The Economic Impact of an Accelerated Rollout of Broadband in Hospitals

Prepared for

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by

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"FOREWARD - - THE ECONOMIC IMPACT OF AN ACCELERATED ROLLOUT OF BROADBAND IN HOSPITALS"

In this report, Access Economics estimates the net economic benefit accruing to Australia from the deployment of broadband to major Australian hospitals currently without broadband at $190 million over 10 years. A delay in the rollout of broadband would reduce the net present value of this benefit in the order of $58 million to $87 million.

The objective of NOIE in commissioning this report has been to support the development of the National Broadband Strategy and inform the policy decisions of the National Broadband Strategy Implementation Group by contributing to the ongoing debate relating to the potential economic benefits of broadband.

The research will be of interest to policy makers in all levels of government, and to the executive and administrative officers of medical institutions and specialist clinics, and is intended to result in a deepened appreciation of the savings and improved service delivery that broadband-enabled applications are able to provide.

Health services in Australia are a significant part of the economy and the costs associated with its delivery continue to grow. Direct expenditure on health services in 2001-2002 was $66.6 billion, of which $44.3 billion was funded by federal, state and local governments. In this context, productivity benefits of more efficient health service delivery are potentially significant. Even modest productivity improvements will yield substantial ongoing economic benefit.

This research contributes to a growing body of work that suggests that broadband is able to simultaneously maintain service delivery standards and contain the economic costs associated with the provision of many essential health care services. At present, much of the delivery of online health services in Australia is achieved using narrowband platforms. This limits the quality of outcomes compared to those achievable using higher speed platforms.

The report makes a contribution to the understanding of broadband's economic impact. While the paper's findings suggest the need for further work, it appears likely broadband networks could deliver significant economic benefits. The methodology makes conservative assumptions throughout, which leave scope for larger economic benefits than those quantified here to be realised as a result of investments in broadband. Only quantifiable benefits were included. For example, of

the eight potential kinds of cost savings from telemedicine applications, only the four that were readily quantifiable were included (see page 20).

Similarly, Voice over Internet Protocol (VoIP) is seen by many of the stakeholders consulted as a key benefit of broadband, in some cases justifying the entire cost of the infrastructure. For example, the recent deployment of an IP telephony network by the South West Alliance of Rural Hospitals (SWARH) has resulted in a 40% saving on call costs, a 90% saving for video-conferencing services and a 30% reduction for travel costs.

However, NOIE and Access Economics were unable to obtain sufficient data to model an estimate of VoIP savings in this report. Nevertheless, these benefits seem likely to provide a significant additional upside to the forecast benefit.

The findings of this research are not focussed on cost savings to the government – many of the economic benefits of broadband identified in this report flow to patients through reduced travel costs, not to hospitals

The analysis has deliberately focussed on several key broadband-enabled health applications - including telepsychiatry, teleultrasound and teleradiology. The costs and service delivery benefits of these applications are particularly relevant to the Australian context and well suited to rigorous economic analysis.

Each of these applications are capable of reducing the tyranny of distance by improving the access to essential health services of many Australians living in regional and rural areas, thereby reducing the costs and emotional distress often experienced by patients travelling to major hospitals to receive medical attention. Importantly, telehealth projects in these three areas are now occurring on an increasingly frequent basis. Data from a number of these trials has provided a useful resource for the development of this report.

The rollout of broadband to general medical practices, the electronic management of patient records, voice over IP technologies and the deployment of broadband enabled remote care devices are all areas that appear particularly worthy of further exploration and cost-benefit analysis.

Data on the benefits of broadband-enabled health applications have been comparatively scarce and sometimes underestimated by government and the health sector. This study reflects an important step towards quantifying these benefits, and it is our hope that the report will pave the way for further analysis by the health-

sector of the benefits associated with the adoption of advanced network connectivity.

While predicting diffusion rates of emerging technologies is necessarily speculative, this analysis reflects a realistic estimation of observable trends. By limiting its analysis to broadband enabled applications and benefits that are currently being delivered and realised, the report provides a conservative and robust estimation of the potential value of broadband to the health sector and the community.

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EXECUTIVE SUMMARY

The National Office for the Information Economy (NOIE) commissioned Access Economics to assess the economic impact of an accelerated rollout of broadband in hospitals. This report examines the impact of a particular intervention – accelerated rollout of broadband connecting major hospitals and specialist medical centres.

Telehealth applications such as telepsychiatry and teleradiology have a strong track record of efficiently delivering clinically-effective health services to rural and regional areas. However, in spite of increasing use of broadband in some areas, there are many hospitals in Australia that do not yet have access to broadband or are still using relatively costly ISDN services (broadband is often a more cost effective alternative to the older technology of ISDN).

This report analyses the costs and benefits of five scenarios – connecting major hospitals in capital cities ('Level 1'); connecting major hospitals in each statistical division ('Level 2'); connecting major hospitals in each statistical sub-division ('Level 3'); connecting the major hospital in each town ('Level 4'), and finally, the ubiquitous scenario of connecting every hospital in Australia ('Level 5'). The rollout of broadband to GPs or individuals for at-home care is beyond the scope of the report. The numbers of hospitals connected under each scenario are:

	Level 1	Level 2	Level 3	Level 4	Level 5
Number of Hospitals	14	67	211	749	1,472

The estimates are based on detailed health data from the Health Insurance Commission, official medical workforce surveys, and the relevant telehealth literature, focussing on applications in the Australian context. Disaggregated census data is used to provide a profile of the population and health status in each statistical sub division by age and gender.

The report is not intended to be a business case. The purpose of the model is to be predictive at the national level rather than reflect the subtleties of local circumstances. It should be noted that the analysis necessarily includes a number of simplifying assumptions. Sensitivity analysis, showing the impact of changing key parameters such as travel distance and infrastructure costs on the quantum of net benefit is provided in section 6.4.

Consistent with standard cost benefit analysis, the focus is on **economic costs and benefits**, and extends beyond direct financial flows. For example, as well as direct financial costs to government or patients, the analysis includes estimates of opportunity cost of time. In particular, a large amount of the economic benefits from broadband are in the form of reduced travel times for patients. While these savings have been converted into a monetary value, they may not be captured by the individual as explicit financial flows.

Similarly, the analysis attempts to capture **costs and benefits regardless of who accrues them, from an economy-wide perspective**. That is, net benefit is assessed from a societal point of view - 'a dollar is a dollar is a dollar'. As such, it should not be confused with assessments of the impact on government budgets, or costs to particular health agencies or patients.

The methodology for estimating the economic impact of an accelerated rollout of broadband, involves three steps:

Step 1: calculate the total economic impact of broadband in hospitals if rolled out immediately.

Step 2: deduct the economic impact being generated from broadband already in place, including the costs and benefits from existing ISDN health applications, where applicable.

Step 3: estimate the economic impact of alternative rates of broadband rollout and thus the benefit of *accelerating* broadband rollout in hospitals.

Step 1 accounts for the considerable efficiencies gained by delivering some health services by broadband. Not all health services are amenable to delivery by broadband. The results are largely based on the potential savings from three relatively well established telehealth applications: telepsychiatry, teleradiology and fetal teleultrasound. Given the rapid growth in technology, other applications may use the network, although this 'upside' is not included in our report.

Major benefits accrue from a reduction in patient travel. That is, patients residing in rural and regional Australia who would otherwise travel to a capital city / major regional centre for treatment gaining access to health services via broadband, see Chapter 3 for details. The net benefit is calculated by deducting the cost of installing broadband, based on a combination of fibre, microwave and satellite technologies (depending on the location of the hospital), terminating equipment,

videoconferencing equipment and the ongoing operating costs (such as training and IT support). These costs are detailed in Chapter 2. The key results from Step 1 are in the table below:

	Level 1 & 2	Level 3	Level 4	Level 5
	($'000)	($'000)	($'000)	($'000)
Telepsychiatry benefits	71,507	91,798	103,722	103,722
Fetal teleultrasound benefits	8,332	9,719	10,606	10,606
Teleradiology benefits	14,379	210,665	312,500	312,500
Training benefits	135,614	152,589	163,062	163,062
Total Benefits	**229,832**	**464,771**	**589,889**	**589,889**
Total Costs	**143,336**	**269,282**	**617,453**	**873,250**
Total Net Benefit	**86,496**	**195,489**	**-27,564**	**-283,361**

From the analysis in step 1 the highest economic net benefit of broadband is generated by rolling out broadband to Level 3 hospitals (the largest hospital in each statistical subdivision). The impact is estimated to be $195 million over the next ten years (net present value based on a discount rate of 6%). The finding that ubiquitous broadband (Level 5 – broadband connecting every hospital) is not optimal is not surprising. Like other forms of infrastructure, a point is reached where the additional infrastructure and other costs of expanding the network are larger than the additional benefits, in terms of quantifiable savings to the economy. Indeed, the costs of the network are not justified at level 4 and level 5 under our analysis.

