care for long term health conditions, with a consequent demand for better integration and coordination of clinical care across organisational and temporal boundaries; and

- Explosive increases in healthcare costs and consequent strategies to better manage healthcare at both the system and healthcare provider levels."[75]

Box 5.1 Biomedical applications

There are many areas in which ICTs contribute to health and medicine as embedded or enabling technologies, but they are not core to this project, which focuses on the applications of ICT systems across the healthcare system. Nevertheless, some brief examples demonstrate the enormous benefits possible through such technologies.

Among the more important biomedical application areas likely to be impacted by ICTs are imaging, sensors, robotics and applications supporting the lives of people with disabilities.

Imaging – it seems likely that much more complex and more revealing imaging will be possible in the future, and that we will be able to display and manipulate these images more easily and communicate them across vast distances.

Sensors – are likely to develop to rapidly enable low cost, local and remote real time continuous monitoring systems, suitable for monitoring both the critically and chronically ill. Implanted sensors and computer controlled biofeedback are also likely to find wider application. Sophisticated, low cost diagnostic kits, and lab-on-a-chip analysis kits are also likely to become widely available.

Robotics – may become increasingly common in surgical and pharmaceutical applications, and will be controllable remotely for such applications as virtual surgery. Miniaturisation and nano-robots might work inside the body at the cellular level, with swallowing a robot becoming as common as swallowing a pill.

Disability applications – sensors and implants are likely to make an increasing contribution to the quality of life of people with disabilities, building on the many existing implants already in use.

Source: Hancock, T. and Groff, P. (2000) *Information Technology, Health and Healthcare: A view to the Future*, CPRN Discussion Paper No H/02, June 2000, Ottawa, pp15-17.

It is clear ICTs impact on the way healthcare systems are designed and operated in ways that are already significant and are likely to be more so over the coming years. Stratton (2001) suggested that: "information drives healthcare. How you collect, analyse, and use that information determines whether you are the driver, the sightseeing passenger, a back-seat driver, or road kill."[76] The USD 60 million loss suffered by US-based Harvard Pilgrim in 1999 highlights what happens when managed care organizations (MCOs) do not invest in IT systems. In early 2000, a headline in *Managed Care*

75 NOIE (2000) *E-commerce beyond 2000*, DCITA, Canberra, p121.

76 Stratton, S.D. (2001) 'Informatics in Managed Care: HIM Adds Value to Data,' *AHIMA Journal*, September 2001. Available http://www.ahima.org/journal/features/feature.0109.3.htm

proclaimed: “Byte by Byte, Harvard Pilgrim Choked on Unhealthy IT Systems,” adding: “Harvard Pilgrim Health Care learned the hard way."[77]

Broshy et al (1998) identified a range of potential savings through the application of ICTs in healthcare in the United States. Using the same proportions for Australia's total annual healthcare spend of approximately AUD 55 billion would imply the possibility of saving around:

- AUD 1.3 to 2.0 billion through giving consumers the right information, which could lead to better medical outcomes;
- AUD 1.7 to 2.0 billion from more informed decision making, leading to more efficient use of medical resources;
- AUD 1.5 to 2.0 billion from the use of electronic channels to replace doctor visits;
- Realising AUD 300 to 349 million more from sales of pharmaceuticals – resulting from an estimated 10 per cent increase in patient prescription fill rates; and
- A fall in the cost of claims processing of around 75 per cent.[78]

So, the costs and dangers of not adopting up-to-date information systems, and the benefits available from doings so seem clear. The following sections look at ICT applications from the perspective of four major groups of stakeholders: payers, providers, practitioners and patients.

5.1 Payers

Ultimately patients and the public are the payers for healthcare services, but it is common to portray those agencies and institutions funding the provision of healthcare as the *payers*. Chief amongst these in Australia are the Commonwealth and State governments, health and medical insurance funds. As payers they share an interest in keeping track of expenditures and a lid on overall healthcare costs.

5.1.1 Payers in the Australian healthcare system

In Australia, the Commonwealth government has a leadership role in policy formulation, particularly in areas such as public health, research and national information management.[79] It funds, directly or indirectly, most non-hospital medical

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77 Bowen, R.B. (2001) 'Managed Care Series: Decision Support: How Managed Care Uses Information to Take Action,' *AHIMA Journal*, October 2001. Available http://www.ahima.org/journal/features/feature.0110.02.htm

78 See Broshy, E. et al (1998) *Managing for a Wired Health Care Industry*, Boston Consulting Group. Available www.bcg.com/aboutbcg/article_healthcare.html; and Hancock, T. and Groff, P. (2000) *Information Technology Health and Health Care: A view to the future*, CPRN Discussion Paper No H/02, June 2000, Ottawa, p26.

79 This outline is taken from ABS (2001) *Australia Now: Health care delivery and funding*, ABS, Canberra. Available www.abs.gov.au See also Department of Health and Aged Care (2000) *The Australian Health Care System: An Outline*, Financing and Analysis Branch,

services, pharmaceuticals and health research. With the States and Territories, it jointly funds public hospitals and home and community care for aged and disabled persons. Residential facilities for aged persons are funded by a number of sources, including the Commonwealth. Public health insurance is provided through Medicare.

Public hospitals, which provide the majority of acute care beds, are funded by the Commonwealth Government and the State and Territory Governments, in addition to receiving revenue from services to private patients. Large urban public hospitals provide most of the more complex types of hospital care such as intensive care, major surgery, organ transplants and renal dialysis, as well as non-admitted patient care. Public hospitals have their own pharmacies which provide medicines to admitted patients free of charge and do not attract direct Commonwealth subsidies under the Pharmaceutical Benefits Scheme (PBS).

The private sector, operating in the delivery of, and insurance for, health services, receives substantial direct and indirect government subsidies. Within this sector, organizations operating for-profit and not-for-profit play a significant role in providing health services, public health and health insurance. For example, privately owned nursing homes provide the majority of long-term aged care beds. In the past, private hospitals tended to provide less complex non-emergency care, such as simple elective surgery. However, they are increasingly providing complex, high technology services. Separate centres for non-admitted and day-only admitted patient surgical procedures are often in the private sector. Most prescribed pharmaceuticals dispensed by private sector pharmacies are directly subsidised by the Commonwealth through the PBS.

Another important component of the Australian health care system is private health insurance, which can cover part or all of the hospital charges to private patients directly, a portion of medical fees for services provided to private admitted patients in hospitals, paramedical services and some aids such as spectacles.[80] At 30th June 2001, there were 44 registered health benefits organizations, of which 29 were available to the public generally (open membership organizations). The remaining 15 were restricted membership organizations. There were six organizations operating on a 'for-profit' basis. At 30th June 2001, 8.7 million Australians had private hospital cover (45 per cent of the population). During 2000-01, health insurers received AUD 5.26 billion in benefits, and payed out AUD 5.19 billion in claims relating to just over 6 million hospital days.[81]

Health and Aged Care, Canberra, September 2000, pp1-2. Available at www.health.gov.au Both accessed January 2002.

80 Department of Health and Aged Care (2000) *The Australian Health Care System: An Outline*, Financing and Analysis Branch, Health and Aged Care, Canberra, September 2000, pp5-11.

81 Private Health Insurance Administration Council (2001) *Operations of the Registered Health Benefits Organizations: Annual Report 2000–01*, Canberra.

5.1.2 The impacts of ICTs on payers

While providing access to quality care no doubt underpins their activities, payers have a shared interest in containing the cost of healthcare. Consequently, the major impact of ICTs will be on the ability of payers to manage the system in order to better account for expenditures, to manage the flow of funds and the contain costs. There will be strong motivation to adopt systems which enable payers to track expenditures, manage costs and exercise control over the processes of referral and prescription – the initiators of health services. From the payers' perspective, ICTs are often seen as tools for demand management and cost containment.

Government: An indication of the impacts of ICTs for governments can be gained from a review of the current activities of the Health Insurance Commission (HIC), the principal agency charged with implementing and managing the Government's health care policy and spending. HIC is developing its role as a provider of health information products and services, and has already established one of the largest electronic business applications in Australia. The system handles an average of more than 2.5 million transactions each working day.

HIC maintains a range of data collected from administering programs such as Medicare, the Pharmaceutical Benefits Scheme (PBS), the Australian Childhood Immunisation Register and the Australian Organ Donor Register. This information, used within strict privacy guidelines, has the potential to help improve community health by:

- supporting clinicians to evaluate and improve their clinical practice;
- promoting evidence-based approaches to health care;
- coordinating care between medical practitioners and integrating information from different sources;
- providing health care consumers with information to make more informed decisions and improve access to services; and
- promoting consumer control in relation to the storage, transportation and security of personal health information.[82]

HIC is responsible for preventing and detecting fraud and inappropriate servicing. As part of this role HIC undertakes education, feedback and best practice programs in cooperation with medical and other health practitioners, relevant peak bodies, educational institutions and government agencies. HIC is also playing an important part in the development of Australia’s health information and payments arrangements. It is developing its capacity for electronic communication, facilitating information exchange through partnerships and communication systems, developing standards for information exchange and helping to resolve issues relating to the privacy, security and

82 Health Insurance Commission (2001) *Annual Report 2000-01*, Health Insurance Commission (HIC), Canberra, p45.

authentication of electronic transactions.[83] ICTs are central to HIC's activities and to the fulfilment of its management role.

In 2000-01, HIC was involved in a variety of projects which sought to utilise ICTs to advance Australian health care.[84] These included:

- *Health eSignature Authority Pty Ltd (HeSA)* – an independently registered company established to facilitate the introduction of Public Key Infrastructure (PKI) into the health sector. HeSA registers individuals and locations to use PKI for secure online transactions, paving the way for many e-health/e-business initiatives.
- *e-Health Technology Centre* – created to test and showcase emerging e-health technology, and to provide a centre where leading-edge technology and healthcare stakeholders combine to develop online business solutions. To replicate actual health environments, the e-Health Technology Centre contains a series of 'zones' that are furnished with appropriate fittings and equipment. The zones include a doctor's surgery, pharmacy, hospital, pathology lab, Medicare office and nursing home.
- *Better Medication Management System* – aims to create an electronic patient medication record that lists prescriptions written by different doctors and dispensed by different pharmacists. This will enable better informed prescribing and supply of medications, thus reducing the risk of adverse reactions or interactions.
- *Authority Notification System* – a real-time, interactive process to notify an authority prescription in relation to an 'Authority Required' drug, which is being explored as an alternative to the system where medical practitioners are required to call HIC by phone to obtain the necessary approval.
- *The National Prescribing Service* – feedback and evaluation programs in which practitioners are provided with personalised information regarding prescribing practices and a comparison of their prescribing practices with those of their peers.
- *The WA Visiting Medical Practitioners Assessing and Information System* – is designed to assess invoices from visiting medical practitioners for medical services provided to public patients in non-teaching metropolitan and rural hospitals in Western Australia. It aims to improve coordination and accountability.

These examples show that the implementation of ICTs, in the form of both information technology and information management, for the purposes of enhancing government's ability to track activities and expenditures under its funding programs lies at the heart of HIC's activities.

Health insurers: Collaboration between players in the health insurance industry, combined with the use of e-commerce, can provide a wide range of benefits. Health

83 Health Insurance Commission (2001) *Annual Report 2000-01*, Health Insurance Commission (HIC), Canberra, pp8-9.

84 See Health Insurance Commission (2001) *Annual Report 2000-01*, Health Insurance Commission (HIC), Canberra, pp42-44.

insurance is an information intensive business, but in the past interaction between entities in the industry has been characterised by duplication, inefficiency and time consuming and expensive paper-based systems. A number of initiatives driven by HIC and the Private/Public Health E-commerce Group (PheG) are encouraging greater use of e-commerce throughout the system. Benefits for health funds include human resource savings through automation, infrastructure savings and greater availability of timely information on healthcare costs.[85] However, a recent survey suggested that, to date, health funds' progress in realising the full cost saving benefits of ICTs has been slow, saying: "Australia's private health funds are failing to use the internet to cut costs in the light of rising insurance premiums."[86]

5.2 Providers

There are many providers of healthcare services. They include: government/public and not-for-profit institutional providers – eg. public hospitals and clinics, Catholic Health, etc; and corporate/private for-profit providers – eg. corporatised general practices, pathology centres, clinics and hospitals, and their corporate owners/managers. Individual practitioners and practices are dealt with in the following section.

5.2.1 Public and not-for-profit institutional providers

It has been reported in a number of places that both public and private hospitals in Australia have information and communication systems of 'highly variable quality and utility'. The larger ones have made some progress in basic computerisation of internal information functions, but the use of technologies for communicating externally or for supporting clinical transactions is 'generally primitive'. The Victorian Department of Human Services noted that: "IT&T capabilities in most public hospitals provide sub-optimal support for many hospital activities. In fact IT usage in most hospitals appears to be at least a decade behind many commercially oriented organizations. Furthermore, current capabilities would provide negligible support for the anticipated clinical care and business processes inherent in an integrated healthcare model."[87]

Nevertheless, individual hospitals are reported to have implemented some integrated systems. For example, Melbourne's St. Vincent's Hospital has implemented a range of ICT systems supporting clinical care, including information management systems for intensive care and systems that have encouraged a total re-engineering of the admissions system, resulting in the elimination of a central admissions facility. The new Children's Hospital in Sydney was designed around a paperless records system. In terms of

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85 See NOIE (2001) *Insurance @ Risk: National e-commerce scoping study*, NOIE, Canberra, pp32-33.

86 The Age (2002) 'Health funds failing to use the web to cut costs: survey,' *The Age*, 27th June 2002.

87 Victorian Department of Human Services (1996) cited in NOIE (2000) *E-commerce beyond 2000*, DCITA, Canberra, p121.

hospital supplies, St. Vincent's in Melbourne has achieved significant improvements in cost and timeliness through e-procurement, reporting a reduction in its supplies inventory from AUD 600 000 to less than AUD 57 000 among the gains realised. The PeCC project has contributed to similar gains elsewhere.[88]

It is clear, however, that the entire healthcare system could reap significant gains from an integrated approach to supply chain management that goes beyond pharmaceuticals to include the entire range of hospital and medical supplies and linkages to other players in the healthcare system (eg. insurers). The NHIMAC suggested that:

> *"Greater uptake of electronic commerce within the health care sector offers opportunities to reduce costs across both supply and distribution chains and to provide improved client services through faster turnarounds. It can substantially reduce costs associated with inventories, procurement and distribution of products. Supply chain reform is likely to achieve significant cost and resource efficiencies, particularly in the acute care sector… Associated improvements in managing and costing episodes of care will also contribute to better planning and resource allocation… Similarly, efforts to enhance the quality of patient safety and care will also be supported by linkages to clinical initiatives such as electronic prescribing and therapeutic device tracking and monitoring."*[89]

Initially targeting pharmaceuticals, PeCC projects grew to incorporate a wider range of products and services in the healthcare supply chain. Follow-on projects have included linking raw materials suppliers and manufacturers, wholesalers to retailers of both pharmaceuticals and a range of medical supplies, and retailers to hospitals. Other projects have focused on more integrated systems to particular healthcare services providers, such as the Department of Defence / Veterans' Affairs, the Ballarat Hospital, and a number of clinics and pharmacies operating in regional NSW.[90] PeCC project estimates suggested that there were savings of AUD 350 million to be realised from the full implementation of supply chain management improvements and e-commerce – based on extrapolations from a US survey showing that 23 per cent of the cost to hospitals of consumables is attributable to supply chain costs.[91]

There are also significant potential benefits in administration and logistics. Electronic scheduling and patient management systems could improve scheduling of tests and procedures, and thereby reduce the length of hospital stays and reduce the need for multiple visits. Linking insurers, healthcare providers, financial institutions and

88 See NOIE (2000) *E-commerce beyond 2000*, DCITA, Canberra, p124; and Moore, E. and McGrath, M. (2000) *health & industry collaboration: the PeCC story*, DCITA, Canberra, p44.

89 NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, pp100-101.

90 See Moore, E. and McGrath, M. (2000) *health & industry collaboration: the PeCC story*, DCITA, Canberra for details of PeCC projects.

91 NOIE (2000) *E-commerce beyond 2000*, DCITA, Canberra, p126.

consumers into claiming and payments systems also has the potential to reduce administrative costs significantly. The Australian Health Insurance Commission (HIC) has estimated that paper-based claims cost insurers AUD 3–5, whereas electronic processing costs just 70 cents.[92]

Box 5.2 Public Hospitals in Australia

In 1999-2000, there were 748 public hospitals nationally, including 24 psychiatric hospitals. There were an average of 52 947 beds in public hospitals during 1999-2000, representing 68 per cent of all beds in the hospital sector (public and private hospitals combined). Public hospital beds have declined from 3.3 beds per 1 000 population in 1995-96 to 2.8 beds in 1999-2000.

The number of patient separations (discharges, deaths, and transfers) from public hospitals during 1999-2000 was 3.9 million, compared with 3.6 million in 1995-96. Same-day separations accounted for 46 per cent of total separations, compared with 40 per cent in 1995-96. Total days of hospitalisation for public health patients during 1999-2000 amounted to 16.2 million, a decrease of 2 per cent since 1995-96. The average length of hospital stay per patient was 4.2 days.

