Telehealth for aged care

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Report by Access Economics Pty Limited for

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Glossary

ABS	Australian Bureau of Statistics
CACP	Community Aged Care Package
CBA	cost benefit analysis
CITL	Center for Information Technology Leadership
CNP	Community Nursing Program
CSIRO	Commonwealth Scientific and Research Organization
DALY	disability adjusted life year
DBCDE	Department of Broadband, Communications and the Digital Economy
DOHA	Department of Health and Ageing
DVA	Department of Veterans Affairs
EACH(D)	Extended Aged Care in the Home (Dementia)
GDP	gross domestic product
GP	general practitioner
HACC	Home and Community Care
NBN	national broadband network
NICTA	National Information and Communications Technology Australia
NPV	net present value
NSW	New South Wales
OBPR	Office of Best Practice Regulation
PICO	Population Intervention Comparator Outcomes
POTS	Plain Old Telephone Services
RAC	residential aged care
TMC	TeleMedCare
US	United States
VHC	Veterans' Home Care

Executive Summary

Access Economics was commissioned by the Department of Broadband, Communications and the Digital Economy (DBCDE) to provide a cost benefit analysis (CBA) of introducing a telehealth intervention into existing aged care programs.

The setting for the CBA is a potential pilot program over 2012-13 to 2013-14, or earlier if possible, of such an intervention in a selection of sites with early access to the national broadband network (NBN). The three sites selected were:

- an area of Townsville in Queensland's mid-north;
- the coastal communities of Minnamurra and Kiama Downs south of Wollongong, NSW; and
- an area of west Armidale, NSW.

Access Economics adopted a 'PICO' approach to the prospective two-arm CBA modelling, guided by a workshop of key Government stakeholders:

- P – Target Population;
- I – Intervention;
- C – Comparator; and
- O – Outcomes.

The relevant **target population** was estimated as those people (excluding veterans) aged 65 years and older living in the community who have particular chronic diseases– cardiovascular disease (CVD), diabetes and chronic obstructive pulmonary disease (COPD). This population was identified in the literature as being an effective target for telehealth interventions, with good data availability on the efficacy of interventions in this group. Over all sites there are a potential 1,165 people in the intervention group which, for the purposes of this exercise, was the number modelled, along with 1,165 in a control group in nearby non-NBN areas.

The **intervention** selected, on the basis of evidence of efficacy, supplies two principal components of telehealth: telemonitoring and teleconsultation provided through a single device – a TeleMedCare (TMC) Health Monitor (or a more sophisticated device where this is needed or where the patient would prefer it, assuming additional costs can be met). Healthcare would be provided by the person's local general practitioner (GP) in collaboration with a nurse coordinator (the pilot design should consider suitable, flexible arrangements for community provision of coordination services). At the GP surgery, the videoconferencing equipment is assumed to be more sophisticated –a Tandleberg 990 MXP, as used by Queensland's Statewide Telehealth Service. The cost per person for the intervention was estimated to be $9,279 in net present value (NPV) terms over the two years - $3,393 for the coordination costs, $2,804 for the telemonitoring device, $2,167 for the data management services, $47 for GP videoconferencing equipment and $866 for data/voice costs to support patient participation. The NPV of the intervention costs for aged people, excluding veterans, living in the community would be $10.8 million, with $7.9 million of this in 2012-13 and $3.9 million in 2013-14 (undiscounted).

The **comparator** was modelled as the absence of the intervention i.e. standard care services as currently provided.

Four key **outcome** measures were agreed at the workshop, grouped as follows:

1. hospitalisation rates and other health expenditures – importantly GP costs;
2. displacement of other community services, notably informal care burden and transport costs;
3. admission to residential aged care (RAC) and hence impacts on formal sector community care services; and
4. quality of life, measured using the 'burden of disease' (BoD) units of disability adjusted life years (DALYs) and converted to dollars using the value of a statistical life year (VSLY).

Additional outcome measures (e.g. health workforce productivity) would be important to include in an actual pilot evaluation, but were out of scope for this prospective indicative CBA.

Efficacy and cost data for outcomes were sourced from a variety of literature and data as outlined in Section 4 of this report. Costs and benefits were allocated to payers based on funding arrangements. For this prospective evaluation of a potential pilot, it is assumed in the base case that the Australian Government bears the costs. In the sensitivity analysis, costs are allocated as per the spread of financial benefits. Table i summarises the base case results.

Table i: Impact of telehealth intervention, $2010-11 m

Item	NPV	2012-13*	2013-14	Australian Govern-ment	State & local government	Indiv-iduals	Other payers
				NPV			
Intervention cost	10.8	7.9	3.9	10.81	-	-	-
Benefits							
Health spending	6.8	4.4	3.0	3.66	1.20	1.19	0.70
Informal care & transport	1.7	1.1	0.8	-	0.06	0.24	1.40
RAC/formal care	8.9	0.0	10.2	8.94	-	-	-
Total financial benefits	**17.4**	**5.5**	**14.0**	**12.60**	**1.26**	**1.43**	**2.10**
BoD	9.5		10.9	-	-	9.54	-
Net financial benefits	**6.6**	**-2.4**	**10.1**	**1.80**	**1.26**	**1.43**	**2.10**
Financial Benefit-cost ratio (BCR)	**1.61**			1.17			

Note: NPV is over both years with a discount rate of 7% applied to real 2010-11 dollars. * Or earlier if possible.

In terms of financial costs (excluding the burden of disease or BoD), the intervention was estimated to save $17.4 million in NPV terms for the three pilot sites modelled, over half from reduced RAC and formal community care ($8.9 million), with a further $6.8 million in health system savings. Informal care and transport cost savings account for the residual $1.7 million. If the benefits from reduced pain and suffering are included, the total gross benefit is a further

$9.5 million. The main benefit for participants is that around a quarter of them should be able to stay in their homes for a year or two longer, rather than entering nursing homes.

> Over the course of the two-year intervention, net financial benefits are expected to be $6.6 million for the three pilot sites modelled. This is equivalent to a benefit-cost ratio (BCR) of 1.61 to 1 (a 61% return on investment). From the Australian Government perspective, the BCR is 1.17 to 1 (a 17% return on investment). In addition, benefits to patients in terms of improved health outcomes are estimated to be $9.5 million in NPV terms.

Including BoD, the total gross benefit of the trial is $26.9 million, with net benefits of $16.1 million, and a BCR of 2.49 to 1.

Three sensitivity analyses were undertaken to test the change in outcomes in relation to key parameters.

- The first sensitivity analysis changed the **distribution of costs** to match the distribution of benefits in the base case, which did not change the overall NPV, but increased the net benefit for the Australian Government (to $4.77 million from $1.80 million) and reduced it for other payers, although all remained positive.
- The second sensitivity analysis **reduced the discount rate to 3% per annum**. This increased the NPV of all cost and benefit items, and increased the net benefit overall to $7.2 million from $6.6 million and the overall BCR from 1.61 to 1.63.
- The third sensitivity analysis **increased the discount rate to 11% per annum**. This reduced the NPV of all cost and benefit items, and reduced the net benefit overall to $6.0 million from $6.6 million and the overall BCR from 1.61 to 1.59.

> Overall, the sensitivity analysis did not affect the conclusion that there are net benefits for all participants from the proposed pilot intervention.

This does not take account of the capital cost of the NBN itself. Risks include:

- benefits may be different in nature or magnitude from those itemised in this study;
- interventional technology may be different in type or cost to the telemonitoring and teleconsultation devices with associated service protocols as outlined here, although the view of the workshop was that these devices and protocols are of typical cost so any such differences should not be substantial; and
- start dates of the pilot, implementation of the NBN in locations, or the locations themselves may differ from those modelled here.

For these reasons it is advisable that the pilot also be evaluated prior to any nation-wide rollout.