Relatively few hospitals already have broadband connectivity. The next step is to remove the benefits already being generated by existing broadband infrastructure. We also remove the benefits currently being generated from ISDN-based telehealth services[1] and the costs of existing spending on ISDN subscriptions that will be saved once broadband becomes available. For the optimal Level 3 scenario, the net benefit of rolling out broadband to those hospitals that do not currently have broadband is:

[1] Note that ISDN is considered by many to be below broadband standard.

	Level 3
	($'000)
Psychiatry Benefits	105,934
Ultrasound Benefits	5,633
Radiology Benefits	140,445
Training	114,601
Total Benefits	**366,612**
Total Costs	**176,663**
Total Net Benefit	**189,949**

The economic impact of rolling out broadband to Level 3 hospitals currently without a high speed connection and upgrading existing ISDN facilities to broadband is estimated to have a net present value of **$190 million over the next ten years.**

The final step is to examine an alternative pace of rollout. Four scenarios are considered: immediate rollout (while probably not feasible to achieve rollout within 12 months, this scenario is a useful benchmark); rollout over the next two years; rollout over the next four years; and, rollout over the next eight years.

The economic impact of an accelerated rollout of broadband in hospitals is:

NPV ('000) - discount rate 6%	Net Benefit	Cost of delaying
Rollout immediately	$189,949	-
Rollout takes 2 years	$160,959	$28,990
Rollout takes 4 years	$131,969	$57,980
Rollout takes 8 years	$102,979	$86,970

It is difficult to judge the pace of rollout that might occur over the next few years without further intervention. Governments are gradually increasing the number of broadband connections to hospitals. If it were to take 4 to 8 years for all Level 3 hospitals to be connected at the current pace of rollout, an intervention by government to accelerate the rollout of broadband in hospitals is likely to generate a net economic benefit in the order of $58 million to $87 million.

We highlight in the report that the quantitative estimates are sensitive to the detailed assumptions made in the course of the analysis. This includes the extent to which other policies provide an environment conducive to the rapid adoption of the new approaches made possible by broadband. The estimates are conservative in that there is a range of potential benefits from the use of telehealth that we have not quantified, including greater patient satisfaction, improvements in health outcomes and future telehealth applications. In additional, administrative use of

the broadband network are likely to provide further benefits. A substantial administrative benefit of broadband is likely to be the savings in long distance phone call costs from using Voice over Internet Protocol (VoIP). However, NOIE and Access Economics were unable to obtain sufficient data on current expenditures by hospitals on long distance phone calls, so could not include an estimate of VoIP savings in this report. These benefits are likely to provide substantial additional 'upside' to the results above.

The analysis in this report indicates that a carefully planned broadband network connecting major health care facilities has the potential to generate net economic benefits to Australia by enhancing the delivery of health services. These findings suggest there is merit in proceeding with the detailed business cases necessary to progress the rollout of broadband to hospitals in individual regions.

Access Economics

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1. INTRODUCTION

The National Office for the Information Economy (NOIE) has commissioned Access Economics to undertake a hybrid cost benefit analysis of the impact of accelerating the rollout of broadband infrastructure in hospitals.

This report estimates the impact of a particular intervention – accelerated rollout of broadband connecting major hospitals and specialist medical centres. The rollout of broadband to GPs or individuals for at home care is beyond the scope of this report.

The report is not intended to be a business case. Rather it is an attempt to derive a 'top down' aggregate estimate of the costs and benefits of broadband rollout from a national, economy-wide perspective, given existing data limitations.

In order to measure the net impact of accelerated rollout, we first measure the impact of broadband rollout in hospitals in total (gross impact) and then deduct the impact of existing broadband infrastructure on the delivery of health services in hospitals (net impact).

'Telehealth' describes the use of telecommunications infrastructure and information technology to deliver health care services at a distance. The existing telehealth networks across Australia deliver a range of health services including mental health, diabetes management, and diagnostic imaging. Many of these services currently run over ISDN lines, which could potentially run more effectively over broadband.

1.1 METHODOLOGY

A hybrid cost benefit analysis refers to the fact that some of the benefits of improved health services are difficult to measure in monetary terms (such as increased life expectancy or a reduction in pain). There is a considerable literature on methods for converting some non-monetary benefits into monetary measures, but it often results in judgements regarding the value of life. To avoid this situation, we report the benefits that are readily measured in monetary terms such as travel cost savings and provide a description of the non-monetary benefits that are also likely to occur. The results are part way between a cost effectiveness study and a cost-benefit study. Costs and benefits that occur in the before and after

scenarios are not explicitly included, as they are common to both cases. The focus is on the incremental costs and benefits that arise from the intervention.

Consistent with standard cost benefit analysis, the focus is on **economic costs and benefits**, and extends beyond direct financial flows. For example, as well as direct financial costs to government or patients, the analysis includes estimates of opportunity cost of time. In particular a large amount of the economic benefits from broadband are in the form of reduced travel times for patients. While these savings have been converted into a monetary value, they may not be captured by the individual as explicit financial flows.

Similarly, the analysis attempts to capture **costs and benefits regardless of who accrues them, from an economy-wide perspective**. That is, net benefit is assessed from a societal point of view - 'a dollar is a dollar is a dollar'. As such, it should not be confused with assessments of the impact on government budgets, or costs to particular health agencies or patients. For example, while a new telehealth facility may reduce travel costs for patients, it may involves a higher capital costs for the party who funds the infrastructure.

The raising of revenue to finance government activities is not costless. In order to finance the cost of broadband, the government can increase taxes, reduce other expenditure, or borrow the funds. We have assumed that the funds are borrowed at the government bond rate.

The discount rate appropriate for a government intervention is usually the government bond rate, provided all the risks associated with the project (construction risk and the risk of some benefits not occurring) are explicitly incorporated in the estimates of costs. This is best handled via the inclusion of a construction contingency and by ensuring the estimate of benefits uses appropriately conservative estimates of likely take-up rates, rather than penalising the flow of benefits with a higher discount rate.

1.2 STRUCTURE OF THIS REPORT

The remainder of this report is organised as follows:

- Section 2 examines the cost of broadband infrastructure and outlines a number of scenarios for broadband rollout;

- Section 3 examines the potential benefits of broadband connectivity in terms of three telehealth applications, being telepsychiatry, teleradiology and fetal teleultrasound;
- Section 4 examines the potential benefits of broadband connectivity in terms of education and training applications;
- Section 5 summarises the *gross* economic impact of broadband connectivity in hospitals (before taking account of existing telehealth activity);
- Section 6 summarises the *net* economic impact of broadband connectivity in hospitals (after taking account of existing telehealth activity); and
- Section 7 summarises Access Economics' conclusions.

2. COST OF BROADBAND INFRASTRUCTURE

2.1 TYPE OF TECHNOLOGY

There is a wide range of technologies that can deliver broadband communications, including optic fibre, DSL, satellite, microwave and various combinations of these. ISDN is sometimes labelled "broadband" but given the high transmission costs and relatively low transmission speeds, the consensus appears to be that ISDN does not deliver the same level of functionality as these other types of "broadband".

The exact technology used for broadband rollout in health is likely to depend on the outcomes of competitive tenders and may vary from region to region, so it is not appropriate to prescribe a particular technology as being the most suitable for health applications in all areas in Australia. Furthermore, some technologies may be better suited to rural and remote areas, while other technologies may be better suited to densely populated areas.

Even so, it is necessary to base the costing of broadband rollout on some sort of generic technology, to enable some reasonably firm cost estimates to be developed. For this purpose we have elected to base our costing on rolling out optic fibre in most areas, with microwave for some remote and rural hospitals. This is not an endorsement of these specific technologies. There may be other technologies that can achieve the same level of functionality at a lower cost, but for the purpose of this evaluation, this technology is likely to provide a sensible ballpark cost figure against which we can measure the benefits.

Robust data on the cost of installing broadband is not available. It is beyond the scope of this report to seek firm quotes from telecommunication companies or to conduct detailed engineering or quantity surveying. Some indicative costs relating to specific projects in specific regions were able to be sourced, though confidentiality restrictions prevent us from actually using or quoting this data. No comprehensive Australia-wide benchmark data on the cost of installing broadband could be found. Standard construction cost references such as *Rawlinson's Australian Construction Handbook* did not cover the cost of constructing broadband infrastructure. It did have some information on data and phone installation and cabling costs *within* a building, but not the cost of constructing broadband *between* buildings. The best data we could find on the cost savings likely to be generated

from replacing ISDN subscriptions with broadband was the ISDN price list on the Telstra website ($15 per hour per 64kbps data channel, so $90 per hour for a 384kbps videoconferencing unit).

Several stakeholders provided anecdotal evidence on the costs associated with installing broadband (which includes cabling, terminating equipment, staff training and IT support) for specific projects. In the absence of any more robust data, we have relied on these estimates. We stress that the cost estimates in the paper are a reasonable high-level estimate of the costs likely to be achieved by a government with bulk-buying power, but are not of sufficient accuracy to underpin a business case. A competitive tender process could generate a final cost which differs considerably from our cost estimates. Furthermore, the technology changes rapidly, so that within 12 months, new technology may become available, which could provide twice the capability at half the price of technology currently available.

