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Financial and externality impacts of high-speed broadband for telehealth

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Report by Access Economics Pty Limited for

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Glossary

AIHW	Australian Institute of Health and Welfare
CCHT	care coordination/home tele-health
CTL	Center for Technology Leadership
CVD	Cardiovascular disease
DALY	Disability Adjusted Life Year
DBCDE	Department of Broadband, Communications and the Digital Economy
ECG	echocardiograms
EHR	Electronic Health Record
ICER	Incremental Cost Effectiveness Ratio
NBN	National Broadband Network
NHIMAC	National Health Information Management Advisory Council
QALY	Quality Adjusted Life Year
RCT	randomised controlled trial
RRMEO	Rural and Remote Medical Education Online

Executive Summary

The Department of Broadband, Communications and the Digital Economy (DBCDE) requested Access Economics to report on the financial and externality impacts of ubiquitous high-speed broadband in relation to health and aged care costs, in particular the impacts that would result from increased use of:

- tele-medicine for remote consultations;
- remote home-based monitoring of chronic-disease patients and the aged; and
- remote training of medical professionals (using haptics); while
- excluding the benefits of personalised electronic health records (EHRs).

The report was required to:

- identify and articulate the nature of the impacts;
- determine a methodology to estimate these impacts, both on a net present value (NPV) and an annualised cash basis; and
- provide high-level estimates of the impacts.

Tele-health offers the potential for significant gains to Australia's population, especially for people who are elderly or who live in rural or remote communities. Unfortunately, however, despite a myriad of tele-health studies, it is difficult to measure such benefits. Tele-health studies to date have been constrained by poor economic and health data and methods.

Most studies have, however, shown that tele-health is cheaper and faster (and at least equally effective) compared to transporting patients or health care providers over large distances. Thus, it should be possible to estimate time and money savings at a national level, if not health gains.

- There does not appear to be sufficient data to estimate the benefits of online training for rural / remote medical professionals.

Using a combination of a national level United States (US) study into one aspect of tele-health (tele-consulting) and a national level Australian study that was mostly based on EHRs but had tele-health components, Access Economics estimates that steady state benefits to Australia from wide scale implementation of tele-health may be in the vicinity of $2 billion to $4 billion dollars per annum.

Access Economics
May 2010

1 Background

The Department of Broadband, Communications and the Digital Economy (DBCDE) requested Access Economics to report on the financial and externality impacts of ubiquitous high-speed broadband in relation to health and aged care costs, in particular the impacts that would result from increased use of:

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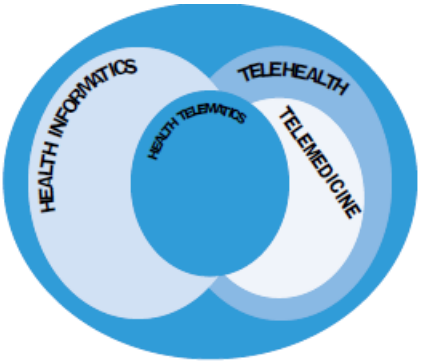
1.1 What is tele-health?

The United States Center for Technology Leadership (CTL) (2007) provides the following succinct summary of tele-health as "bringing the collective wisdom of the whole medical system to any patient anywhere"

More formally, the National Health Information Management Advisory Council (NHIMAC, 2001) provided the following definitions of e-health, tele-health and tele-medicine[1]:

E-health is the combined use in the health sector of electronic communication and information technology (digital data transmitted, stored and retrieved electronically) for clinical, educational and administrative purposes, both at the local site and at a distance.

Figure 1.1 Components of e-health



Source: NHIMAC (2001).

[1] This document appears to be the only official Australian source with definitions of all components of e-health.

Tele-health is that subset of e-health that includes the application of information technology and tele-communications for diagnostic and treatment services, educational and support services and the organisation and management of health services (including health information management and decision support systems).

Tele-medicine is that subset of tele-health that deals with medical diagnostic and treatment services.

- E-Health also includes the introduction of electronic health records (EHRs). However, DBCDE indicated that they did not wish to include EHRs and related developments in the scope of this study, as there has been ample consideration of costs and benefits in this arena.

There are four main components of tele-health.[2]

- Real time (or synchronous) tele-health involves "live" consultations in a wide range of specialities ranging from dermatology and cardiology to psychiatry. Consultations may occur between medical professionals and patients, or among medical professionals only (for example, a GP and a specialist).
- Store and Forward (or asynchronous) tele-health is the transmission of medical data – such as echocardiograms (ECGs), photographs of skin lesions, blood glucose levels, and x-rays – for remote diagnosis.
- Tele-homecare (or remote monitoring is the transmission of medical data for disease and injury management and prevention. Examples include monitoring of patients undergoing dialysis, remote foetal monitoring, or support and care to elderly people with chronic conditions living at home.
- Tele-education is the transmission of medical information, either for the training of health professionals or to assist members of the public to self-manage their health (including tele-triage).

[2] Definitions of telehealth are quite varied. This list comes from the California Telemedicine and e-health Centre, a US Federal Telehealth Resource Centre. Some definitions exclude asynchronous technology. However, Access Economics has interpreted DBCDE's brief to include all aspects of e-health other than EHRs.

2 Literature review of the costs and benefits of tele-health

There have been well over a thousand studies conducted of telehealth. Unfortunately, very few have been conducted from an economic perspective, with quantitative data on costs and benefits. Fewer still contain health related quality of life results that would enable the cost effectiveness of telehealth to be compared to standard interventions. Also, most studies were both small in size (some as few as one patient), and short term in duration. However, Center for Technology Leadership (CTL) (2007) has estimated the net benefits for a hypothetical nation-wide adoption of tele-consulting in the US. Darkins (2008) has evaluated the US Department of Veterans Affairs remote monitoring program, which is the world's largest, with 35,000 patients. In the Australian context, Access Economics' (2008) assessment of a rural telehealth program in northwest Victoria contained quality of life results.