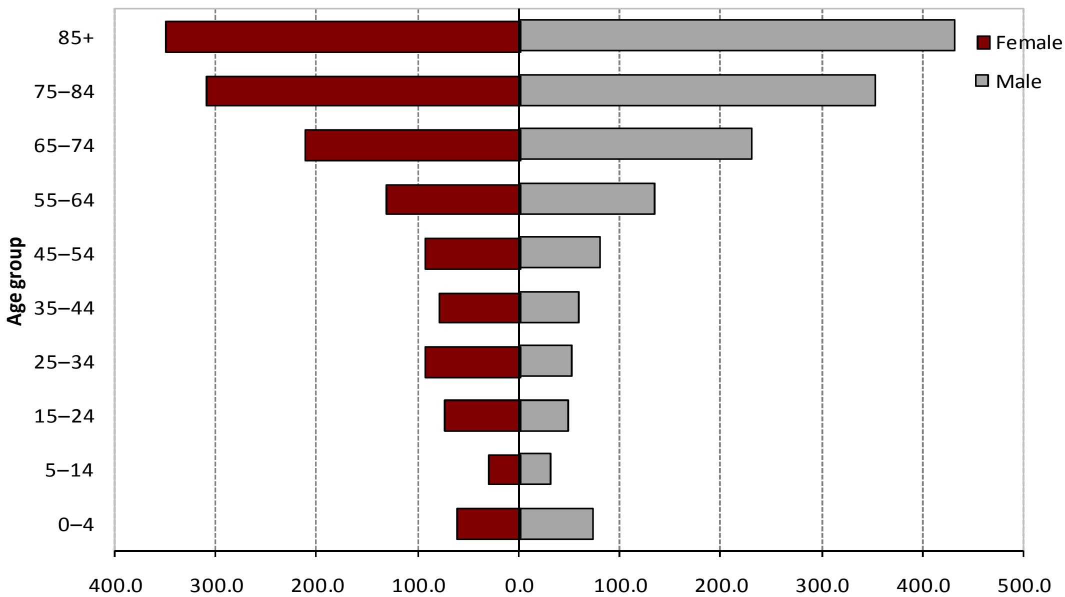
1 Background

Access Economics was commissioned by the Department of Broadband, Communications and the Digital Economy (DBCDE) to provide a cost benefit analysis (CBA) of introducing a telehealth intervention into existing aged care programs. The setting for the CBA is a potential pilot program of such an intervention in a selection of sites with early access to the national broadband network (NBN).

1.1 Context

In 2010, Australians aged 65 or older comprised 13.5% of the population. By 2050, this share is projected to rise to 22.6%. The share of those aged 85 or older is projected to increase even more rapidly, from 1.8% to 5.1%. Health expenditure per capita rises rapidly with age (Chart 1.1), so demographic ageing will drive an increase in Australian Government spending on health, aged care and aged pensions from 7.5% of gross domestic product (GDP) in 2010 to 12.8% of GDP by 2050, according to the third InterGenerational Report (Treasury, 2010). Of this, aged care spending will more than double relative to GDP, from 0.8% to 1.8%, with a larger share going to residential care in future, on current trends.

Chart 1.1: Health expenditure by age (% relative to average per capita spending)



Source: AIHW (2009a).

Telehealth has promising potential to defray some of these health and aged care costs. But in the absence of the necessary infrastructure, progress in implementing telehealth, particularly in rural and remote areas, has been slow and disjointed.

1.1.2 Current aged care arrangements

There are a number of Australian Government programs providing assistance for aged care, including both those at home and those in institutions. There are two classes of residential care:

- low level care, which focuses on personal care services such as help with daily activities, accommodation, support services such as cleaning, laundry and meals, and some allied health services such as physiotherapy and occupational therapy. There is limited access to nursing staff.
- high level care, for those who require full-time supervised health care under the supervision of registered nurses and access to the same services as those under low care.

All community care programs could potentially incorporate telehealth services and equipment in the future. Table 1.1 compares the unit cost to the Australian Government of different care streams.

Table 1.1: Average cost per recipient of different care streams, Australia, 2009

Care stream	Cost $
HACC – Home and Community Care Program	1,868
CACP – Community Aged Care Package	11,934
EACH – Extended Aged Care in the Home	38,566
EACH-D – Extended Aged Care in the Home (Dementia)	41,021
Total – CACP, EACH and EACH-D	17,756
RAC – low care	19,963
RAC – high care	56,658
RAC – all	37,972
VHC – Veteran's Home Care	1,400
CNP – Community Nursing Program	3,924

Source: Access Economics (2010) and Department of Veterans Affairs (DVA, 2009). All costs 2008-09 except VHC, which is 2009-10. Note: These are average unit costs across all population groups and greater granularity will be incorporated into the modelling.

Access Economics (2010) estimated the relative difference between (standardised) high care and low care in the community and in residential settings:

- $11,934 to $41,021 for high care in the community compared to $56,658 in RAC high care; and
- $17,756 for all community care compared to $19,963 for RAC low care and $37,972 for all RAC.

The reasons for the difference comprise the accommodation (capital) component of the cost of RAC, and the 'free' (largely, to the Government) provision of informal care in the community.

1.1.3 The NBN rollout pilot locations

NBN Co Limited is rolling out high-speed broadband fibre-to-the-premise network to five 'first release' sites on mainland Australia as part of live trials of its network design and construction methods. The network aims to enable speeds of up to 100 Megabits per second to 93% of Australian premises and up to 12 Megabits per second to the remaining 7%.[1]

These five sites were selected as they represent the diverse situations that engineers and planners will encounter during the network rollout, with differing geography, housing type and density, local infrastructure and other factors, and representing a mix of major regional, smaller regional and differing climate and geography. Around 3,000 premises will be in each area selected, except the rural town of Willunga, where there are fewer dwellings. The sites are summarised below.[2]

1. Part of the inner-city Melbourne suburb of **Brunswick**, Victoria. The rollout is planned to cover some 2,600 premises in an area bounded by Stewart Street, Lygon Street, Glenlyon Road and Sydney Road.
2. An area of **Townsville** in Queensland's mid-north. Around 3, 100 premises covering parts of the western suburbs of Aitkenvale and Mundingburra will comprise the NBN fibre rollout area, bounded by Ross River Road, China Street, the Ross River and the Bruce Highway/Nathan Street.
3. The coastal communities of **Minnamurra and Kiama Downs** south of Wollongong, NSW. Around 2,600 premises are in the rollout area, bounded by Rocklow Creek in the north and Riverside Drive and the Princes Highway in the west.
4. An area of west **Armidale**, NSW, including the University of New England campus. Approximately 2,900 premises are in the area covered.
5. The rural town of **Willunga** in South Australia. Willunga lies between Adelaide and Victor Harbour, and the rollout will cover some 1,000 premises.

In addition, three sites in Tasmania have already been connected and are thus also included in this analysis. These three sites comprise Stage 1 of the Tasmanian NBN rollout, which began in July 2009 with completion in August 2010.[3] The sites are:

1. **Midway Point**, which is an outlying suburb of Hobart located on a small peninsula and close to the Hobart airport:
2. **Scottsdale**, which is a rural town in north eastern Tasmania, some 63kms north east of Launceston; and
3. **Smithton**, which is a small rural town in north-western Tasmania, 85kms north west of Burnie.

Of these eight sites, the three used in the modelling, as suggested by DBCDE, were Townsville, Minnamurra/Kiama, and Armidale.

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[1] http://www.nbnco.com.au/wps/wcm/connect/cb3c278043d0e67c829f82fcbbdbc23d/NBNCo_fact_sheet_our_network.pdf?MOD=AJPERES&CACHEID=cb3c278043d0e67c829f82fcbbdbc23d

[2] http://www.nbnco.com.au/wps/wcm/connect/first-release/site-base/first-release-areas, last accessed 6 October 2010.

[3] http://www.nbntasmania.com.au/index.php?Doo=PageView&id=255

1.2 Methodology

To explore how costs and benefits would accrue to different key participants in the aged care industries, the CBA considers the perspectives of:

- the aged themselves (out of pocket costs/benefits);
- the Australian economy as a whole (all costs/benefits);
- the Commonwealth budget;
- State budgets;
- other payers, such as the aged care industry and health insurance industry.

Access Economics adopted a 'PICO' approach to the prospective two-arm CBA modelling (Richardson et al, 1995):

- P – Target Population (Section 2)
- I – Intervention (Section 3);
- C – Comparator (the absence of the intervention i.e. standard care services as currently provided); and
- O – Outcomes (Section 4).

Sections 5 and 6 present the findings from the CBA modelling.

The modelling approach was developed and agreed at an initial workshop of key stakeholders held 24 September at Access Economics' head office in Canberra. The invited participants at the workshop comprised representatives from DBCDE, the Department of Health and Ageing (DoHA), the Department of Veterans Affairs (DVA), the Commonwealth Scientific and Research Organization (CSIRO), the National Information and Communications Technology Australia (NICTA) and the Queensland and New South Wales (NSW) Governments.

At the workshop, Access Economics' proposed approach was discussed and inputs from participants were incorporated into the modelling framework. CSIRO also provided a presentation on relevant technologies for the intervention[4], and the main outcome measures were agreed. Other participants provided background on current telehealth initiatives underway.