The cost of rolling out the infrastructure depends largely on the location of hospitals. In consultation with every State and Territory Health Department, we have compiled a list of some 1,400 hospitals, clinics, nursing posts, day surgeries and pathology labs around Australia. The database records the size, location and types of services offered at each hospital. The database also records the existing level of connectivity at each hospital. Many hospitals outside the capital cities currently rely on ISDN connections, while many more have no high speed data transmission capabilities. Based on our survey of State and Territory health departments, there are only a few hospitals outside the capital cities with true broadband infrastructure, including SWARH (South West Alliance of Rural Hospitals, in Victoria).

There are two main alternatives for providing broadband through the government sector:

1. The government sector owns the cable and network. This tends to involve a high upfront cost and then low usage costs
2. The government sector leases capacity from a telecommunications provider. This tends to involve less up front costs and higher usage costs.

In NPV terms, these options are often similar in cost. There are many complex issues surrounding the procurement of broadband infrastructure for hospitals, including the degree of risk transfer and other strategic benefits such as having

control over the infrastructure. State and Territory governments may not be able to obtain the same economies of scale in purchasing acting alone rather than collectively bargaining.

For the purpose of compiling a benefit-cost study, the focus in on the entire resource cost to the economy rather than how those resource costs are divided between various levels of government or divided between public and private sector.

That is, the focus of this paper is on the total economic benefit of rolling out broadband rather than ownership arrangements of the infrastructure (the latter is likely to have relatively little bearing on the overall cost to the economy). We have necessarily made certain assumptions regarding the cost of broadband infrastructure, related to owning or leasing the asset, in net present value terms.

The costs of supplying broadband fall into the following categories:

1. The cost of laying new cable/installing the satellite to connect a hospital to the network.

2. A prorated cost of using some capacity on existing networks (such as an existing backbone).

3. The cost of terminating equipment, PCs, software licensing and teleconferencing equipment.

4. The cost of training staff to use the new equipment (both initial training and ongoing training due to staff turnover).

5. Any additional technical staff or IT support required to maintain/operate the equipment.

Investments in terminating equipment, PCs and teleconferencing equipment tend to have shorter life spans, so the equipment will need replacing every 4 years or so. Optic fibre and satellite dishes have potentially much longer useful lives of around 10 years. The lifespan concept used here is the “economic” life span (how long the asset will continue to deliver services effectively) rather than the lifespan used in tax accounting or business cases. The “economic” lifespan is often similar to the engineering lifespan, but quite different to a tax or business case lifespan.

For the purposes of preparing this report, we have used the following costs inclusive of construction contingency as the basis for our preliminary estimates. These costs are based on anecdotal evidence and are potentially subject to substantial revision if alternative data becomes available. In the interim, the reader is cautioned to treat this data as only an indicative estimate rather than hard data on the quotes likely to be achieved from a competitive tender process.

1. Laying cable: $10,000 per kilometre every 10 years. Satellite dishes for remote hospitals: $10,000 every 10 years for the equipment and $10,000 per annum for transmission costs.

2. No cost of connecting to a backbone is included, based on the expectation that hospitals would have a dedicated network (partly due to privacy concerns). There may be additional savings from piggy backing off existing infrastructure.

3. Terminating equipment: $30,000 per hospital every 4 years (an economic life of 4 years appears sensible, given the technology).

4. Training to use broadband-based clinical equipment: $10,000, $15,000 and $20,000 per annum per small, medium and large hospital respectively.

5. IT support to maintain & operate the equipment: $15,000, $20,000 and $25,000 per annum per small, medium and large hospital respectively.

The Access to Bandwidth report found that it costs around $24,100 per annum per location for broadband for a school network in Western Australia, including terminating equipment.[2] While this is not directly comparable to the cost of an Australia-wide hospital network, it is a recent estimate and a useful benchmark.

Our estimate allows for the cost of building a standalone network, without relying on commodity networks. As such, costs and benefits related to commodity networks have not been included.

[2] http://flexiblelearning.net.au/projects/accesstobandwidth.htm

2.2 SITES RECEIVING BROADBAND

Drawing on a number of sources, including relevant websites and directories, a comprehensive national database of over 1400 hospitals was collated, in consultation with State and Commonwealth government health departments. The database compares well with ABS data, which has fewer establishments, due to confidentiality reasons. Nursing homes have not been included, nor have many 'sub-departments' of hospitals contained in the same building.

The database contains information on geographic location and bed numbers, as an indicator of hospital size. This database was then mapped according to ABS statistical divisions and sub-statistical divisions based on the ABS census maps.[3]

Five different levels of broadband rollout were then specified, with 'hospitals' including private and public hospitals and specialist medical facilities (such as mental health centres). In expanding the network, priority was given to larger facilities (often using number of beds as a proxy). The five levels are as follows:

1. **Major hospitals in capital cities**
   - Due to the proximity of major hospitals to universities and backbone, a low connection cost is expected. We have allowed 10 km of line to connect each major hospital.

2. **Major hospitals in each SD (In addition to level 1 hospitals).**
   - Distance between all major towns was calculated from the centre of town, with remote hospitals joined by satellite.

3. **Major hospitals in each SSD (In addition to level 2 hospitals).**
   - Distance between all major towns was calculated from the centre of town, with remote hospitals joined by satellite.

[3] For more detail on ABS census maps, see http://www.ausstats.abs.gov.au/ausstats/2001maps.nsf/HomePages/AusStats+Maps

- Additional line city centre is estimated at 30kms per hospital (as most additional hospitals would be located outside of city centre).

4. Major hospitals in every town (In addition to level 3 hospitals).

- Distance between all major towns was calculated from the centre of town, with remote hospitals joined by satellite.

5. Every hospital (In addition to level 4 hospitals).

- Additional line within smaller regional centres is estimated to be 5kms per hospital.
- Additional line to connect remaining capital city hospitals is estimated to be 10kms per hospital (as most of the remaining hospitals would be near the capital city backbone).

The final indicative technology requirements are as shown in table 2.2.1.

Table 2.2.1 – Levels of broadband rollout

	Level 1	Level 2	Level 3	Level 4	Level 5
Number of Hospitals	14	67	211	749	1,472
Total Line Distance (km)	140	12,560	20,491	41,416	47,626
Number of Satellites/Microwave	0	2	6	51	51

The costs associated with this specification are reported as part of the results in Chapter 6.

3. BENEFITS OF BROADBAND ROLLOUT – TELEHEALTH APPLICATIONS

The previous section set out the capital and other costs associated with accelerating the rollout of broadband in the health sector. This section seeks to estimate the magnitude of social benefits from telehealth applications utilising the broadband network (telehealth) that may be offset against the cost of the infrastructure rollout. Some costs and some benefits are common to both the accelerated rollout and no rollout scenarios. For example, a medical practitioner still delivers a service and a patient still receives the service. Common elements are not included.

Once the broadband infrastructure is established, telehealth applications have the potential to provide significant benefits in terms of cost savings and improved access to health services.

Before including the benefits of particular telehealth applications in the model, the telehealth literature was examined to ensure that, from a diagnostic and health management point of view, there is sufficient evidence to support the use of the service as a clinically effective alternative to face to face consultations. It is also important that use of the technology be generally accepted by medical practitioners and other staff and that patients are satisfied with treatment via telehealth.

Numerous studies have been published in Australia and overseas, focussing on the more qualitative aspects of diagnostic effectiveness, practitioner and patient satisfaction, and the potential for telehealth applications to become increasingly important in delivering health care. Some have attempted to provide quantitative data, including cost benefit or cost effectiveness studies, or simple estimates of costs or cost savings of a particular application or network.

However, our own examination of the telehealth literature confirms the finding of a recent systematic review which suggested that 'Although useful clinical and economic outcomes data have been obtained for some telemedicine applications,

good quality studies are still scarce and the generalizability of most assessment findings is rather limited'[4].

Studies in the telehealth area usually focus on a specific telehealth program. Our purpose is to derive a national, aggregate estimate for the accelerated rollout of broadband. The analysis necessarily includes a number of simplifying assumptions regarding the costs and benefits which may not accord with specific applications in particular locations, such as a mental health service between Brisbane and Gympie. That is, the purpose of the model is to be predictive at the national level rather than reflect the subtleties of local circumstances.

Whether a particular telehealth service is more cost effective than the existing service will depend on a number of factors, including the alternative delivery mechanism (visiting specialist, or patient transfer), types of equipment used, communication costs and staffing costs. The volume of consultations is also important, with some studies providing estimates of the point at which a telehealth service 'breaks even'.[5]

Major benefits, in the form of cost savings may include savings in the direct travel and accommodation costs of patients or medical practitioners, and opportunity costs associated with foregone wages or time.

Our focus is on the more common telehealth applications used in Australia, being psychiatric consultations performed via videoconferencing (telepsychiatry) and the electronic transmission of medical images (teleradiology and fetal teleultrasound). Telehealth facilities have expanded rapidly in recent years, funded largely by State governments, using ISDN connections. For example, beginning with 16 sites on 1996, the NSW network has expanded to over 200 facilities. Box 1 describes the NSW telehealth network and its role in the NSW health system.