The literature review reported a variety of benefits that can potentially be captured through tele-health for patients, providers and society as a whole, as well as associated costs of the technology itself (excluding the broadband aspects). This chapter summarises from the literature the impacts from the four main types of tele-health: tele-consulting, store and forward, remote monitoring and tele-education. At the end of the chapter, the particular applicability of these impacts for rural and remote communities is examined.

A sample of the types of benefits that have been presented by tele-health studies is presented in Table 2.1, from the perspective of the client, the provider and other stakeholders.

Table 2.1: Some potential benefits of tele-health – by type and by perspective

Client	Provider	Other stakeholders
Healthcare services and other outcomes		
Increased access to healthcare	Reduced length of hospital stay	Increased productivity of workers (less travel, less illness)
Increased health knowledge/ability for self-care	Avoided hospitalisations	Avoided cases of communicable diseases
Faster/accurate diagnosis and treatment	Avoided hospital readmissions	More efficient access to healthcare for special groups (prisoners, etc.)
Reduced waiting and/or consultation time	Avoided emergency room visits	
Increased medication adherence	Avoided laboratory tests	
	Avoided patient transportation to healthcare facilities	
	Avoided health care visits	
	Avoided referrals	
	Reduced length of consultations	
	Increased medication adherence	
	Increased knowledge transfer among practitioners	
	Increased accuracy and faster diagnosis and treatment	
	Increased patient satisfaction	
Decreased travel		
Increased employment / leisure / classroom time	Increased employment time (productivity)	
Avoided travel expenditures: transportation, accommodation, and other expenses	Avoided travel expenditures: transportation, accommodation and per diem	
Decreased risk of job loss: less time away from work for travel		
Medical effectiveness		
Reduced morbidity (higher quality of life)		
Avoided mortality		
Employment		
Higher employment participation and earnings		Higher earnings for informal carers
		More tax revenue and fewer welfare payments for governments

However, it is also worth noting what tele-health studies usually do not include. Davalos et al (2009) identified a number of shortcomings.

- There is limited generalisability due to the heterogeneity of tele-medicine programs.

- Disparate estimation methods - there are no uniform methodologies or guidelines to conduct standardised economic evaluations in tele-medicine.
- Most economic evaluations focus only on program costs, and do not consider other measures such as cost-benefit analysis or cost effectiveness.
- The use of randomised controlled trials (RCTs), the gold standard in medicine, is scant.
- Long-term evaluation studies in tele-medicine are rare, so sustainability of these initiatives cannot be studied.
- Absence of quality data and appropriate measures undermines the quality and reliability of economic evaluation.
- Tele-medicine programs usually involve small samples, thus posing important statistical limitations.

Davalos et al (2009) reviewed over 600 articles addressing the costs and effectiveness of tele-medicine and found that fewer than 4% contained a legitimate economic evaluation. The vast majority of studies only conducted a simple cost analysis, without linking costs to program outcomes. The authors conclude that: "The absence of a cohesive body of rigorous economic evaluation studies is a key obstacle to the widespread adoption, proliferation, and funding of tele-medicine programs."

The result is that unequivocal evidence of the relative efficacy or cost-effectiveness of tele-medicine has not yet materialised. Despite there being over 1,500 studies of individual tele-health programs (California Telemedicine and eHealth Centre, 2008), Reardon (2005) observes that, for most meta studies, "lamenting the lack of information on tele-medicine cost analysis has become a standard preface."

2.1 Tele-consulting

Arguably the area where tele-consulting has become most established is in mental health. The California Telemedicine and eHealth Center (2008) notes that meta studies consistently find that: "tele-psychiatry is effective, feasible, increases access to care, enables specialty consultation, yields positive outcomes, allows reliable evaluation, generally satisfies patients and providers, facilitates education, and empowers parties using it." In Australia, there are currently two types of telehealth services that Medicare specifically reimburses. One is for rural tele-psychiatry, and the other enables practitioners to communicate via videolink or telephone in a case conference with other practitioners about a patient's care[3].

- Hunkeler et al (2000), in an RCT, found that tele-nurse support improved depression outcomes by 50% over the control group (who only received medication).
- Jackson et al (2008) studied an ophthalmology program for low-birth-weight infants and found that the cost per quality adjusted life year (QALY) gained was $3,193 with tele-medicine and $5,617 with standard ophthalmoscopy. These incremental cost

[3]Tele-radiology is also included to the extent that Medicare pays for diagnostic imaging without ascertaining whether it is performed on site or remotely, but there is no specific tele-radiology item in the Medicare Benefits Schedule.

effectiveness ratios (ICERs) rate as highly cost effective by most benchmarks, notably those of the World Health Organization (WHO).[4]

The other major use for such real time tele-health is to enable physicians to consult with specialists (generally, but not always, with the patient also present).

- Kempe et al (2000) found that paediatric tele-triage halved urgent after hours referrals with no adverse affects.
- A large RCT across multiple disciplines in the United Kingdom (UK) (Wallace et al, 2002) reported a 19.7% reduction in the number of tests when comparing individuals undergoing real-time video tele-consultations to standard outpatient consultations.
- Similarly, Zanaboni et al (2009), reporting on an Italian trial of 927 tele-consultations, found that they saved 600 GP visits and 122 ED admissions, yielding savings of €20,400 plus reduced travel costs to patients of €3,700, for an all up cost of €$16,800.

CTL (2007) provides a breakdown of technology costs that would be required for tele-consulting (Table 2.2). At a minimum, at least one of each item would be required at each end for hybrid consulting involving real time video conferencing plus store and forward images.

Table 2.2: Equipment costs for tele-consulting

Type of data transmission	Type of equipment	Average cost ($US)
Patient textual data	Document scanner	150
	Live document camera	575
Still images	Digital camera	250
Live images	Video conferencing	1,405
	Video medical scopes	10,450
Audio	Electronic stethoscope	445
	Headphones	50
	Sound equipment	490
Other	Computers	540
	Monitors	275
	Encryption software	60
	Cables	75
	AV Cart	130

Source: (CTL 2007)

2.2 Store and forward

The main use of store and forward technology is in radiology. Adler et al (2009) report that two-thirds of Australian radiology service providers use tele-radiology, including around 20% who send their images interstate for diagnosis. This leads to improved productivity in over 75% of cases, especially from hospitals which would have otherwise had to employ under-

[4] WHO rates interventions that cost less than gross domestic product (GDP) per capita to purchase a QALY as highly cost effective, and interventions between one and three times per capita GDP per capita as cost effective. See http://www.who.int/choice/costs/CER_thresholds/en/index.html

utilised night locums, but can now outsource assessment. Interestingly, around 2% of images are analysed by Australian radiologists who are employed overseas, so that their standard hours can overlap night hours in Australia.