An average of 175 291 staff (full-time equivalent) were employed in public hospitals in 1999-2000, of whom 45 per cent were nursing staff and 10 per cent were salaried medical officers. Revenue amounted to $1.22 billion. Most of this revenue (59 per cent) was from patients' fees and charges. Recurrent expenditure amounted to $14.35 billion, of which 62 per cent was for salaries and wages. The difference between revenue and expenditure is made up by payments from State/Territory consolidated revenue and specific payments from the Commonwealth for public hospitals, in roughly equal proportions.

Source: ABS (2001) *Australia Now: Health care delivery and funding*, ABS, Canberra. Available www.abs.gov.au

The HIC has a range of initiatives in progress to improve access to Medicare and the Pharmaceuticals Benefits Scheme (PBS). Under the banner of *easyclaim*, the HIC introduced a variety of products to encourage the submission of claims information electronically. The HIC has also pursued the goal of *simplified billing* to assist the adoption of e-commerce. To this end, the HIC has developed a panel of approved software for use by billing agents and health funds. This software is posted on the HIC's simplified billing website and is available for use by any interested parties. Some health funds and billing agents have also developed appropriate software to enable electronic lodgement of simplified billing claims. Twenty per cent of all in-hospital claims are now lodged via simplified billing, with approximately 80 per cent of these claims being lodged electronically.[93]

Drives for accountability, quality and patient safety are also pushing further changes in the use of information management and communication tools in clinical care. At the

92 NOIE (2000) *E-commerce beyond 2000*, DCITA, Canberra, p128.

93 NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, pp104-107.

point of care, the ability to electronically request and receive diagnostic testing and treatment services has the potential to create significant benefits for the health sector. These include:

- increased access to test results for practitioners, thus reducing delays in responding to abnormal results and hence improving quality of care for health consumers;
- accurate and timely communication and accounting for service requests and cancellations from clinicians to service departments such as pathology laboratories and medical imaging;
- less time wasted and fewer errors resulting from difficulties in reading clinicians' handwritten requests and/or incomplete request data; and
- less duplication of tests requested, as the information system will alert the clinician to potential duplicate orders.[94]

'Adverse events' resulting from communication failures are estimated to account for around 8 per cent of hospital bed-days. In 1995, a government report suggested that 18 000 people die each year in Australia from medical mistakes and that another 50 000 suffer permanent injury.[95] One recent report suggested that:

> *Despite the extensive information resources, in 47 per cent of drug reviews, lack of information was given as a reason for drug intervention. Pharmacists reported problems with a lack of information about appropriate dosages (42 per cent of interventions), lack of access to alternative drug information (31 per cent), lack of information about the patient (15 per cent) and lack of information about previous prescribing history (12 per cent). This information is generally stored somewhere, but poor systems mean access to it is difficult.*[96]

The cost of inappropriate use of pharmaceuticals is estimated at AUD 500 million per annum, and Australian research has shown that GPs are unaware of 26 per cent of the medications being taken by their older patients – among whom adverse reactions to medication accounts for around one third of emergency admissions. Roughead et al (1998) estimated that the monetary cost of drug-related hospital admissions in Australian Public Hospitals alone is around AUD 350 million annually.[97] Estimates

94 NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, p97.

95 See The Age (2002) 'When Doctor does not know best', The Age, Melbourne, February 26th 2002. Available www.theage.com.au/articles/2002/02/25/1014471628826.html Accessed March 5th 2002; and various reports from The Medical Error Action Group.

96 Sydney Morning Herald (2002) 'IT-aided prescriptions for healthy savings,' 9 May 2002. http://www.smh.com.au/articles/2002/05/07/1019441472549.html

97 Roughead, E.E., Gilbert, A.L, Primrose, J.G. and Sansom, L.N. (1998) 'Drug-related hospital admissions: a review of Australian studies 1988–1996,' *Medical Journal of Australia* 168, 20th April 1998.

Box 5.3 Case Study: Secure Email System for Health

Medi-safe Communications is a 1999 Commonwealth Government funded pilot of a secure email system within the health sector on the Gold Coast. It will electronically link general practitioners to both hospitals and other health service providers and will demonstrate the efficiency of online communication to the traditionally paper-based health care sector. The project is funded by the National Office for the Information Economy's Information Technology Online Program (ITOL).

General Practitioners (GPs) are the coal face workers within the health sector, and are reliant on numerous medical service providers to complete patient diagnosis and treatment. Those service providers include hospitals; medical specialists such as surgeons, anaesthetists and psychiatrists, often housed within hospital infrastructure; and health professional service providers such as pathologists, radiographers, pharmacists, physiotherapists and psychologists.

Communication between these entities is very manual. Doctors request services on hand written forms and diagnoses are returned via typed reports that are faxed or mailed to the GP. By moving to an electronic messaging system, the service provider will be assured of receiving the service request, the patient service can be scheduled immediately, and the GP can view the diagnostic report more quickly than under the current system. All relevant documentation can be filed either electronically or copied into subsequent reports.

Discussions with members of the Gold Coast's health community reveal that the highest frequency of communications is between GPs and pathologists, radiologists and hospital administrators. Hence these communication processes were targeted for trial in this pilot. Medi-safe Communications will utilise generic email systems, familiar to users, and cost-effective, publicly available communications infrastructure. Privacy will be provided by encryption and authentication, via the use of third-party key management. The project will electronically link GPs with health service providers including hospitals and pathology, radiography, pharmacy and other medical service groups. Each of the medical practices and service providers participating in the pilot will be equipped with a smartcard reader to be attached to the PC used for email, and each authorised user within the organization will be issued a smartcard. These tools will enable the participants to safely communicate with other members of the service network. That is, only authenticated users will be able to read or send mail via the secure system.

Medi-safe Communications will be one of the first installations of a trusted third party certification, PKI-based, secure email system operating via the Internet in Australia. It will allow GPs and their related service providers to reduce administration costs and improve service quality to their patients. Administration savings will be immediately evident in reductions in transport, record search and clerical duplication costs. Furthermore service provider patient scheduling will be improved, promoting a more efficient throughput of patients.

Forty per cent of Australian general practices utilise computer technology to aid practice management. Only fourteen per cent use computers in the clinical side of their practice, and Gold Coast estimates indicate that only eleven per cent have any form of email facilities. The Medi-safe project will demonstrate to the relatively computer illiterate health care community the safety and efficiency of contemporary online technologies. If this can be achieved within the highly confidential world of healthcare, the task of encouraging economy-wide adoption of such technologies will be boosted.

Source: NOIE (2001) *National Policy Framework for E-Health,* DCITA, Canberra. Available www.noie.gov.au/projects/ecommerce/ehealth/

suggest that, in addition to the health outcomes, around AUD 500 million could be saved through coordinated prescription and improved compliance.[98]

A major barrier to e-commerce in healthcare service delivery is the need for a standard form of electronic record keeping and the establishment of systems for storing and communicating information which are secure and reliable, have appropriate authorisations for use and are efficient in a wide range of contexts and conditions. The other major barrier is resistance to the change process and to re-engineering across the range of healthcare organizations and within organizations across professional and functional divisions. It has been suggested that: innovative developments are often limited to one section of a hospital, with little integration into an overall e-commerce strategy for the hospital. A widespread weakness in change management for the implementation of ICT systems in hospitals means that many promising pilot studies cannot be replicated in the wider system and that more than half of all hospital IT systems initiatives fail.[99]

Box 5.4 Catholic Health Australia

Catholic Health Australia is the national organization representing more than 680 Catholic health care sponsors, systems, facilities, and related organizations and services. This represents the largest non-government provider grouping of health, aged and health related community care services in Australia. It operates on a private non-profit basis.

Services cover aged care, disability services, family services, children and youth services, mental health services, palliative care, alcohol and drug services, veterans health, primary care, acute care, non acute care, step down, rehabilitation, diagnostics, preventive public health, medical research and ethics. These services are provided in a number of settings, for example, residential, community care, in the home, the workplace, hospitals, medical clinics, hospices, prisons and correctional facilities, as well as for people who are homeless. In addition, services are provided in rural, provincial and metropolitan settings, in private facilities as well as on behalf of the public sector.

The Catholic health ministry consists of: 130 owners of Catholic health, aged and health related community care services, 111 of which are members of CHA; 500 aged care services; 330 approved residential services; 16,753 residential aged care beds; 5,334 retirement and independent living units and serviced apartments; 8,500 beds in 58 health care facilities - publicly and privately funded hospitals and hospices, acute and non acute services; 7 teaching hospitals; and expanding home and community care services.

Source: Catholic Health Australia. www.cha.org.au

The automation of clinical information and clinical information systems issues are dealt with in more detail below.

98 NOIE (2000) *E-commerce beyond 2000*, DCITA, Canberra, p127.

99 NOIE (2000) *E-commerce beyond 2000*, DCITA, Canberra, p122 and 124.

5.2.2 Corporate providers

Corporate for-profit providers include corporatised general practices, pathology centres, clinics and hospitals, and their corporate owners and managers. Private sector providers face many of the issues facing those in the public sector. However, their corporate owners and managers have additional concerns: such as ensuring greater cost control through better information management, providing more integrated and advanced practice and institutional management systems that can be used throughout a chain of practices and institutions, and using information technology and management to enable vertical integration of the health services delivery process through their organizations. There is, in short, somewhat greater emphasis on information management, cost control and health services integration in the private sector.

Major players in the private healthcare sector in the United States have entered the Australian scene, but have yet to become as significant a part of the Australian system as they have in the United States. Tenet/NME (National Medical Enterprises), GSI, Columbia/HCA (Hospitals Corporation of America), Sun Healthcare and Kaiser Healthcare all entered the Australian industry as operators of private hospital and clinic facilities during the 1990s. More locally, Alpha Healthcare and Mayne Nickless moved into health services from other industries – ie. minerals exploration and transport and logistics, respectively. There has been a good deal of volatility in ownership structures and mixed fortunes in terms of profitability, but a few corporate providers remain. Mayne Health is now among the largest corporate provider in the Australian market. Other significant players include Ramsay Health Care, and Healthscope Limited, which manages medical, surgical, rehabilitation and psychiatric hospitals.

Corporatised pathology has been one of the most active areas for private firms. In addition to Mayne (see below), Sonic Healthcare operates a string of pathology laboratories throughout eastern Australia and in New Zealand, Singapore and Korea. In 2000, Sonic realised a consolidated revenue of more than AUD 387.[100] Similarly, MIA Group Limited, formerly known as Medical Imaging Australasia, operates and integrates medical imaging services such as x-ray, ultrasound, computerised tomography, magnetic resonance imaging, nuclear medicine and related practices.

Corporatised general practices are also becoming more common, as doctors find the administrative burden of the practice increasing and impacting their ability to care for their patients. Corporate players (eg. Revesco) offer to purchase the practice and re-employ doctors on contracts, relieving them of the administrative burden of the practice. While there is concern about the potential for corporate players to pressure doctors to refer patients for treatment within their vertically integrated corporate empires, corporatisation does facilitate greater standardisation and automation of activities *and* provide greater incentive to integrate services from the general practice, through pathology and diagnostic imaging to clinic or hospital admission.

[100] Sonic Healthcare Limited (2001) *Annual Report 2000*, Sydney. www.sonichealthcare.com.au

Table 5.1 Private medical services providers' market capitalisation, February 2002 ($m)

	Market Capitalisation (February 2002) $m
Mayne Nickless	5,504
Sonic Healthcare	1,926
MIA	988
Ramsay Healthcare	602
Primary Health	475
Gribbles Group	423
Foundation Healthcare	65
Lifecare Health	10

Source: Deutsche Bank (2002) *Vital Signs*, 1st February 2002, Deutsche Bank, Sydney.

Mayne Health provides an indication of the application of ICTs among private providers in Australia. Mayne has three arms, Mayne Health, Mayne Logistics and Mayne Pharma. Mayne Health operates 58 hospitals across Australia, three in Indonesia and one in Fiji. Mayne Health also manages Australia's second largest pathology business and one of the leading diagnostic imaging groups, with operations in five states. Mayne Health realised more than AUD 1.5 billion revenue in 2001 — AUD 1.2 billion from hospitals, AUD 246 million from pathology and AUD 147 million from diagnostic imaging. Mayne entered the pharmaceuticals market via the acquisition of FH Faulding in 2001. Mayne's pharmaceutical division is represented in more than 50 countries, with a focus on developing, manufacturing and marketing generic injectable and oral pharmaceuticals, primarily for the hospital market. Mayne claims to have developed a "fully transparent health care network".[101]

Mayne Health's hospitals range from 45 to 365 beds and operate in five states. Mayne's integrated pathology network brings together around 3 000 pathologists, scientists, technical and collection staff in 41 laboratories around the country. It focuses on bringing advanced diagnostic technology to bear. Mayne's pathology network provides results online to authorised doctors, which: allows doctors to access results from computers in various locations using an encryption 'key' and password; features customisable e-mail alerting, which enables doctors to be notified immediately of urgent or unusual results; and stores all results in a database personal to each doctor, allowing centralised storage of information and providing a searchable historical record.

Mayne's diagnostic imaging services provide a wide range of imaging services, through almost 70 centres – 29 in Victoria, 25 in NSW and 13 in Queensland and Western Australia. Mayne Health provides around 7 million services to patients each year, including around 5 million pathology episodes, 500 000 hospital admissions, and 1.4

101 This summary of Mayne Health's activities is drawn from Mayne Health (2001) Mayne Health Website at www.maynegroup.com Accessed February and July 2002.

million imaging examinations. Using ICTs to provide integrated services through such mechanisms as online results and notification are a key element of operations, and typical of the developments among private providers.

Box 5.5 Private Hospitals

There were 509 private hospitals in operation in 1999-2000, comprising 278 acute hospitals, 24 psychiatric hospitals and 207 free-standing day hospital facilities. The number of acute and psychiatric hospitals has continued to decline since 1995-96 when 323 of these hospitals were in operation. In contrast, day hospital facilities have shown strong growth for several years, with only 140 in operation in 1995-96. The average number of beds available at private acute and psychiatric hospitals for admitted patients increased by 4 per cent to 23 665 between 1995-96 and 1999-2000. Although there was a slight decrease in the average number of beds from 1998-99, the trend towards larger hospitals continues. There were 1.2 private hospital beds available per 1 000 population in 1999-2000. The average number of beds or chairs at free-standing day hospital facilities (used mainly for short post-operative recovery periods) increased over the same five-year period by 55 per cent to 1 581. This large increase reflects the substantial growth in the numbers of free-standing day hospitals in recent years.

Private hospital separations in 1999-2000 totalled 2.1 million, of which 84 per cent were from private acute and psychiatric hospitals and 16 per cent from free-standing day hospital facilities. Same day separations accounted for 56 per cent of all private hospital separations (compared with 46 per cent of public hospital separations).

The average number of full-time equivalent staff employed in private hospitals was 44 657, of whom 59 per cent were nursing staff. Total operating expenditure for private acute and psychiatric hospitals during 1999-2000 amounted to $3.79 billion. Some 57 per cent of this amount was spent on salaries and wages (including on-costs). Revenue received during the year was $4.01 billion, of which 91 per cent was received as payments from or in respect of patients. Total recurrent expenditure for free-standing day hospital facilities during 1999-2000 amounted to $163 million, and revenue received during the year was $192 million.

Source: ABS (2001) *Australia Now: Health care delivery and funding,* ABS, Canberra. Available www.abs.gov.au

5.3 Practitioners

A recent report entitled *Getting Real About E-Health* began:

> *"Much of today's hype about the Internet echoes the hype about information technology of the early 1990s. Back then, predictions abounded that IT would dramatically increase the efficiency and lower the cost of delivering and administering health care. Community hospital information networks (CHINs), electronic data interchange (EDI), and electronic medical records (EMRs) were going to redefine medicine. They did not.*
>
> *But those who dismiss the current predictions about e-business as just more hype are unaware that something big is actually happening this time around. The Internet - and businesses that incorporate Internet-based services in their*

> *offerings - are poised to provide significant value to the most critical constituents in health care: physicians and their patients."*[102]

In the author's opinion this rather pre-emptively writes off community hospital information networks (CHINs), electronic data interchange (EDI) and electronic medical records (EMRs), which may yet prove significant despite being more difficult to implement successfully than some had expected. Nevertheless, it does highlight the importance of the internet. *HealthCast 2010* suggested that the internet would be responsible for creating massive change in the healthcare industry in the next few years. Eighty-nine per cent of the 400 experts surveyed said that internet consulting services would change the patient-provider relationship, and 71 per cent said they believed that internet would force improvements in the healthcare industry.[103]

Recent surveys suggest that a considerable proportion of doctors in the United States and in Europe are already using e-health tools, and that adoption intentions suggest that growth in the number of adopters will be rapid. Interestingly, one survey reported that: the internet is not a diversion for a small group of doctors who are technophiles or have light clinical practices, but is used widely. Indeed, it is the busiest practitioners who are most likely to turn to the internet for research, education and information updates. Moreover, the information they find is influencing their diagnoses, prescribing and treatment practices; and the doctors who have used ICT/online tools find them effective.[104] From the perspective of medical practitioners, three of the more important areas of ICT/online activity and use are knowledge enrichment or education, practice administration and clinical tools. Telemedicine applications amount to little more than enabling these same activities to be undertaken remotely. Nevertheless, they do offer certain specific opportunities for cost savings and quality improvements.

