

The future of hospitals

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Abstract

In 2100, hospitals will focus on care of the sick, but the nature of health, sickness, treatment and care will be very different. Current hospital-based diagnostic services will be automated and deliverable in the home, resulting in a major shift of the burden of caring. This shift will eliminate today's community hospital. Work of low to medium complexity will be undertaken, usually by machines, in the home. Ambulatory centres, highly automated, highly accessible, will be customer friendly one-stop health shops of tomorrow. Machines will substantially replace human labour. Hospitals will remain cherished icons and centres of health knowledge, but will be a lesser component of the health care system than they are today, there will be less of them, and they will lose their dominance as the focus of health care training, policy and activity. The four major factors driving these changes are science & technology, demography, the economy and the environment. The "chaos factor" will be society's response to moral questions such as the diffusion of genetic technology. By 2100 we will be spending twice as much on health care as we are today and there will be less doctors relative to other health care workers, continuations of well-established twentieth century trends.

Introduction

The dictionary defines a hospital as an institution providing medical and surgical treatment for persons ill or injured (Sykes 1984). Words like health, illness, sickness and treatment are largely subjective. Today's meaning may not correspond to that of one hundred years past or one hundred years hence. Phrases such as "treatment of illness" and "care of the sick" carry differences in meaning; the former implies technology and depersonalisation, the latter community and humanity. And yet both are legitimate descriptions of the role of a hospital.

The core, enduring role of the hospital is to receive persons of unsound body or mind and to take actions with a view to making them sound again. By implication, once they are in sound health they no longer need the hospital.

Health is the product of biology, environment and behaviour. Our health care system is a response to individual, community and population health imperatives, framed in an economic context. The health system is a social construct in which people have roles as providers and consumers of health services, as financial contributors to health systems, as workers within them, and as citizens responsible for planning and managing them. Hospitals are one part of a system characterised by constant change. Much of this change is predictable, a logical extension of past behaviours and developments. But some change is random, radical and revolutionary, and this is especially noticeable over the long run.

In the big picture of human history, organised health care is a relatively recent thing. The relationship between health and society over the last 100 years can only be described as a happy marriage. Good health, and more particularly fair access to the means of achieving it, has come to be regarded as a fundamental human right (World Health Organisation 2001). Developed society's commitment to the health of its citizens is most tangibly expressed by the growth in economic effort devoted to it over the last century, from around 2% of GDP in 1900 to 8-10% in 2000 (Mullen 2002). The principle of health as a right has virtually universal acceptance across nations.

At the beginning of the last century there was considerable individual and social ambivalence towards health and health care. The three competing doctrines of "let nature take its course" (homoeopathy), "in God we trust" (spiritualism) and the "healing hands of the physician" (medicine) were quite evenly matched in the minds of

many. None of them offered much if you were seriously ill. Over the course of the twentieth century the alliance of science and medicine has achieved stunning advances, in the process convincing society that ever greater and more exciting frontiers are within our immediate grasp. With increasing life expectancy and leisure time, developed societies have been eager to overcome the inconvenience, discomfort and disability that unsound health can occasion. Health and by extension, the health care system has become a high social priority. Health is important, and modern health care is delivering better health.

Early in the twentieth century, hospitals were a modest part of a health care system based on the private endeavours of practitioners operating within the community. Most sick people were cared for at home by the extended family, with occasional visits for those who could afford them by a medical or other health practitioner. Hospitals were mostly charitable institutions providing nursing care for the destitute. Doctors tended the hospitalised sick in an honorary, unpaid capacity. The ailing well to do were cared for at home. Controversial issues at this time included the hospital's role in caring for "convalescents", "incurables" and those with infectious diseases. Such persons were generally seen as undesirable, deflecting the hospital from its proper work of ministering care to acutely ill, curable, deserving poor. Various means and other tests were applied to determine who fell into the category of deserving poor. Fee-paying wards for private patients were beginning to emerge. Hospitals were frowned upon by the organised medical profession as competition and a threat to the independent, community-based practitioner (Mitchell 1977).

The twentieth century has delivered spectacular advances in the science and practice of health care. Described as an enterprise built on surgery (The Advisory Board 2002), hospitals rose in prominence initially due to surgical advances and later through modalities such as pharmaceuticals, radiotherapy and procedural medicine (Porter 1996). They reached their apogee in Australia in the 1970's, consuming almost 40% of the health care budget. Over recent decades the emergence of ambulatory care has shifted medical and surgical work away from hospital inpatient settings (Institute for the Future 1999). Notwithstanding this latter day slowdown, the hospital enters the new millennium as the centrepiece of the modern health care system and the temple of medical science and technology.