The timeframe of the prospective CBA was modelled as the period for 2012-13 to 2013-14, which the workshop considered a realistic start date and duration for the trial. However, this does not preclude earlier commencement if possible. Over this period costs and benefits are measured in net present value (NPV) terms, as recommended by the Office for Best Practice Regulation (OBPR) for CBA. Real discount rates used in the calculating the NPV of benefits and costs are 7% in the base case with sensitivity analysis at 3% and 11%, in accord with OBPR recommendations (OBPR, 2007:120).

Although the intervention is modelled as continuing for two years, ideally the trial should go for three to five years. However, there are very few telehealth studies that provide more than

[4] CSIRO is conducting trials of telehealth, e.g. the Care Assessment Platform tele-rehabilitation randomised controlled trial, see http://aehrc.com/cap/

24 months of data, very few that provide useable cost data, and none identified with both. Some studies that evaluated benefits over longer periods found that they dwindled after the first two years. For example, Jia et al (2009) found that reduced hospitalisations were significant in the first 18 months, but the differences between the intervention and control groups were not significant after this period in their four year study. Jia et al (2009) note that this result may be due to the fact that the control group had more deaths than the treatment group during the initial 18 months, which likely resulted in the groups' decreased average number of hospitalisations during the rest of the follow-up period.

This prospective CBA is indicative. If the initiative progresses to an actual pilot proposal design, there will naturally be more detailed development and discussion of design parameters and practical arrangements for the trial in line with the principles that have been introduced. . For example, if the pilot goes ahead there needs to be a strategy in place to address continuity of care for participating clients at the conclusion of the pilot, which would be particularly relevant if the pilot period is not extended. There are also assumptions in relation to interaction with existing aged care arrangements which require more detailed consideration.

2 Target population

The relevant population was estimated as those people (excluding veterans)[5] aged 65 years and older living in the community, based on the Access Economics demographic model (which in turn is based on data from the Australian Bureau of Statistics (ABS) Series B projections) as at end-June of the relevant year (i.e. 2013 for the pilot program). Of these people, only those with particular chronic diseases were included in the target population – the eligible conditions being:

- cardiovascular disease (CVD), with a prevalence of 22.8% in the 65+ population;
- diabetes, with a prevalence of 9.31% in the 65+ population; and
- chronic obstructive pulmonary disease (COPD), with a prevalence of 17.63% in the 65+ population.

In total, almost half (49.7%) of Australia's elderly have at least one of these conditions[6]. The conditions were chosen for a number of reasons.

- Having chronic heart diseases, chronic lung diseases and diabetes (or combinations thereof) are the criteria for entry into the United States Department of Veterans' Affairs (US DVA) telehealth program. This is the largest and longest running telehealth program in the world, having operated over the best part of a decade. There are a wealth of published studies on the program[7], and US DVA even makes de-identified patient data available online for researchers. A potential outcome of a telehealth pilot would be a national rollout of telehealth in Australia, and due to the similarity of context and richness of data, much of this modelling is based on the US DVA program experience.
- Of US veterans, the 2% who accounted for 30% of US DVA health expenditure had these diseases. Patients selected for the initial US DVA telehealth program had consumed on average, over US$25,000 of health expenses in the previous year (Kobb, 1996).
- Veterans with these conditions in the US are at high risk of early admission to residential aged care (RAC). It is an explicit aim of the US DVA program to allow veterans to age at home as long as possible. This is because elderly people prefer to remain at home, and also because US veterans go to US DVA nursing homes, which cost the Department many times more per person than its telehealth program does. One of the principle aims of this trial too, would be to help elderly Australians to remain in their own homes.
- The Australian DVA has a (non telehealth) care coordination program, which is designed to reduce preventable hospital admissions in the veteran population (DVA, 2009). This program also targets chronic heart and lung diseases and diabetes. One of the principle findings from the US DVA program is that technology, of itself, is not enough; there also need to be care coordinators who monitor the telehealth data and then make

[5] Note: while DVA publishes projections of the veteran population, these are not disaggregated by age. Accordingly, it is assumed that the percentage of the elderly who are veterans will be the same in 2012-13 as currently.

[6] Prevalences are from the Australian Institute of Health and Welfare (Begg et al, 2007). The AIHW only records persons by their primary condition, however it likely that many elderly have multiple chronic conditions. More than a third (36%) of patients in the US DVA program have multiple comorbidities. (Darkins, 2008).

[7] Darkins (2008) is an excellent example.

appropriate interventions. The care coordinator aspect of this trial is modelled on the Australian DVA program.

As one of the major aims of the trial is to help the elderly to stay living in the community, those already in RAC i.e. 5.4% in 2009 (Access Economics, 2010a) are excluded from the intervention population.

As veterans (6.2% of the Australian elderly[8]) belong to another similar proposed pilot trial, they are also excluded from this intervention population.

This intervention population was matched with a theoretical control group in nearby non-NBN areas, assuming that both groups are representative of the population in the area.

In line with the workshop view, it was assumed that people with these conditions are able to be identified in practice through GPs and hospital specialists, and thereby referred into the intervention group or into the control group. Patient compliance with the intervention was assumed to be 100%, based on the literature which suggested that 94% to 96% of patients were able to use the technology, and liked to do so (Huddleston and Kobb, 2004; Philips Home Health Care Solutions, 2008)[9]. Pare et al (2007) observed that 'regardless of their nationality, socioeconomic status, or age, patients comply with telemonitoring programs and the use of technologies'.

- That said, telehealth is not suitable for all patients. Botsis and Hartvigsen (2008) reported that telehealth was not user-friendly for people with middle-stage or later Alzheimer's disease, because they had difficulties in learning how to use the telemedicine device. However, Botsis and Hartvigsen (2008) also specifically reported that those with non-cognitive diseases – such as in this intervention - found the devices easy to use and had high user satisfaction.

Based on these assumptions, the estimated target population is shown for each site in Table 2.1, representing the maximum for a pilot intervention.

Table 2.1: Maximum target population: people 65+ excluding veterans with chronic disease

	Premises	Persons	Elderly (65+)	'Chronic' elderly in community	Maximum trial arm (excludes veterans)
Townsville	3,100	6,217	951	447	420
Armidale	2,900	5,816	890	419	393
Minnamurra/Kiama Downs	2,600	5,215	798	375	352
Total	**8,600**	**17,248**	**2,638**	**1,241**	**1,165**

Source: Premises, Section 1.1.3. Persons, ABS demographic data. Persons per premise are derived as 2.0 based on ABS information on persons per premise, and allowing for non-dwelling premises. Chronic' population includes only those with CVD, diabetes and COPD. 'In community' means those people not living in nursing homes.

[8] DVA data were provided under a special data request for each site in the separate the veteran report, but the Australian average was used in this report as some eligible veterans would be under 65 years old.

[9] In other cases, carers helped patients to use the technology. Huddleston and Kobb (2004) also report that 100% of participating GPs and nurse practitioners believed telehealth benefited their patients, and would continue recommending it to other patients.

3 Intervention

Access Economics reviewed potential interventions including those used by the US DVA Telehealth Program. In 2008, the program serviced around 35,000 veterans at home, provided nearly 50,000 unique patient tele-consultations, and used store and forward telehealth for over 120,000 veterans (mostly retinal screening)[10].

In line with the workshop's view, it was assumed that the intervention would be able to be delivered through coordinated care as an extension to existing services provided under current aged care services programs (HACC, CACP, EACH, EACH-D).

For the purposes of modelling, it is assumed that the intervention will be applied in first release NBN intervention areas only (Armidale, Kiama and Townsville). However, this should only be regarded as indicative. It is possible that the intervention may not be able to be applied in all selected first round areas. Alternatively, by the time the actual trial gets underway, there may be several suitable second round NBN rollout areas available.

3.1 Intervention equipment and services

The intervention selected, on the basis of evidence of efficacy, supplies two principal components of telehealth: telemonitoring and teleconsultation.

Telemonitoring: Most of the US DVA studies of telehealth assess the effects of fairly rudimentary telemonitor devices that utilise Plain Old Telephone Services (POTS), because most US veterans did not have computers and could not afford broadband, especially early on when the US DVA started its program in the early 2000s. The main unit asks a series of daily questions, which the elderly can press various buttons to answer. There are also several peripherals which can be utilised where appropriate, such as scales, peak flow metres, and glucose and blood pressure monitors.