5.3.1 Knowledge enrichment, research & education

Many doctors are using the internet to stay up-to-date, research specific questions and areas of interest and to undertake formal or informal education (eg. refresher courses). Of the US-based physicians surveyed by Harris Interactive in late 2000,[105] 49 per cent reported that they were using the internet to increase their medical knowledge – ie. updating or continuing their medical education, interacting with professional associations, reading journals, researching topics of interest, exploring drug details and interacting with groups of practitioners with similar interests. While these activities are important, and may well contribute significantly to the quality of care at the coal-face,

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102 Lesser, R. (2000) *Getting Real about E-Health: Opportunities for Action in Health Care*, Boston Consulting. Available www.bcg.com

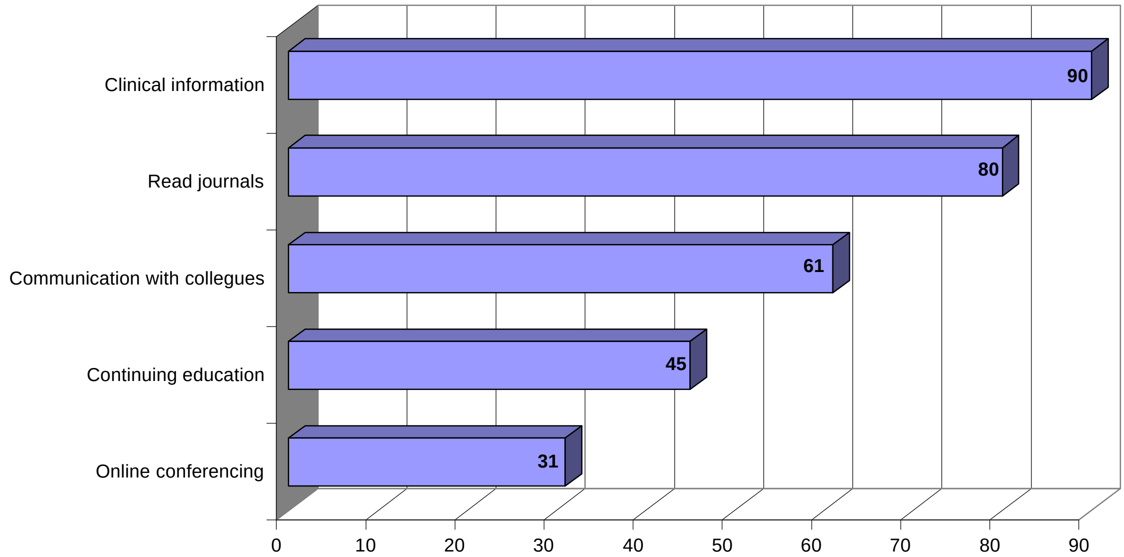
103 NUA (1999) '*Net to Radically Change Health Care Industry*,' November 2nd 1999. Available www.nua.com/surveys/

104 von Knoop, C., Lovich, D. and Silverstein, M.B. (2001) *Vital Signs Update: Doctors Say E-Health Delivers*, Boston Consulting Group, September 2001. Available http://www.bcg.com

105 Harris Interactive surveyed 10,000 patients and 769 doctors in 1999 and 2000.

the overall opportunity to generate new value for players in the healthcare system is relatively limited because they represent a shift of medium rather than new activity.[106]

Figure 5.1 What American doctors are looking for online (percentage of US-based doctors using internet)



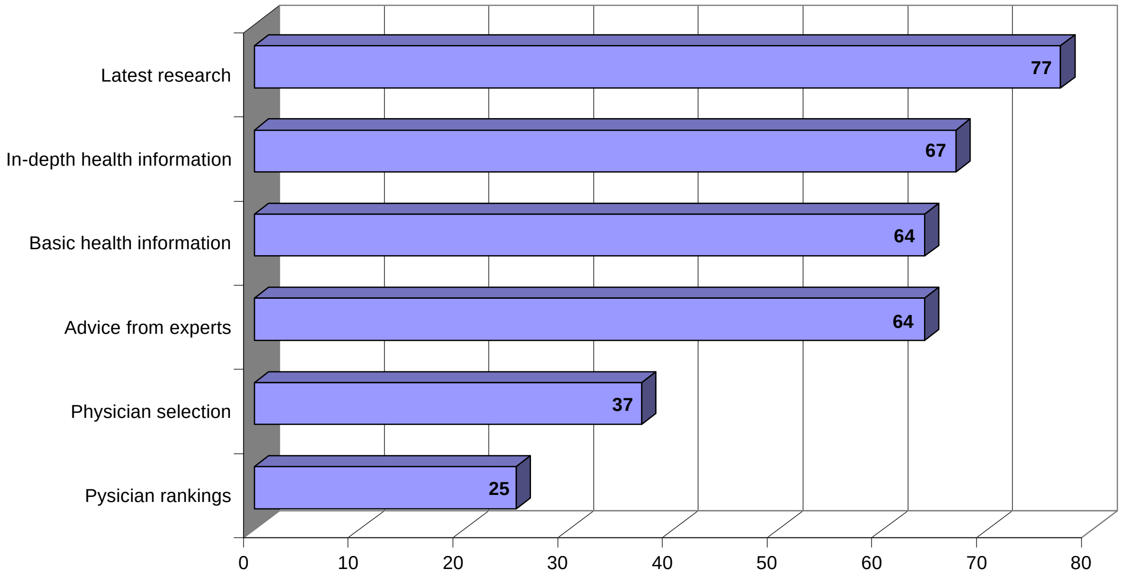
Source: von Knoop, C., Lovich, D. and Silverstein, M.B. (2001) *Vital Signs Update: Doctors Say E-Health Delivers*, Boston Consulting Group, September 2001. Available http://www.bcg.com

A more recent survey (conducted in early 2001) highlights the rapid take-up of online applications, reporting that 89 per cent of the 400 US-based physicians surveyed used internet for an average of around 8 hours a week – including 3 hours devoted to upgrading their knowledge and research. Of those doctors online: 90 per cent reported researching clinical information; 80 per cent read journals online; 61 per cent communicated with colleagues online; 45 per cent undertook continuing medical education online; and 31 per cent used online conferencing. The survey also suggested that what doctors find online does influence their practice. Between 70 and 90 per cent of doctors (depending on the specific question asked) reported that the information they found online influenced their knowledge, their diagnoses, the types of drugs they prescribe, and the way they interact with their patients. Around one-third reported that the information found online had a major impact on their knowledge of drugs and other

[106] Lovich, D., Silverstein, M.B. and Lesser, R. (2001) *Vital Signs: The Impact of E-Health on Patients and Physicians*, February 2001 Report on the U.S. Market, Boston Consulting Group, p18. Available http://www.bcg.com

treatments, 20 per cent said that it had a major impact on their knowledge of symptoms and diagnoses, and 13 per cent said it had a major impact on the drugs they prescribe.[107]

Figure 5.2 What European doctors are looking for online (percentage of interviewees)



Source: Poensgen, A. and Larsson, S. (2001) *Patients, Physicians and the Internet: Myth, Reality and Implications*, Boston Consulting Group, January 2001. Available http://www.bcg.com

5.3.2 Practice administration

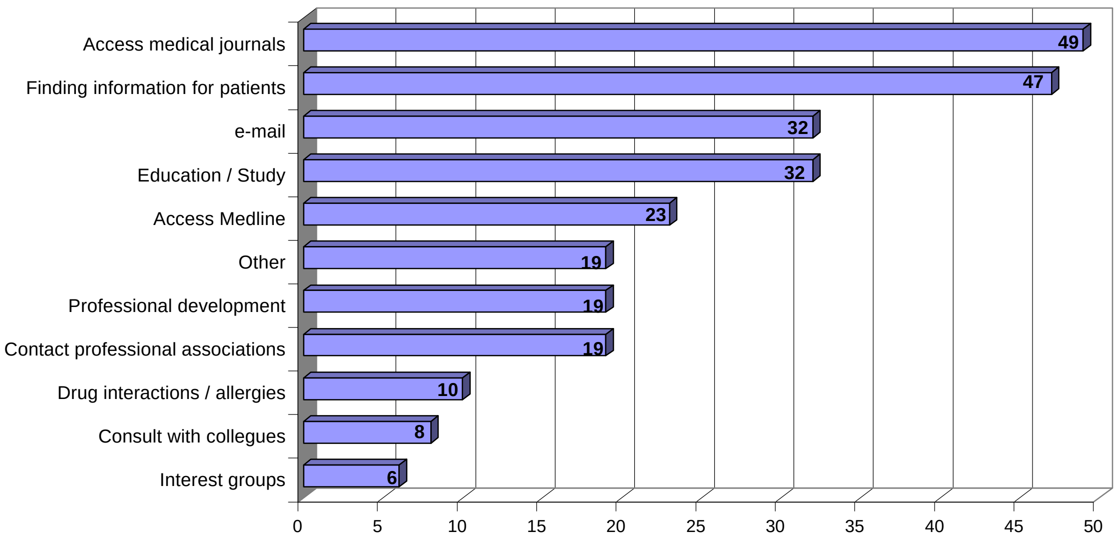
Practice administration is an area in which there are significant opportunities for efficiency gains and cost savings, even though the costs and barriers to putting practice administration tools in place are considerable. The possible gains include staff savings, less time on the phone seeking clarifications and faster more efficient claims processing. However, there are learning and administrative costs involved in implementing such systems, in addition to the cost of implementing and maintaining the systems themselves.

In late 2000, 36 per cent of US-based doctors surveyed were already using administrative tools in their practices – for such things as scheduling patient visits, processing claims, managing office staff, recording billing information and billing,

107 von Knoop, C., Lovich, D. and Silverstein, M.B. (2001) *Vital Signs Update: Doctors Say E-Health Delivers*, Boston Consulting Group, September 2001. Available http://www.bcg.com

authorising referrals, pre-checking hospital admissions, and reporting to health plans.[108] In late 1997, 31 per cent of Australian general practices surveyed had computers. Seventy-four per cent reported using them for a combination of administrative and clinical function, and 19 per cent reported administrative functions only. The most common administrative functions reported by Australian GPs were: patient registration, billing and the financial management of practices.[109] By early 2000, 65 per cent of the 5 088 registered general practices in Australia were using electronic prescribing, and 79 per cent were receiving payments under the data connectivity program (ie. the practice has computers with internet/e-mail connection).[110]

Figure 5.3 What Australian doctors are looking for online (percentage of those using internet)



Source: AC Neilsen (1998) *A study into levels of, and attitudes towards, information technology in general practice*, Research consultancy report prepared for General Practice Branch, Department of Health and Aged Care, AC Nielson Research, Sydney, p56.

108 Lovich, D., Silverstein, M.B. and Lesser, R. (2001) *Vital Signs: The Impact of E-Health on Patients and Physicians*, February 2001 Report on the U.S. Market, Boston Consulting Group, p19. Available http://www.bcg.com

109 AC Nielsen (1998) *A study into the levels of, and attitudes towards information technology in general practice*, AC Nielsen, Sydney. Available www.health.gov.au/hsdd/gp/gpit.htm

110 Department of Health and Aged Care (2001) Information Management and Technology Initiatives. Available at www.health.gov.au/hsdd/gp/imit.htm Accessed January 2002.

5.3.3 Clinical tools and systems

The recent evolution of the healthcare system has seen a blurring of traditional boundaries between physical settings and between professional groups. The NHIMAC suggested that:

> *"With shorter hospital stays and substitution of care settings, care is increasingly moving out of hospitals and into the community and the home. Greater emphasis on coordination of care has led to increased involvement of multi-disciplinary teams and the development of partnership models, breaking down more traditional approaches to patient care. The boundaries between the health and community sectors are also blurring. These changes have brought with them increasing recognition of the need for effective communication and sharing of clinical information both with providers and consumers to optimise individual care - and the limitations of the current paper-based system in this context. Better information flow for clinical care is about bringing information to the provider and the consumer at the point of care to enhance the quality of clinical decision-making.*
>
> *The health care system in the future is likely to be underpinned by increasingly sophisticated clinical and administrative information systems that enable a whole range of clinical information to be available online at the point of care. For example, clinicians in hospitals will be able to access a patient's medical record online at clinical workstations located throughout the hospital, record notes, order tests and treatments, receive results, refer the patient to other clinicians or services, and review the progress notes of nurses, allied professionals and other clinicians. Built into these clinical workstations will be a variety of decision-support tools - such as alerts and prompts and online access to up-to-date clinical advice, including clinical practice guidelines and other health knowledge bases. Such systems will also have the capacity to provide patients with health information tailored to their needs (electronically and in hard copy)."* [111]

But the adoption of clinical tools has been relatively slow. In late 2000, only around 11 per cent of US-based doctors surveyed were using clinical tools in their practices – to record patient history, receive and implement practice protocols and guidelines, request laboratory tests, provide diagnostic support, prescribe drugs, check formularies, give samples, authorising refills, provide patient information and recommend information sources to patients, communicate with patients via e-mail, monitor patients remotely, use electronic medical records for note taking and consult with peers.[112] In late 1997, 74

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[111] NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia,* National Health Information Management Advisory Council, Canberra, pp76-77.

[112] Lovich, D., Silverstein, M.B. and Lesser, R. (2001) *Vital Signs: The Impact of E-Health on Patients and Physicians*, February 2001 Report on the U.S. Market, Boston Consulting Group, pp19-21. Available http://www.bcg.com

per cent of the Australian general practices with computer reported using a combination of administrative and clinical tools, and a further 7 per cent reported using clinical tools only. Of the clinical tools, script writing was the most common among Australian GPs (12 per cent of all GPs), only 7 per cent of all GPs reported storing information electronically, using recall systems and clinical notes. However, recall systems were in use in 47 per cent of practices, suggesting that clerical staff, rather than GPs, are undertaking the recall functions.[113]

More recently, Pro Medicus, one of Australia's leading e-health providers, reported that it had registered 9 000 or more than 42 per cent of all Australian GPs with promedicus.net, which enables referring doctors to receive diagnostic and clinical information via internet.[114] In February 2002, it was reported that 87 per cent of Australian GPs were using clinical applications, such as prescribing.[115] GPs using clinical tools in Australia have reported that they believed that computers offered benefits for doctors, patients and the government. Doctors are thought to benefit through better information storage and retrieval, efficiency of storage space and time, more accurate records, improved drug management, improved legibility and presentations, better security and integration of clinical and administrative functions. Patients are thought to benefit through better prescribing, improved referrals and access to information. The benefits for government are thought to be cost savings, better control over doctors, control over 'doctor shoppers' and improved access to population health data.[116]

Lovich et al (2001) suggested that the relatively slow rate of adoption in the United States reflected the complexity of such applications and a range of doctor concerns, including: patient privacy and security of patient records, the possibility that the tools will generate activities that are not billable and/or reimbursable, the cost of integrating clinical tools with current systems, the difficulty of use and possible interruptions to the workflow and doctor patient interactions, and the time needed for training to effectively use the new tools.[117] Similarly, a 1998 report by AC Neilsen suggested that the key barriers in Australia were: costs (including financial, time and effort), lack of computer skills and literacy, concerns about privacy and confidentiality, scepticism about the actual direct benefits to general practitioners, concerns about reliability and potential

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113 AC Nielsen (1998) *A study into the levels of, and attitudues towards information technology in general practice*, AC Nielsen, Sydney. Available www.health.gov.au/hsdd/gp/gpit.htm

114 Bryan, M. (2002) 'More doctors online,' *Australian Financial Review*, 22 May 2002, p48.

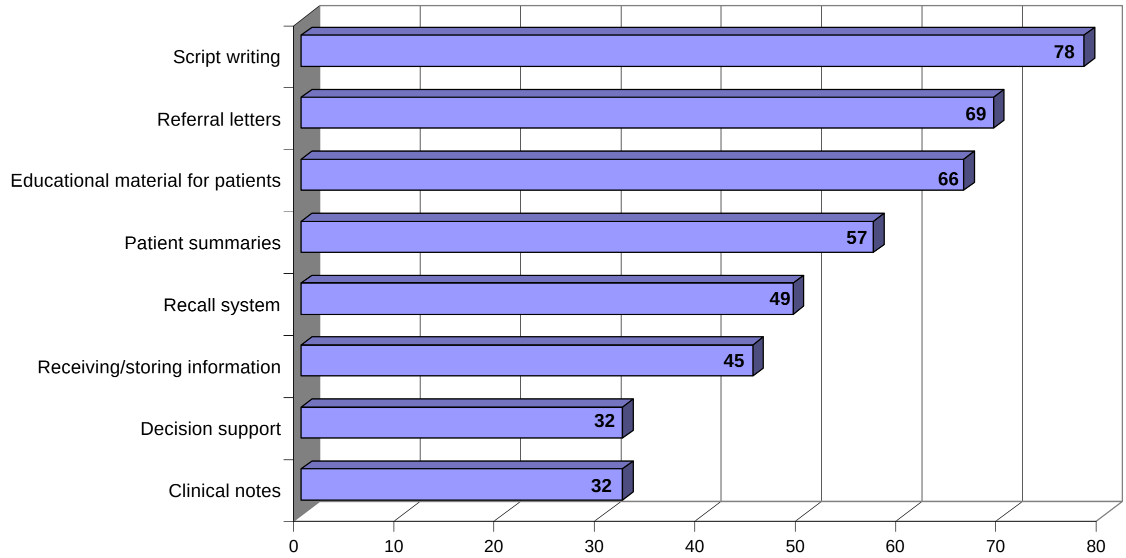
115 Magennis, A. (2002) 'Use of Decision Support Systems to Support Clinical Care,' ICT in Health Forum, 30th May 2002. www.noie.gov.au

116 AC Nielsen (1998) *A study into the levels of, and attitudes towards information technology in general practice*, AC Nielsen, Sydney. Available www.health.gov.au/hsdd/gp/gpit.htm

117 Lovich, D., Silverstein, M.B. and Lesser, R. (2001) *Vital Signs: The Impact of E-Health on Patients and Physicians*, February 2001 Report on the U.S. Market, Boston Consulting Group, pp19-21. Available http://www.bcg.com

obsolescence of software and hardware, and the lack of appropriate software applications.[118]

Figure 5.4 Clinical functions used by Australian GPs (Percentage of those GPs using clinical function)



Source: AC Neilsen (1998) *A study into levels of, and attitudes towards, information technology in general practice*, Research consultancy report prepared for General Practice Branch, Department of Health and Aged Care, AC Nielson Research, Sydney, p41.