Hospitals have a special place in our society. Not only are they the most visible icon of the modern health care system, the place to which we turn when we are "really sick", but they are also an important element in local, regional and national economies. Hospitals are a mix of service and knowledge-based industry, and both have enjoyed strong growth in the Australian economy over the last two decades. During the twentieth century there has been a dramatic decline in agriculture and manufacturing industries as employers, and the impact of this decline is felt hardest in rural communities (Rifken 2000). Hospitals have acted as a buffer in these communities, providing alternative employment options to traditional agriculture and manufacturing jobs. The new century sees hospitals more strongly positioned in society than was the case a century earlier; they are cherished as symbols of excellence in health care and highly valued as employers.

Can hospitals have an even more successful twenty-first century, or will further momentous advances force change to meet new expectations? One thing is certain: hospitals of 2100 will bear no more resemblance to our current institutions than do today's hospitals to their forbears in 1900. For hospitals and those that use them and work in them, the change experienced over the twentieth century has been massive and all pervading. Though the basic intent of hospitals has endured, the skills, science and knowledge which underpins hospital work has changed utterly, as has community expectation of what can and should be delivered.

One hundred years of evolution has confirmed five core enduring roles of hospitals:

- Institutions within the health care system for receiving, assessing and caring for the sick, with a focus on physical illness;
- Major employers within our communities;
- Important centres of health care teaching and knowledge advancement;
- Consumers of significant resources
- Cherished icons of the local community, with considerable political and policy importance.

Peering into the future

Can we rely on the past to predict the future? For the short run it seems safe enough, but becomes less reliable the further our prediction extends. Long and short run timeframes are borrowed from economics. Economists see the difference between the two as relating to “fixed factors” of production. In the short run buildings and expensive items of equipment are regarded as fixed, because they require large but infrequent capital investment (Collins, Archbold et al 1985)). For hospitals, short-run changes can be made to the nature, production and delivery of health services without major capital investment; long-run goes beyond the expected lifespan of hospital buildings and major equipment items.

In order to truly speculate on the hospital of the future, minimising the influence of the century just gone, we need to go beyond the lifespan of current buildings and equipment, which significantly determine what hospitals currently do. To this end we will consider the hospital as it might look at the end of this century. Such long-run future prediction forces identification of the big factors impelling change in our society, and consideration of the impact these factors have on individual and population health status and the health care system. Four big drivers of long-term change will be reviewed here: science and technology, demography, the economy and the environment. The impact of these drivers on the five core hospital characteristics will be examined as the basis for predicting the future of hospitals.

Science and technology: The trends and methods

Scientific breakthroughs, delivering technological advances that have reshaped our health care system during the twentieth century, were barely on the horizon in 1900. It is safe to assume key discoveries that will influence the current century haven't yet been made. We can, however, glean some broad principles and trends.

The most powerful intellectual instruments of the modern scientific era have been reductionism and analytical mathematical modelling (Wilson, 1999). Reductionism, first expounded by Descartes in the mid-seventeenth century, is the study of the world as an assemblage of discrete physical parts that can be analysed separately. Reductionist thinking has contributed to increasing compartmentalisation and specialisation in western scientific thought generally, and in health and medical science and practice in particular. It is difficult to envisage significant reunification of scientific effort over the coming century.

Scientific endeavour has generally, but not always, led to the betterment of humanity. In economic terms, scientific discovery has led to technological advancement, enhancing productivity and prosperity. Within health research this trend of health betterment through scientific endeavour generally holds true, though again there are exceptions. Scientific discoveries have often been converted to technological advances, then made available to the population through commercialisation. Scientific ideas are turned into health care products by those who own the ideas, and these products are sold to consumers. This process is founded on a market model of social interaction and technology diffusion, and it has proven remarkably effective at harvesting good ideas and enabling the general population to benefit from them. Consumers or their intermediaries pay the cost of development of the idea and manufacture of the product. They are willing to pay because they are convinced of the health benefit they will derive. Consumer willingness to consume is an essential component of this diffusion model. Consumption of health care products has risen steadily over the last century and shows no sign of abating. In most developed countries high levels of health care consumption are effectively underwritten by taxation-funded social insurance. Such underwriting is very attractive to the commercial sector that is eager to identify and develop new scientific ideas with health application, stimulating scientific endeavour to this end. As we enter the new millennium biotechnology is seen as an exciting and vibrant sector for investment.