BOX 1: NSW TELEHEALTH NETWORK

[4] Hailey, H., Roine, R., Ohinmaa, *Systematic review of evidence for the benefits of telemedicine* Journal of Telemedicine and Telecare, Volume 8, Supplement 1, 2002.

[5] Where 'break even' is often a narrow budget definition rather than an economy-wide definition of costs and benefits.

Technological changes are enabling new ways of providing patient care across rural and remote NSW. The increasing availability of high speed and distance-independent communication capabilities offers new opportunities for health service delivery.

Telehealth services, particularly those involving interactive video and image transfer has grown to support a number of public health care services in rural and remote centres and the greater metropolitan Sydney region. Information technology has the potential to improve health outcomes for patients, clients and carers through more timely access to specialist support, improved satisfaction and retention of health service practitioners through better peer support and education opportunities, and increased productivity by reducing travelling times. The NSW Telehealth Network extends to over 200 public health service facilities across NSW. The Network stretches from Tibooburra to Tweed, Broken Hill to Bombala and Coonamble to Cootamundra. The current range of proven services which have been integrated into mainstream health care delivery include diabetes footcare, chronic pain management, paediatric and adult oncology, radiology, rehabilitation, ophthalmology, cardiology, dental services, palliative care, paediatric, adolescent and adult psychiatry.

In providing services over a distance, telehealth in NSW has demonstrated increased access to services without compromising on the quality of care.

Advantages for clinicians include:

- improved working relationships between staff at remote sites
- greater integration of remote health services
- support for isolated staff; identified training and support programs
- greater networking between rural and metropolitan services
- reduced travel time and costs
- improved access to supervision for staff.

...Advantages for consumers include:

- earlier access to care due to the impact of telehealth
- improved access to the best expertise in the area

- increased contact between hospital and community based staff leading to greater continuity of care
- improved discharge planning and follow up care of patients leading to reduced readmission rates within 28 days
- increased contact between hospital patients and their families. For example, if a child with cancer was hospitalised for specialist care away from their home and accompanied by one carer, a videoconference link can be established to link with the rest of the family or carers.

Source: NSW Health Department 2002, *The NSW Rural Health Report – The Report of the Rural Health Implementation Coordination Group NSW Government Action Plan, Sydney*, (page 27).

3.1 MEASURING THE BENEFITS

The base of the model is disaggregated census data, which provides a profile of the population in each statistical sub division by age and sex, such the number of males aged 15-24. We have used statistical sub divisions as our basic unit of analysis. As an example, the population data for the Wollongong SSD, including a sample of the projected population, is shown below in table 3.1.1.

Table 3.1.1 – Wollongong SSD population, 2001-02.

Population: Wollongong SSD	2001-02	2006-07	2012-13
Males			
Males aged under 14	27,689	26502	24796
Males aged between 15 and 24	20,060	20454	20214
Males aged between 25 and 34	19,417	18591	18173
Males aged between 35 and 44	19,675	19149	18759
Males aged between 45 and 54	17,359	18606	18843
Males aged between 55 and 64	13,121	15489	17437
Males aged between 65 and 74	9,965	10559	13115
Males aged 74 and over	6,504	7852	8914
Total Males	133,790	137,202	140,251
Females			
Females aged under 14	26,460	25469	23904
Females aged between 15 and 24	18,597	18730	18442
Females aged between 25 and 34	18,757	17954	17351
Females aged between 35 and 44	19,783	19278	18919
Females aged between 45 and 54	16,972	18894	19255
Females aged between 55 and 64	13,431	15328	17625
Females aged between 65 and 74	10,913	11401	13592
Females aged 74 and over	9,718	11302	12558
Total Females	134,631	138,356	141,646
Total population	268,421	275,558	281,897

Source: ABS Cat. 3222.0 - Population Projections Australia by SLA (ASGC 1996) 1999-2019, DHAC.

This demographic data can then be combined with Health Insurance Commission (HIC) data regarding Medicare-funded items, to derive the existing utilisation of health care services (number of consultations) in each area.

Following on from the population base, in broad terms, the model derives:

- the proportion of cases potentially treated via telehealth (taking into account existing activity by resident medical practitioners, visiting services and patient travel), and
- an estimated benefit in terms of cost saving per eligible telehealth consultation, for each clinical application, in each region.

Other intangible benefits such as the potential for improved patient management and clinical outcomes have not been quantified.

Reflecting the availability of suitable data, our focus has been on the more readily quantifiable benefits. Where possible, we have based our own estimates on health data such as Medicare claims collated by the HIC, official medical workforce surveys, and the relevant telehealth literature, focussing on applications in the Australian context.

Where we have made assumptions in the model, we have attempted to be conservative in their magnitude and transparent in their application. Once established, the model is capable of further refinement in light of additional empirical evidence and data.

Potential cost savings from telehealth

In terms of broad categories, Lobley[6] outlined a range of potential cost savings from telemedicine as follows:

1. reductions in the costs of patient movement, including the costs of ambulances, aircraft and so on such savings are likely to depend on the distance between the patient and the specialist and the mode of transport;
2. reductions in the costs of moving staff, including direct costs of travel, accommodation and subsistence for specialist staff;
3. reductions of the opportunity costs of the time spent by specialist staff in travelling, which would be more effectively spent working in their profession;
4. savings through not undertaking laboratory tests which might be deemed unnecessary as a result of a telemedicine consultation;
5. savings from the increased use of highly skilled medical staff at a specialist centre;
6. savings due to better scheduling of patient diagnosis and treatment;

[6] Lobley, D., *Economics of telemedicine*, Journal of Telemedicine and Telecare, Volume 3, Number 3, 1997.

7. savings due to patients receiving more effective treatments and recovering more quickly as a consequence; and

8. reduced costs of travel for patients, including the direct costs and the opportunity costs of time spent travelling.

Depending on the particular application, we have sought to incorporate the more readily quantifiable savings described in numbers 1, 2, 3 and 8. that is, the direct travel costs and the opportunity cost of time of patients and health professionals.

The following sections describe in more detail the assumptions incorporated into the model, for each telehealth application.

3.2 TELEPSYCHIATRY (MENTAL HEALTH)

The use of videoconferencing to deliver mental health services in Australia (telepsychiatry) began in South Australia in 1993, with a trial undertaken between the Royal Adelaide Hospital and the Whyalla Hospital. Since then, telepsychiatry has become very well established in Australia, as a clinically effective alternative to face to face consultations.[7]

Since 1 November 2002, telepsychiatry consultations have been listed on the Medicare Benefits Schedule (items 353 to 358). Registered psychiatrists are able to claim a maximum of 12 telepsychiatry consultations in total for each patient per calendar year. The items may be used when the consultant psychiatrist is located in a metropolitan or regional area, and the patient is located in a rural or remote area. However, after every fourth telepsychiatry session, a face-to-face consultation must be performed.

[7] For an overview see the national survey undertaken as part of Lessing, K. and Blignault, I., *Mental health telemedicine programs in Australia* Journal of Telemedicine and Telecare, Volume 7, Number 6, 2001.

A major objective in introducing the new Medicare rebate was to improve access to mental health services for those living in rural and regional Australia. For over 90 per cent of Australian psychiatrists, their main place of work is in a capital city[8].

Various modes of delivery of telepsychiatry are possible[9], including:

- Outpatient therapy, whereby videoconferencing is used by a psychiatrist to conduct a therapy session, with follow up support provided by local health care personnel;
- Case conferencing, whereby health care professionals jointly consider the management of complex and chronic cases, including the formulation of management plans and exchange of clinical information;
- Inpatient support for rural patients being treated in city hospitals, allowing them to communicate with family and/or rural health care professionals prior to discharge.

Outpatient therapy, or more generally, ambulatory mental health care may be suitable for delivery by telepsychiatry. Ambulatory care services can be defined as 'services that are delivered to clients or patients in non-residential and non-admitted patient care settings'[10]:

Ambulatory mental health services may be undertaken by:

- Private psychiatrists (Medicare-funded);
- Public and private hospital-based non-admitted patient mental health services;
- Community-based mental health centres;

[8] Australian Institute of Health and Welfare (AIHW) 2003, *Mental Health Services in Australia 2000-01,* Canberra :AIHW (Mental health series no. 4) Page 163.

[9] See The Royal Australian and New Zealand College of Psychiatrists, *Telepsychiatry, position statement #44, October 2002* for more detail.

[10] Australian Institute of Health and Welfare (AIHW) 2003, *Mental Health Services in Australia 2000-01,* Canberra :AIHW (Mental health series no. 4) Page 23.

- General practitioners; and
- Commonwealth/State disability agreement–funded non-residential disability support services, such as accommodation and employment service support.

Our focus is on using telepsychiatry to deliver ambulatory services under the first three categories - private psychiatrists, public, hospital-based psychiatrists, or community-based mental health services, rather than primary care services delivered by general practitioners, or support services delivered under the CSDA.

In particular, telepsychiatry can be used as an alternative delivery mechanism to a periodic visiting service, or patients travelling large distances to visit a psychiatrist.