Nevertheless, clinical tools hold significant promise, both in terms of direct efficiency and cost savings and in terms of influencing doctors' behaviour and practices. It is this latter that is likely to see major players in the healthcare system driving the adoption of e-health, and especially of clinical tools. As Martin (2000) put it:

> *Money is tied to doctors signatures. They authorise the treatment and everything else that happens to citizens who are ill. A government which can control doctors signatures can control costs. A corporation which controls doctors can make a profit.*[119]

A survey of 400 US-based doctors conducted in early 2001 examined the take-up of the three clinical tools that appear to offer the greatest potential benefits. Namely:

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118 AC Nielsen (1998) *A study into the levels of, and attitudes towards information technology in general practice*, AC Nielsen, Sydney. Available www.health.gov.au/hsdd/gp/gpit.htm

119 Martin, B. (2000) *The Corporatisation of Health Care in Australia*, p1. Available www.uow.edu.au/arts/sts/bmartin/dissent/documents/health/corp_austral.html Accessed 12th February 2002.

- *electronic medical records* – which help manage overall practice and patient documentation;
- *electronic prescribing* – which promises to affect changes in drug selection, prescription and fulfilment processes; and
- *online communication and remote disease monitoring* – which offer new ways of handling patient interactions and provide health care.

The survey reported that 26 per cent of doctors surveyed were already communicating with patients via internet and a further 13 per cent expected to be doing so during the next 18 months; 22 per cent were already relying on electronic medical records and a further 20 per cent expected to be doing so within 18 months; 11 per cent were already using electronic prescribing and a further 20 per cent expected to be doing so within 18 months; and 5 per cent were already using remote monitoring and a further 9 per cent expected to be doing so within 18 months.[120]

Electronic medical records (EMRs): EMRs have been slow to develop, but there is considerable promise that automated records would be more complete and accurate, and would enable much more accurate diagnosis and reduce costly medical errors. Klienke (1998) saw the electronic medical record as *the* essential technology.[121] The NHIMAC (2001) suggested that:

> *"Access to necessary information at the time care is delivered is central to good clinical decision-making - practitioners and consumers need the right information at the right time. The greater focus of health care policy on providing 'seamless care', particularly for the frail aged, the chronically ill, and those with other complex care needs, has highlighted the need to improve information exchange between different types of services and providers. The increasing shift of health care service delivery out of hospitals and into the community has led to a wider range of services being utilised, often resulting in duplication of time and effort through the repetition of assessments, testing and history-taking.*
>
> *Electronic health records and transmission can provide powerful tools to link the isolated islands and fragments of information that currently exist between services, thereby allowing practitioners almost instant access to a comprehensive picture of an individual's health history and current status. The potential benefits to health consumers and providers are substantial, including:*
>
> - *Reduced numbers of adverse events caused by lack of information about the individual consumer at the point of care;*

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[120] von Knoop, C., Lovich, D. and Silverstein, M.B. (2001) *Vital Signs Update: Doctors Say E-Health Delivers*, Boston Consulting Group, September 2001. Available http://www.bcg.com

[121] Klienke, J.D. (1998) 'Release 0.0: Clinical Information Technology in the Real World,' *Health Affairs* 17(6), pp23-38.

- *Reduced duplication of diagnostic tests due to unavailability of previous test results;*
- *Enhanced decision-making for providers and consumers (and therefore increased quality of care and health outcomes) through online access to decision-support tools such as clinical practice guidelines, prescribing alerts and recent information on diagnoses, treatment and prevention;*
- *Greater coordination and integration of care across the care continuum through increased exchange of information between service providers in the health and community sectors;*
- *Individual consumers being confident that, subject to appropriate privacy protection and their consent, regardless of where they seek or need health care, the health care professional treating them has full access to relevant clinical histories and treatment information - meaning that consumers will not have to go over the same questions and assessments each time they see a different provider; and*
- *Efficiency gains through time saved in retrieving information and reduced duplication in ordering tests - ordering tests and treatments and arranging appointments and referrals can be substantially accelerated with direct electronic requests, and data will be collected and made available more quickly, thereby increasing the time available for direct patient care."*[122]

No less than 92 per cent of the US-based doctors surveyed who are using EMRs reported that they helped improve overall efficiency, 88 per cent reported that they have improved the quality of care, and 29 per cent reported significant time and cost savings.[123] Differences between the levels of reported adoption of EMRs in different countries suggest that institutional and related incentives structures play a significant part in fostering or retarding adoption (Figure 5.5).

In Australia, *HealthConnect* is the major national initiative focusing on the development of a robust, secure and user-friendly national health information network capable of supporting the collection, management and distributed access to electronic medical records.[124] Under *HealthConnect* health related information about individuals will be collected in a standard format at the various points of care. This information will then be available for retrieval as needed via a secure network accessible to authorised healthcare

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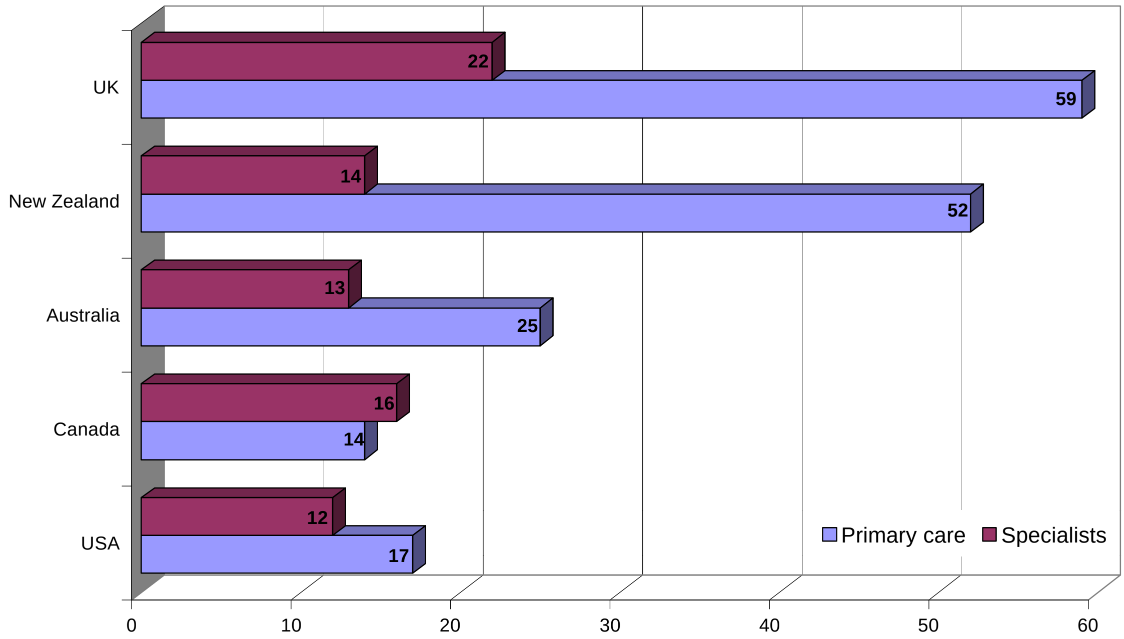
122 NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, pp79-80.

123 von Knoop, C., Lovich, D. and Silverstein, M.B. (2001) *Vital Signs Update: Doctors Say E-Health Delivers*, Boston Consulting Group, September 2001. Available http://www.bcg.com

124 See NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra for details.

providers.[125] Initial trials are currently being conducted, and are scheduled for completion in mid-2003.[126]

Figure 5.5 Percentage of doctors using Electronic Medical Records, 2000



Source: Harris Interactive.

Electronic prescribing: Electronic prescribing also offers considerable promise for cost savings, greater efficiency and improved healthcare outcomes. The NHIMAC suggested that:

> *"There has been increasing interest in the use of online technologies for pharmaceutical transactions to improve both the efficiency and effectiveness of medication prescribing. Electronic medication management can provide much safer arrangements and achieve better health outcomes for consumers. With the current fragmented approach to medication records, whereby individual providers or pharmacists only have records of their own prescribing and dispensing activity, there is always a possibility of adverse interactions between medications prescribed by different providers. This is because one provider will not be aware of what another has prescribed. For prescribers and pharmacists, more accurate and up-to-date knowledge of a consumer's medication history*

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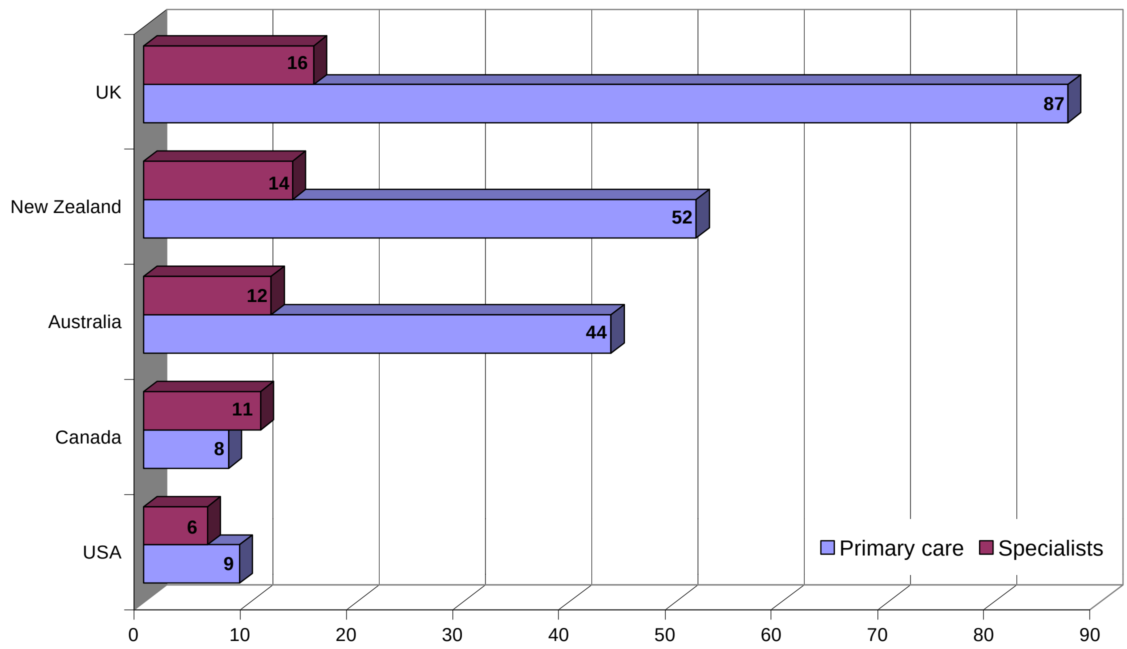
125 See National Electronic Health Records Taskforce (2000) *An introduction to HealthConnect: a health information network for all Australians*, July 2000. Available at www.health.gov.au/healthonline/connect.htm

126 Thorp, D. (2002) 'Healthcare e-record trial begins,' *The Australian*, 21 May 2002, p38.

and the automatic triggering of drug alerts can result in a much improved and safer prescribing and dispensing environment. Electronic medication management also means that prescription data only has to be entered once, removing a major potential source of error. In addition, pharmacists will not have to rely on their ability to decipher the prescriber's handwriting. As well as these clinical aspects, health information and technology advances also provide opportunities for improvements in administration (eg. online claiming) and planning."[127]

Electronic prescribing accounts for an average of 55 per cent of the scripts written by US-based doctors reporting that they have already adopted the technology. Most reported that they had adopted electronic prescribing to improve efficiency, and 36 per cent reported that it had. But perhaps of greatest interest is that 45 per cent reported that the major impact had been upon their compliance with formularies.[128]

Figure 5.6 Percentage of doctors using Electronic Prescription, 2000



Source: Harris Interactive.

In Australia, the main national initiative is the *Better Medication Management System (BMMS)*, which is currently commencing trials. The BMMS will create individual

127 NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, p87.

128 von Knoop, C., Lovich, D. and Silverstein, M.B. (2001) *Vital Signs Update: Doctors Say E-Health Delivers*, Boston Consulting Group, September 2001. Available http://www.bcg.com

electronic medication records, linking prescriptions written for a particular individual by different providers or dispensed by different pharmacists. Initially, consumers will also be able to access a paper copy of their record. The system will be voluntary for consumers, providers and pharmacists (ie. they will not be part of the system unless they choose to participate). Consumers will have to give their consent before either their provider or pharmacist can look at their medication record. Consumers, providers and pharmacists may also withdraw at any time. The Health Insurance Commission (HIC) systems necessary to support the BMMS (including public key infrastructure) have been developed and are being tested, work is being undertaken with the pharmacy and medical software industry to refine specifications for desktop systems that will communicate with the HIC-based central record, and barcodes are being established for pharmaceuticals to provide a basis for automation.[129] Initially, BMMS will be used in general practice and community settings, but it is expected that it will extend into hospitals as it evolves. BMMS has met with some resistance from key stakeholders, with trials and roll out running behind initial schedules.[130]

Widespread adoption of electronic prescribing will require greater standardisation,[131] but it is likely to be an important area for many players in the healthcare systems as it impacts so directly on prescription practices, and thereby upon the choice of drugs and management of drug expenditures.

Online communication: The use of online technologies for direct provision of health care presents exciting opportunities to increase consumer and provider access to a range of health services, particularly for those living in remote and rural communities.[132] The emergence of internet-based technologies and distributed systems, together with business integration and improvement, are increasingly seeing the merging of telehealth with mainstream health care delivery (see 'Telemedicine', below).[133]

Online communication between patients and their doctors tends to be resisted by doctors, concerned about the time it will take and whether that time can be billed; but driven by patients, who would like a more flexible relationship. Harris Interactive reported that at the end of 2000 most US-based physicians connect to the internet daily and 42 per cent of practices had websites. Over 55 per cent of doctors reported

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129 See NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra for details.

130 Bryan, M. (2002) ‘A testing time for health database,’ *Australian Financial Review*, 22nd April 2002, p53.

131 See, for example, PriceWaterhouseCoopers (2001) 'Physicians welcome increased role for the internet,' PWC, March 2001. Available http://www.pwcglobal.com/

132 For example, remote disease monitoring (RDM) allows providers to track patients with chronic conditions remotely – eg. internet connected glucose monitors, peak flow meters to measure lung capacity and scales to monitor weight to automatically collect and transmit data to the healthcare provider without requiring a visit by the patient. Although take-up is as yet low, adoption expectations suggest that growth may be rapid.