Technological innovation leads to consumer benefit via a more effective product, and producer benefit via improved efficiency of production or better market share leading to increased profits. For workers, however, increased productivity can lead to “technological unemployment” (Toffler, 1990). Greater productivity can mean fewer workers needed to produce enough products to meet demand. This saga has been played out at least twice during the last century, first in agriculture (where steam engine replaced horse, then combustion engine and electricity replaced steam), then in manufacturing. With the dawn of the so-called information age, a similar trend is emerging in some service industries. Technological advancement tends to spur growth in knowledge

industries, made up of people who support and enhance the technology. Knowledge industries are notoriously capital intensive, and labour growth is modest relative to the declines in formerly labour-intensive industries like agriculture and manufacturing. Health care has yet to experience any great labour force impact as a result of technology change. Hospitals are beginning to see productivity improvements in some non-clinical areas, for example management of supplies, corporate services such as finance, payroll and engineering, and medical records handling, but the impact has been largely countered by growing demand for patient services.

Science and technology: The ideas

Current research areas likely to have a profound impact on hospitals over the coming century include genetics, robotics, nanomedicine and informatics. Each promises much but as yet has delivered relatively little, and each has a dark side.

The emergence of genetics has been phenomenally rapid. It is only 45 years since Watson and Crick defined the double helix structure of DNA. Prior to this discovery geneticists were largely confined to application of the work of Mendel. The entire human genome has now been decoded, and genes can be manipulated (The Economist, 21 June 2001). Animals have been cloned. DNA strands have been synthesised and soon proteins will be. Optimists believe we are on the threshold of a new era, where genetic imperfections can be rectified and spontaneous mutations identified and corrected. This has the potential to greatly reduce the burden of disease and disability for humanity (Zey 2000). The dark side of genetics is eugenics. Eugenics mixes and sometimes confuses the goals of treatment of illness and easing of the burden of disease with enhancing capabilities of the individual for essentially selfish motives. Applications which raise concerns in this context include selective screening of fertilised eggs to identify birth “defects” and germ-line re-engineering to ensure desirable characteristics are passed on to the next generation (Fukuyama 2002).

Despite the current debate about future directions of genetic research, rapid advances are likely during the first half of this century. New ideas will spawn new technologies and new products. Genetics will change health care by providing individuals with practical options to decrease their own genetic risk factors and those of their offspring. It will change hospitals by moving them away from invasive procedures towards earlier intervention with preventative or curative genetic manipulation and with “smart drugs”. This change will necessitate substantial re-fitting of hospitals with the relevant diagnostic and treatment equipment, not yet invented. The nature of this work will in the long term be highly automated, ambulatory, not particularly expensive and very accessible for the consumer. The end-point will be a biennial gene check and tune-up, carried out by a machine (Zey 2000).

Research and development of robots has been around for most of the twentieth century, but practical applications have only emerged over the last few decades. Robotics is about precision engineering, microcircuitry, new building fabrics and powerful computers using mathematical modelling to direct behaviour. The technological applications are surprisingly widespread, particularly in manufacturing. It is estimated that there are now around 750,000 robots worldwide, and Japan is the world leader in this technology (The Economist 29 November 2001). Robot use in hospitals is relatively uncommon, but they are coming. Some centres in the United States and Europe are using robots for surgical procedures. Purported advantages include availability, precision and greater technical dexterity, thereby enabling minimal invasiveness. They are also being used in areas that are labour-intensive, repetitive and prone to human error, for example, the storage, retrieval and dispensing of pharmaceuticals. An attraction of robotics is automation and reduction of variability due to the vagaries of human labour. The work of the future in robotics is the development of machines with minds of their own, able to analyse situations and adjust behaviour accordingly. This has been coined “Artificial Intelligence”. In 1997 the IBM supercomputer “Deep Blue” defeated Chess Grand Master Garry Kasparov. It did so because of huge number crunching capacity that allowed it to consider millions of possible game options and quickly narrow down to those few with the highest probability of successful outcome (The Economist 22 March 2000). Will Deep Blue be the 1997 equivalent of Thomas Moore’s hospital radiology department one hundred years earlier in London’s Millar Hospital, the first of its kind; Radiology is now a ubiquitous and multi-faceted diagnostic tool present in almost all hospitals (The Advisory Board, 2002).