- Daucourt et al (2006) reports that a small group of French hospitals are saving over €100,000 a year by centralising their diagnosis at one central hospital and transmitting images from the others.
- The European Union (Stroetmann et al, 2006) found that two hospitals in a remote part of Sweden reduced their costs by 35% per scan by sending images to Spain for diagnosis, saving them collectively over €800,000 a year. Moreover, because neither hospital had been able to recruit a full time radiologist and previously had had to rely on visiting locums, patients benefited by an average 50% reduction in waiting times for an appointment.

Desphande et al (2009) lists a number of studies that show effectiveness gains from other forms of asynchronous tele-health (Table 2.3).

Table 2.3: Gains from asynchronous tele-health

Study	Field	Result
Callahan et al (2005)	Pediatrics	Air ambulance avoided in 12% of cases.
Eminovic et al (2003)	Dermatology	23% reduction in admissions.
Fortin et al (2003)	Multiple	23% reduction in patient transfers.
Heautot et al (1999)	Neurology	50% reduction in unnecessary transfers.
Klaz et al(2005)	Dermatology	50% reduction in wait times.
Knol et al(2006)	Dermatology	53% reduction in referrals.
Kokesh et al (2004)	Ear Nose and Throat	Over 80% of cases saved a transfer (with average cost of over $600). Savings 8 times larger than tele-health cost.
McConnochie et al (2005)	Pediatrics	63% reduction in absenteeism with tele-medicine (4 days per 100 children vs 8 days without).
Pak et al(1999)	Dermatology	45% of patients avoided visit.
Patterson et al (2004)	Neurology	Diagnosis time 44% faster than with face to face visit.

Source: Desphande (2009)

2.3 Remote monitoring

The Australian Institute of Health and Welfare (AIHW) reports that over two thirds of health expenditure in Australia is consumed by chronic diseases (AIHW, 2006). Fortunately, chronic conditions are ideally suited to remote monitoring. Conditions commonly covered by remote monitoring include cardiovascular disease (CVD), diabetes, cancer, infections, injuries, skin

diseases, high-risk pregnancies and age-related conditions. In addition, nurses can use telephone, personal computer or video communication to monitor (and advise) chronic patients at home. While most of the literature focuses on telehome monitoring, remote monitoring is also often used by physicians in major urban hospitals to care for patients in smaller rural hospitals.

Below are some examples of health benefits that have been gained from remote monitoring.

- Bosch's *Health Buddy* Telehealth System is a technology for self-monitoring using a variety of devices as appropriate, including blood glucose meters, weight scales, peak flow meters and blood pressure cuffs. In a 12 month study looking at the impact on the health of 169 indigent people with diabetes, statistically significant outcomes included a 32% reduction in inpatient admissions, a 34% reduction in emergency admissions, a44% reduction in post discharge visits and a 49% reduction in outpatient visits (Cherry et al, 2002).
- In another 12 month study with 791 veterans with long-term conditions and 120 mental health patients, use of Health Buddy resulted in increases in medicine compliance from 63% to 93%, and 90% of participants said they felt more educated about their condition (Ryan et al, 2003).
- Another RCT of a home tele-care intervention showed that a weekly tele-nurse visit to patients with congestive heart failure resulted in 84% lower readmission rates and also had significantly fewer emergency visits (Jerant et al, 2001).
- *WristCare* is a wrist-worn remote alarming device with multiple sensors measuring movement, skin temperature and skin conductivity. A study in the UK of pre- and post-data found a 70% reduction in repeat fall incidents and a reduction in hospital bed days from 947 to 157 - an 83% reduction (UK Department of Health, 2005).
- Smith et al (2007) found that tele-health home monitoring of patients with dementia improved their medication compliance rates to 81%, against 66% in the control group. Further, compliance remained at this level for 12 months in the tele-health group, whereas it declined in the control group.

A number of studies have also found cost savings from remote monitoring.

- Dansky et al (2001) found that with home tele-healthcare, nurses can provide video contact with 15–25 patients a day while, on average, a mobile visiting nurse can only see 5.2 patients per/day. In addition, the same patient can be monitored two or more times a day.
- Reigel et al (2002) in a study of tele-nursing for patients with chronic heart failure found that the heart failure hospitalisation rate was 45.7% lower in the intervention group at 6 months. Heart failure hospital days and multiple readmissions were also significantly lower in the intervention group at 6 months. Inpatient heart failure costs were 45.5% lower at 6 months, resulting in net cost saving after intervention costs were deducted.
- Barnett et al (2007) examined the cost-effectiveness of a care coordination/home tele-health (CCHT) program for veterans with diabetes (n=370) before and after the introduction of the CCHT program, for two periods of 12 months. In one of the few tele-health studies to use QALYs (the gold standard in medical evaluations) the authors found the incremental cost effectiveness ratio (ICER) for the program was $60,941 per QALY.