133 NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, p93.

communicating with colleagues, and 34 per cent communicated with support staff via e-mail. However, only 13 per cent reported that they were willing to communicate with patients by e-mail. Fourteen per cent of doctors reported sending clinical information via e-mail, while 39 per cent said they would be willing to if they sure about privacy and security.[134]

In Australia, 47 per cent of general practices had access to internet and 44 per cent access to e-mail in late 1997. Of the Australian doctors using clinical tools, 30 per cent had internet access from the desk and 27 per cent had e-mail access at their desk. Only 15 per cent had received e-mail from patients. Twelve per cent reported having no security measure in place. Among those accessing internet, access to medical journals and finding other information for patients are the most common uses.[135] Of those US-based doctors surveyed by von Knoop et al (2001) already communicating with patients via e-mail, 41 per cent cited improved patient satisfaction as the reason for adopting the practice. Ninety per cent reported that an improvement in patient satisfaction was realised, while 82 per cent said it enabled them to deliver better care, and 65 per cent reported improved overall efficiency.[136]

Telemedicine: is one aspect of e-health in which Australia is seen as a leader, with a relatively long history of providing services to rural and remote areas of the country. While definitions vary, in essence telemedicine or telehealth simply refers to delivery of health services at a distance via telecommunication links.[137] As the Australian New Zealand Telehealth Committee pointed out telemedicine/telehealth is not new: "in the first decades of the twentieth century, when medical expertise was not available in outback Australia, the telegraph was used to obtain diagnosis and prescribe treatment."[138] The NHIAC suggested that the further development and expansion of telehealth services in Australia offers many benefits, including:

- increased access to appropriate health services for both providers and consumers in regional and remote areas;
- reduced time away from work and home for health consumers living in regional and rural Australia;
- more efficient delivery of health services through reduced delays and costs relating to patient transfers;

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134 NUA (2001) 'Doctor's internet use rising,' March 2nd 2001. Available www.nua.com/surveys/

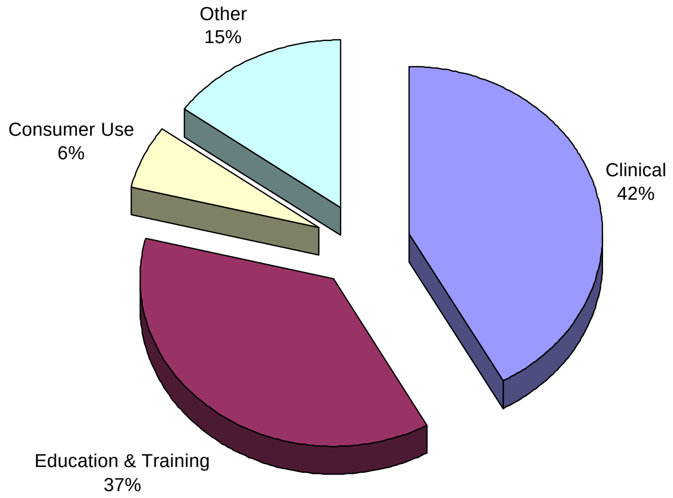
135 AC Neilsen (1998) *A study into levels of, and attitudes towards, information technology in general practice*, Research consultancy report prepared for General Practice Branch, Department of Health and Aged Care, AC Nielson Research, North Sydney, p5.

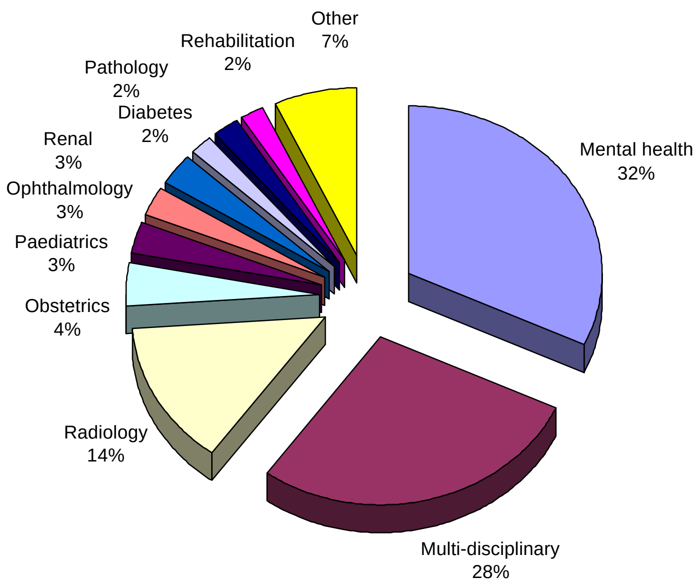
136 von Knoop, C., Lovich, D. and Silverstein, M.B. (2001) *Vital Signs Update: Doctors Say E-Health Delivers*, Boston Consulting Group, September 2001. Available http://www.bcg.com

137 Mitchell, J. (1998) Fragmentation to integration: national scoping study of the telemedicine industry in Australia, DISR, Canberra.

138 ANZ Telehealth Committee (2000) 'Telehealth in Australasia: Major Milestones.' Available www.telehealth.org.au

Figure 5.7 Australasian telehealth activities, March 2000





Source: NZ Telehealth Committee (2000) 'Telehealth Activity in Australasia Today.' Available www.telehealth.org.au

- more efficient and effective diagnosis and treatment through rapid access to diagnostic test results and online advice for providers;

- improved communication between health care providers across health care settings;
- improved professional support and decreased professional isolation for rural and remote practitioners;
- potential cost-savings through support for home-based rather than institutional care;
- increased online support, education and training of health care professionals; and
- a valuable vehicle to export Australian health care expertise.

Box 5.6 Case Study: Teleradiology combined with videoconferencing

Teleradiology images are regularly transmitted to the Women's and Children's Hospital (WCH) in Adelaide, South Australia, from country towns as well as from Alice Springs and Darwin. Teleradiology enables a range of sub-specialists within the WCH to provide second opinions on complex cases, sometimes in emergency situations.

Records of teleradiology transmissions were kept for the period from September 1998 to February 1999, showing that the teleradiology activities were, on occasion, very significant in the timely diagnosis of patients. In some instances, as a result of the diagnoses, patients and their families were able to avoid the cost and discomfort of travelling long distances. This was particularly important for Aboriginal patients, including children, from the desert areas of the Northern Territory, who prefer not to leave their tribal lands, for the 2 000km trip to Adelaide.

Sometimes teleradiology diagnoses result in the sub-specialists at the WCH recommending immediate retrieval of the patients. On one occasion in June 1999, an image was transmitted from to the WCH from a country site and an abscess on the spine was identified by the WCH radiologists, leading to immediate evacuation and an operation that prevented certain paralysis.

The WCH has conducted a renal case management session where teleradiology images were reviewed while a live videoconferencing session was held with Alice Springs paediatric and radiology staff. The staff at the WCH had the images available on a PC hard disc, for viewing on a 21-inch computer monitor. The staff at Alice Springs Hospital used the original images, displayed on a light box in the videoconferencing room. For the case conference, the two groups were linked by live videoconferencing, using PictureTel equipment and ISDN. To prepare for the meeting, the images of five children were transmitted from Alice Springs the day before and the morning of the videoconferencing session.

The renal case conference resulted in two patients not being transferred to Adelaide. A cost benefit analysis of this session was completed, demonstrating the positive benefits of using the technology. According to the chair of the session, Dr Lloyd Morris from the WCH, a feature of the session was that it enabled staff from a number of different disciplines to participate. He believed that the technology facilitated in-depth discourse and achieved a greater outcome than if fewer specialists were involved, as the decisions taken depended on having a range of specialists present. It was a true multi-disciplinary team approach, with inputs from everybody attending.

The WCH is now combining teleradiology with its digital recording system. Each teleradiology episode is reported on the digital system, enabling easy access to patients' records later.

Source: Mitchell, J. (1999) *From Tele-Health to E-Health: The Unstoppable rise of E-Health*, DOCITA, Canberra.

They also suggested that the main applications for telehealth services in Australia are: interactive video (for clinical care, health care worker education, training and peer support, and administrative purposes); tele-imaging (eg. for the transmission of radiological and ophthalmological images between locations); and telepathology (eg. for the transmission of medical tests between locations).[139]

The ANZ Telehealth Committee suggested that: clinical activity (42 per cent) is slightly ahead of professional education and training (37 per cent) in Australian tele-health applications. Other activities account for 15 per cent and include administrative, research work, and interpreter services. Mental health remains the most common area of activity, accounting for almost one-third of applications, followed by multi-disciplinary (28 per cent) and radiology (14 per cent). Almost three quarters (73 per cent) of telehealth applications are now classified as 'ongoing activities'. A further 16 per cent are classified as being at the 'trial or pilot stage', and the remainder as being at the 'planning or implementation stage'. Capital and recurrent funding comes from various sources including hospital and health services, State and Territory Health Departments, other State and Territory Departments and organizations, and Commonwealth programs (eg. Networking the Nation). Some education activities are funded from fees charged to participants.[140]

With the rapid development of the internet, the special focus on telemedicine has given way to a more general view of internet-enabled activities being integrated into new and existing health information management, and to the use of the generic term e-health.[141]

5.3.4 Clinical decision support systems

Clinical decision support systems (CDSS) are software systems that integrate information on the characteristics of patients with a computerised knowledge base for the purpose of generating patient specific assessments or recommendations designed to aid in making clinical decisions.[142] CDSSs provide a key component for evidence-based care.

Such systems focus on three main areas: prevention and monitoring, prescribing drugs, and diagnosis and management. The use of CDSSs in prevention and monitoring has been shown to improve compliance with guidelines in many clinical areas. Computerised drug subscribing is particularly useful in such areas as drug selection,

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139 NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, pp93-94.

140 ANZ Telehealth Committee (2000) 'Telehealth Activity in Australasia Today.' Available www.telehealth.org.au

141 Generally defined as the use in the health sector of digital data – transmitted, stored and retrieved electronically – for clinical, educational and administrative purposes, both at the local site and at a distance. See Mitchell, J. (1999) *From Tele-Health to E-Health: The Unstoppable rise of E-Health*, DCITA, Canberra, pv.

142 IOM (2001) *Crossing the Quality Chasm: A New Health System for the 21st Century*, Institute of Medicine, Washington DC, p152. Available http://books.nap.edu/books

dosing calculations and scheduling, screening for interactions and monitoring and documentation of adverse reactions. Computer assisted diagnosis and management aids are at an earlier stage of development due to the complexities involved. They require: an extensive knowledge base covering the full range of diseases and conditions; detailed patient specific clinical information (ie. complete patient and treatment history); and a powerful computational engine that employs some form of probalistic decision analysis.[143]

The NHIMAC suggested that:

> *Rapid advances in new therapies and interventions, increasing emphasis on evidence-based health care, and greater consumer expectations mean that health care professionals can no longer expect to retain the substantial amount of knowledge required to keep abreast of modern medicine. Information and communication technologies have the potential to enable practitioners (and consumers) to gain rapid access to essential and up-to-date information about individual patients, their conditions and management choices, thereby supporting decision-making for both practitioners and patients… Electronic decision-support systems can include:*
>
> - *Direct electronic access to individual patient records, which allows clinicians to determine allergies, current medications and conditions, etc;*
> - *Electronic links to medical information, journals and specific 'chat groups';*
> - *Electronic access to endorsed clinical guidelines and pathways;*
> - *Built-in alerts and prompts to assist in treating, prescribing, and ongoing monitoring. Such electronic prompts can also advise of potential interactions between current and new medications, and so on; and*
> - *Peer support networks and access to second opinions.*[144]

In Australia, The National Health and Medical Research Council (NHMRC) is developing and promulgating clinical guidelines, and endorsing guidelines developed by other organizations. Work on evidence-based medicine is being conducted by the Royal Australasian College of Physicians through its Clinical Support Systems Program (CSSP). The program has developed a model that integrates the methodologies of clinical practice improvement and evidence-based medicine to enable clinicians to embed best practice routinely in clinical care. The college is testing this model in sites across the country. The HIC, in collaboration with its Clinical Advisory Groups, has been able to develop dynamic information reports targeted at Divisions of General

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143 IOM (2001) *Crossing the Quality Chasm: A New Health System for the 21st Century*, Institute of Medicine, Washington DC, p153. Available http://books.nap.edu/books See also the work of the General Practice Computer Group http://www.cpcg.org/

144 NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, pp89-90.

Practice, practices, general practitioners and consumers. The focus of these reports is on improving disease management by facilitating access to aggregated population data beginning in the area diabetes. And the Commonwealth Department of Health and Aged Care has initiated preliminary discussions to link the interests of the NHIMAC, general practice, the National Institute of Clinical Studies, and the Australian Safety and Quality Council in this area.[145]

Box 5.7 Case Study: HCN puts Knowledge Bases Online

Health Communication Network (HCN) continues to build its range of knowledge bases. Recently added were the Antibiotic Guidelines (and the other guidelines books will be added soon); Harrison's Online; St Vincent's Formulary; Altmedex (an alternative medicines database); and an ECG training programme.

HCN now hosts an online library for health professionals that, it claims, does not have a peer anywhere in the world. According to HCN, the requirements of the recent NSW Health Knowledge Base Tender could not have been met by any other group in the world. HCN has been selected as the successful tenderer for that tender which will see NSW Health extend their world-leading Clinical Information Access Project (CIAP) for another three years.

HCN now has over 300 hospitals in Australia using its online library. Most excitement has come from rural areas where clinicians are suddenly able to access world-best practice reference material in the ward or at home using the Internet. Feedback has been enormously positive. This is tele-health at work on a grand scale. It is estimated that in NSW Health alone, 25 000 clinicians (many of them nurses) have used the CIAP/HCN resource online.

HCN continues to work with Australian doctors helping them introduce computers and clinical and practice management software to their practices. Several hundreds have been helped and trained. It is also working with several organizations to send clinical information such as patient records and diagnostic information securely over the Internet.

HCN is a partner in the Integrated Care Program providing modified software and web best practice information (locally modified) for GPs in three Divisions: Central Bayside, Hunter Urban and Hornsby Kuringai, treating three groups of patients in three disease areas. Again, this is about providing best practice information at the point of care, using technology. HCN provides support and training for the GPs involved. This project is taking HCN into the clinical software area, as it sees clinical software interfaces to HCN's library as being a logical way for busy GPs to quickly and easily have access to best practice material during consultation, if it is required.

Source: Mitchell, J. (1999) *From Tele-Health to E-Health: The Unstoppable rise of E-Health*, DOCITA, Canberra.

In addition, the *Integrated Care Program (ICP)* seeks to rollout computer supported evidence-based decision making in general practice in three disease areas: asthma, heart failure and depression. Each area involves the development and implementation of clinical decision support systems (CDSS) incorporating evidence-based, best practice

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[145] NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, p92.

guidelines. These systems aim to attack the two central challenges facing medical practitioners. Namely, to have access to the most current evidence, and keep track of the complex management required for patients with chronic illnesses.[146]

Asthma: The ICP at Central Bayside Division of General Practice (Victoria) aims to improve patient health by bringing to the GP's fingertips the best current information about asthma, using decision support software. It makes evidence based practice available to the GPs in the consultation using CDSSs to improve the quality of care. From November 1999 to June 2000, 20 GPs from Central Bayside division trialed the asthma decision support software with 435 patients. The trial is now moving into its second phase.

Heart failure: The heart failure ICP trial was undertaken by the Hunter Urban Division of General Practice (NSW). The program is based on developing and implementing GP best practice approaches for heart failure with a particular emphasis on using information technology. Its aim is to develop and implement a computerised decision support system which is evidence based and utilises local best practice to aid GPs in making diagnosis and management decisions for patients with heart failure. The project was guided by a Clinical Expert Group, consisting of 5 local cardiologists, 1 physician, 5 GPs and 1 GP with ethics expertise, who have been responsible for the clinical content in the Decision Support System. The project also convened a Community Advisory group to review the project’s patient/community aspects. Thirty GPs were recruited to pilot the decision support software.

Depression: The depression ICP trial was undertaken by the Hornsby-Kuringai Division of General Practice (NSW). A clinical working group consisting of five GPs, a TPA representative, an Area Health psychiatrist, two consumer representatives and Divisional staff has almost completed the revision of the computerised decision support tool for the diagnosis and management of depression that was developed in Phase 1 of the project. ICP Phase 2 will consist of: a revision of the depression module and preparation of software functional specifications; software development and beta testing; the development of GP training program and recruitment strategies and incentives; GP recruitment and initial training; and implementation. There will also be a full evaluation.

The ICP has shown that, while difficult, it is possible to design systems to support GPs and their patients in the management of ongoing conditions. Critical success factors are flexibility and working closely with practitioners in the development of content and system design. CDDSs can be made to work effectively for all concerned.

[146] NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra.

5.4 Patients

Outlining his vision for the future of healthcare, Flower (1999) suggested that:

> *"Health care, at its base, is about a deep, ongoing series of connections, between the patient, the doctor, the doctor's colleagues and peers, the institution, the pharmacy, the vendors, the patient's family and support network, the home health providers, the emergency medical technicians, the public health network, and the whole world of knowledge about health, disease, medicine and prevention. All of those connections will become closer, more intimate, deeper, wider, more easily navigated and searched."*[147]

ICTs are altering the relationship and balance of power between patients and providers, and will result in more empowered consumers and enhanced self, home and community care capabilities.

5.4.1 Community and home-based care

One of the impacts of ICTs on healthcare is likely to be to enable people to move away from hospital episodes to more community and home-based care – a trend that is already being driven by community expectations and changing cost structures within healthcare. It has been observed that:

> *"Integrated health care for the increasing number of people disabled by a chronic health condition requires effective collaboration and communication among many service providers. In the past, this has been conveniently and cheaply provided in institutional settings but changing patient demands, social attitudes and cost structures have meant that the majority of such care is now provided to patients who live in their own homes. Integrated care in the community is a major issue for all providers."*[148]

In Australia, there have been a number of 'coordinated care' trials with electronic records and messaging as elements of the coordination between the agencies involved. Local integrated information and communication systems, such as the Northern Territory's Community Care Information System, have been developed. Home nursing services are also experimenting with various information and mobile communication systems and technologies (eg. the Royal District Nursing Service in Melbourne). But the lack of agreed standards for medical records and of security and access protocols have prevented widespread adoption.[149]

A further implication of healthcare information systems developments is the potential for it to change the nature general practice and the skills required in community nursing.