The potential to further rely on telepsychiatry is significant. Ambulatory mental health services have grown in importance with the move towards greater community based systems of care, rather than delivering care through inpatient services in hospitals or psychiatric institutions. For example, between 1992-93 and 1999-00, national expenditure on ambulatory mental health care grew by 109 per cent, with the number of clinical staff involved in ambulatory care increasing by 90 per cent over the same period.[11]

Clinical effectiveness and patient satisfaction

In the Australian context, an early study by Baigent et al[12] comparing videoconferencing with face to face interviews reported that patient acceptance of telepsychiatry was high. While there were some clear differences between telepsychiatry and psychiatry performed in a face-to-face setting, diagnoses were as reliably made by telepsychiatry. Similar conclusions have been reported by other studies, including Hawker et al[13] and more recently, Kennedy and Yellowlees[14].

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[11] Commonwealth Department of Health and Ageing, 2002, *National Mental Health Report 2002: Seventh Report. Changes in Australia's Mental Health Services under the First Two Years of the Second National Mental Health Plan 1998-2000. Commonwealth of Australia.* (page 2).

[12] Baigent, M., Lloyd, C., et al, *Telepsychiatry: 'tele' yes, but what about the 'psychiatry'?*, Journal of Telemedicine and Telecare, Volume 3, Supplement 1, 1997.

[13] Hawker, F., Kavanagh, S., et al, *Telepsychiatry in South Australia*, Journal of Telemedicine and Telecare, Volume 4, Number 4, 1998.

The peak body representing psychiatrists in Australia, The Royal Australian and New Zealand College of Psychiatrists (RANZCP) consider that:[15]

> *There is now substantial literature available to indicate that electronic video diagnosis is possible across a wide range of psychiatric disorders and indeed there is no evidence to suggest that any types of psychiatric consultations should be excluded from the remit of telepsychiatry applications. Psychiatry, by its nature, is the specialty most suited to video consultations and there is a substantial body of evidence to support the satisfaction that practitioners derive from this form of care, and more importantly, the acceptance in a very positive way of patients and consumer groups.*

The RANZCP consider that telepsychiatry is an important tool for increasing specialist support to rural primary health care providers, and improving access to mental health services in rural and regional Australia. However, face to face meetings are still preferable to telepsychiatry consultations. In addition, telepsychiatry may not be suitable for all patients (who may not be comfortable interacting in front of a camera).

Existing consultations performed by private psychiatrists

Based on Medicare claims compiled by the Health Insurance Commission (HIC), private psychiatrists provided around 2.1 million services across Australia in 2001-02[16]. The HIC also collates the number of services per 100,000 population, by state, gender and age group. For example, in NSW in 2001-02, there were 19,515 services per 100,000 females aged 35-44.

[14] Kennedy, C. and Yellowlees, P. *The effectiveness of telepsychiatry measured using the Health of the Nation Outcome Scale and the Mental Health Inventory,* Journal of Telemedicine and Telecare, Volume 9, Number 1, 2003.

[15] The Royal Australian and New Zealand College of Psychiatrists, *Telepsychiatry, position statement #44, October 2002.*

[16] All HIC data downloaded from www.hic.gov.au

Correlating this data with the population base in the model (also by state, gender and age group) yields an estimate of the number of private psychiatric consultations per statistical sub division.

However, these averages conceal considerable variation within states, between metropolitan and non--metropolitan areas. Due to a number of factors, including the lower supply of psychiatric services in non-metropolitan areas, the utilisation of psychiatric services is significantly lower in non-metropolitan areas. In order to account for regional differences in utilisation, the statistical sub divisions in the model were benchmarked against historical figures contained in the National Mental Health Report 2002[17], showing the distribution of services by metropolitan and non-metropolitan locations.

Of the consultations servicing people in non-metropolitan statistical sub divisions:

- some are serviced by psychiatrists residing in non-metropolitan areas;
- some are serviced by a metropolitan psychiatrist as part of a visiting service; and
- the remainder travel to visit a psychiatrist in a major regional area or metropolitan area.

Telepsychiatry has potential as an alternative delivery mechanism in the latter two cases. Based on available data concerning the pattern of psychiatric services to non-metropolitan residents, we have estimated the total services performed by resident psychiatrists, and visiting services by metropolitan psychiatrists below.

Services to non-metropolitan patients by resident psychiatrists

The distribution of psychiatrists is heavily skewed, with over 90 per cent of psychiatrists having a metropolitan area as their main place of work. Based on the number of 2000-01 Medicare-funded items, Australia's psychiatrists number

[17] Commonwealth Department of Health and Ageing, 2002, *National Mental Health Report 2002: Seventh Report. Changes in Australia's Mental Health Services under the First Two Years of the Second National Mental Health Plan 1998-2000. Commonwealth of Australia.* (page 250).

around 1,058 of which around 68 reside in rural and remote Australia, as shown below in Table 3.2.1.

Table 3.2.1 – Medicare-funded full-time equivalent private psychiatrists, by metropolitan, rural and remote region, States and territories, 2000-01.

Full-time-equivalent psychiatrists	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Total
Number									
Metropolitan	317	339	142	54	112	13	11	2	**990.0**
Rural and remote	24	13	21	3	2	5	0	0.1	**68**
Total all regions	**341**	**352**	**163**	**57**	**114**	**19**	**11**	**2**	**1,058**

Source: Department of Health and Ageing, quoted in AIHW 2003, *Mental Health Services in Australia 2000-01*, Canberra :AIHW (Mental health series no. 4) page 164.

Based on the average rural or remote psychiatrist undertaking around 2,009 consultations per annum[18], the estimated number of consultations undertaken by psychiatrists residing in non-metropolitan Australia by state is as follows:

Table 3.2.2 – Estimated psychiatric consultations undertaken by resident psychiatrists in rural and remote Australia, by State and Territory.

Estimated rural and remote psychiatric	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Total
by resident psychiatrists	47,212	26,921	42,993	5,023	4,219	10,648	0	201	137,215

Source: Access Economics estimate.

Visiting services to non-metropolitan patients by metropolitan psychiatrists

According to a survey undertaken by the RANZCP and AMWAC, across Australia, of the psychiatrists who have a metropolitan area as their main place of work, around 12 per cent provide psychiatric services via a visiting service to a non-metropolitan area[19]. However, there is considerable variation across states, as shown below.

Table 3.2.3 – Estimated percentage of metropolitan based psychiatrists providing a rural visiting service, by State/Territory, 1999.

	NSW	Vic	Qld	SA	WA	Tas	ACT	NT
% of Metropolitan based psychiatrists involved in a rural visiting service	12.2	8.2	9.4	25.4	9.0	20.8	22.2	0

Source: Derived from RANZCP/AMWAC survey of College Fellows, contained in Australian Medical Workforce Advisory Committee (1999), *The Specialist Psychiatry Workforce in Australia*, AMWAC Report 1999.7, Sydney (page 103).

[18] Based on the 2.1 million Medicare consultations in 2000-01, divided by 1,058 Medicare-funded psychiatrists.

[19] Derived from results of RANZCP/AMWAC survey of RANZCP Fellows. See Australian Medical Workforce Advisory Committee (1999), *The Specialist Psychiatry Workforce in Australia*, AMWAC Report 1999.7, Sydney (page 103).

On average, these metropolitan practitioners spend around 3.1 days per month as part of a visiting service[20]. The RANZCP/AMWAC survey also provides results for the average number of days per month metropolitan psychiatrists spend providing the visiting service, by state, as follows.

Table 3.2.4 – Number of days spent per month by metropolitan psychiatrists in providing rural visiting services, by State/Territory, 1999.

	NSW	Vic	Qld	SA	WA	Tas	ACT
Visiting service, days per month	3.5	2.6	2.5	3.2	3.7	1.7	5.2

Source: RANZCP/AMWAC survey of College Fellows, contained in Australian Medical Workforce Advisory Committee (1999), *The Specialist Psychiatry Workforce in Australia*, AMWAC Report 1999.7, Sydney (page 104).

Assuming each psychiatrist performs 8.4 consultations per day[21] as part of the visiting service, and combining these results with the number of metropolitan psychiatrists in each state yields an estimate of total consultations per year performed by visiting psychiatry services, by State as follows.

Table 3.2.5 – Estimated number of psychiatric consultations provided by rural visiting services, by State/Territory.

	NSW	Vic	Qld	SA	WA	Tas	ACT	Total
Consultations provided by rural visiting services	13,626	7,293	3,341	4,421	3,766	476	1,252	34,176

The remaining psychiatric consultations, not provided by resident psychiatrists, or visiting services, are assumed to involve non-metropolitan patients travelling to a psychiatrist located in a metropolitan area.

Existing psychiatric consultations by public sector services and telepsychiatry-related cost savings

Data for ambulatory mental health services performed in hospitals and community mental health services is less detailed and reliable than Medicare-funded private consultations, especially when making comparisons across states. With regard to their review of mental health services in Australia for 2000-01, the Australian Institute of Health and Welfare (AIHW) commented:

[20] Australian Medical Workforce Advisory Committee (1999), *The Specialist Psychiatry Workforce in Australia*, AMWAC Report 1999.7, Sydney (page 104).

[21] Taking the average annual number of services per psychiatrist of 2,009 and dividing by 240 working days per year.