- *Veterion Monitor* allows people to measure a range of vital signs including blood sugar, blood pressure, blood oxygen, temperature, weight, ECG, peak flow, etc. A 12-month randomised trial involving elderly patients with complex heart failure, chronic lung disease or diabetes showed a significant decrease in bed days, and emergency visits. It was also found to improve the patients' cognitive status, medicine compliance, and the stability of their long-term condition. Overall, this led to health care costs decreasing by 58% (Noel et al, 2004).
- A Pennsylvania State University study of one group of diabetes patients showed estimated hospital costs of $87,327 for patients monitored through tele-homecare compared to $232,872 for patients that received traditional homecare from a visiting nurse (Dansky et al, 2001).
- Darkins et al (2008) report on a large program (17,025 participants) in a Veterans Health Administration care coordination / home tele-health program. CCHT patients showed benefits of a 25% reduction in numbers of bed days of care, and a 19% reduction in numbers of hospital admissions. These savings were not quantified, but the cost of CCHT was only $1,600 per patient per annum – around the average cost of one day's hospital stay in the US.
- Johnston et al (2000) report on an early landmark trial by Kaiser Permanente where it provided 24-hour access to home tele-nursing to an intervention group with a variety of diseases. Over the course of a year, the intervention cost US$663 per patient, but saved US$726 in hospitalisations compared to the control group.
- Jerant et al (2001) report on a one year home tele-nurse RCT for patients with congestive heart failure. In the control group, the average cost of heart-related readmissions was US$44,479; these costs were 86% lower in the intervention group, at US$5,850.
- Litan (2005) citing Adomeit et al (2001) states that: "In fact, the potential savings from disease management enabled by broadband based remote monitoring for all chronically ill patients are potentially quite extraordinary – as much as 30% of all hospital, out-patient, and drug expenses."
    - Access Economics cannot validate this figure as the Adomeit reference is a *McKinsey Quarterly* article that bases this claim on uncited and undated "case studies" pertaining to asthma treatment in Germany.

Rojas and Gagnon (2008), after screening nearly 10,000 references, came up with 23 that they considered enabled some measurement of cost effectiveness for home tele-healthcare (Table 2.4).

Table 2.4: Remote monitoring costs and effectiveness

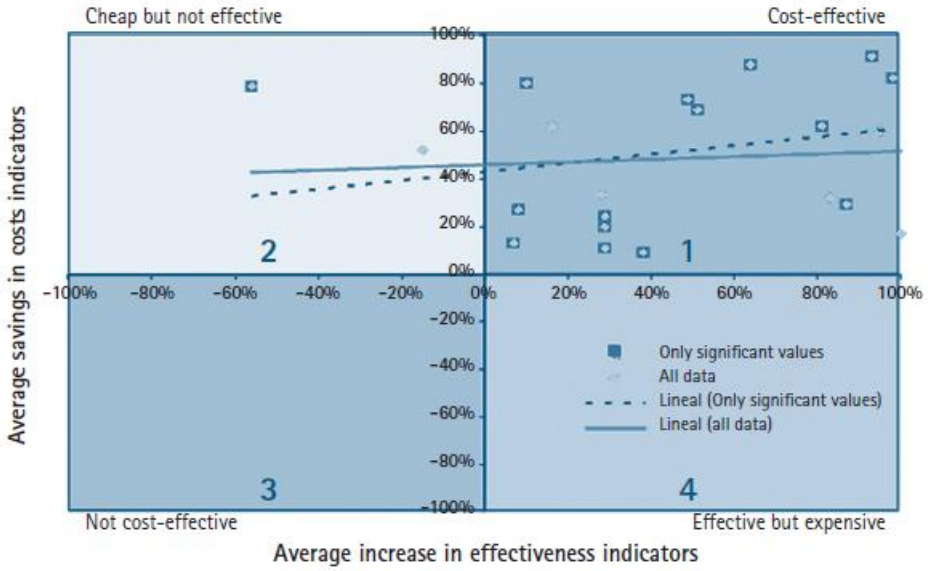
Expected effectiveness indicator	Studies supporting (%)	Total studies
Health effectiveness		
Reduced ED visits	89%	9
Reduced hospitalisations	89%	9
Reduced readmissions	100%	3
Reduced length of hospitalisation	88%	8
Increase or no change in quality of life	100%	8
Cost savings		
Reduced outpatient visits	78%	9
Reduced home visits	50%	12
Reduced travel time (professionals)	78%	9
Reduced travel time (patients)	100%	1
Reduced distance travelled (professionals)	100%	5
Patient productivity	100%	2
Total Costs	100%	14
Cost increases		
Remuneration tele-intervention	80%	5
Technical support	100%	2
Software	100%	2
Hardware purchase	94%	17
Hardware maintenance	78%	14

Source: Derived from Rojas and Gagnon (2008).

Using a scale which measured the (unweighted) average percentage difference in home tele-healthcare against the control groups to measure effectiveness (time, money or health outcomes), against total costs (for each group) Rojas and Gagnon found that 17 out of 19 interventions were cost effective (Chart 2.1).[5]

[5] The other studies did not permit this analysis.

Chart 2.1: Cost effectiveness of home tele-healthcare



Source: Rojas and Gagnon (2008).

2.4 Education / training

The barriers of distance do not just afflict patients: those providers who are practising in rural areas may not have access to continuing medical education, which may put them at a disadvantage when compared to their urban counterparts. Tele-health with videoconferencing capabilities can improve provider access by removing financial and geographic barriers, and subsequently helping them provide better care for their patients. Delivery of programs through tele-communications allows for the dissemination of new developments and research, provides training opportunities, and increases educational experiences for primary care providers through consultations with specialists and attendance at virtual academic conferences. In addition, distance education via the web can be done in an asynchronous fashion. Providers can download and review materials and take examinations at times convenient to them.

Tele-health can also increase the skills and expertise of primary care providers in a direct "hands on" manner, through being part of the consultative process during the tele-health encounter with the specialist. For example, prior to tele-health, a provider would refer a patient to a dermatologist with an unusual rash. With tele-health, the provider works in concert with dermatologists during the tele-consultations, learning from this interaction. With time, the primary care provider gains confidence in treating a particular type of rash independently, without the need to consult a dermatologist. Thus, tele-health programs may initially increase the number of referrals to specialists but in time may decrease as providers are educated and gain confidence, enabling them to make management and treatment decisions on their own.

The **Australian College of Rural and Remote Medicine** has an online platform, Rural and Remote Medical Education Online (RRMEO), which provides whole-of-career support for Australian medical practitioners. Innovations, such as the first online accredited mental health courses and virtual classrooms, help users keep pace with the demands of the medical profession.