Teleconsultation enables face to face consultation between the patient and their care coordinator, GP and/or other medical professionals. Because both the equipment and data transmission costs were relatively high in the past, most telehealth studies modelled this intervention in the setting of large facilities, such as between remote and urban hospitals, or correctional facilities and doctors' practices. In this report, most of the teleconsulting parameters are based on estimates from the Center for Information Technology Leadership (CITL), a US study which appears to be the only extant attempt to model nation-wide implementation of teleconsultation (Cusack et al, 2007).

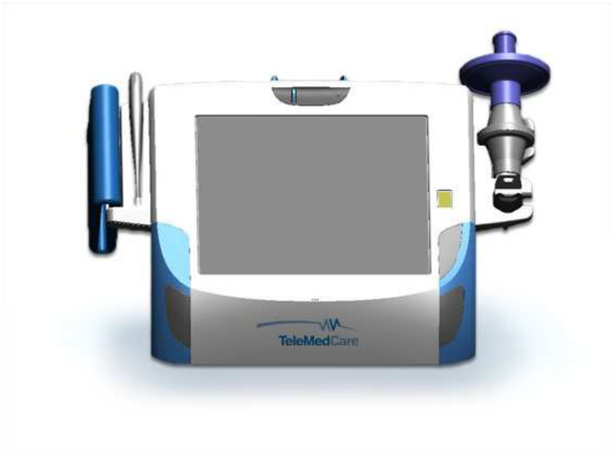
For the purposes of this report, it is assumed that both telemonitoring and teleconsulting are provided through a single device – specifically, a TMC Health Monitor, made by an Australian company called TeleMedCare (see box below)[11].

[10] http://www.carecoordination.va.gov/activity/index.asp

[11] This study only provides an illustrative cost benefit analysis for a potential intervention. If the pilot trial proceeds, the actual intervention(s) will be determined systematically.

TMC Health Monitor

The TeleMedCare Health Monitor lies at the core of the TMC Home, TMC Care and TMC Clinical solutions.



The TeleMedCare Health Monitor has been designed for optimal accessibility. Its intuitive touch screen user interface has been designed to be used by the elderly and chronically ill following many years of research with a range of users in a range of environments. Other key features include video conferencing and messaging capability. (http://www.telemedcare.com.au/index.php/equipment)

The system has the functionality and devices to measure and record the following:

- Weight
- Body temperature
- Blood pressure
- Blood oximetry
- Blood glucose
- Spirometry (lung function)
- Electrocardiogram - ECG (heart function)
- Questionnaires
- Scheduling
- Health Diary

While this report is costed using a TeleMedCare device, there are other options. For example, Bosch's Health Buddy device, which is the mainstay of the US DVA telehealth program, but does not do video conferencing, could be combined with Cisco's Umi home video conferencing device. This American device (soon to be available in Australia) has very high resolutions

(1080p) that are advantageous for visual triage, but requires upload speeds which are currently available only with the most expensive cable modem packages or fibre-optic services[12]. However, such upload speeds would become widely available in Australia under the NBN rollout. Such high speed, high resolution videoconferencing devices could confer other benefits through multi-functionality, such as allowing the elderly to continue to work by telecommuting.

Figure 3.1: Health Buddy, non-video home telemonitoring device

Source: http://www.bosch-telehealth.com/content/language1/html/5661_ENU_XHTML.aspx

Figure 3.2: Umi, high resolution home videoconferencing

Source: http://home.cisco.com/en-us/telepresence/umi

TeleMedCare (or whichever device is eventually selected) would collect, maintain, and transmit the intervention group's healthcare data to the chosen healthcare coordinator.

[12] http://www.cnbc.com/id/39540147/Cisco_to_sell_videoconferencing_box_for_the_home, accessed 29 Oct 2010.

At the GP surgery, the videoconferencing equipment is assumed to be more sophisticated – specifically, a Tandleberg 990 MXP, as used by Queensland's Statewide Telehealth Service. However, such devices are also assumed to have a variety of roles; and only 50% of the utilisation of this equipment is assumed to be for trial participants.

Following the telehealth workshop, Access Economics believes that the most appropriate healthcare would be provided by the health professional closest to the person i.e. the person's local GP in collaboration with a nurse coordinator. US DVA data (Darkins et al, 2008) shows that a nurse coordinator can effectively monitor 100 to 150 veterans on an ongoing basis. Thus, recalling Table 2.1, most NBN sites would only need one or two such coordinators to monitor their local intervention group.

The intervention is modelled as continuing for two years. Ideally, the trial should go for three to five years. However, there are very few telehealth studies that provide more than 24 months of data, very few that provide useable cost data, and none identified with both. Moreover, the AIHW (2009) study on the progression of the elderly from HACC to RAC only covers two years. Accordingly, in the absence of better data, Access Economics considers that it could not perform robust modelling of a telehealth trial beyond two years' duration.

- Access Economics would strongly recommend that six to twelve months before the trial finished, its costs and benefits should be reviewed, with a view to extending the trial for a further 12 to 36 months, should it be showing promise at that point.

3.2 Intervention costs

As the trial is only modelled as continuing for two years, costs are only modelled for two years and then costs cease. All costs are expressed in constant 2010-11 dollars.

3.2.1 Cost of the care coordinator

DVA's preventable admissions project (DVA, 2009) provides a payment of $417.50 per veteran per quarter to participating GP practices with nurse coordinators. There is also a $400 sign on bonus per veteran.[13]

By way of triangulation, the cost differential between US telehealth programs that have coordinators (e.g. Darkins et al, 2008) and those that do not (e.g. Litan, 2008), is around $1,000 US per patient per year. On a purchasing power parity basis, and allowing for inflation differences, this amount is close to the A$1,670 per year under the Australian DVA scheme. Accordingly, Access Economics believes that the Australian DVA payment is a reasonable proxy for care coordination in this trial.

- Overseas surveys of telehealth show that GP 'buy in' is very important for success. For example, in Philips Home Health Care Solutions (2008) survey of 167 providers of telehealth, around two thirds had developed strategies specifically to obtain physician buy in.

[13] The sign on bonus is split over the intervention for modeling purposes, to enable constant annual costs. As the project is a new program, these figures may have changed by the time of the actual trial.

- Coordination does not necessarily need to be provided through a GP service. The pilot design should consider suitable, flexible arrangements for community provision of coordination services.

> In total the coordination cost is thus $2,070 in the first year and $1,670 in the second year, with a NPV of $3,393.22 in 2010-11 dollars.

3.2.2 Cost of equipment

The TMC Health Monitor costs around $3,000 to purchase[14].

- The New England Healthcare Institute (2009) reports that most telemonitoring devices come with basic attachments such as scales and glucose metres. Accordingly, no allowance has been included in the costing for such peripherals.

Ongoing data management services cost $1,200 per year (including software upgrades).[15]

The video conferencing equipment at the GP practice (the Tandleberg 990 MXP) is assumed to cost $10,000 (Kennedy et al, 2008). Half of this is for the purposes of the telehealth pilot trial (i.e. $5,000), and each unit is assumed to support 100 participants (at a cost of $50 per participant)[16].

> In total the equipment cost is thus $4,250 in the first year and $1,200 in the second year, with a NPV of $ $5,020.09 in 2010-11 dollars.

3.2.3 Cost of data transmission

The only internet service provider (ISP) to have actual 'live' NBN pricing plans up and running as at the time of drafting is iinet in Tasmania. Their basic plan 'NBN-1' costs $39.90 a month. This includes 20 gigabytes of downloads at 100 megabits per second (8 Mps upload) and all domestic phone calls, which is adequate for weekly video teleconsultations.

[14] Source: Personal communication with TMC (Graham Douglas). Costs vary by quantity, length of contract and bundled equipment and services. In the actual trial, the issue of what to do with equipment provided to participants who die or become institutionalised may have to be considered, and what to do with equipment at the end of the trial if it does not continue.

[15] This figure is based on the assumption that both equipment and data management services are provided by TeleMedCare. Costs may differ with other data management service providers, or if multiple providers of equipment and data management are used. However, the workshop view was that any such differences should not be substantial.

[16] Medicare rebates for online consultations will have come into effect by 2011, with associated financial incentives for GPs to purchase telehealth equipment. This, coupled with high speed broadband in the trial areas, should lead to reasonable demand for telehealth services between GPs and non-trial patients in hospitals, specialists, allied health and nursing homes in the trial areas. Accordingly GP videoconferencing equipment is assumed to be shared equally between trial and other telehealth services.

In total the data transmission cost is thus $478.80 in the first year and the second year, with a NPV of $ $865.68 in 2010-11 dollars.

3.2.4 Summary of intervention costs

The cost per person for the intervention was estimated to be $9,278.99 in NPV terms over the two years (Table 3.1).