Most processes, products and services in our centennial hospital will be provided by robots and machines, meaning a dramatic reduction in the involvement of humans. In addition, robots will be playing a very prominent role in other aspects of health care, in particular pharmaceutical prescribing and dispensing and home-based nursing care and general support for those with chronic physical, mental and spiritual ill-health. Robots will be companions, literally tailored to meet our needs and preferences.

Another machine application is use of prostheses to either enhance or replace malfunctioning body parts. Prostheses are already common, especially useful for overcoming the wear and tear conditions of old age such as worn out joints or cloudy eye lenses. But we can go further. We already have implanted defibrillators, pacemakers and ventricular assist devices for failing hearts. Other organs such as kidney, liver and lungs will become available in a mechanical, implantable form over the course of this century. Increased use of implantable machines to supplement performance or overcome the failures and frailties of the human body is inevitable. Hospitals will experience growth in prosthetic work and associated maintenance, repair and replacement. For individuals with single or multiple organ failure this will improve quality of life, but it will inevitably raise questions regarding access, value for money and end of life decisions.

Nanomedicine is medicine at the nanometre scale (billionths of a metre). Thus far science's greatest miniaturisation achievement is the microchip. Similar approaches have medical application. One example is pancreatic "Islet Cells" implants for patients with certain types of diabetes. Islet cells produce insulin in response to glucose. A researcher in the US has been able to successfully implant mouse islet cells in diabetic rats, so that the rats have a sustained period of survival without insulin. Normally the rat immune system would disable and kill mouse islet cells in a matter of minutes. This doesn't happen because a protective sheath with holes of a few nanometres diameter punched in it surrounds the mouse cell. The holes allow glucose into and insulin out of the islet cell, but they are too small for the larger rat antibody molecules to penetrate (The Economist 20 December 2001). Research applications for nanomedicine include labelling and tracking proteins to understand complex interactions and also precision-guided drug treatment of tumours. If this technology evolves into useful products, it is likely to be disseminated through hospitals, at least initially. Again this suggests significant re-fitting with yet to be invented equipment to allow the necessary micro-monitoring (The Economist, 7 December 2000, Zey 2000).

Computers were invented in the United States in the late 1940's. They were essentially monstrous calculators. It was only in the 1970's that computers became accessible to the common man because the microchip made them affordable and of manageable size. The other great break through in informatics came in the early 1980s with the development of the World Wide Web. Health has been a late adopter in the information age, but computerisation is now ubiquitous in our industry. Much has been written about the potential for medical informatics and eBusiness to greatly improve health care generally and hospital performance in particular (Maheu, Whitten & Allen, 2001). Inevitable ongoing research and technical development will bring better, quicker, more reliable and cheaper hardware and software applications. Implementation will change the way hospitals organise their work and interact with community-based health care providers and the customers in their home. The challenge is ensuring security of information and legal protection for all involved regarding collection, storage, transmission and use of personal health information (National Electronic Health Records Taskforce 2000). Society will resolve these matters and they are unlikely to impede the rollout of new informatics technology. Health information will be available when it is needed, where it is needed, with permission of and benefit for the consumer.

As we get better at identifying and dealing with causes and effects of physical unsound health, science will devote more attention to mental and spiritual aspects of our wellbeing. Unsound mental health features prominently as a cause of burden of illness in our community (AIHW, 2000), but it has been a poor cousin to physical illness in terms of research and development effort. The interplay between physical, mental and spiritual to deliver "holistic health", though recognised as important, remains poorly understood. Both mental and spiritual health will receive much greater scientific attention over the coming century (The Economist, 25 May 2002). The role of the hospital will broaden to encompass these areas, with hospitals at the forefront of high-end technology that emerges. On the other hand, the hospital's role in ministering treatment in these areas, along with physical health care, is likely to be small relative to the community-based and home-based health care sector.

Demography

Demographic changes influencing the role of hospitals over the course of this century are already well under way. Life expectancy will continue to rise. Through illness and accident prevention less people will die young, illness which kills people prematurely will be more effectively managed, and lifespan will be extended through anti-aging research (The Economist, 23 December 2000). A consequence will be increased burden of illness in the community as old people with chronic conditions live longer with a reasonable quality of life rather than dying as a result of these conditions. What growth there is in health care, relative to the rest of the economy, will be directed to agents and agencies caring for those with unsound health in the community.