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147 Flower, J.(1999) 'The End of Health Care as We Know It', *Health Forum Journal*, July/August 1999.

148 NOIE (2000) *E-commerce beyond 2000*, DCITA, Canberra, p123.

149 NOIE (2000) *E-commerce beyond 2000*, DCITA, Canberra, p124.

It may, for example, be that with much improved diagnostic technologies and greater use of decision supports systems, direct 'referrals' to specialists from community based care centres and even by patients themselves may become possible. Thus bypassing the diagnostic role of the GP. Moreover, with greater emphasis on community and home-based care, and greater coordination and support available, the role of the community practitioner might shift towards that of 'case manager'. These trends are likely to see significant shifts in the roles and required expertise of medical practitioners, and the emergence of new kinds of community healthcare workers.[150]

It is also possible that increased community and home-base care will shift the location of treatment enough to reduce the need for the large buildings, facilities and personnel we now associate with healthcare (ie. hospitals). Instead, we might see the development of a range of community health centres, with much more flexibility and the ability to link to remote specialist facilities as required.

5.4.2 Informed consumers

Perhaps the greatest change in the patient-practitioner relationship may be brought about by the use of internet by patients. In a special presentation on healthcare in the information age reported in *Managed Care* US expert commentator, Jack Shaw, said:

> *"Four years ago, it was unusual for a patient to walk in with a recommended course of treatment in hand. But it is not unusual anymore. Forty million people visited health care sites in the first quarter of this year [2000]. By 2005, it is expected that 88 million … will use the internet for health care information. The health care industry is beginning to recognise that we are rapidly running out of ignorant, uninformed patients. This is going to have a profound impact on every aspect of the industry."*[151]

In *Pharma 2005*, PriceWaterhouseCoopers (1999) noted that: "the enfranchisement of consumers wrought by the Internet will have a major impact on formularies and treatment regimes. But e-patients (those who use the Web) will do more than influence what drugs are prescribed; they will also influence the kind of drugs that are developed and the way in which they are developed."[152] An earlier report noted that:

> *"When AIDS patient groups learned that Wellcome was developing AZT, they obtained copies of the protocols, visited the company and made suggestions about how to improve the clinical trials. They also took to the streets in an effort to ensure that the drug was tested and approved as rapidly as possible, even though it did not meet the normal criteria for safety and efficacy. For the victims*

[150] Hancock, T. and Groff, P. (2000) *Information Technology, Health and Healthcare: A view to the Future*, CPRN Discussion Paper No H/02, June 2000, Ottawa, pp20-21.

[151] Shaw, J. (2000) 'Health Care in the Information Age,' *Managed Care* 9(11), November 2000, p13.

[152] PriceWaterhouseCoopers (1999) *Pharma 2005: Silicon Rally, The Race to e-R&D*, PriceWaterhouseCoopers, p11. Available http://www.pwcglobal.com/

of AIDS, the promise of a few extra years outweighed the risk of taking an as yet unproven drug. The FDA ruled in its favour.

Consumer clout has traditionally featured little in an industry dominated by the demands of regulators and doctors. Scientific conventions about proof of concept determine what gets asked and what gets measured, although much of this data is redundant and has nothing to do with how patients feel: few people, for example, could detect a four point decrease in their Hamilton depression rating scale, yet this counts as a clinically significant outcome.

But things are changing. In a 1996 survey of US Internet users carried out by FIND/SVP, 38% of all respondents actively sought health and medical information. Moreover, the traffic is not just one-way. Some AIDS patient groups now conduct self-administered trials and publish the data on the Internet for the use of other patients and the industry itself.

A better educated customer base will have an enormous impact on the whole healthcare industry…If you want to see the model for tomorrow's marketplace, look back to the AIDS patients who went to their doctors knowing more about experimental therapies and alternative care options than the physicians who cared for them. People power will force every healthcare business to learn how to operate in smart markets…

In short, as the public becomes more knowledgeable, it will start to call some of the shots. The 33% rise in US direct-to-consumer advertising, from $900 million to $1.2 billion, over the past year alone reflects the industry's growing awareness of its importance, but this is just one manifestation of the change. Consumers will increasingly influence the decisions companies make about which treatment areas to tackle, the sorts of questions they ask in clinical trials and the criteria on which a drug is judged."[153]

Broshy et al (1998) suggested that two types of information will be particularly important: information about managing health and chronic disease; and information about provider quality and cost.[154]

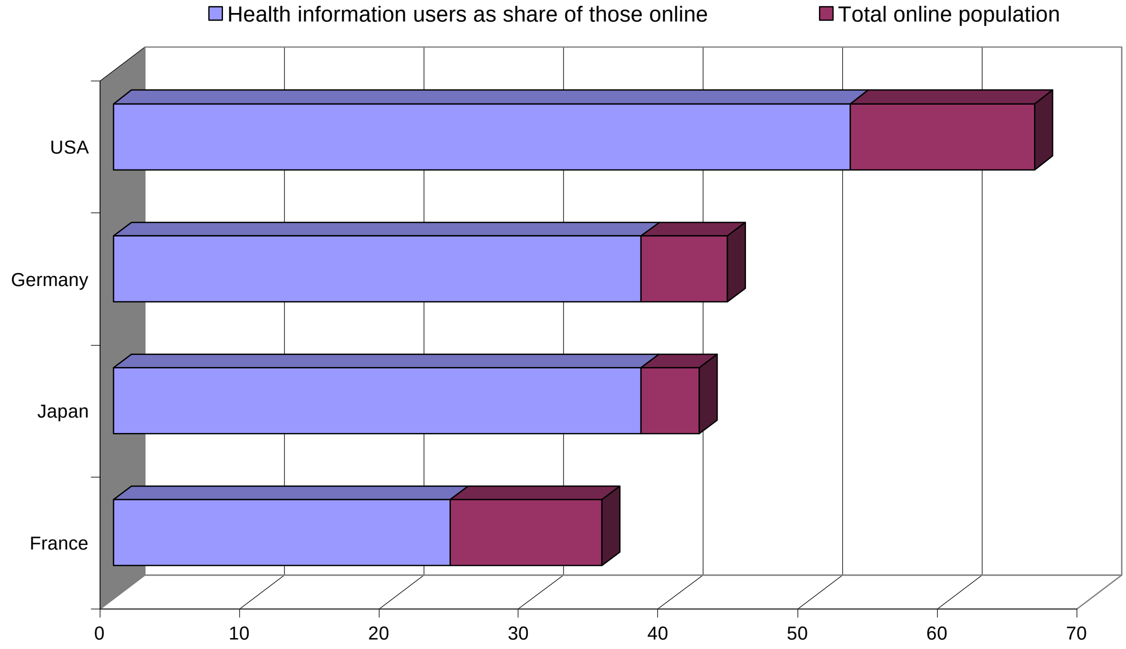
In a survey conducted in January 2002, Harris Interactive found that some 110 million people in the United States had sought health information on internet, compared to 48 million people in Japan, 31 million people in Germany and 14 million people in France. While a relatively low 42 per cent of adults in Japan were online in January 2002, 90 per cent them had looked for health information on internet. Eighty-six per cent of those online in Germany reported that they had looked for health information, 80 per cent of

[153] PriceWaterhouseCoopers (1998) *Pharma 2005: An Industrial Revolution in R&D*, PriceWaterhouseCoopers, pp14-15. Available http://www.pwcglobal.com/

[154] Broshy, E. et al (1998) *Managing for a Wired Health Care Industry*, Boston Consulting Group. Available www.bcg.com/aboutbcg/article_healthcare.html

those online in the United States and 69 per cent of those online in France.[155] That means that more than 50 per cent of the adult population of the United States has sought health information online, as have more than 35 per cent of the adult populations of Germany and Japan. It is reported that: "The types of websites visited vary somewhat from country to country. In the United States, the most visited sites are medical journals (45%), commercial health pages (44%) and academic or research institutions (43%). In France and Germany, they are commercial health pages (52% and 40%), academic or research institutions (50% and 50%). In Japan, patient advocacy or support groups (46%) top the list, followed by hospital sites (36%) and government sites (34%)."[156]

Figure 5.8 Internet health information users (per cent)



Source: Harris Interactive (2002) 'Four-Nation Survey Shows Widespread but Different Levels of Internet Use for Health Purpose,' *Health Care News* 2(11), May 28, 2002.

Lovich et al (2001) suggested that patients accessing the internet for health information can be grouped into four major categories:

- *Accepting* – depend on their doctor and rarely access internet for additional health information (8 per cent of those accessing internet health information);
- *Informed* – supplement what their doctor tells them with their own research (55 per cent of those accessing internet health information);

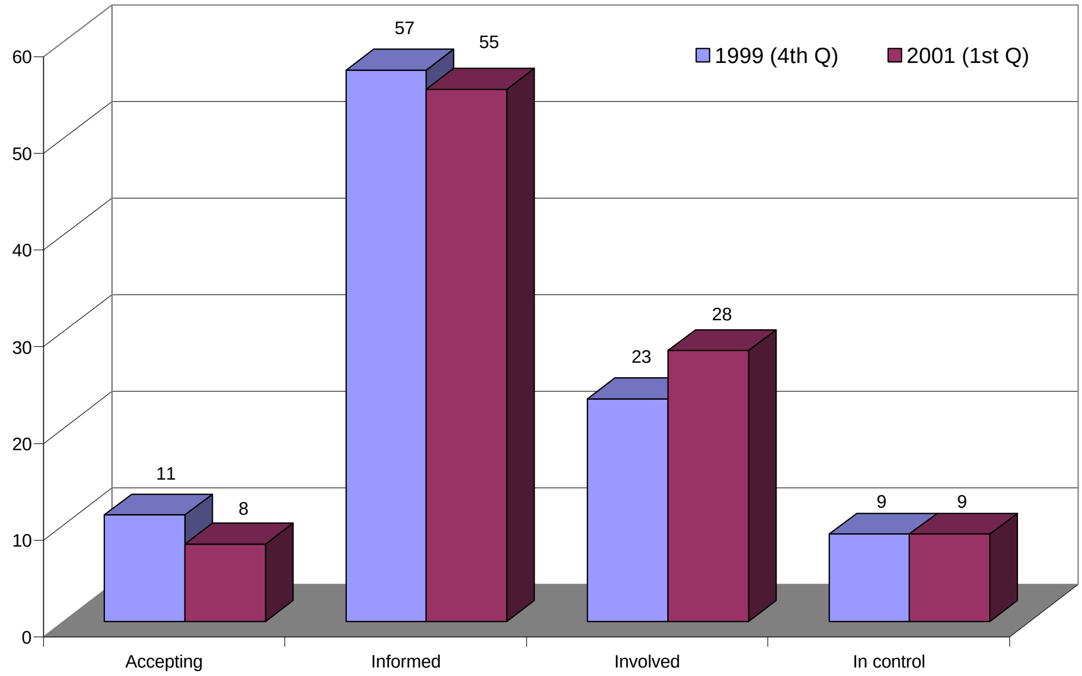
155 Harris Interactive (2002) 'Four-Nation Survey Shows Widespread but Different Levels of Internet Use for Health Purpose,' *Health Care News* 2(11), May 28, 2002.

156 Harris Interactive (2002) 'Four-Nation Survey Shows Widespread but Different Levels of Internet Use for Health Purpose,' *Health Care News* 2(11), May 28, 2002.

- *Involved* – want more interaction with their doctor and use internet to research before and after seeing their doctor, and seek to discuss diagnoses and treatments with their doctor (28 per cent of those accessing internet health information); and
- *In control* – do not completely trust their doctor and will do their own research, often coming to their doctor with a request for a specific treatment and/or drug (9 per cent of those accessing internet health information).

They also found that the patients with the most serious conditions, and women, seek to manage their care most actively – suggesting that as e-health moves beyond relatively simple information tools towards interactive care-management, patients in most need and consuming most healthcare are likely to be most responsive to the adoption of such tools.[157]

Figure 5.9 Patients using internet for health information become more active, 1999-2001



Source: Lovich, D., Silverstein, M.B. and Lesser, R. (2001) *Vital Signs Update: The E-Health Patient Paradox*, Boston Consulting Group, May 2001, p4.

More recent evidence suggests that internet health information does influence how patients interact with their doctors, how they manage their health and healthcare, and how they comply with prescribed treatments – with those that use the internet

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[157] Lovich, D., Silverstein, M.B. and Lesser, R. (2001) *Vital Signs: The Impact of E-Health on Patients and Physicians*, February 2001 Report on the U.S. Market, Boston Consulting Group. Available http://www.bcg.com Available also Updated Report.

frequently 2 or 3 times more likely to take actions that affect their diagnosis and treatment. About 36 per cent of US patients who frequently use internet for health information suggest to their doctors which illness they may be suffering from, and 45 per cent request specific treatment. This suggests that there is considerable scope for healthcare system organizations to influence healthcare behaviour, prescription decisions and compliance with prescribed treatments *through patients.*[158]

Patients who access internet for health information are becoming more active in their healthcare management, with more in the 'involved' category in early 2001, and fewer in the 'accepting' and 'informed' categories, than there had been in late 1999. It also appears that those more informed and involved patients are more likely to be visiting specialist health related websites and portals and disease specific sites. Only 28 per cent of patients in the 'accepting' category visited health related portals and websites, compared to 42 per cent of the 'in control' category. With around the same percentage of each category visiting health care portals, the difference is in visits to disease specific sites.[159]

Table 5.2 Type of health related websites visited, January 2002 (percentage of those visiting websites)

	U.S. %	*France* %	*Germany* %	*Japan* %
Medical journals	45	45	33	27
Commercial health pages	44	52	40	32
Academic or research institutions	43	50	50	33
Pharmaceutical companies	34	18	27	23
Medical societies	34	21	45	35
Patient support or advocacy group for specific diseases	29	30	42	46
News media	29	28	40	33
Government sites	25	29	24	34
Hospitals	16	21	14	36
Individual doctors	11	10	15	25

Source: Harris Interactive (2002) 'Four-Nation Survey Shows Widespread but Different Levels of Internet Use for Health Purpose,' *Health Care News* 2(11), May 28, 2002.

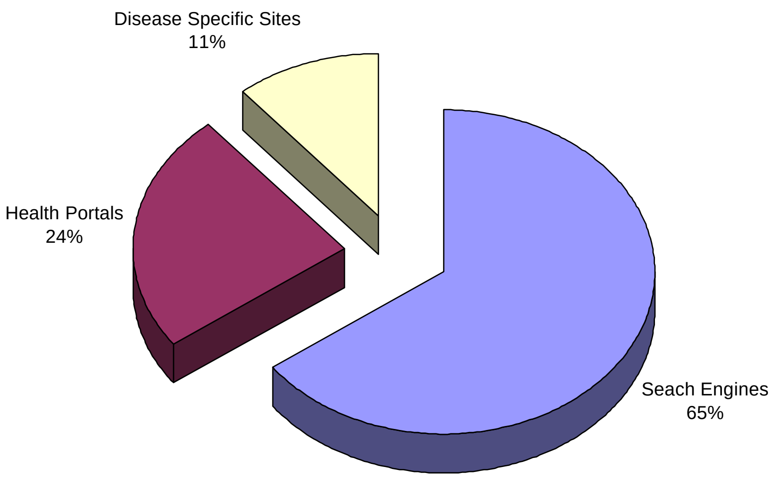
When on internet both patients and doctors want information to be organised in readily accessible ways (eg. by disease) and they want to be able to feel that it is complete, reliable and unbiased. They tend to trust data from university research centres and

158 Lovich, D., Silverstein, M.B. and Lesser, R. (2001) *Vital Signs Update: The E-Health Patient Paradox*, Boston Consulting Group, May 2001. Available http://www.bcg.com. It has been reported that physicians in Europe are less likely to be questioned by their patients than their colleagues in the United States. See Poensgen, A. and Larsson, S. (2001) *Patients, Physicians and the Internet: Myth, Reality and Implications*, Boston Consulting Group, January 2001. Available http://www.bcg.com

159 Lovich, D., Silverstein, M.B. and Lesser, R. (2001) *Vital Signs Update: The E-Health Patient Paradox*, Boston Consulting Group, May 2001. Available http://www.bcg.com

clinics, medical societies and professional associations; but are sceptical about information from pharmaceutical companies, insurers or any other players they see as having a vested interest in partial information and specific outcomes. Because of the trust attached to known brands (eg. particular universities, clinics, etc.) information is often sought from national sources rather than international.[160] Having said that, it is clear that internet users report relatively high levels of visits to commercial health pages and pharmaceutical company websites (Table 5.2).[161]

Figure 5.10 How patients access health information on internet



Source: Lovich, D., Silverstein, M.B. and Lesser, R. (2001) *Vital Signs Update: The E-Health Patient Paradox*, Boston Consulting Group, May 2001.