Table 3.1: Intervention costs, per person ($2010-11)

Component	NPV	2012-13	2013-14
Coordination costs	3,393.22	2,070.00	1,670.00
Telemonitoring device	2,803.74	3,000.00	
Data management service	2,169.62	1,200.00	1,200.00
Videoconferencing	46.73	50.00	
Data/voice cost for patients	865.68	478.80	478.80
Total	**9,278.99**	**6,798.80**	**3,348.80**

Source: Access Economics calculations.

The NPV of the intervention costs for aged people excluding veterans living in the community would be $10.8 million ($9,278.99*1,165 people), with $7.9 million of this in 2012-13 and $3.9 million in 2013-14 (undiscounted).

In addition, allowance needs to be made for program overheads and reporting on the control arm. The Australian National Audit Office reports that administrative costs are between 2% to 18% for Commonwealth programs[17]. A mid-range estimate of 10% is assumed here, split evenly between monitoring the control arms and central administration / overheads[18]. This yields an estimated cost of $1.08 million in NPV terms. However, in the CBA this nets out, since half would be allocated to the intervention and half to the control.

3.2.5 Total costs by who bears them

For this prospective evaluation of a potential pilot, it is assumed in the base case that the Australian Government bears the costs. In the sensitivity analysis, costs are allocated as per the spread of financial benefits.

While the Australian Government may pay the cash cost of the initial trial, if telehealth is to be implemented nationally it is important that costs be shared with other beneficiaries (for example state governments, private and non-profit hospitals, GPs and other health

17 http://www.archive.dcita.gov.au/2006/06/networking_the_nation/evaluation_of_networking_the_nation/review_of_the_administrative_efficiency_of_networking_the_nation_program_-_final_report/3._program_governance__administrative_processes/3.7_performance_indicators_and_benchmarking_efficiency

18 This would include any preliminary research or other administration costs (e.g. for interoperability, multiple vendors, evaluation) necessary to set up the trial.

professionals, and possibly the higher income elderly.) Equally however, for this to occur on an equitable basis, an important aspect of the trial will be to define and measure telehealth activities and their associated costs. Queensland Health's Telehealth Data Management Project (Queensland Government, 2010) has been established to do just that, and would provide a useful role model in this regard.

4 Outcomes

Four key outcome measures were agreed at the workshop, subsequently grouped as follows:

1. hospitalisation rates and other health expenditures – importantly GP costs;
2. displacement of other community services, notably informal care burden and transport costs;
3. admission to RAC and hence impacts on formal sector community care services; and
4. quality of life, measured in disability adjusted life years (DALYs) and converted to dollars using the value of a statistical life year (VSLY).

Additional outcome measures (e.g. health workforce productivity) would be important to include in an actual pilot evaluation, but were out of scope for this prospective indicative CBA. For example, tele-nursing may provide more visits to the elderly for a given cost level: 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.

Efficacy and cost data for outcomes were sourced from a variety of literature and data as outlined in the sections below.

4.1 Health system expenditure

Hospitalisation rates under the comparator were modelled as per current rates by age and gender. Under the intervention, evidence from the literature has been used to assess the efficacy of telehealth in reducing hospitalisation rates e.g. Dansky et al (2001).

Access Economics has previously estimated the costs of COPD (2008), diabetes (2006) and CVD (2005). Per person costs from these reports are updated to 2010-11 dollars, using AIHW (2009a) estimates of health cost inflation (Table 4.1).

Table 4.1: Health system expenditure per person per annum, selected diseases ($2010-11)

Component	CVD	COPD	Diabetes
Hospitals	9,001	252	407
Medical services	2,355	37	258
Pharmaceuticals	4,567	135	330
Other	820	32	282
Total health spending	**16,742**	**457**	**1,276**

Source: Access Economics (2008, 2006, 2005).

For the 1,165 people in the control arm (534 with CVD, 218 with COPD and 413 with diabetes), this leads to expected annual health costs of $9.6 million per annum, of which hospital costs would be $5.03 million, medical services $1.37 million, pharmaceuticals $2.60 million and other health costs $0.56 million per annum.

While the literature provides efficacy parameters for telehealth with respect to hospitalisation and pharmaceutical consumption, there is no parameter for 'medical services', so aggregated.

However, there are parameters for the individual components of medical services. Access Economics (2005) estimated a detailed breakdown of medical services costs for CVD. While such a breakdown is not available for COPD and diabetes, given that CVD accounts for the great majority of chronic disease costs, it may be reasonable to extrapolate from CVD to these other two diseases. GPs and specialists account for the majority of medical expenditure (Table 4.2).

Table 4.2: Estimated breakdown of medical costs in the NBN control arm ($2010-11)

Component	% of CVD expenditure	Estimated control expenditure ($ '000 pa)
GPs	40.5%	554.9
Imaging	11.1%	152.2
Pathology	19.3%	264.6
Specialists and other	29.1%	399.6
Total medical costs	**100.0%**	**1,371.2**

The impact of telehealth on GP visits is somewhat problematic. Some unnecessary visits are avoided, but equally, some problems that might have otherwise resulted in hospitalisation are instead dealt with by physicians. Taking a simple average from Access Economics' literature search yields a marginal reduction (4%) in GP consultations under telehealth (Table 4.3).

Table 4.3: Reported impact of telehealth on GP consultations

Authors	Intervention	Disease	Change in visits compared to control
Johnston et al (2000)	Video visits	Heart disease, lung disease, diabetes, chronic wounds	+12%
Meyer et al (2002)	Physiological monitoring, video visits, messaging	Heart disease, lung disease, diabetes, chronic wounds	-20%
Noel et al (2004)	Physiological monitoring, remote wound camera	Heart disease, lung disease, diabetes, chronic wounds	+10%
Trappenburg et al (2008)	Remote messaging	Lung disease	-17%
Huddleston and Kobb (2004)	Remote messaging	Heart disease, lung disease, diabetes, chronic wounds	-4%
		Simple average	**-4%**

After reviewing the literature, Cusack et al (2007) report that teleconsulting reduces diagnostic testing by 44.9%. This parameter is applied to pathology and diagnostic imaging. Cusack et al (2007) also report that teleconsulting, where it is used, reduces face to face specialist visits by 49%. This parameter is applied to 'specialists and other'. In aggregate, the expected impact of telehealth is a 29.5% reduction in medical expenditure for the intervention arm, a saving of around $405,000 per annum (Table 4.4).

Table 4.4: Impact of telehealth on medical services ($2010-11)

Component	Control ($'000 pa)	Reduction under teleconsulting	Intervention ($'000 pa)	Savings ($'000 pa)
GPs	554.9	4.0%	532.7	-$22.2
Imaging	152.2	44.9%	83.9	-$68.4
Pathology	264.6	44.9%	145.8	-$118.8
Specialists	399.6	49.0%	203.8	-$195.8
Total medical	**1,371.2**	**29.5%**	**966.1**	**-$405.1**

Source: Cusack et al (2007), Table 4.3 and Table 5.2.

The impact on hospitalisations is one of the most widely reported aspects in telehealth studies. Whether measured by emergencies, general admissions or bed days, the average impacts are much the same, roughly around 45% to 55% reductions. For this exercise, a simple average across all reported reductions of 51.3% is utilised (Table 4.5).

Table 4.5: Reported reductions in hospitalisation outcomes under telehealth

Source	Emergency	Admissions	Bed days
Barnett et al (2006)	25%		
Britton and Hoggard (2008)	69%	71%	
Brookes (2005)		72%	
Cherry et al (2002)	34%	32%	
Darkins et al (2008)		19%	25%
Denholm (2008)*	100%		
Huddleston and Kobb (2004)	54%	43%	
Jerant et al (2001)		84%	
Litan (2008)	55%	38%	
Meyer et al (2002)	40%		60%
Average	**53.9%**	**51.3%**	**42.5%**

* Denholm (2008) cites a 100% reduction in ED visits over six months, which is high compared to other estimates. The reference is from grey (unpublished) literature (a webinar) and the weblink in the New England Healthcare Institute is no longer functional. However, since the average admissions rate is 51.3% also (using high quality studies), and admissions are likely to drive costs, the overall efficacy figure of 51.3% was considered acceptable.

Finally, Huddleston and Kobb (2004) also report that the introduction of the telehealth program in the US led to a 38% reduction in expenditure on pharmaceuticals. It is interesting to note that Huddleston and Kobb also report a 50% improvement in medication compliance. Presumably this means that there was a substantial reduction in wasted medications. Similarly, Smith et al (2007) found that telemonitoring improved compliance even in patients with dementia. Compliance rates improved to 81% under telehealth, against 66% in the control group. Further, compliance remained at this level at 12 month follow up in the telehealth group, whereas it declined in the control group.