Fertility will continue to decline (The Economist, 23 December 2000). Current low and falling birth rates characteristic of affluent western societies will persist unless some cataclysmic event disturbs social and economic prosperity and tranquillity. As second and third world countries become more affluent we can expect decline in their fertility rates also (United Nations Population Fund 2001).

Hospitals of the future will increasingly focus on the elderly and the ancient (those over ninety years of age). The health care system will devote a greater share of available resources towards this section of the population. It may be that society is “jolted” out of this demographic pattern by some great and unforeseen event. Inter-generational tensions may emerge. Meeting the needs and wants of elderly and ancients may prove too onerous for prevailing levels of economic activity. Much of our experience over recent decades has been based on continuous economic growth with occasional, painful blips of recession. If there was a period of prolonged economic downturn which market manipulation was unable to redress, would society be prepared to curtail the rights of some of its citizens to meet the new economic circumstances? Some unforeseeable catastrophe may cause tomorrow’s society to revisit allocation of health care resources across the various population segments and reconsider the relative rights of the ancients, the elderly, the workers, the juveniles and the unborn. During the previous century the juveniles were usually beneficiaries in such debates, followed by the workers, then the elderly. Ancients are a new phenomenon, and the unborn did not fare well in the twentieth century, as demonstrated by declining fertility rates and the contribution of contraception and termination of pregnancy. Even if there were a dramatic change in population management policy, however, it would take the best part of a century to have any real impact. Accordingly, the hospitals of 2100 will be dealing with the legacy we are providing them today.

The economy

Implicit in our discussion is the affordability of hospitals and health care. While this is likely to be true at a society level, at least for developed countries, it is unlikely that every individual will be able to afford all the health care they might desire. Over the course of the twentieth century total economic output of developed countries grew massively, and health increased its slice of a growing pie by three to four times. Will this pattern be repeated in the twenty-first century? Many commentators argue that further growth in health care expenditure is unaffordable, and yet today we have the world’s largest economy, the United States, approaching health care expenditure of 15% as a proportion of gross domestic product, fully one third higher than comparable developed countries.

The market model has succeeded in translating the ideas of science, through technology, into products, services and commodities. Society and individuals have embraced the notion and practice of consumption based on wants rather than needs, and we’ve moved beyond a savings mentality to a buy-on-credit mentality (Rifken 2001). However, this dominant capitalist social paradigm doesn’t seem to work so well for hospitals due to concerns around market failure (Eastaugh 1992). So will it remain the dominant paradigm? It certainly wasn’t at the beginning of the twentieth century. Western societies were more frugal, focussed on having enough to meet need and the “Protestant work ethic” (Rifken 2000). If the science, technology, production, consumption cycle persists, ability to pay for service at the consumer/provider level may again become a barrier to service access.

Recent aggregations in pharmaceutical and other industries may be a sign of the future. Such global aggregations may be replicated among science/technology component suppliers for hospitals. This might increase the

attraction of regulation, collective planning and purchasing, effectively an aggregation of consumers. Such aggregations could be the beginnings of a move towards health care becoming part of the basic social infrastructure of our society, a public good, much as defence is today (Stillwell 2002). This move away from a user-pays, fee-for-service market transaction method of distributing hospital products to a community and population focus, where services are delivered on the basis of need, would be underwritten via social contribution through taxation, philanthropy, or in-kind labour. Such a change might decrease the need to foster ever more consumption, through marketing, to sustain profitable research, development and production.

A key element of economic importance is the workforce. The health care industry is now a major global employer. Big issues to be tackled over this century will continue to be cost containment, number and distribution of workers, shortages of particular workers in particular places at particular times, and the impact of technology on the workforce. One obvious economic impact will be that the cost per worker to the employer will climb with the need to train and retrain to ensure competence with emerging technologies. Gaining a return on this investment will be paramount, enforcing a new focus on employee satisfaction and retention. In the medium to long term, however, human labour will become too expensive relative to machines. The capability of machines will improve, the cost will come down and productivity will be higher than the equivalent human worker will.

The environment

The United Nations Population Fund (2001) identifies the major environmental challenges we face this century as atmospheric pollution, water availability and cleanliness, energy availability, food availability and global warming with resultant climate change. Poverty and the growing gap between the developed countries and the third world exacerbate the impact of these factors. At the heart of the environmental challenge is the massive disparity in consumption of non-renewable resources between wealthy and poor countries. A child born today in an industrialised country will add more to consumption and pollution over a lifetime than 30 to 50 children born in developing countries.