At 30 June 2009, more than 13,000 people were registered as users of RRMEO. Over 2,400 of these were using the learning planner and record keeping systems to maintain their learning records (for vocational training, professional development, and other reporting requirements). RRMEO had scored 4.8 million hits with almost 700,000 pages viewed and 80 Gigabytes of data downloaded across the site.

Two of the College's online programs, Tele-Derm and Radiology Online, are available for free to all rural and remote doctors as part of a partnership with the Australian Government Department of Health and Ageing under the Medical Specialist Outreach Assistance Program.

D'Souza (2000) reports on one trial of distance education for mental health professionals in rural Australia. Forty-six community mental health workers from nine rural areas and 20 general practitioners from five rural areas participated. Tele-medicine reduced the disincentives to rural practice, and also improved the professionals' competence and confidence in managing patients with psychiatric illness.

Access Economics' literature search uncovered a number of articles describing new developments in remote medical training, particularly using virtual environments (for example, Gorini et al, 2008 or Alverson et al, 2008).

- DCBDE specifically requested information on using haptics (touch sensitive technology) within tele-medicine. Access Economics was only able to find two journal articles that used both these terms within their titles. In Broeren et al (2002) the authors describe the use of a 3D computer game with "force feedback" used for stroke rehabilitation on a single patient on a tele-medicine platform in a laboratory setting. Later, the same team (Broeren et al, 2006) describe how this technology could potentially be used in a home based setting.

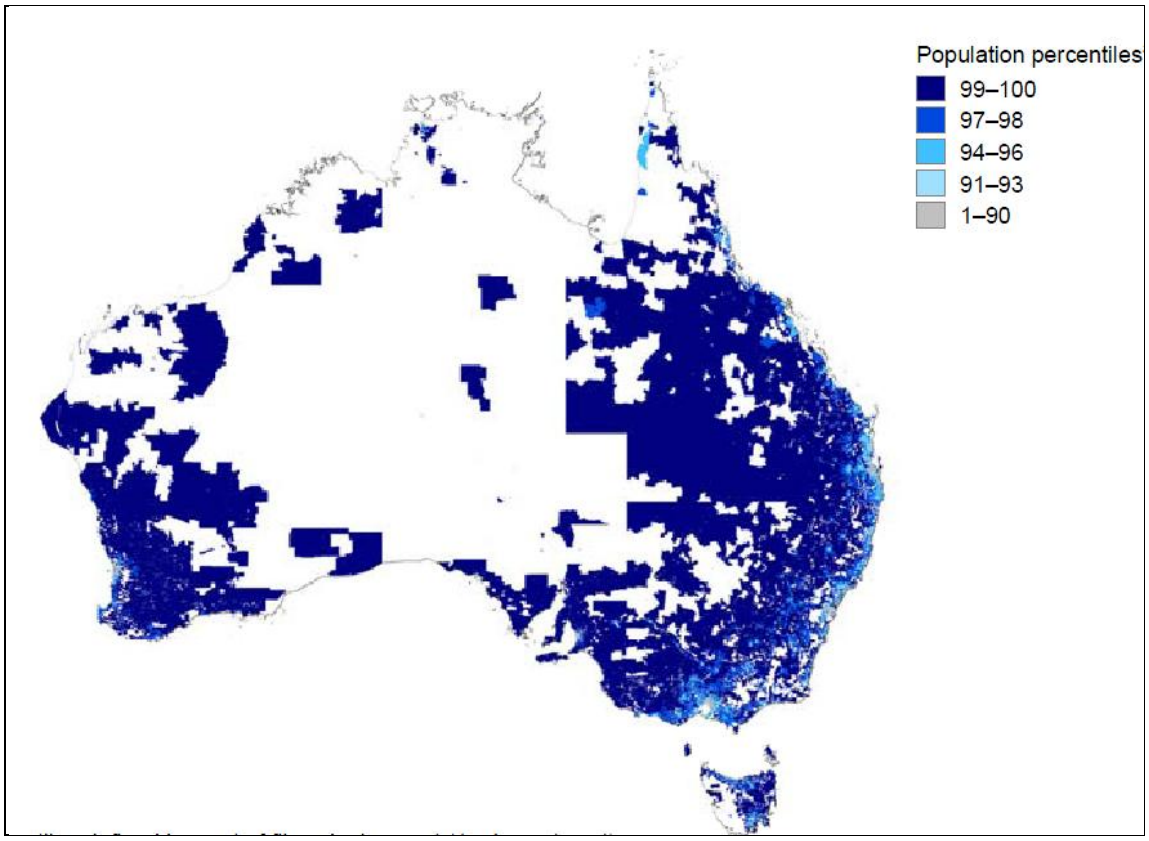
Access Economics was not able to find any publications that mentioned costs or assigned a quantitative value to the benefits of remote training. CTL (2007) did suggest a method whereby such benefits could potentially be measured. Their idea was that the value of the knowledge gained where a physician works together remotely with a specialist could be measured by subsequent reductions in referrals by that physician for the same condition in future patients. Such savings in disease treatment is particularly relevant in the Australian setting, as without remote education rural practitioners would simply not be able to access much of this training.

Regarding patient education, Connected Nation (2008) reports that 63% of Kentucky residents who use the internet for healthcare purposes report that doing so has saved them money, with an average of 4.2 unnecessary visits avoided for an average saving of US$217 per capita.

2.5 Rural issues

Along with Canada, and certain remote parts of Asia, Australia has one of the most dispersed populations in the world, as shown in Figure 2.1 (the darker the shading is, the more dispersed is the population).

Figure 2.1 Australian population distribution



Source: DBCDE (2010).

Around one-third of Australia's population live outside of major cities. Collectively, the number of people who live in communities with less than 5,000 residents is equivalent to the number of Sydney residents. However, unlike Sydney-siders, all these people dwell in districts too small to support traditional models of health delivery locally, forcing them to travel to larger urban centres for healthcare. Moreover, these communities are characterised by higher hospitalisation rates and higher prevalence of health risk factors compared with metropolitan areas (Walkerman et al, 2008).