> *This report presents more data on private medical practitioner services and the hospital care provided to admitted patients than on the ambulatory mental health care provided by hospitals and community-based mental health care services. This reflects data availability, with comparatively little data available on patients receiving public ambulatory mental health care services. This is not an indication of the relative importance or utilisation of this service type. In fact, ambulatory mental health care provided by hospitals and community-based mental health care services accounted for 37.1% of State and Territory expenditure on mental health services for 1999–00 (DHA 2002). The AIHW has collated the available data on ambulatory care service contacts with public community mental health services for 2000–01. Concerns with the quality and comparability of the data mean that these data have not been presented in this chapter.*

Similarly, in the context of increased expenditure on ambulatory care mental health services, the National Mental Health Report 2002, noted:

> *Limited data are available on the 'outputs' of ambulatory care mental health services to determine the extent to which the increased investment has in fact delivered more services, or provided treatment to an increased population. Initial baseline collected on community contacts and persons treated...are not yet of sufficient reliability to develop comparative indicators, a situation applying across all jurisdictions to varying extents.*

Given the uncertain nature of the data, it is difficult to model existing modes of delivery, travel costs and other factors estimated as part of the analysis undertaken for private psychiatric consultations.

However, although there are significant caveats to be attached to the data on ambulatory care in public settings, activity is significant. In aggregate, the National Community Mental Health Care Database service contacts in 2000-01 at 4.27

million, with the National Survey of Mental Health Services estimating service contacts in 1999-00 at 5.67 million.[22]

Like the private sector, not all of these services could be performed by telepsychiatry. This is an area where more work could be performed, and the results refined when more accurate, comprehensive data becomes available.

However, if it were expected that greater use of telepsychiatry in the public sector involves half the cost savings that accrue in the private sector, this would result in further cost savings of around $46 million (level 3 in net present value terms over ten years). These savings have not been included in our results.

Proportion of cases treated via telehealth

As previously described, telepsychiatry is relatively well established as a clinically acceptable alternative to face to face consultations. This is evidenced by the rapid expansion of telepsychiatry services, funded by State governments through the public health system.

However, existing usage of telepsychiatry as an alternative to face-to face consultations is low. The exact take-up of telepsychiatry over a ten year period, with the availability of an extensive broadband network is uncertain and difficult to judge. As well as cultural factors (such as the acceptance of the technology by patients and practitioners) part of the low use of telepsychiatry currently can be attributed to the limited availability of suitable bandwidth and videoconferencing facilities. Most existing consultations are performed across relatively expensive and less reliable ISDN connections, funded by state governments through the public health system.

To a large degree, future take up rates are a matter of policy, given government's influence over the remuneration of medical practitioners. For example, under the Medical Specialist Outreach Assistance Program (MSOAP), announced as part of the 2000-01 Budget, the Commonwealth committed $48.4 million over four years to

[22] See Australian Institute of Health and Welfare (AIHW) 2003, *Mental Health Services in Australia 2000-01,* Canberra :AIHW (Mental health series no. 4) Page 205, and Appendix 1 and 2 for further information on data issues.

encourage more medical specialists, including psychiatrists, to visit rural areas. The MSOAP covers some costs including travel and accommodation, and ongoing communication with local practitioners, as well as funding visiting specialists to deliver training to other health professionals.

For the purposes of our national estimate we have assumed that, with the availability of an extensive broadband network, 50 per cent of eligible private psychiatric consultations (those currently performed by a rural visiting service, or by patients travelling to a metropolitan psychiatrist) will be performed by telepsychiatry. It should be noted that this proportion is applied to a sub-set of total psychiatric consultations. That is, we have sought to exclude metropolitan consultations, and those performed by psychiatrists residing in non-metropolitan areas. Of the over 2 million psychiatric consultations across Australia per annum, around 230,000 relate to patients in non-metropolitan areas. Around 88,000 involve a rural visiting service, or patients travelling to a metropolitan psychiatrist. Applying the 50 per cent proportion implies around 44,000 (around 2 per cent of the total) private psychiatric consultations performed by telepsychiatry.

There are differing views regarding the likely use of an extensive broadband network for telepsychiatry services, related to differing expectations regarding the extent to which telepsychiatry has the potential to form part of mainstream health delivery. The sensitivity of our results, including to the take up assumption is detailed in section 6.4. The take up rate will be higher to the extent telepsychiatry sessions reduce the need for visiting services or the need for patients to travel large distances to metropolitan areas. In particular, the take up rate will be higher to the extent:

- governments reduce funding of rural visiting services, in favour of telepsychiatry as a more cost effective, yet clinically effective alternative;
- private metropolitan psychiatrists offer telepsychiatry services to rural patients, given the existence of an extensive, reliable broadband network; and
- patients demand access to telepsychiatry sessions as a cheaper, more convenient alternative than travelling large distances or waiting for a visiting service.

The take up rate will be lower to the extent:

- governments impose policy or regulatory restrictions on the use of telepsychiatry;
- governments decide to fund rural visiting services, in favour of telepsychiatry;
- private metropolitan psychiatrists do not offer telepsychiatry services to rural patients, despite the existence of an extensive broadband network, due to reluctance to use new technology, or concerns over clinical effectiveness;
- Patients prefer to travel large distances or wait for a visiting service to have a face-to-face consultation, rather than a telepsychiatry consultation.

Defining cost savings related to travel and time

With various degrees of quantification, a number of studies have suggested that there are considerable cost savings available from the use of telepsychiatry services[23]. For example, in the Australian context, Trott and Blignault[24], undertaking a simple comparison of costs, estimated that the availability of the telepsychiatry service between Townsville and Mt Isa resulted in savings to the Northern Regional Health Authority of around $85,000 in the first year and over $110,000 in subsequent years when compared to the same level of service delivered by conventional care. Savings flowed from reduced travel costs of patients and health care workers.

Costs associated with establishing the broadband infrastructure and videoconferencing equipment necessary for telepsychiatry have been covered in

[23] See, for example, Buist, A., and Silvas, A., *Evaluation of the Victorian Telepsychiatry Program*, Victorian Department of Human Services, October 1998; Doze, S., Simpson, J. et al *Evaluation of a telepsychiatry pilot project*, Journal of Telemedicine and Telecare, Volume 5, Number 1, 1999; and Trott, P. *The Queensland Northern Regional Health Authority Telemental Health Project*, Journal of Telemedicine and Telecare, Volume 2, Supplement 1, 1996.

[24] Trott, P., and Blignault, I., *The Queensland Northern Regional Health Authority Telemental Health Project*, Journal of Telemedicine and Telecare, Volume 4, Supplement 1, 1998.

section 3. This section attempts to quantify the savings related to direct travel costs and the opportunity costs of time, whether they are borne by the patient or medical practitioner.

Cost savings are calculated per consultation and then applied to the number of eligible telepsychiatry consultations estimated previously.

Cost savings from telepsychiatry depend on the conventional method of delivering the service. For example, if patients normally travel to a major regional centre, they may gain via lower travel costs. Alternatively, a visiting psychiatrist service may avoid travel costs being incurred by a large number of patients. However, the health service would incur additional costs in respect of the psychiatrist, such as travel and accommodation, and the opportunity cost of time.

Cost savings - patients travel to the psychiatrist

Potential travel cost and time savings accruing to the patients will largely depend on the mode of transport and the distance travelled. We have calculated cost savings as shown in table 3.2.6., involving:

- Before broadband, a round trip by car or plane to visit a psychiatrist, with car costs of 59 cents per kilometre[25]. In the case of car travel, an average speed of 80 kmph and the relevant distance is used to derive the travel time. The value of the patient's time is valued at 75 per cent of Access Economics' forecasts of Average Weekly Earnings (AWE). The discounting from full AWE is based on the fact that some people will not be in the workforce, and people tend to value leisure time at less than their full wage rate (although most travel will be within work time). In addition, wages on average tend to be lower in rural and regional Australia than in urban areas.
- The cost of the consultation performed via telepsychiatry is calculated in the same way, involving a shorter round trip to a videoconferencing centre.

[25] The rate prescribed by the ATO for a medium car, for income tax deductibility purposes.

- A locally based health care professional is present with the patient during the telepsychiatry session (with their time valued at average weekly earnings, for a 45 minute consultation).[26]

The cost savings shown in table 3.2.6 relate to savings per adult consultation in the level 3 case. For patients under the age of 14 we have assumed they are accompanied by a parent or guardian when travelling to a consultation. This adds additional time opportunity cost savings for the adult (and travel cost savings in the case of plane travel, but not car travel).

Table 3.2.6 – Estimated cost savings per consultation due to avoided travel to the psychiatrist, by State/Territory.

[26] 'Consistent with the RANZCP Quality Practice Guidelines for Telepsychiatry, which state '*Wherever possible there should be a locally based healthcare professional with the patient during the telepsychiatry session. If this is not possible then it is the consulting psychiatrist's responsibility to ensure that provision is made for locally based personnel (healthcare professionals, ancillary staff, family, friends) to be available for the patient to call on during and after the session.*' See The Royal Australian and New Zealand College of Psychiatrists, *Telepsychiatry, position statement #44, October 2002* (page 13).