Perhaps environmental conditions will become so bad that humanity accelerates its planned interstellar travel program to find new worlds for colonisation and exploitation! Back on Earth, poor environment will continue to cause significant mortality, and our problems will be bigger problems in 2100 than they are today. On the other hand, aquaculture will advance, as will ability to desalinate and encourage precipitation. There may even be a multi-national agreement on environmental management by 2100! But how will people feel about living longer in a society that is largely based on work and consumption, with all its residual inequalities and injustices? If over-production and over-consumption have become more immediate environmental threats to developed countries then it is more likely to elicit a social response. It is difficult to predict what impact this may have on health and hospitals. Social unrest and division may emerge, spawning violence. This would slow down scientific and technological advances in health care, deflecting economic resources to other priorities, as well as providing victims for treatment in hospitals.

Big moral challenges

Moral and ethical challenges may be the “chaos factor” in the smooth and orderly advance of science and technology. What if, as a society, we decide to reject particular lines of scientific inquiry and technological development on the basis that they are immoral? Consider the question of death. Society may reject technologies that artificially slow down or arrest aging. Alternatively, when such scientific discoveries are made and technologies developed, society may choose to ration available economic resource by mandating a lifespan of, say, 120 years. Citizens reaching this age have had their allotted time, and lose entitlement to health care and hospitalisation, becoming candidates for voluntary euthanasia. The requirement to die would be related to the social need for sufficient resources to support the living. If the twenty-first century brings effectively unlimited resources and equitable distribution, the need for death may be questioned, spurring increased efforts to overcome the natural limitations of our human bodies.

The principles of health care as a right and equity of access are also challenging propositions. Both relate to resource scarcity and fair distribution, and they are guiding principles for the World Health Organisation (2001). Will they be extended during this century, in particular to the poorer nations of the earth, as a social obligation and global public good, or will the market-based allocation of health care gain precedence?

Consider advances in genetic research and therapy. Will people who are genetically manipulated or enhanced enjoy the same legal and social rights as “natural” persons? Will there be entirely new humans such as children with only one genetic parent, or cross-species beings such as ape-men, and how will they be treated (Fukuyama 2002)? Society may endeavour to halt genetic/eugenic experimentation. But how successful will this be, will it last, and will it be possible for rogue states or rogue scientists to persist?

Will society determine that the incursion of machines into the traditional role of human labour is detrimental to health and well being? Health consequences of under-employment may become so significant as a cause of morbidity and mortality that society decides to protect the role of labour in our lives. Is the machine with an implanted human brain a different moral and legal proposition to a human with implanted mechanical lungs, liver or perhaps brain parts?

Response to questions like these is difficult to predict. Public opinion is likely to be divided and it can be manipulated by the powerful vested interests in such debates. Based on history social intervention aimed at halting or changing the course of science is rarely successful. Social qualms will curb the enthusiasm of more radical researchers in at least some areas for some period of time, but the basic direction of science and technology towards the enhancement of the life and health of individuals will be maintained.

Short run determinants of change in hospitals

A series of articles entitled “The hospital of the future” was published in the British Medical Journal in late 1999. The articles explore major factors shaping the design and operation of hospitals for the next twenty years (Henscher, Edwards & Stokes 1999; Henscher & Edwards, 1999; Posnett 1999; Dowie & Langman 1999; Haycock, Stanley Edwards & Nicholls 1999, Edwards & Harrison 1999). Rather than repeat these sound and well-founded observations here, we focus on short run factors with significant implications for the long run future of hospitals; the consumer/customer, the provider/clinician, governance/management and the market.

Over recent years it has become acceptable to openly discuss something we’ve known for much of the last century. Hospitals generally give poor customer service and hospital care entails some risk to the patient. The patient-focussed care movement advocates hospital work practice re-engineering and facility re-design (Lathrop 1993). The aim is to overturn accepted practice of designing hospitals and work practices for the convenience of hospital workers, and to design with the patient experience of accessing and using hospital services as the paramount consideration.

Those who advocate the need for a safer patient care environment argue that hospitals are replete with poorly designed systems of care delivery prone to unacceptably high failure (error) rates, with significant adverse health and economic consequences for patients and their associates (Leape 1994; Wilson, Runciman et al 1995). The health care industry should work towards identifying and rectifying root causes of system failure (Australian Council for Safety and Quality in Health Care 2001). Risks and failures should be openly disclosed so customers know what they might be in for and can factor this into their decision-making (Vincent 2001).