Combing all the above information sources yields an expected total saving for the telehealth intervention of $4.4 million per annum (or 46%), see Table 4.6.

Table 4.6: Impact of telehealth on health expenditure

Health cost item	Telehealth effect	Control	Intervention	Difference
		$2010-11m pa		
Hospitals	-51.3%	5.0	2.4	-2.6
Medical services	-29.5%	1.4	1.0	-0.4
Pharmaceuticals	-54.7%	2.6	1.2	-1.4
Other		0.6	0.6	0.0
Total health spending		**9.6**	**5.2**	**-4.4**

Note 'Other' includes components such as allied health and capital expenditure. As no parameters are available to estimate the impact of telehealth, conservatively, it has been assumed to be zero[19].

Public hospital costs borne by government are estimated to be borne 60% by the Australian Government and 40% by the state and territory governments, in line with current policy directions. Private hospital, medical, pharmaceutical and other costs are shared between payers as estimated in AIHW (2009a).

The shares from AIHW (2009a) and those utilised in the modelling are shown in Table 4.7, with $2.4 million of health costs borne by the Australian government), $0.8 million by State and local government), $0.8 million borne by individuals and $0.5 million borne by other payers in the modelling.

Table 4.7: Shares of health expenditure by payers (% total)

	Australian Government	State and local government	Individuals	Other payers	Total
Hospitals (historical)	38.5%	43.6%	2.1%	15.8%	100.0%
Hospitals (future)	51.8%	30.4%	2.1%	15.8%	100.0%
Medical services	78.2%	0.0%	11.8%	10.0%	100.0%
Medications	51.7%	0.0%	47.4%	0.9%	100.0%
Other	25.7%	29.1%	24.1%	21.1%	100.0%
Total (historical)	43.2%	25.5%	16.8%	14.5%	100.0%
Total future	48.2%	20.5%	16.8%	14.5%	100.0%
Total savings ($m pa)*	**2.4**	**0.8**	**0.8**	**0.5**	**4.4**

Source: AIHW (2009a) and Access Economics assumptions for future public hospital shares. * Note that the savings do not follow the same shares as the total as the composition of savings is quite different from the overall composition of Australian expenditure.

[19] 'Other' also includes nursing home expenditure, but this has been netted out, as RAC is dealt with separately in this model.

4.2 Informal care and transport costs

4.2.1 Informal care costs

Access Economics usually reports on a range of indirect costs in its cost of illness models, including the impact of diseases on productivity, lost taxation revenue, increased welfare expenditure, and the deadweight losses caused by government transfers. However, conservatively, Access Economics has assumed that anyone who is over 65 and has one of these chronic diseases will not be working, so the model has no losses in output or taxation revenue. Similarly, as pension eligibility is determined by age for this group, rather than disability, the model also has no impact on welfare payments or deadweight losses.

However, there is one category of indirect cost which is important in this analysis – carer costs.

While a number of international studies report that telehealth has a beneficial impact on carers (for example, Nichols 2008), only one reports a numerical impact (Access Economics, 2008a). The reported reduction in carer hours per week under this telemonitoring project was 27.1%.

- The annual cost of informal care for people with CVD was estimated in Access Economics (2005) as $847 per person, while for COPD the cost was $3,138 per person Access Economics (2008) and for diabetes $5,430 per person (Access Economics, 2006). All of the carer cost is allocated to 'other' payers – i.e. the friends and family of the person with the chronic disease, with the total being $3.4 million per annum.

Table 4.8: Impact of telehealth on informal carer costs, by chronic condition ($2010-11)

	CVD	COPD	Diabetes	Total
Informal care cost per person ($ pa)	847	3,138	5,430	
Number of people	534	218	413	1165
Total cost, control arm ($m pa)	**0.5**	**0.7**	**2.2**	**3.4**
Effect size (%)				27.1%
Cost in intervention arm ($m pa)				2.5
Difference ($m pa)				**0.9**

Source: Access Economics (2008a, 2008, 2006, 2005).

4.2.2 Transport costs

Due to lack of data from elsewhere, DVA and Queensland health data are utilised in estimating transport costs. DVA provides full reimbursement for reasonable transport, meals and accommodation costs for veterans who need to travel for health services. For our purposes, the advantage of this approach is that it provides a measure of the actual costs that people incur when they need to travel for medical reasons.

- A number of States provide some subsidies for people who need to undertake medical travel, but it is usually only a fraction of the private costs incurred. For example, Kennedy et al (2008) calculates the average private costs for Queenslanders who need to travel over 50 kms for appointments (the minimum qualifying distance) at $289 per visit. The average Queensland Health subsidy is $57, or 19.7% in part payment of costs.

In 2009-10, DVA spent $152.5 million on veteran's medical travel costs. Across 394,810 veterans, that translates to $386 per veteran per year. This estimate is used in the model to calculate per capita costs in the control arm and, in total for 1,165 people, $0.45 million per annum.

- This may underestimate the value of telehealth, as the above figure includes no allowance for the cost of time lost in travelling. Studies into travel costs often use the minimum or average wage rate as a proxy for the value of time. While such a proxy is inappropriate here, as the intervention population is largely not working due to age, there is still an opportunity cost for their leisure time that is not captured in this model.
- Similarly, the model does not account for other time costs associated with physical visits, such as time spent in GPs waiting rooms or emergency departments.

Kennedy et al (2008) calculates that 12% of consultations at the Toowoomba base hospital's Pre Admissions Clinic are conducted by teleconsultation – representing a saving of over 800 kilometres for some of the remote population the hospital serves. According to the Census, some 28% of Queenslanders live in locations smaller and / or more remote than Toowoomba (i.e. Rural Remote and Metropolitan Area categories 4 to 7). Thus, the 12% of patients who teleconsult suggests a reasonable proportion of those who might otherwise travel (12/28 = 42.9%). The model thus assumes that telehealth can save 42.9% of travel costs.

Thus, telehealth is estimated to save a total of $0.19 million dollars in transport costs for the intervention arm (Table 4.9), 19.7% assumed to be borne by state and territory governments and the remainder by the individuals themselves.

Table 4.9: Impact of telehealth on transport costs

Cost item	Telehealth effect	Control	Intervention	Difference
		$2010-11m pa		
Transport costs	-42.9%	0.45	0.26	-0.19
Borne by state/territory government				0.04
Borne by individuals				0.15

Source: Access Economics calculations based on DVA and Queensland Health data.

4.3 Admission to RAC

RAC admission rates under the comparator were modelled as per current rates. Under the intervention, evidence from the literature was used to assess the efficacy of telehealth in reducing RAC admission. RAC costs were based on Table 1.1 (Access Economics, 2010).

One of the principal ways that telehealth could delay transition to RAC is through providing some substitute for carers. Lack of a partner to help with some activities of daily living (ADL) is a major factor in otherwise relatively healthy aged persons being institutionalised. The gap is widening between those who have a carer and those who require one. By mid-century, there will be 1.23 million Australians aged 65 and older with profound or severe core limitations, but only around 480,000 will have a primary carer. By providing regular video visits (supplementing physical visits) tele nursing could provide services to prevent institutionalisation due to absence of a carer.

The AIHW (2009) undertook a study of how elderly people progressed through the care system. The Institute followed a cohort of 77,000 elderly who had an ACAT assessment in 2003-04, and who had not previously used aged care which required an ACAT assessment (e.g. CACP or RAC). The cohort was then followed for the next two years.

However, the majority of this cohort (55%) had previously used HACC or VHC (which do not require an ACAT assessment). Given that the target group for this intervention are those who are still at home, but at risk of RAC admission due to having chronic disease, the sub cohort with previous HACC/VHC was chosen as representative for this study.

In total, there were over 10,000 pathways that the cohort took through the aged care system (people could change to higher and lower care levels, and back again, multiple times through the period). However, the top 14 most common pathways accounted for 82% of the cohort members. These pathways are sorted by end state in Table 4.10.

- Pathways ending up in EACH, EACH-D, or Respite RAC are not included in the top 14 pathways published by the AIHW, as each of these pathways accounted for less than 1% of the cohort. Hence it is assumed that EACH and EACH-D are amalgamated into the CACP end state, and Respite RAC into the RAC end state, for costing purposes.
- The AIHW did not measure whether the elderly were actually using HACC/VHC at the time of their ACAT assessment, only whether they had used such services (concurrently or previously). The model assumes, however, that such persons were utilising HACC/VHC at the time – due to lack of alternative data. Of this group, 14% recorded no change in status over the two year period, so the model similarly assumes that these people remained on HACC/VHC.