Tele-health can enhance access to care for rural or remote patients with less common conditions or those in need of specialist care, without the need for an increase in the number of specialists, who are under-represented in regional Australia for a variety of reasons. Improved access to specialty care can raise the quality of care. Tele-triage and tele-monitoring can improve patient access and quality of care, as well as reducing travel and costs.

If only those costs to be met by the health-care system are included, the tele-health alternative is not always cheaper. If patients' travel and lost working time are included, many of the tele-health alternatives become cost-saving from a societal perspective. However, as

with tele-health in general, quantitative evidence on the cost-effectiveness of tele-health in the rural context is sparse.

- Jennett et al (2003), summarising studies across a variety of disciplines and diseases,[6] report that there is good evidence that interactive video-consultation is effective and efficient in rural and remote areas, and increases access to healthcare. Other socio-economic implications include the avoidance of travel for patients and providers, improved access to services, increased quality of care and cost-savings. They report that cost-savings depend on the numbers of patients and distances involved, as well as on the perspective of the study.
- Darkins et al (2008), in their study of home tele- monitoring, found that reductions in hospitalisations were greater in remote areas (with a 50% decrease in bed-days) compared to urban areas (a 29% reduction in bed-days).
- Nooriafshar and Maraseni (2007) found that the introduction of tele-consulting in Kingaroy in rural Queensland saved $125 per visit avoided (as measured from a whole of society perspective) as opposed to sending patients to Toowoomba, the nearest city.
- Access Economics (2008) evaluated a remote monitoring program for patients with chronic diseases in north-west Victoria. The study found savings of around $4,740 per participant per annum on average, as shown in the table below. The savings were attributable to reduced health system expenditures (29% of total benefits), lower carer burden for assistance with activities of daily living (ADL, 69% of total benefits) and travel cost savings (2% of total benefits). The costs of the program totalled $4,347 per annum per person; comprising an estimated $1,833 for the monitors, $2,099 for the transmission fees, $121 for phone calls and $294 for patient time. Thus, the net benefit per person was $393 per annum. The intervention group also scored better in quality of life tests than did the control group, however Access Economics did not consider these results sufficiently robust to conduct cost-effectiveness analysis.
- The Australian e-Health Research Centre has also recently been conducting rural telehealth trials. The Centre's Care Assessment Program uses tele-rehabilitation to prevent the recurrence of cardiac events. An RCT found that measurements obtained by remote monitoring were an effective substitute for those conducted in clinical settings.[7] The Centre has also been using tele-ophthalmology for diabetes prevention in remote settings. This is particularly significant given Australia's indigenous population has one of the highest rates of diabetes in the world.

[6] Specificially radiology, cardiology, colonoscopy, neuropsychology, minor injuries, dermatology and nutrition.

[7] http://aehrc.com/cap, accessed 26 May 2010.

3 Methodology

There are two main constraints to the widespread adoption of tele-health in Australia. The first is the lack of high speed broadband - especially in rural areas; potentially removing this constraint is the *raison d'être* for this report.

- At present some institutions, including some rural public hospitals, have access to the high-speed, high-capacity data connections needed for telehealth. However, with the National Broadband Network (NBN), small hospitals and medical centres, individual doctors and private homes will all be able to participate in telehealth. While many urban locations currently have high-speed broadband, usually upload speeds are much slower than download speeds, and reliability can be patchy. Both of these are substantial impediments to telehealth, which would be remedied by the NBN.

The second constraint is that the current Medicare funding model is built upon face to face transactions, and at present allows only two tele-health procedures, and then only in rural / remote areas. Following discussions with the Department of Health and Ageing, this report assumes that the Australian Government will eventually allow tele-consultation for all people in rural areas, and remote monitoring for the elderly in metropolitan areas (as they are often too frail to transport, prefer home/community care, and save the travel costs).

As noted above, there is a severe shortage of large scale tele-health cost-effectiveness data. Thus, were Access Economics to undertake proper modelling of the costs and benefits of tele-health, we would propose to build upon two large US studies.

1. We would use the CTL (2007) model for tele-consultation as it is the only national scale model unearthed in the literature search.
2. For the aged care / remote monitoring, we would build upon Darkins (2008), as the US Department of Veterans Affairs runs the world's largest tele-health program, caring for 35,000 patients.

Essentially under this approach parameters, such as the numbers of hospitalisations, patient and physician visits and unnecessary procedures avoided would be sourced from international studies. However costs, including such hospitalisations, patient and physician visits and unnecessary procedures, would be sourced from Australia, to the maximum extent feasible.

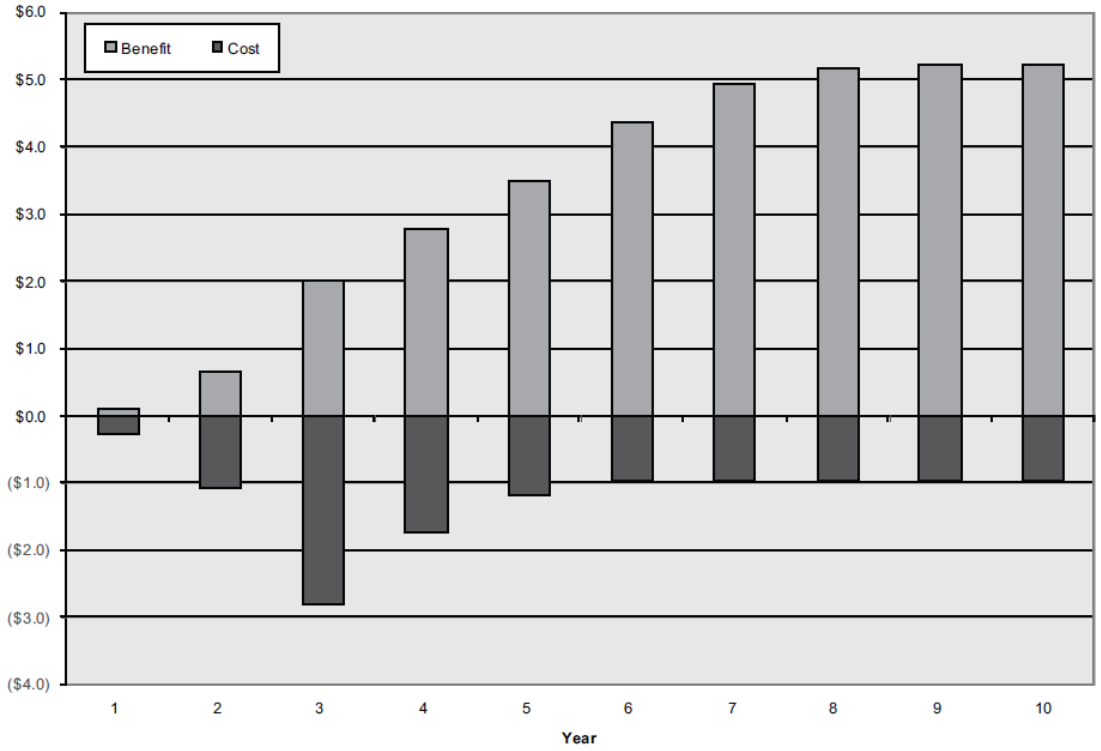
As noted above, there is an under-provision of medical services to rural and remote areas. Tele-health should increase the supply of medical services to these areas. For modelling purposes, an *x*% saving in time for provision of service *y* in rural areas would translate into the same percentage increase for that service in rural areas – unless that would increase service provision beyond levels observed in metropolitan areas, where access is presumed to be adequately met (albeit with some queues).