Irrespective of the merits of either movement, they strike an empathetic chord with those who work in and use hospitals. Both will require significant change in the prevailing culture of hospitals, a culture with roots early in the last century, when hospitals provided care for the “deserving poor”, as judged by the hospital. Greater customer orientation that recognises that informed patients should be able to choose between alternative forms of care is inevitable. Hospitals will learn to live with high levels of public and individual scrutiny of their methods and motivations. Such profound change may so alter the nature of work that hospitals become more stressful and less attractive as a workplace. Clinicians may choose to practice away from burdensome hospital structures and protocols in less regulated community environments.

Changes in the processes of government and governance over the last 50 years have had an impact on hospitals. There have been three broad models of change (Ingraham, Romzek et al 1994). The market model focused on commodification and consumption of services. Hospitals produce outputs (products and services), outputs can be costed and quantified, and hospitals are paid for what they produce. Hospitals are expected to increase their productivity over time, usually by implementing new technology to enhance efficiency. Hospitals are benchmarked for quality and efficiency of outputs against their peers, often in a public manner. Recourse to the market model for governing public institutions (such as public hospitals) has been a relatively recent phenomenon in Australia, but it is likely to persist for at least the next decade or two.

The “temporary organisation” model has its roots in mounting concerns that government, particularly their associated bureaucracies, and social institutions are inflexible, conservative and ossify over time. Too much permanence of organisation structure and job tenure, especially for senior positions, means bureaucracies and institutions become unresponsive to the needs of the general public and those who use their services. To counter this tendency, elected governments adopt tactics such as short-term employment contracts and frequent re-organisation. Within Australian public hospitals the impact of this trend is illustrated on the honour-boards in many hospital boardrooms; tenures of board chairs, senior clinicians and managers have reduced dramatically in recent years. Length of service was once admired, but more recently it has become the exception rather than the expectation. Fixed term contracts and frequent organisational structure revamps are ubiquitous instruments of change across Australia’s public and private hospital landscape. Proponents argue that such practices promote flexibility and high level capacity to respond to a changing environment, as well as facilitating the introduction of new, improved work practices and ideas. Opponents counter that such frequent changes are expensive, destabilising and demoralising for those who work within the institutions. Peters (Ingraham, Romzek 1994) argues that such changes are less about the service than the balance of power between politicians and bureaucracies. Politicians increasingly want to “run the show” and to be seen by their electors to do so. Accordingly, senior job tenure and organisational structure are increasingly related to the political cycle and government tenure in office. The era of “neutrally competent” boards, senior bureaucrats and institutional leaders and managers may well be past.

Under the participatory model, governments and governing bodies use marketing and information to link with constituencies. The aim is community participation in governance, and through this community ownership of decisions taken and subsequent enactment. Without debating the merits of community participation in hospital governance, it is likely that this trend will grow stronger over the next two or three decades. Hospitals have traditionally commanded strong loyalty from staff and local communities, and they have been relatively stable in terms of leadership and structure. This has changed. Employee loyalty is declining, and senior management change and organisational restructure is predictably frequent. Simultaneously hospitals and those who work within are subjected to higher levels of public scrutiny, with leaders experiencing unprecedented levels of public accountability. The community has become more influential in determining the future direction of hospital services, at the expense of the health professions who have traditionally controlled the agenda. Hospitals are recognised as a community asset, and future hospitals will need to actively engage the support and ownership of the community if they are to survive and thrive.

The World Health Organisation (2001) states that human resources are the most important of health system inputs. The long run workforce trend is for replacement of human labour with machines. In the short run, however, the three big trends are growth (in absolute and worker to population ratio terms), diversification (more types of health care worker, changing roles) and specialisation (dedicated knowledge and practice niches within professional groups) (Dowie & Langman 1999).

The hospital workforce is segmented and based on professions, but it wasn’t always so. In 1900 in the United States it is estimated that health employment accounted for around 1% of the workforce, and for every one medical practitioner there was one other health care worker. By the end of the twentieth century health provided around 7% of all employment, and the ratio of medical practitioners to other workers was 1 to 12. These statistics illustrate massive growth and diversification, especially in the non-medical practitioner workforce (Mullen 2002). Within each of the professions, particularly the medical professional, there has been significant specialisation. Specialist practitioners now tend to dominate hospital practice, with generalists forming the backbone of community-based health care.