While the majority of this group (52%) had progressed to RAC within two years (of whom a third died there), a substantial proportion (48%) remained at home (with less than one third dying at home).

- For the purposes of the model, those who change state (e.g. from HACC to RAC) are assumed to spend 50% of the follow up period in each state. This also applies to those whose change of state is from life to death. Those who change care states and then die are assumed to spend 50% of the time that they are alive in each care state.

Thus, for the 1,165 persons in the control arm (at the start), and using the aged care service costs provided in Table 1.1, expected total aged care costs after two years are $22.04 million, with around 90% of these costs accounted for by those admitted to RAC (Table 4.10).

Table 4.10: Pathways through aged care for people and control arm costs

Aged care status	End state after two years	Persons	End state 2013-14 cost per capita ($2010-11)*	Total costs over 2 years ($m)
Use of HACC/VHC, still alive	30.0%	350	1,868	1.31
Use of HACC/VHC, deceased	13.9%	162	0	0.30
Progressed to CACP, still alive	4.3%	50	11,934	0.69
Progressed to RAC, still alive	34.1%	397	37,972	15.80
Progressed to RAC, deceased	17.7%	206	0	3.93

Aged care status	End state after two years	Persons	End state 2013-14 cost per capita ($2010-11)*	Total costs over 2 years ($m)
Total	**100.0%**	**1,165**		**22.04**

Source: AIHW (2009). * From Table 1.1.

- The AIHW (2009) does not distinguish between those who receive HACC only and those who receive VHC only. However, it does note that 40% of those who received VHC also accessed HACC. Hence, while VHC is around 30% cheaper than HACC, because of this double dipping, and lack of a split, it was assumed that the average cost of those in the 'HACC/VHC' category is same as the cost for HACC.

Next, we turn to the question of the impact of telehealth upon RAC admission. Despite there being nearly 10,000 studies on telehealth published by 2008 (Rojas and Gagnon, 2008), our literature search could only uncover four which yielded quantitative efficacy estimates[20]. Three of these references utilised US DVA data which, given the size and length of that program, means the data should be fairly reliable. On average, telehealth resulted in a 69% reduction in nursing home admissions. While two studies only covered respite RAC, the average efficacy actually increases slightly without them. While at first glance this seems fairly high, Brownsell et al (2007) report that telehealth is efficacious for two thirds of the top three dozen causes of RAC entry in the UK – and for three quarters of the top dozen reasons for admission.

Table 4.11: Estimates of impact of telehealth on RAC admission

Study	Reduction vs control	Comments
Finklestein et al (2006)	58%	Teleconsultation, 6 months
Meyer et al (2002)	77%	US DVA, 2 years
Bendixon et al (2009)	53%	US DVA, 2 years, bed days (respite RAC)
Harris et al (2007)	88%	US DVA, 2 years, bed days (respite RAC)
Average	**69%**	

In the model, this parameter (69%) is used to calculate the reduction in people who progress from HACC/VHC to CACP or RAC. [21] Telehealth is presumed to have no impact on mortality rates here – to avoid double counting as this is modelled in the next section. In summary, telehealth is presumed to keep around a quarter (26.5%) of people at home who otherwise would have had to go to RAC or CACP (Table 4.12).

[20] Bayer et al (2007) model the impact of telehealth on RAC admission, but using a 'systems dynamic approach' which, while employing a range of plausible parameters, does not actually use any real world data. Their model does still show a 'very substantial drop in institutional population'.

[21] Bayer et al (2007) observe 'it can be expected that telecare will be more effective in preventing admission to institutional care from the medium frailty category than from the high frailty category since very frail patients are likely to need either more frequent hands on help, or a quicker response in case of a crisis than can be provided in a home setting without the permanent presence of a carer'.

Table 4.12: Impact of telehealth on aged care status (%of population)

State	Control	Intervention	Difference
Use of HACC/VHC, still alive	30.0%	56.5%	+26.5%
Use of HACC/VHC, deceased	13.9%	13.9%	-
Progressed to CACP, still alive	4.3%	1.3%	-3.0%
Progressed to RAC, still alive	34.1%	10.5%	-23.5%
Progressed to RAC, deceased	17.7%	17.7%	-

Applying the costs from Table 1.1 to end state population distribution in the intervention arm yields a saving of $10.24 million (or 46.5%) over the control arm. While there is an increase in HACC/VHC costs under the intervention, this is offset several times over by reductions in RAC costs (Table 4.13). Since cost differences were largely due to higher RAC and CACP services in the control arm, the savings were assumed to accrue to the Australian Government. The cost is applied to the second year, since it is modelled on progression rates.

Table 4.13: Impact of telehealth on 2-year aged care costs ($m)

State	Control	Intervention	Difference
Use of HACC/VHC, still alive	1.31	2.46	+1.15
Use of HACC/VHC, deceased	0.30	0.30	-
Progressed to CACP, still alive	0.69	0.21	-0.48
Progressed to RAC, still alive	15.80	4.89	-10.91
Progressed to RAC, deceased	3.93	3.93	-
Total	**22.04**	**11.80**	**-10.24**

4.4 Quality of life

Quality of life is measured using DALYS (Disability Adjusted Life Years) an objective measure developed by the World Health Organization (WHO) to compare the burden of lost health across diseases. It is possible to monetise the value of healthy life lost from chronic diseases. Using a variety of market based mechanisms (such as compensation demanded in return for increased risk and willingness to pay to reduce risk) the Office of Best Practice Regulation Review (OPBR) requires Commonwealth agencies to use a value for a full year of healthy life of $151,000 (in 2007 dollars) when assessing the costs and benefits of interventions that may affect health. This enables the cost effectiveness of various approaches to be evaluated. Under WHO measures, an evaluation is highly cost effective if the cost of averting one DALY is equal to or less than GDP per capita – or around $58,681 in Australia at present[22]. Up to three times GDP per capita per DALY is still regarded as cost-effective.[23]

Access Economics (2008, 2006, 2005) studies into COPD, diabetes and CVD estimated the cost of the DALYs associated with each of these diseases in Australia. Updating these to 2010 dollars shows the burden of disease (BoD) for those with chronic illness can be quite

[22] Using ABS (2010) key national accounts aggregates, annual current price measures and population estimates are as published in Australian Demographic Statistics (Cat No 3101.0) and ABS projections.

[23] http://www.who.int/choice/costs/CER_thresholds/en/index.html, accessed 11 October 2010.

substantial (top row of Table 4.14). Applying these figures to the population in the control arm yields an expected BoD cost of $40.5 million per annum according to WHO criteria.

Table 4.14: Burden of disease in control arm, DALYs converted to 2010-11$

Disease	CVD	COPD	Diabetes	Total
Cost per person ($)	80,040	14,401	31,980	
Costs in control arm ($m)	17.1	17.4	5.9	40.5

Assessing the efficacy of telehealth on BoD prospectively is problematic. In the actual trial, there are a variety of techniques that can be employed to measure changes directly for each patient - for example, the SF-36 questionnaire utilised in Access Economics' telemonitoring study (Access Economics, 2008a)[24]. Prospectively, one could take an average of other efficacy measures (hospital admissions, GP consultations, etc) and assume that it also applied to BoD.

As an alternative approach, a handful of studies have assessed the impact of telehealth on mortality. Dang et al (2009) reported on two telehealth interventions which resulted in a 30% and a 67% reduction in mortality, respectively. Similarly, Philips Telemonitoring Services (2003) reported a 27% increase in survival from another telehealth intervention. Conservatively taking the lowest of these measures (27%) yields an estimated reduction in DALY costs of $10.9 million (once off, since a person cannot die twice). The cost is conservatively applied to the second year, and accrues to the individual.

Table 4.15: Impact of telehealth on burden of disease, intervention arm ($m)

Control	Telehealth effect	Intervention	Difference
$40.5	-27%	$29.5	-$10.9

[24] That said, Access Economics' literature study revealed only one telehealth study that had used measured dollars per DALY (Barnett et al, 2007). Not surprisingly, this also utilized US DVA data.

5 CBA model findings

5.1 Summary of costs and benefits

Costs and benefits are summarised in Table 5.1. While annual benefits of the intervention were reported in the previous section, it is not simply a matter of multiplying these figures by two to get the totals for the intervention and then calculating the NPV. An estimated 31.6% of patients are expected to die over the course of the intervention (only elderly patients with chronic diseases are chosen). Thus, in the second year, annual costs for health spending, informal care and transport are reduced by this amount to obtain totals. (Formal aged care costs and BOD were allocated just to the second year as explained in the previous chapter.)