Before broadband

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Average kilometres travel	100.00	250.00	400.00	400.00	600.00	100.00	200.00	200.00
Cost per km	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Average flight cost	0.00	0.00	0.00	0.00	0.00	0.00	350.00	450.00
Direct travel cost	**59.00**	**147.50**	**236.00**	**236.00**	**354.00**	**59.00**	**468.00**	**568.00**
Average speed (kmph)	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
75% AWE	15.02	15.02	15.02	15.02	15.02	15.02	15.02	15.02
Travel time (hours)	1.25	3.13	5.00	5.00	7.50	1.25	6.50	7.00
Time opportunity cost ($)	**18.78**	**46.94**	**75.10**	**75.10**	**112.65**	**18.78**	**97.63**	**105.14**

After broadband

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Average kilometres travel	25.00	50.00	50.00	50.00	50.00	50.00	100.00	100.00
Cost per km	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Average flight cost	-	-	-	-	-	-	-	-
Direct travel cost	**14.75**	**29.50**	**29.50**	**29.50**	**29.50**	**29.50**	**59.00**	**59.00**
Average speed (kmph)	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
75% AWE	15.02	15.02	15.02	15.02	15.02	15.02	15.02	15.02
Travel time (hours)	0.31	0.63	0.63	0.63	0.63	0.63	1.25	1.25
Time opportunity cost ($)	**4.69**	**9.39**	**9.39**	**9.39**	**9.39**	**9.39**	**18.78**	**18.78**

Cost savings

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Direct Travel Cost Saving ($)	**44.25**	**118.00**	**206.50**	**206.50**	**324.50**	**29.50**	**409.00**	**509.00**
Travel Time Cost Saving ($)	**14.08**	**37.55**	**65.71**	**65.71**	**103.26**	**9.39**	**78.86**	**86.37**
Total cost saving ($)	**58.33**	**155.55**	**272.21**	**272.21**	**427.76**	**38.89**	**487.86**	**595.37**

Cost savings - visiting psychiatrist service

The savings, in terms of saved time and travel accommodation costs will depend on the number of visits and the number of consultations performed as part of each visit.

We assume that the visiting psychiatrist travels to patients at the same average distance and mode of travel used for each state in the case of patients travelling above. Similarly, patient travel costs to the videoconferencing centre are roughly the same as the distance that would have been travelled previously to the consulting room of the visiting psychiatrist, so they are excluded. As the psychiatrist is located in a metropolitan area, we have allowed a travel distance of 10 kms to the videoconferencing centre (as the psychiatrist's office may not have broadband connectivity). We also assume the visiting psychiatrist:

- Performs 8.4 consultations per day;
- Spends the number of days (rounded to the nearest day) at the non-metropolitan centre, as outlined in Table 3.2.4;

- Depending on the number of visiting days, is paid accommodation and meal allowance equal to the ATO 'reasonable amount' ($170.60 per day)[27];
- Travel time, measured by the psychiatrist's wage is estimated at $140 per hour.

Cost savings are then derived as shown in table 3.2.7.

[27] Based on the 2003-04 'reasonable amount' that can be claimed by employee taxpayers for accommodation and meal expenses incurred when visiting 'other country centres' without providing substantiating documentation. For more information see *Taxation Ruling TR2003/7 Income tax: reasonable allowance amounts for the 2003-2004 income year.*

Table 3.2.7 – Estimated cost savings per consultation due to replacement of visiting psychiatrist service, by State/Territory.

Before broadband

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Average kilometres travel	100.00	250.00	400.00	400.00	600.00	100.00	200.00	200.00
Cost per km	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Average flight cost	0.00	0.00	0.00	0.00	0.00	0.00	350.00	450.00
Direct travel cost ($)	**59.00**	**147.50**	**236.00**	**236.00**	**354.00**	**59.00**	**468.00**	**568.00**
Average speed (kmph)	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Specialist wage	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00
Travel time (hours)	1.25	3.13	5.00	5.00	7.50	1.25	6.50	7.00
Time opportunity cost ($)	**175.00**	**437.50**	**700.00**	**700.00**	**1050.00**	**175.00**	**910.00**	**980.00**
Plus accomodation and meals per day	170.60	170.60	170.60	170.60	170.60	170.60	170.60	170.60
Number of visiting days	1.70	2.60	3.50	3.20	0.00	5.20	2.50	3.70
Number of consultations per day	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
Number of consultations per visit	18.13	27.73	37.33	34.13	0.00	55.47	26.67	39.47
Additional cost	**290.02**	**443.56**	**597.10**	**545.92**	**0.00**	**887.12**	**426.50**	**631.22**
Additional cost per consultation	15.99	15.99	15.99	15.99	0.00	15.99	15.99	15.99

After broadband

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Average kilometres travel	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Cost per km	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Average flight cost	-	-	-	-	-	-	-	-
Direct travel cost	**5.90**	**5.90**	**5.90**	**5.90**	**5.90**	**5.90**	**5.90**	**5.90**
Average speed (kmph)	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00
Specialist wage	140.00	140.00	140.00	140.00	140.00	140.00	140.00	140.00
Travel time (hours)	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Time opportunity cost ($)	**23.33**	**23.33**	**23.33**	**23.33**	**23.33**	**23.33**	**23.33**	**23.33**

Cost savings per consultation

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Direct Travel Cost Saving ($)	**2.93**	**5.11**	**6.16**	**6.74**	**0.00**	**0.96**	**17.33**	**14.24**
Travel opportunity cost and allowance saving ($)	**24.36**	**30.93**	**34.12**	**35.82**	**0.00**	**18.73**	**49.24**	**40.23**
Total cost saving ($)	**27.29**	**36.03**	**40.28**	**42.56**	**0.00**	**19.69**	**66.57**	**54.48**

Total cost savings from telepsychiatry

Aggregating across Australia yields a total estimated cost saving (level 3 in net present value terms over ten years) of around $202.5 million from the use of telepsychiatry.

3.3 TELERADIOLOGY

Along with mental health services, the use of telecommunications to deliver specialist radiology services is relatively common in Australia. According to the

stock take of telehealth activity undertaken by the Australian New Zealand Telehealth Committee in March 2000, teleradiology constituted around 14 per cent of total telehealth activity related to clinical applications.[28] For example, Jones and Partners provides teleradiology services between Mt Gambier and Darwin; the Victorian Imaging Group transmits images to radiologists at a number of metropolitan locations.[29]

The Royal Australian and New Zealand College of Radiologists (RANZCR) defines teleradiology as[30]:

> *the electronic transmission of radiological images in digital form from one location to another using a data communication link provided by a third party carrier(s). This usually implies sending images from a primary acquisition site to a secondary location where they are interpreted for the purpose of either official diagnosis or consultation.*

For example, teleradiology enables rural hospitals without a resident radiologist to transmit digital images to a radiologist based in a metropolitan area or large regional centre, for specialist interpretation and opinion. It may involve a number of different diagnostic imaging procedures, including standard x-rays, computerized tomography, magnetic resonance imaging, nuclear medicine imaging and ultrasound. The potential benefits from fetal teleultrasound are examined separately in section 5.3.

For our purposes, MRI, CT and Nuclear Medicine Imaging services have been excluded, as the capital equipment may not be available in smaller rural hospitals to enable teleradiology in these cases.

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[28] See Australian New Zealand Telehealth Committee, *Proceedings of Telehealth Think Tank, Melbourne 2000, Fact Sheet 3: Telehealth Activity in Australasia Today,* 2000. Of clinical telehealth activity, mental health was the largest proportion, at 32 per cent, followed by 'multi-disciplinary' use at 28 per cent, radiology at 14 per cent and other clinical activity (obstetrics, paediatrics, ophthalmology, renal, diabetes, pathology, rehabilitation and other) making up the remaining 26 per cent.

[29] See Crowe, B., *A review of the experience with teleradiology in Australia*, Journal of Telemedicine and Telecare, Volume 7, Supplement 2, 2001.

[30] Royal Australian and New Zealand College of Radiologists, *Position on Teleradiology*, November 2001.

Clinical effectiveness and patient satisfaction

Unlike psychiatry, radiology services do not necessarily require a face-to-face consultation between the medical specialist (radiologist) and the patient. Radiology involves two stages - the capturing of the medical image (which may be performed by a radiologist, radiographer, ultrasonographer or other appropriately qualified imaging technologist) and the interpretation and reporting on the image, performed by a radiologist. These two functions need not be performed at the same location as medical images can be physically or digitally transported to the radiologist.