Unfortunately, very few tele-health studies include health-related quality of life outcomes, so it is difficult to directly measure the health benefits consequent upon increases in service provision in rural areas. However, it is probable that conditions where there are treatment gaps will eventually show up as hospitalisations. Thus, in modelling, an increase in provision of tele-health service *x* would translate into a decrease in hospitalisations for condition *y*, where the parameters would be drawn from the literature.

For both tele-consulting and remote monitoring, equipment costs would be sourced from the CTL (2007)[8], and to the extent practicable, various State health departments (most of which have some form of existing tele-health programs) and the Australasian TeleHealth Society.

Costs and benefits would be modelled over a ten year period (from 2010-11 to 2019-20) following the methodology employed by the CTL (Chart 3.1), and excluding the broadband cost.

Chart 3.1: Expected annual costs and benefits of tele-health implementation in the US (US$billion)



Source: CTL (2007)

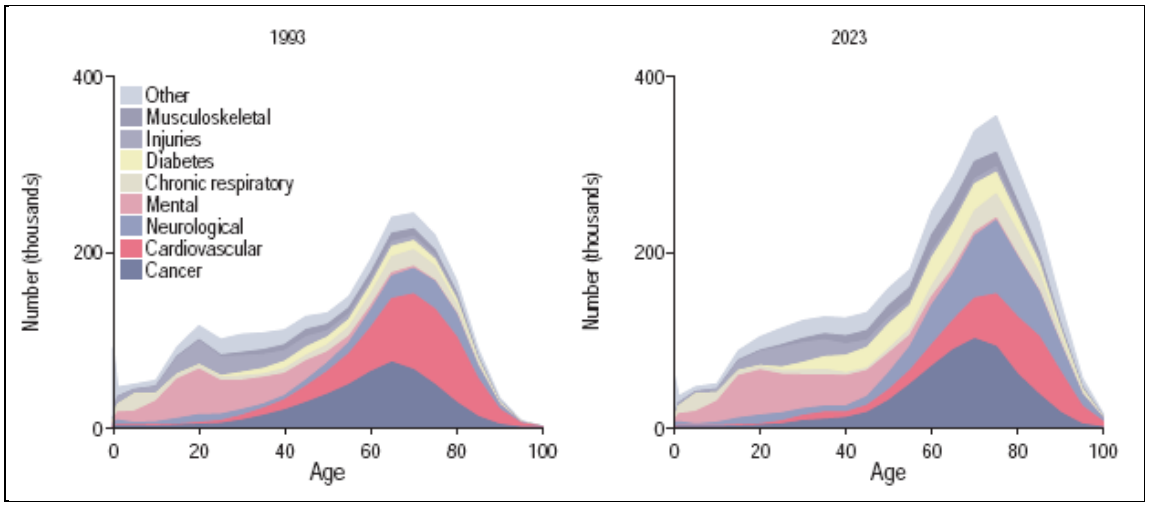
The proportion of the population who are elderly is rapidly increasing, and would be measured based on Access Economics' in-house demographic model (AE-DEM).

Similarly, the burden of chronic diseases is also rapidly increasing. The AIHW has projections for all the specified health conditions out to 2023 (Chart 3.2). Access Economics has a close working relationship with the AIHW and has recently been able to acquire access to these data, which would form the underlying projections by age and gender for 2020. Underlying these projections are assumptions about historical trends in each condition and its risk factors, which would be transparently discussed in the report.

[8] As well as costing individual items, this document also estimated how many items would be needed for various institutions.

Tele-health is potentially applicable to hundreds of different diseases and injuries, with thousands of treatments. However, Access Economics would primarily focus its analysis on the following major therapeutic areas: cancer, chronic obstructive pulmonary disease, CVD /stroke, mental illness, diabetes, asthma, and skin diseases, for the following reasons. First, from the literature, these are the conditions most frequently addressed by tele-health. Second, collectively, they account for most of the burden of disease in Australia[9]. Third, Access Economics has already modelled the economic impact of each of them, (except skin diseases not caused by allergies).

Chart 3.2 Projected burden (DALYS)[10] for selected health conditions, 1993 to 2023



Source: AIHW (Begg et al, 2007).

- It is less problematic to assume that the National Broadband Network is in place 1 July 2010, than to attempt to begin modelling disease projections eight years down the track and attempt to continue to 18 years, as that is beyond current epidemiological projections. Since the network costs are not included in the NPV analysis, there is little distortion in adopting such an approach.

Costs and benefits would be calculated on an annual basis, and then converted to NPV terms using discount rates recommended by the Office of Best Practice Regulation – namely 7% in the base case with sensitivity analysis at 3% and 11%.

Wage costs for medical professionals would be drawn from existing medical associations' surveys, previous Access Economics health workforce modelling (covering most major disciplines) and ABS data.