Table 5.1: Impact of telehealth intervention, $2010-11 m

Item	NPV	2012-13	2013-14	Australian Govern-ment	State & local government	Indiv-iduals	Other payers
				NPV			
Intervention cost	10.8	7.9	3.9	10.81	-	-	-
Benefits							
Health spending	6.8	4.4	3.0	3.66	1.20	1.19	0.70
Informal care & transport	1.7	1.1	0.8	-	0.06	0.24	1.40
RAC/formal care	8.9	0.0	10.2	8.94	-	-	-
Total financial benefits	**17.4**			12.60	1.26	1.43	2.10
BoD	9.5		10.9	-	-	9.54	-
Net financial benefits	**6.6**			1.80	1.26	1.43	2.10
Financial BCR	**1.61**			1.17			

In terms of financial costs, the intervention was estimated to save $17.4 million in NPV terms, over half from reduced RAC and formal community care ($8.9 million), with a further $6.8 million in health system savings. Informal care and transport cost savings account for the residual $1.7 million. If the benefits from reduced pain and suffering are included, the total gross benefit is a further $9.5 million.

Over the course of the intervention, net financial benefits are expected to be $6.6 million. This is equivalent to a benefit-cost ratio (BCR) of 1.61 to 1 (a 61% return on investment). From the Australian Government perspective, the BCR is 1.17 to 1 (a 17% return on investment). In addition, benefits to patients in terms of improved health outcomes are estimated to be $9.5 million in NPV terms.

Including BoD, the total gross benefit of the trial is $26.9 million, with net benefits of $16.1 million, and a BCR of 2.49 to 1 (a 149% return on investment).

This range is similar to the only other BCR uncovered in the literature: Philips Telemonitoring Services (2003) reported a BCR of 2.1 for telemonitoring in Europe.

On a per-person basis, net financial benefits are $5,659 in NPV terms for the 1,165 people modelled to be in the pilot's intervention arm.

5.2 Sensitivity analysis

Four sensitivity analyses were undertaken to test the change in outcomes in relation to key parameters. Findings are presented in Table 5.2, with changes from the base case denoted in blue font.

- The first sensitivity analysis changed the **distribution of costs** to match the distribution of benefits in the base case. This did not change the overall NPV, but did change the net financial benefits by payer – increasing the net benefit for the Australian Government (to $4.77 million from $1.80 million) and reducing it for other payers, although all remained positive. Naturally, across all payers the BCR thus became 1.61 (the overall total).
- The second sensitivity analysis **reduced the discount rate to 3% per annum**. This increased the NPV of all cost and benefit items, and increased the net benefit overall to $7.2 million from $6.6 million. The overall BCR increased a little from 1.61 to 1.63 and the Australian Government BCR increased from 1.17 to 1.19. Overall the net benefit per person would increase to $6,184 (from $5,659 per person). Total benefits (including BoD) would increase to $28.9 million (from $26.9 million), and the total BCR would increase from 2.44 to 2.49.
- The third sensitivity analysis **increased the discount rate to 11% per annum**. This reduced the NPV of all cost and benefit items, and reduced the net benefit overall to $6.0 million from $6.6 million. The overall BCR fell a little from 1.61 to 1.59 and the Australian Government BCR fell from 1.17 to 1.14. Overall the net benefit per person would fall to $5,191 (from $5,659 per person). Total benefits (including BoD) would fall to $25.2 million (from $26.9 million), and the total BCR would fall from 2.44 to 2.39.

Table 5.2: Sensitivity analysis for the impact of telehealth intervention, $2010-11 m

Item	NPV	2012-13	2013-14	Australian Government	State & local government	Individuals	Other payers
				NPV			
1. Changed distribution of costs							
Intervention cost	10.8	7.9	3.9	8.10	0.80	0.87	1.04
Benefits							
Health spending	6.8	4.4	3.0	3.66	1.20	1.19	0.70
Informal care & transport	1.1	0.7	0.5	-	0.06	0.24	1.40
RAC/formal care	8.9	-	10.2	8.94	-	-	-
Total financial benefits	**17.4**	**5.5**	**14.0**	**12.60**	**1.26**	**1.43**	**2.10**

Item	NPV	2012-13	2013-14	Australian Govern-ment	State & local government	Indiv-iduals	Other payers
				NPV			
BoD	9.5	-	10.9	-	-	9.54	-
Net financial benefits	**6.6**	**-2.4**	**10.1**	**4.77**	**0.48**	**0.54**	**0.80**
Financial BCR	**1.61**			1. 61	1.61	1.61	1.61
			2. Lower discount rate (3%)				
Intervention cost	11.4	7.9	3.9	11.36	-	-	-
Benefits							
Health spending	7.1	4.4	3.0	3.86	1.27	1.26	0.74
Informal care & transport	1.8	1.1	0.8	-	0.06	0.25	1.48
RAC/formal care	9.7	-	10.2	9.65	-	-	-
Total financial benefits	**18.6**	**5.5**	**14.0**	**13.51**	**1.33**	**1.51**	**2.22**
BoD	10.3	-	10.9	-	-	10.30	-
Net financial benefits	**7.2**	**-2.4**	**10.1**	**2.15**	**1.33**	**1.51**	**2.22**
Financial BCR	1.63			1.19			
			3. Higher discount rate (11%)				
Intervention cost	10.3	7.9	3.9	10.30	-	-	-
Benefits							
Health spending	6.4	4.4	3.0	3.48	1.14	1.13	0.67
Informal care & transport	1.6	1.1	0.8	-	0.04	0.15	0.87
RAC/formal care	8.3	-	10.2	8.31	-	-	-
Total financial benefits	**16.3**	**5.5**	**14.0**	**11.79**	**1.18**	**1.28**	**1.54**
BoD	8.9	-	10.9	-	-	8.87	-
Net financial benefits	**6.0**	**-2.4**	**10.1**	**1.49**	**1.18**	**1.28**	**1.54**
Financial BCR	1.59			1.14			

Note: Blue colour signifies change from base case.

Overall, the sensitivity analysis did not affect the conclusion that there are net benefits for all participants from the proposed pilot intervention.

6 Conclusions

This analysis has estimated the costs and benefits of undertaking a pilot program for telehealth for aged Australians as agreed at the consultative workshop. The prospective CBA has been based on a number of key assumptions including that:

- the pilot program would occur in 2012-13 and 2013-14;
- the pilot program might run in three early sites indicatively;
- the benefits are limited to those itemised in this study; and
- the intervention might involve technology of similar type and cost to the telemonitoring and teleconsultation devices with associated service protocols as outlined in Chapter 3.

As such, the pilot findings are related to the demographics of the populations in the pilot areas, the relatively early timeframe of the analysis (which makes costs and benefits larger in dollar terms than for interventions further in the future), and the cost of currently available technological solutions. Any changes in these critical factors may change the findings, and there is also uncertainty regarding the nature and size of benefits. Hence it would be desirable for any pilot study to be evaluated to establish a sound empirical basis for wider rollout of telehealth interventions, and to identify and mitigate any implementational issues. As modelled, the prospective pilot evaluation modelled here has an expected financial BCR of 1.61 (1.59-1.63, with the range determined by the 3%-11% discount rate). The net financial benefit of the pilot is in the order of $6.6 million in NPV terms.

The three technology components that make up the core telehealth intervention are:

- the combined consumer endpoint that brings together video conferencing and data collection;
- the primary care desktop video conferencing unit; and
- the clinical data access/management service.

There are likely to be a number of options that either independently or combined deliver the core services and, looking beyond the pilot, it will be important to ensure that the standards for the core services are supported in a manner that opens up to the possibility of alternative technology providers into the future i.e. alternative technical connectivity solutions and alternative consumer endpoints. There could potentially be scope for lower quality protocols for direct consumer access (skype, facetime, etc) in addition to clinician-to-clinician and clinician-to-pilot participant, since specialised video conferencing units are typically expensive and not generally useful for other purposes.

To prevent being locked into proprietary technical solutions which might make it difficult to allow for alternative information uses beyond the suggested portal, the pilot itself – should it proceed – should examine a variety of potential information collection and distribution protocols as well as allow for alternative information aggregation, management and access solutions. Exposing restrictions and enablers prior to implementation would be important so that pilot results are not misinterpreted in light of scalability or capability issues.

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