In Australia, there are a number of initiatives aimed at providing reliable and 'localised' internet health information. The Commonwealth's *HealthInsite* and pilot *AgeInsite* internet projects, as well as South Australia's *HealthySA* and Victoria's *BetterHealth* channel, provide authoritative sources of health information online for the benefit of consumers. The ACT Government has launched the *Health First* consumer access centre, which provides a single point of contact for health-related information for ACT and regional healthcare consumers. The core of the service is nurse-based triage and referral using voice and internet-based technologies. A health advisory service for

160 Poensgen, A. and Larsson, S. (2001) *Patients, Physicians and the Internet: Myth, Reality and Implications*, Boston Consulting Group, January 2001. Available http://www.bcg.com

161 Harris Interactive (2002) 'Four-Nation Survey Shows Widespread but Different Levels of Internet Use for Health Purpose,' *Health Care News* 2(11), May 28, 2002.

public health notices, service provider directory and best practice advice will also be provided.[162]

Box 5.8 Case Study: Heartline

The Heart Foundation, one of Australia's leading charities, has turned to a fully integrated call centre to ensure that people throughout Australia can have easy access to reliable, accurate heart health information. Called 'Heartline', this national health information telephone service is the Heart Foundation's latest, and most responsive, weapon in the fight against cardiovascular disease.

Before Heartline was established in August 1998 people wanting heart health information often contacted their local Heart Foundation office. These calls were then handled, subject to the staffing and resources of the particular office. This could mean a call might be returned several days later when an appropriately trained staff member could address the inquiry.

The Heart Foundation relied on brochures and pamphlets, which are expensive to produce and distribute and don't address people's specific inquiries. The Heart Foundation was also very aware that people living in rural and remote areas have limited access to traditional sources of health information such as GPs and community health centres. The Foundation realised this had to change. Responses had to be immediate and the information given out had to be uniform and up-to-date. A high performance call centre was the answer.

Because most of the calls coming into the Heart Foundation relate to health, nutritional or research matters, quality was a paramount consideration. To ensure this, the Foundation adopted a combination of modern, powerful telecommunication technology with highly qualified health professionals and management techniques associated with a professional, commercial call centre.

Heartline is staffed entirely by Registered Nurses, some with extensive cardiac care experience, and fully qualified Dieticians, to provide instant advice and information to callers. It must be noted that Heartline is not an emergency, diagnostic or counselling service. Heartline provides general advice on issues such as smoking cessation, physical activity, healthy eating patterns and cardiac rehabilitation.

Heartline is built around state-of-the-art computer systems and telephony IT systems to ensure quality. Access to the service is by a national 1300 number charged at the cost of a local call only, the number is then diverted to a number of phone carriers to ensure the Heart Foundation obtains the most economic call cost, regardless of the callers location. Once the call reaches the Adelaide-based call centre an Automatic Call Distribution system (ACD) places the call to an available operator. If all staff are on the phone, the caller is placed in a queue to be answered by the next available operator.

The Heartline manager uses Call Centre management software to constantly monitor demand for the service. This system is used to benchmark Heartline against commercial call centres by assessing caller average wait time, abandonment rates, talk times and handling times per call.

Continued

[162] NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, pp68-69.

Box 5.7 Continued.

Computer technology is also used to support the staff members' extensive knowledge. While talking to a caller, staff members log the type of inquiry being made. The system then provides the nurse or dietician with suggestions on appropriate publications to send the caller, or details of an external organization that is located near the caller and can help or provide further information.

Heartline also embraces Internet technology. While at their workstation, Heartline staff can access information from various approved websites and they also handle all email inquiries generated from the Heart Foundation's own extensive Internet site. It is in this area that the Heart Foundation believes more advances will be made, with a direct 'chatting' style internet interface as the next logical step, should demand for such access continue to rise. The use of technology to enhance the Heartline service also extends to mail fulfilment. Once a day the Adelaide-based centre uses email to send a database file to the Heart Foundation's national warehouse in Canberra. This file is then used to create 'picking slips' for the warehouse staff to construct specific information packages tailored to the callers' specific needs.

While Heartline uses many commercial call centre statistics to manage its service, it places less emphasis on factors such as operator talk time than many commercial operations. Instead Heartline focuses on providing reliable information and minimising the time callers wait for their inquiry to be answered.

Interestingly, Heartline is creating a greater understanding within the Heart Foundation of the needs and demands for heart health information. Before the call centre was opened it was difficult for the Foundation to report accurately on a range of factors, including the demand for health information, what topics were of specific concern to callers and what was the demand for service in regional areas. The Heart Foundation is already starting to use data collected by the Heartline call centre to review its current range of literature and position statements, to ensure information exists on topical issues.

Heartline's results speak for themselves. The centre has handled more than 20 000 inquiries in less than 12 months with 84 per cent of callers being able to speak to a qualified Registered Nurse or Dietician within 30 seconds of dialling the centre's phone number. This number of people could never have been helped under the old system.

With very little promotion the centre has doubled the number of inquiries it has handled in the last six months. On average staff now take more than 160 calls a day and that is set to rise considerably. During the next six months the Heart Foundation plans to start a promotional campaign to ask General Practitioners to refer patients to Heartline if they require further information. Customer reaction to the service has been very positive with many words of encouragement, support and a number of unsolicited donations being received. The Heart Foundation is very pleased with Heartline's initial results and the service is now seen as a key component of the Foundation's service to the people of Australia.

Source: Mitchell, J. (1999) *From Tele-Health to E-Health: The Unstoppable rise of E-Health*, DOCITA, Canberra.

HealthInsite addresses two major deficiencies associated with the increasing tendency of Australian health consumers to source information from the Internet: finding relevant material, and quality assurance. It does so by providing an easy-to-navigate central entry point that links only to quality-assessed health web pages provided by information partners. By April 2001, *HealthInsite* included links to over 4 800 resources on 46 information partners' websites, and was visited by over 1 000 users each day. Other significant national initiatives include the establishment of a 'Your Health' area on the Health Insurance Commission (HIC) website and the development of a targeted rural health website (www.ruralhealth.gov.au).[163]

Nevertheless, there is still widespread concern about the reliability of online health information. A recent Forrester report entitled *Why Doctors Hate the Net* suggested that industry analysts have made all sorts of glowing predictions about the future of the online healthcare sector, but they choose to ignore the fears of the medical profession that internet health sites lean too far towards the commercial and away from the clinical. Doctors are also concerned that new web-based working practices will stretch their already overburdened working hours even further. Forrester suggested that patients also distrust many online health information sources. A survey by *LaurusHealth.com* showed that over two-thirds of patients found the websites recommended by their doctor most credible, while 56 per cent trusted sites affiliated with doctors and hospitals. Commercial sites barely scored in the credibility stakes.[164] A study published in the March 2001 edition of the *Journal of the American Medical Association* found that many health information websites offer incomplete, misleading or difficult to understand information, while others blur the distinction between advertising and medical advice. The study suggested that many sites left out key information, offered out of date information, or offered contradictory information.[165] Clearly, there is still a long way to go, but the importance of consumer empowerment should not be underestimated.

5.4.3 New intermediaries

It is widely believed that the vast volumes of information available will require new intermediaries to help navigate the information and bring people together around sets of information. In the past institutions like the church, the media, community and professional organizations functioned as trusted gatekeepers, but with the information revolution people no longer rely on these intermediaries. Instead, they get information themselves, and/or use new kinds of intermediaries to help them navigate and to provide the context.

In healthcare, as elsewhere, there are likely to be growing numbers of new kinds of intermediaries, such as the authors and compliers of internet gateways and portals, and a range of different organizations vying for a share of the control of these key gatekeeper functions. Who runs health portals, who funds the development of health information

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[163] NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, pp70-71 and appendices.

[164] See NUA (2000) 'Healthy, Wealthy and Wise?' Editorial April 10th 2000. Available www.nua.com/surveys/analysis/weekly_editorial/

[165] NUA (2001) 'Many health sites mislead visitors,' May 23rd 2001. Available www.nua.com/surveys/

databases and decides what to include and what to exclude, who manages the balance between unbiased information and advertising a specific or limited range of products, who judges performance of providers, and who provides the links between stakeholders throughout the healthcare system are questions of fundamental importance to our ability to realise the potential benefits of ICTs and information systems.

The opposite side of the coin is the ability patients gain through the internet to aggregate into virtual communities with common problems. If these communities cohere and mobilise, they may pool resources to hire clinical consultants to help them navigate the health system, or lawyers and lobbyists to help them confront governments and healthcare service providers to demand change and/or recompense for perceived wrongs.[166]

5.4.4 Online pharmacies

While it is widely appreciated that it is the less visible business to business (B2B) e-commerce that is more significant than business to consumer (B2C) e-commerce, e-pharmacies have attracted a good deal of attention. Drugs appear to be well suited to B2C e-commerce. As one reporter put it:

> *"Pills are small, light and pricey. Purchasers do not need to touch them or try them on. Getting them from pharmaceutical company to consumer, via wholesaler, distributor and pharmacy is expensive. Sick people are reluctant to queue in a shop, or to discuss their herpes in public. So hurrah for the Internet, which cuts out middlemen, saves costs and eliminates the trudge down to the local drug store."*[167]

For consumers easy access to drug information and the ability to order prescription drugs online is a boon, but there are serious concerns about global 'advertising' and distribution of drugs via internet that may not be available in some countries, and may not even have been approved for use in some countries. Both industry players and governments are concerned. In May 1998, the World Health Organization passed a resolution calling on governments to tighten controls on the quality of information provided about drugs on internet and to clamp down on cross-border trading in drugs via internet where such trading is illegal. But how? Perhaps more immediately practical are such industry initiatives as that of the Health on the Net Foundation (HoN) whose members agree to a code of practice which includes cutting any links to sites that are judged to be 'disreputable'.[168]

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166 Goldsmith, J. (2000) 'How Will the Internet Change Our Health System?,' *Health Affairs* 19(1).

167 Economist (1999) 'A dose of reality,' *The Economist*, 9th December, 1999. Available www.economist.com

168 Economist (1999) 'Click and drug,' *The Economist*, 6th August, 1998. Available www.economist.com One benefit is that online pharmacies have encouraged a rethink and efforts to harmonise international regulations on drug advertising and sales.

Some have suggested that sales by online pharmacies totalled USD 10 million in 1998, rising to USD 160 million by the end of 1999. During 2000, MerckMedco was processing 110 000 prescriptions per week via internet, filling 4.2 million in the calendar year and making sales worth USD 460 million.[169] Online pharmacy sales are projected to reach USD 800 million by 2002, and to account for around 10 per cent of sales (perhaps USD 15 billion) by 2010.[170] Worldwide online expenditure on health and beauty products is reported to have reached USD 140 billion in 2000.[171] However, others are much less optimistic. The specialist online 'drug stores' have not fared well, even by the standards of the 'tech wreck'. A survey of online consumers in late 2000 found that just 7 per cent had purchased goods from an online pharmacy. More than 60 per cent said they would be more comfortable dealing with a local pharmacist, and 23 per cent said they were reluctant to use online pharmacies because of privacy concerns.[172] In a survey conducted in January 2002, Harris Interactive found that fully 51 per cent of Americans and 69 per cent of Japanese people who had visited online health sites said they would be at least somewhat likely to purchase drugs online without visiting a doctor if they could, compared to 33 per cent in Germany and 32 per cent in France.[173]

Some suggest that the healthcare market is both more competitive and more complex that many of the online pharmacies had expected. Most markets are tightly controlled by governments, insurance companies, health management organizations and others who seek to keep healthcare costs as low as possible.[174] Controls on the market are likely to put a brake on online pharmacies. Like so many other areas of internet-based commerce there is a very useful supporting role to be played, but no overnight revolution should be expected.

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169 Merck (2001) *Merck Annual Report 2000: Leading in Innovation and Access*, Whitehouse Station, New Jersey, p15.

170 Shaw, J. (2000) 'Health Care in the Information Age,' *Managed Care* 9(11), November 2000, p15.

171 Silverstien, M., Stranger, P. and Abdelmessih, N. (2001) *The Next Chapter in Business-to-Consumer E-commerce: Advantage Incumbent*, Boston Consulting Group, March 2001. Available www.bcg.com

172 NUA (2000) 'Pharmacies flop online,' October 24th 2000. Available www.nua.com/surveys/

173 Harris Interactive (2002) 'Four-Nation Survey Shows Widespread but Different Levels of Internet Use for Health Purpose,' *Health Care News* 2(11), May 28, 2002. See press release at http://www.harrisinteractive.com/news/allnewsbydate.asp?NewsID=467

174 Economist (1999) 'A dose of reality,' *The Economist*, 9th December, 1999. Available www.economist.com

6 Implications for the Healthcare System

This chapter briefly explores some of the visions of the future ICT-enabled healthcare system, before turning to an analysis of the implications of what is currently happening (the reality) and what might realistically be expected to happen over the next 5 to 10 years.

6.1 The vision

Broshy et al (1998) anticipated that: the convergence of media, computing and communications will create a wired healthcare market in which information availability and connectivity is vastly increased. In their view this convergence would result in four interrelated changes in healthcare: more activist consumers, better informed care providers, lower cost care delivery, and more efficient healthcare administration.[175]

Flower (1999) anticipated:

- Clinical assistants/expert systems that will enable physicians to provide just-in-time knowledge;
- Clinicians connected to each other, enabling them to better care for their patients;
- Electronic medical records and evidence-based medicine, increasing the "amount of science in the craft of medicine", thus reducing mistakes, and increasing accountability;
- Imaging, which by combining a variety of techniques will allow virtual reality, and three-dimensional viewing of the body and its parts from inside;
- Robotics, with everything from delivery carts and security to surgery being conducted or assisted by robots;
- Enterprise management, through the more effective collection, manipulation, display and use of information about all aspects of the health care system;
- Medical information available to the public through the Web; and
- Tight links between the consumer and the system, allowing for day-to-day, low intensity contact, shown to be both effective in terms of health outcomes and efficient in terms of cost savings in the management of chronic diseases.[176]

In 1998, the UK National Health Service (NHS) commissioned *HealthSmart 2010: A tale of life, death and healthcare in the information age* noted that: "the overall

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[175] Broshy, E. et al (1998) *Managing for a Wired Health Care Industry*, Boston Consulting Group. Available www.bcg.com/aboutbcg/article_healthcare.html. Cited in Hancock, T. and Groff, P. (2000) *Information Technology Health and Health Care: A view to the future*, CPRN Discussion Paper No H/02, June 2000, Ottawa, p14.

[176] See Hancock, T. and Groff, P. (2000) *Information Technology Health and Health Care: A view to the future*, CPRN Discussion Paper No H/02, June 2000, Ottawa, pp14-15.

consensus of our research was optimism, that the IT revolution does offer ways to deliver health care more widely and more efficiently than today… information technology is changing the relationship between health services and the people who use them… the availability of hard facts will shift the balance of power between doctor and patient, changing the practice of medicine in ways that are hard to predict."[177]

Like many others, these analysts foresee considerable change in the practice of medicine and in the balance of power among healthcare system stakeholders; and like almost all futurists looking at the potential impacts of ICTs they foresee a better healthcare system resulting. So much for the vision: what of reality?

6.2 The reality

Healthcare is widely seen as an information intensive business. It is one of the more complex 'product systems' in our economy. Nevertheless, healthcare has been likened to a 'cottage industry', awaiting full industrialisation.[178] Goldsmith (2000) noted that: "…it would be inaccurate to describe most health care organizations as enterprises. What they really are is collections of professions loosely and uncomfortably housed in the same physical structures… As a consequence, systemic innovations are adopted very slowly. Passive resistance to change is compounded by a corrosive suspicion produced by the failure of past IT applications to materially improve productivity or processes of care."[179] Consequently, the barriers are many and their interactions complex. However, they can be seen in simplified form as technological, structural and social in nature.

6.2.1 Technical issues in the automation of clinical information

Automation of clinical information lies at the heart of all the systems that attempt to automate clinical activities and/or integrate administrative and clinical activities within and across the various kinds of stakeholder organizations. The most promising ICT applications depend upon the automation of patient records, but it is here that progress is slowest – largely because of the barriers of standardisation and concerns about security and privacy of patient data, and about the uses to which it might be put by some stakeholder organizations.[180]

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[177] Cross, M. (1998) *HealthSmart 2010: A tale of life, death and healthcare in the information age*, National Health Services, London. Available www.nhs50.nhs.uk. Cited in Hancock, T. and Groff, P. (2000) *Information Technology Health and Health Care: A view to the future*, CPRN Discussion Paper No H/02, June 2000, Ottawa, p14.

[178] NOIE (2000) *E-commerce beyond 2000*, DCITA, Canberra, p129.

[179] Goldsmith, J. (2000) 'How Will the Internet Change Our Health System?,' *Health Affairs* 19(1), p2.

[180] See IOM (2001) *Crossing the Quality Chasm: A New Health System for the 21st Century*, Institute of Medicine, Washington DC, p147. Available http://books.nap.edu/books. Upon which, much of the following discussion draws.