The health workforce differs dramatically across nations without any clear relationship to health outcome (Stillwell 2002). Shortages periodically effect different health workforces in different countries. They are an expression of increasing demand for health services, changing workplace roles, and increasing complexity of work and the relative attractiveness of health and hospitals as employers/careers. The health care workforce is becoming global, with developed countries now seeking to overcome shortages by importing health workers. While workforce shortages are likely to continue for the next few decades at least, particularly in developed countries, these shortages will be less severe for hospitals relative to community-based services because of the gradual introduction of human labour-replacing technology. The threat to this predication is that, until now, hospital positions have outnumbered other health care positions, and they have been highly sought after. The core of health worker training remains hospital based. In the future an increasing variety of non-hospital training and employment options will be made available, if only because hospitals will be unable to cope with the variety and volume of training demand.

Hospital workers will change the way that they work in response to new technology and scientific knowledge, greater availability of information, greater consumer empowerment and involvement, safety and quality concerns and continuing emphasis on cost containment. The paradigm of health care delivery will move away from being service based, with provision of service by a professional possessing exclusive skills, towards being knowledge based, where access to knowledge via eHealth modalities is ubiquitous, consumers help themselves, professionals provide guidance and access to care modalities, and machines provide the service.

In Australia the dominant mechanism for funding hospital work is a mix of fee-for-service and grants payment. In the public sector there is a global cap on the amount of work to be delivered in a given timeframe. Key elements of this market model will remain dominant in hospital funding, but we will see evolution beyond fee-for-service payment towards a richer variety of payment methods promoting integration of health care across hospital and non-hospital settings. Depending on how such payments are structured there may be important incentives that hasten the substitution of extra-hospital for in-hospital work.

Payment reform may threaten the continued relevance of the stand-alone general hospital, as we have known it throughout the twentieth century. Some observers have argued that hospitals of the (near) future will differentiate along lines of emergency versus elective care, medical versus procedural care, and short stay versus long stay care (The Advisory Board 2002). Factors precipitating such change will include market structure, modes and rates of payment, consumer preferences, technology change and workforce preferences.

Summary and conclusion

Table 1 uses selected key aspects of the health care system to make some predictions.

Table 1. Estimated change in key measure of health system in economy

Year	1900	2000	2100
Health Share of GDP	1-2%	8-10%	25%
Health Share of Total Employment	1.5%	7%	5%
Medical Practitioner to Health Care Worker Ratio	1:1	1:12	1:25
Proportion of Health Work by Machines	Nil	Negligible	50%

Footnote: Based on the work of Getzen, T as cited in Mullen (2002), derived from United States experience. Figures for 2100 are the authors.

Within the health system of 2100, hospitals will retain five core and enduring roles:

1. Care of the sick;
2. Employment of health workers;
3. Advancement of health knowledge;
4. Consumers of significant resources, and
5. Cherished social icon.

The four major factors that will influence the role of hospital over this century are science & technology, demography, the economy and the environment.

While our hospital of 2100 will focus on care of the sick, the nature of health, sickness, treatment and care will be very different. Much of what was hospital care will be automated and deliverable in the home, resulting in a major shift of the burden of caring. This shift will eliminate what we know today as the community hospital. Work of low to medium complexity will be undertaken, usually by machines but with some human input, in the home. Ambulatory centres, highly automated, highly accessible, will be the consumer friendly one-stop-shops of tomorrow. Within hospitals machines will replace human labour to a significant degree by the end of the century. Hospitals will remain cherished icons and centres of health knowledge, but they will form a lesser proportion of the health care system than they are today, and they will lose their dominance as the focus of health care training, policy and activity. The “chaos factor” in this science and technology driven evolution will be society’s response to major moral questions such as the diffusion of genetic technology.

Over the next twenty or thirty years hospitals will commence this journey by becoming very different places to work. Consumer responsiveness, convenience and safety will become important, as hospitals respond to demands for increased scrutiny, community participation and public accountability. They will continue to experience frequent leadership turnover and organisational restructures, and they will become less attractive employers relative to other health career options. Workforce maintenance will be the highest priority for management, and escalating cost, declining productivity and scarcity of human labour will hasten the uptake of labour-saving technologies.

Because hospitals are a construction of our society, the priority we give to health care, and the way we organise access to this care, it is likely that hospitals will face enormous and essentially unpredictable change over the coming century. A fundamental insight from chaos theory of how non-linear systems (such as hospitals and health care) change over time is that the unfolding of the world over time is unknowable (McDaniel 1997). However, prediction can spark debate about desirable possible futures and reduce uncertainty, and it is in this spirit that they are offered.

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