Time costs for patients would be measured using ABS wage and employment participation data for the employed and willingness to pay estimates of the value of leisure time in various health states. Travel times would be assumed to be equivalent to average commuting distances for city dwellers with modelling based on literature or data for regional Australians.

[9] The proportionate burden of disease from these illnesses is still higher for the rural and elderly populations who would be the focus of telehealth interventions.

[10] A DALY (Disability Adjusted Life Year is an alternative measure for a QALY).

Costs of hospitalisations and other health care costs avoided would be drawn from casemix and Medicare data, together with various AIHW sources.

4 Preliminary estimates of potential national benefits from tele-health

As noted above, there have been a myriad of small scale studies of individual tele-health interventions, using different measures and small sample sizes, which makes it difficult to scale up to a national level.

However, the CTL[11] (2007) has managed to accomplish this scaling up task, albeit only for one component of tele-health: provider to provider tele-consulting (mostly physician to specialist, with or without store and forward image transfer). CTL estimated that, across the entire US, if the necessary broadband infrastructure were in place,[12] the following could be avoided annually:

- 850,000 patient transports between emergency departments (usually this occurs in order to access a particular type of specialist not available at presentation time in the originating ED);
- 40,000 transfers from prisons to medical centres (which are expensive due to security requirements);
- 387,000 transfers from nursing homes to health facilities; and
- a 19.7% reduction in unnecessary tests and trials using real-time video consulting, and a 21.8% reduction using store and forward image transfer.

After recouping installation costs (which would take five years) this was estimated to yield net savings on an ongoing basis of $US4.28 billion per annum.

On a simple population relativity, that translates to around $296 million per year in Australia. This calculation assumes that higher US health costs roughly balance out the costs of a more dispersed population in Australia and exchange rate effects.

Booz and Co. (2010) estimate that the potential steady state[13] benefits to Australia from e-health implementation are around $7.6 billion per annum. Most of this benefit is derived from electronic health records, but some proportion can reasonably be attributed to tele-health. Booz and Co. have $0.9 billion worth of benefits assigned to "patient self-management", which explicitly includes a tele-health component:

> Patient self-management provides patients with a portal view for managing their health records and researching health topics. In addition, the capability can provide *secure, private patient communications with clinicians*, enabling more effective participation in disease management programs and avoiding unnecessary visits to a clinic (italics added).

[11] The Centre for Information Technology Leadership is an academic health research organisation affiliated with the Harvard Medical School.

[12] CTL also assumed that current health insurance payment system disincentives were removed.

[13] That is, once initial capital costs have been repaid.

Conservatively, half of this benefit ($450 million) could be assigned to tele-health in terms of health benefits alone. On this basis, a tentative national estimate for Australia is steady state benefits of around $750 million per annum for tele-health.

- By way of comparison, this is very close to the figure that the International Data Corporation (2010) estimates that the Australian healthcare industry will spend - $721 million - on telecommunications this year.

However, this represents just the direct benefits in terms of health expenditure and patients time savings. In Access Economics' experience of assessing the economic costs of some 50 diseases in Australia and internationally, almost invariably indirect costs from those suffering the disease exceeds the costs to the health system. To the extent that telehealth will allow diseases to be detected and treated earlier, this will reap productivity benefits to the whole economy through reduced absenteeism, presenteeism and welfare dependence. Other indirect costs such as carers, aids and equipment, and costs associated with welfare and taxes usually also exceed health system costs.

Hence, conservatively, from a whole of society viewpoint, the benefits of wide implementation of tele-health in Australia could be around $2.25 billion dollars a year.

- Again for comparison, this is equivalent to the total amount that International Data Corporation (2010) estimates will be spent on e-health this year.
- These are mostly gross, rather than net, benefits. However, as the National E-Health Transition Authority notes, the lack of information on telehealth in Australia is more likely to lead to these benefits being underestimated than overestimated. (For example, there are significant aspects of telehealth, such as remote education, which are not included in the above estimate due to lack of data.)

Further, to the extent that earlier and more widespread intervention through telehealth reduces the prevalence and severity of diseases and injuries, it is possible to put an economic benefit on the pain and suffering averted by using aggregate willingness to pay to avoid loss of healthy life. In fact, the Department of Finance and Deregulation requires the use of its value of a statistical life year when analysing regulations designed to avoid harm.[14] Such costs usually outweigh health system costs, productivity costs and other costs put together. On this basis, the benefits of implementing tele-health would be at least $4.5 billion a year – noting that the value of the quality of life component is more uncertain and is non-financial (hence, for example, benefits cannot be compared with GDP).

- However, given the lack of health related quality of life data in tele-health studies, it may not be possible to calculate these benefits or, if estimates were made, they might best be reported separately due to uncertainty, and surrounded with sensitivity analysis so that a confidence interval could be reported.

In summary, in the absence of further analysis, Access Economics would expect the net benefits from widespread adoption of telehealth in Australia to be worth between $2 billion to $4 billion a year.

[14] This methodology is required by the Australian Government in assessing the impact of regulations designed to reduce harm, see http://www.finance.gov.au/obpr/docs/ValuingStatisticalLife.pdf.

Conclusions

Tele-health offers the potential for significant gains to Australia's population, especially for those who are elderly or live in rural or remote communities. Although the literature review in this scoping exercise has uncovered a myriad of tele-health studies, it remains difficult to measure such benefits due to data and methodological weaknesses in the sources of evidence.

Most studies have, however, shown that tele-health is cheaper and faster (and at least equally effective) compared to transporting patients or physicians over large distances. Thus, it is considered feasible to estimate the time and dollar savings at a national level, and potentially the indicative health gains.

- There does not appear to be sufficient data to estimate the benefits of online training for rural / remote medical professionals..

Using a combination of a national level US study into one aspect of tele-health (tele-consulting), and a national level Australian study that was mostly based on EHRs, but had tele-health components, Access Economics estimates that steady state benefits to Australia from wide scale implementation of tele-health may be in the vicinity of $2 billion to $4 billion dollars per annum.

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