Privacy: There is a difficult balance to be struck between the privacy interests of the patients (the individual) and the advantages of using detailed clinical information in a variety of managed and evidence-based care applications (the collective). The demands for both security and widespread availability of medical records in a variety of institutional settings make the automation of clinical information extremely difficult.

Box 6.1 Australian National Health Information Management Advisory Council (NHIMAC) structure and operations

In July 1998, Australian Health Ministers agreed to establish the National Health Information Management Advisory Council (NHIMAC) as the national peak body for progressing key issues relating to the use of information technology in the health sector. NHIMAC, which brings together consumers, government and representatives from the private health sector and industry. NHIMAC progresses key issues under the Health Online framework through its sub-committees. The sub-committees make recommendations about new policy directions for key work areas. The recommendations are then reported through NHIMAC for consideration and endorsement by Health Ministers. In most cases, implementation of an agreed new policy becomes the responsibility of a body that reports to the Australian Health Ministers' Advisory Council (AHMAC). To date, NHIMAC has operated four sub-committees as follows.

The National Electronic Health Records Taskforce, which was established in November 1999 to advise Health Ministers on the development of a national framework for electronic health record systems. Health Ministers endorsed the Taskforce report, A Health Information Network for Australia, in July 2000.

The Health Supply Chain Reform Taskforce, which was established in June 2000 to advance a national position on supply chain reform issues. The Taskforce has developed the National Action Plan for Introducing E-Commerce in the Hospital Supply Chain.

The Australian New Zealand Telehealth Committee, which was reconstituted under NHIMAC in June 2000 to establish a framework for the development and implementation of national telehealth policies and standards that are aligned with clinical practice and business objectives. The Committee produced the National Telehealth Plan for Australia and New Zealand.

The National Health Information Standards Advisory Committee, which was formed in June 2000, has an ongoing policy role that straddles both the public and private sectors. Through NHIMAC, it provides advice to Health Ministers on health informatics standards that should be adopted. The committee released *Setting the Standards: A National Health Information Standards Plan for Australia* in February 2001.

NHIMAC's strategy has also been to engage the Commonwealth and the States and Territories in shared responsibility for supporting these sub-committees. Thus, the Commonwealth has provided administrative support for the National Electronic Health Records Taskforce and NHISAC, South Australia for telehealth, and Victoria for supply chain reform. Areas of likely future focus for NHIMAC include telecommunications infrastructure and decision support.

Source: NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia,* National Health Information Management Advisory Council, Canberra, pp15-17.

Standardisation: The lack of commonly accepted definitions and nomenclature for the collection and coding of clinical data and of standards for the exchange of health information are also a major obstacle to the widespread adoption of clinical information technologies. Standards are required to make communication possible, and to ensure minimum levels of data quality. Despite enormous effort and activity in the area of developing appropriate standards the present situation is one of a competing patchwork of different standards. The other major barriers to the widespread adoption of health information systems are the financial requirements, the human factors involved and doubts about whether and how to regulate CDSS software.

Financial requirements: There would need to be much greater investment in IT and in user skills than has occurred to date, if the widespread adoption of integrated health information systems is to be a success. There is some concern that this would likely deflect both money and attention away from core healthcare activities – at least in the short term.

Human factors: These include the ability and willingness of health workers to adapt, learn new skills and divert attention away from their direct healthcare activities during the transitional phase, which may involve them in loss of revenue; the ability and willingness of health workers to forge new relationships within the health system; fear of being undermined and/or replaced by the new technology; and the willingness of patients to participate in what to some seems likely to be a somewhat dehumanised healthcare system.

Regulation of CDSS software: There is also some doubt about whether it is necessary to regulate clinical software systems in the same way as medical instruments; and if so, exactly how to do it. Clearly, if diagnoses are made on the basis of CDSSs, then their fitness for use should meet minimum standards in exactly the same way that medical equipment and supplies (eg. diagnostic kits) have to meet certain requirements.

The recent NHIMAC report, *Health Online: A Health Information Action Plan for Australia* (September 2001), provides an excellent summary of Australian initiatives and progress to date in laying the groundwork for health information systems by addressing these issues.[181] Briefly:

- *Standards*: a national agenda is being perused by the NHISAC, and has been outlined in *Setting the Standards: A National Health Information Standards Plan for Australia* (February 2001). The NHISAC is also charged with identifying barriers to the adoption of standards and recommending to government ways to reduce those barriers.
- *Privacy and data protection*: issues are taken up by the *Privacy Amendment (Private Sector) Act 2000* in general terms, and are now being more fully addressed by work on the Draft National Health Privacy Code.
- *Security and authentication*: are being taken up by the National Health Information Standards Advisory Committee (NHISAC) and Standards Australia's security

[181] See NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra. From which the following points are drawn.

subcommittee, who are working to produce a national health sector security framework with guidelines which specify the administrative and technical measures to safeguard electronic health information. Authentication (who can access the information and for what purposes) is to be based on public key infrastructure (PKI), a rigorous registration process for health locations and individuals, and guidelines as to use.

Despite difficulties, these initiatives are beginning to bear fruit.

6.2.2 Structural change and managing the change process

Healthcare is a highly fragmented industry with a greater diversity of interests among those within it than almost any other. The basic aims of cost management and the practice of medicine (*cost versus care*) often appear irreconcilable, pitting professional practitioners and managers against each other. In such circumstances, the change process is crucial.

The recent final report on the PeCC project noted that:

> *"The global reality is that a new system is bound to be resisted by many stakeholders given that it makes individuals more accountable; challenges the power status quo; threatens jobs, vested interests in proprietary systems, and territorial boundaries; and questions the previous system that hid traces of theft and/or waste. Changing cultures from one focused on patient care without other considerations, to one that also encompasses more cost considerations is also a major ask. The broader problem of increased visibility and accountability is also a politically sensitive issue at all levels, especially given a focus on hospital waste and any criticism of hospital performance or government knowledge."*[182]

The factors Moore and McGrath (2000) identified as challenges facing the deployment of e-commerce in the healthcare system are instructive. They included:

- *Early results* – it is important that the stakeholders all see benefits early in the process to ensure that they remain committed, but early benefits are difficult to realise given the integrated systems nature of the task. Moreover, many of the stakeholders may be sceptical because of past experiences with over-hyped IT promises.
- *Leadership and understanding* – at the highest level is important, but in the PeCC case there was some sense that the power to expedite changes rested at senior levels, while knowledge concerning the changes required typically only existed at lower levels in the hierarchy.
- *Cultural differences* – between the public and private sector and between commercial and professional groups presents a major barrier, with each capable of

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182 Moore, E. and McGrath, M. (2000) *health & industry collaboration: the PeCC story*, DCITA, Canberra, p51.

misunderstanding the other and misreading their levels of commitment and/or resistance.

- *Ownership and control of information* – causes widespread concerns about who has the final control over inclusion and exclusion, who has 'editorial' powers, how commercially sensitive data are handle and who has access to them.
- *The nature and organization of work* – including current and potential impacts in areas such as tasks, job design and descriptions, and a whole range of human resources issues; and threats to current jobs in supply chain personnel (eg. fear on the part of supply managers that as the e-commerce supply chain will electronically shrink the previous paper train, supply officers will be ousted as mediators in the process).
- *Ethical concerns* **-** such as those over the uncovering of waste and theft (the true costs of which remain unknown). Some stakeholders in the system would rather have information remain hidden, and others wish to continue being paid for waste.
- *Concerns over costs* – including possible staff redundancy costs; the costs of setting up, re-equipping and re-engineering existing IT and manual systems; the cost of skills upgrading and training; and the time involved during trial and familiarisation periods.
- *Concerns over funding sources* – and getting the balance right between public and private sector contributions and between all stakeholders to ensure that all feel that it has been fair in terms of costs and benefits.[183]

Clearly, the change process will not be easy and change management will be a major challenge.

6.2.3 Social issues (power and control)

Behind many of the barriers are issues of power and control (eg. who is to control prescriptions and admissions; procurement, logistics and payments systems; and information gateways and content) and demands to balance professional and commercial interests. The healthcare system's stakeholders have different core interests. It has, for example, been suggested that:

> *"public hospitals are spurred on by the growing need to really understand the cost of health consumables and avoid waste. Private hospitals, in order to stay in business and function effectively, need to find ways of saving money and re-establishing a profit margin in an environment where revenue is stagnant and costs are increasing. The health funds are also searching for ways to reduce*

[183] See Moore, E. and McGrath, M. (2000) *health & industry collaboration: the PeCC story*, DCITA, Canberra, Section 9.

operating costs and look to e-commerce, using industry standards, as a better way of dealing with claims."[184]

And governments need to find ways to contain costs, or at least understand fully where and why expenditures are being made. The motivations of key stakeholder groups are pivotal.

Under the heading 'Physicians: The Hardest Sell', Goldsmith (2000) wrote:

> *"The greatest barrier to realizing network computing's full potential is the same barrier that has hampered the spread of enterprise computing: persuading physicians to use these technologies. Historically, the physician has been the principal integrator of knowledge in health care. It will take a great deal of persuading to convince skeptical, time-famished clinicians that after all the broken promises of the past two decades, network computing actually can simplify and strengthen their practices…*
>
> *The lack of trust is even more a problem with physicians than with consumers. All too often, information technology has been imposed on physicians "from above," by alien, imperial powers (hospitals, health systems, or health plans). Vendors and information managers frequently encounter physicians' fear that information systems will be used to profile them, gather information about their practices, and discipline them or deprive them of income.* ***It is difficult to imagine a situation less conducive to the enthusiastic uptake of a new technology than one that consumes tremendous time and energy in its adoption, while simultaneously threatening the autonomy or livelihood of the user****."*[185]

As the NHIMAC concluded:

> *"While much has been documented about the problems in exchanging information in the current paper-based environment, it needs to be acknowledged that information technologies are not in themselves solutions but enablers — technical approaches alone will not achieve better information management. The organisational and cultural aspects of how information is currently exchanged, the barriers to exchange and the clinical information needs of both consumers and providers at the point of care must be addressed before such technologies can be effectively used to improve the management of clinical information."*[186]

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[184] Moore, E. and McGrath, M. (2000) *health & industry collaboration: the PeCC story*, DCITA, Canberra, p61.

[185] Goldsmith, J. (2000) 'How Will the Internet Change Our Health System?,' *Health Affairs* 19(1). Emphasis added.

[186] NHIMAC (2001) *Health Online: A Health Information Action Plan for Australia*, National Health Information Management Advisory Council, Canberra, p77.

ICTs are almost always seen as a cost saver, but it is often the business process changes enabled or forced through the application of ICTs and the contribution that ICTs make to improved quality of products and services that are more important. And it is almost always the social and structural aspects of the change process that are overlook in favour of a technological focus. Healthcare is no different.

6.3 Summary and conclusions

The overall 'agenda' of the research program, of which this project is a part, is to explore ways to square the circle on healthcare costs, pharmaceutical industry development, and better healthcare outcomes. Hence a principal aim of this project is to ascertain the extent to which ICTs may contribute to squaring that circle, by enabling the containment or reduction of healthcare costs, enabling the rejuvenation of pharmaceutical industry development, and/or enabling better healthcare outcomes.

The pharmaceutical industry

In the pharmaceuticals industry there is a convergence of leading-edge information and bio-technologies which looks set to transform the drug development pipeline. The demand for new biotechnology and informatics capabilities within established pharmaceutical companies, and the emergence of new players into the industry with specialist skills in biotechnology and informatics, experience in using bioinformatics in genomics and genetics and much sort after proprietary databases presents many new challenges. There are likely to be rapid changes and developments, requiring immediate responses involving significant, even (corporate) life-and-death decisions.[187] It is a high stakes game, but there are significant rewards available to those who can successfully navigate the risks.

These same developments present both threats and opportunities for pharmaceutical industry development, with changes in core skills likely to effect the relative attractiveness of different locations, the viability of some traditional locations and the mobility of investments within the industry. Governments attuned to the opportunities and threats stand to gain from these changes, while others may lose.

The interface between the pharmaceutical industry and the healthcare industry is also being changed by ICT applications, with many opportunities for cost savings and efficiency gains. The potential of e-commerce and internet-based technologies to enhance drug marketing and distribution has only just begun to be tapped, and the scope for further innovation is enormous. The potential for gathering information from drug trials and from post-launch usage opens up the possibility of closing the loop on

[187] The case of Celera Genomics' move from informatics into pharmaceuticals in the face of its inability to commercialise its database is indicative of the high stakes and turmoil involved. See Langreth, R. (2001) 'After the genome, Celera hunts the profit code,' (Forbes) in *Business Review Weekly*, July 20th 2001, p40.

evidence-based care, right through from drug design and development to consumption, and thereby further improving the efficiency of the drug development pipeline.

The potential for pharmaceuticals manufacturers and suppliers to integrate more fully into clinical systems, opens up enormous possibilities (and risks) in terms of influencing drug selection and usage at the critical point of care. Use of online health information by patients increasingly pro-active in the diagnosis, treatment and management of their conditions provides an entirely new window of opportunity to 'market' health, healthcare products and healthcare services directly to the consumers in such ways as to influence purchasing, prescribing and referral practices. The critical barrier facing pharmaceutical companies in navigating these possibilities and realising potential opportunities appears to be that of maintaining credibility while gaining advantage. Much cautious and well thought through partnering is likely to be required.

The healthcare industry

In the healthcare industry there are some areas where leading-edge ICT developments are employed and developments at the leading-edge will be important. In other areas the health system is some way behind other sectors in the adoption and application of information management and information technology systems. In general, the situation seems to be one of relatively slow progress through the evolving computing paradigms of functional computing, enterprise computing and network computing. Some functions are highly automated, but integrated enterprise computing in hospitals is still rather rare. As a result, linking and integrating the healthcare system (network computing) remains a major challenge. In Australia, many of the healthcare system's organizations are simply not ready for the next step, or capable of making it.

The application of ICT enabled information management systems to healthcare is extremely difficult. The healthcare sector's fragmented constituencies and complex transactions present a major challenge. It is too early to right-off the potential impact of ICTs as mere hype, but it is clear that progress is slow and there are many barriers to overcome. Consequently, at the system level, the impacts of ICTs are likely to be in overall management and cost control, and in influencing decisions at the point of care. In terms of care, the impacts are likely to be in such areas as quality control, patient safety and general improvements in outcomes and performance.

Given the difficulties of realising the savings, where difficulties translate into time and money, they may prove to be more marginal than many expect. When Goldsmith (2000) explored how the internet would change the US health system he concluded that:

> *"The Internet has a greater potential to fundamentally transform both the structure and the core processes of medicine than any new technology we have seen in the past fifty years. Professional resistance to adoption of the technology and political problems associated with protecting the confidentiality of patient records pose the two biggest hurdles to fully realizing this potential. I see the Internet generating some demand for new products and services. However, that demand is likely to be counterbalanced by a more careful weighing of potential*

> *benefits, reduction in medical errors, and the elevation of less expensive substitute therapies to parity with traditional invasive medicine, as well as savings from improved disease management… As a consequence,* the… impact on health care costs may be surprisingly benign*. The most important effect of the Internet will be to strengthen the consumer's role in relation to practitioners and health care institutions, and to create a powerful new tool to help people manage their own health risks more effectively."*[188]

Healthcare is a AUD 55 billion industry, so saving 1 per cent is still worth AUD 550 million. But in many cases the natural human response to being offered the opportunity to undergo significant pain to gain a 1 per cent saving is 'why bother'.

The impacts at the point-of-care are likely to be more significant in the near to medium term. Clinical tools hold more promise that do others, both in terms of direct efficiency and cost savings and in terms of influencing doctors' behaviour. It is this latter that is likely to see major players in the healthcare system driving the adoption of e-health, and especially of clinical tools, because they impacts so directly on prescription practices, and thereby upon the choice of drugs and management of drug expenditures, and on referrals to pathology, diagnostic, specialist and hospital services. Martin (2000) wrote:

> *Money is tied to doctors signatures. They authorise the treatment and everything else that happens to citizens who are ill. A government which can control doctors signatures can control costs. A corporation which controls doctors can make a profit. Other professionals who can wrest control of treatment from doctors can increase control over their own activities.*[189]

How information technology and information management influence the behaviour of both doctors and patients at the point of care is critical.

Longer term, the major challenge for both pharmaceuticals and healthcare may be surviving the transformation to an individualised care paradigm, and adopting strategies to cope with the transformation and thrive in the emerging environment. ICTs, in the form of both information systems and information management, will play an important role in enabling stakeholders throughout the healthcare system to adjust and prosper. Understanding the potential of ICTs to transform cost and control structures is essential for those seeking to benefit from the changes through containing healthcare costs, enabling enhanced health outcomes and encouraging renewed pharmaceutical industry investment and development.

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[188] Goldsmith, J. (2000) 'How Will the Internet Change Our Health System?,' *Health Affairs* 19(1). Emphasis added.

[189] Martin, B. (2000) *The Corporatisation of Health Care in Australia*, p1. Available www.uow.edu.au/arts/sts/bmartin/dissent/documents/health/corp_austral.html Accessed 12th February 2002.

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