Subject to normal quality assurance procedures such as adequate supervision, capturing of the image by appropriately qualified personnel and quality image resolution between acquisition and final display, the RANZCR supports the use of teleradiology[31]:

> *Demographically, Australia and New Zealand are well suited to the application of teleradiology. Relatively small, widely separated population centres, which cannot support the presence of a full-time diagnostic imaging specialist, can access specialist diagnostic services by the appropriate use of teleradiology. This has the potential to significantly improve patient care in many communities, by virtue of immediate specialist reporting of imaging examinations, coupled with professional supervision which is possible from the off-site radiologist.*
>
> *Other relevant applications of teleradiology include interpretation of emergency studies in on-call situations, and access to additional opinions by external consultation.*

Existing consultations performed by private radiologists

In the area of medical imaging, non-Medicare services include those funded by third party insurers, Veterans' Affairs, and services performed in the public hospital system. However, Medicare services account for around 65 per cent of total

[31] Royal Australian and New Zealand College of Radiologists, *Position on Teleradiology*, November 2001.

imaging procedures provided in Australia, with radiologists rendering around 90 per cent of these Medicare services.[32]

In terms of raw figures, Medicare claims compiled by the HIC show that around 12.7 million medical imaging services were billed across Australia in 2001-02. As such, we have grossed up the number of Medicare consultations by 35 per cent, to reflect the quantum of non-Medicare services provided. We have also assumed that, consistent with the pattern amongst Medicare services, radiologists perform 90 per cent of total consultations, as our focus is on services provided by specialist radiologists. As previously mentioned, we have also excluded MRI, CT and nuclear medicine imaging services, as the capital equipment may not be available in smaller rural hospitals to enable teleradiology in these cases. After these adjustments, the annual total is around 14.6 million services.

The HIC also collates the number of services per 100,000 population, by state, gender and age group. Correlating this data with the population base in the model (also by state, gender and age group) yields an estimate of the number of relevant radiology consultations per statistical sub division.

However, like telepsychiatry these averages conceal considerable variation within states, between metropolitan and non-metropolitan areas. The utilisation of radiology services is lower in non-metropolitan areas than in metropolitan areas. In order to account for regional differences in utilisation, the statistical sub divisions in the model were benchmarked against historical figures contained in the AMWAC report[33] into the specialist radiology workforce in Australia, showing the distribution of services by metropolitan and non-metropolitan locations.

Of the consultations servicing people in non-metropolitan statistical sub divisions:

- some are serviced directly by radiologists residing in non-metropolitan areas;

[32] Australian Medical Workforce Advisory Committee (2001), *The Specialist Radiology Workforce in Australia*, AMWAC Report 2001.4, Sydney (page 32)

[33] Derived from 1999-00 figures for services per 1,000 population contained in Australian Medical Workforce Advisory Committee (2001), *The Specialist Radiology Workforce in Australia*, AMWAC Report 2001.4, Sydney (page 35)

- some cases involve x-rays being physically delivered to a radiologist at a second location;
- some are serviced by a radiologist as part of a rural visiting service; and
- for the remainder, patients travel to visit a radiologist in a major regional area or metropolitan area.

Our focus on the use of teleradiology as a potential alternative delivery mechanism in the latter two cases, replacing some visiting services, or the need for patients to travel large distances to visit a radiologist.

Services to non-metropolitan patients by resident radiologists

The distribution of radiologists varies across states. While at a national level, around 83 per cent have a metropolitan area as their main place of work, this varies from around 58 per cent in Tasmania, to around 96 per cent in South Australia. Based on the number of Medicare-funded items, Australia's radiologists number around 1,210, of which around 208 reside in rural and remote Australia, as shown below in Table 3.3.1.

The distribution of radiology services is also related to the distribution of medical imaging equipment. As such, 'specialist radiology services in rural areas are mainly limited to large regional hospitals or private firms in large regional rural centres'[34].

Table 3.3.1 – Medicare-funded specialist radiologists, by metropolitan, rural and remote region, States and Territories, 1999-2000.

Specialist radiologists	NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Total
Number									
Metropolitan	363	230	148	113	105	15	24	4	**1,002**
Rural and remote	66	51	55	20	4	11	0	n/a	**208**
Total all regions	**429**	**281**	**203**	**133**	**109**	**26**	**24**	**4**	**1,210**

Source: Department of Health and Aged Care, quoted in Australian Medical Workforce Advisory Committee (2001), The Specialist Radiology Workforce in Australia, AMWAC Report 2001.4, Sydney (page 21).

Based on the average rural radiologist undertaking around 11,240 relevant services per annum[35], the estimated number of services performed by resident radiologists in non-metropolitan Australia by state is as follows:

[34] Australian Medical Workforce Advisory Committee (2001), *The Specialist Radiology Workforce in Australia*, AMWAC Report 2001.4, Sydney (page 64)

Table 3.3.2 – Estimated services performed by resident radiologists in rural and remote Australia, by State and Territory.

Estimated rural and remote consultations by resident radiologists	NSW	Vic	Qld	WA	SA	Tas	ACT	Total
	741,840	573,240	618,200	224,800	44,960	123,640	0	2,337,920

Visiting services to non-metropolitan patients

According to a survey undertaken by the RANZCR, across Australia, around 23 per cent[36] of all radiologists provide services to a rural area via a visiting service. However, there is considerable variation across states, as shown below.

Table 3.3.3 – Estimated percentage of radiologists providing a rural visiting service, by State/Territory, 2000.

	NSW	Vic	Qld	SA	WA	Tas	ACT	NT
% of radiologists providing a rural visiting service	22.8	19.5	25.2	40.4	21.3	0	33.4	40

Source: Derived from RANZCR 2000 workforce survey, contained in Australian Medical Workforce Advisory Committee (2001), The Specialist Radiology Workforce in Australia, AMWAC Report 2001.4, Sydney (page 34-35).

Of radiologists providing visiting services, we are not certain how often, and for how long, each radiologist visits. For the purposes of the model we have assumed that each radiologist visits a rural centre 3 days per month.

Based on each radiologist performing around 55 services per day[37] as part of the visiting service, and combining these results with the total number of radiologists in each state, estimated total consultations per year performed by visiting radiology services, by State is as follows.

[35] Based on the number of medical imaging services performed by radiologists in 1999-00, grossed up by 35 per cent for non-Medicare services and divided by 1,210 radiologists. For our purposes, MRI, CT and Nuclear Medicine Imaging services have been excluded, as the capital equipment may not be available in rural areas to enable teleradiology. Similarly, pregnancy ultrasounds have been excluded, as they are covered in section 3.4 regarding fetal teleultrasound. This results in around 13.6 million services, divided by 1,210 radiologists.

[36] Australian Medical Workforce Advisory Committee (2001), *The Specialist Radiology Workforce in Australia*, AMWAC Report 2001.4, Sydney (page 34-35).

[37] See Workforce Advisory Board, RANZCR, *2000 Australian Radiology Workforce Report.* Based on an average annual workload of between 13,500 and 14,000 procedures per year per radiologist and 250 working days (13,750/250).

Table 3.3.4 – Estimated number of radiology services provided by rural visiting services, by State/Territory.

	NSW	Vic	Qld	SA	WA	ACT	NT	Total
Consultations provided by rural visiting services	194,048	108,634	101,289	106,453	46,056	15,848	3,202	575,530

The remaining radiology services, not provided by resident radiologists, or visiting services, are assumed to involve rural patients travelling to a radiologist, in a major regional centre or metropolitan area.

Proportion of cases clinically suitable for treatment by telehealth

As part of this report, we are not including any additional rollout of medical imaging equipment beyond that already existing (largely in hospitals and private practices in capital cities and regional centres).

For the purposes of our national estimate we have assumed that, with the availability of an extensive broadband network, most routine cases will be performed by teleradiology. However, for complex cases, travel to a major centre will not be avoided.

Excluding resident radiologist services, we have assumed that with the availability of an extensive broadband network 50 per cent of remaining relevant radiology services (those currently performed by a rural visiting service, patients travelling to a major centre, or through physical delivery of x-rays) will be performed by teleradiology. It should be noted that this proportion is applied to a sub-set of total radiology consultations. That is, we have sought to exclude metropolitan consultations, and those performed by radiologists residing in non-metropolitan areas. Of the over 14 million relevant radiology consultations across Australia per annum, around 3.6 million relate to patients in non-metropolitan areas. Just over 1 million services involve a rural visiting service, patients travelling to a radiologist, or physical delivery of images. Applying the 50 per cent proportion implies around 530,000 (around 3.5 per cent of the total) radiology consultations performed by teleradiology.

We are uncertain regarding the proportion of services rendered through the physical delivery of medical images from rural sites. While around 43 per cent[38] of radiologists are involved in the interpretation of studies delivered from rural sites, we have been unable to determine the approximate number of consultations delivered in this way.

Replacing the delivery of studies to the radiologist with teleradiology will not involve cost savings in the form of lower transport and travel time savings. However, there may be cost savings (and a more responsive service) depending on the cost of courier or other delivery services, and any reductions in film costs with digital transmission.[39]

Like telepsychiatry, the exact take-up of teleradiology over a ten year period, with the availability of an extensive broadband network is uncertain and difficult to judge. As well as cultural factors (such as the acceptance of the technology by patients, and private and public practitioners) the current use of teleradiology can be attributed to the limited availability of suitable bandwidth. There are differing views regarding the likely use of an extensive broadband network, related to differing expectations regarding the extent to which teleradiology has the potential to form part of mainstream health delivery. The sensitivity of our results, including to the take up assumption is detailed in section 6.4. The take up rate will be higher to the extent teleradiology sessions reduce the need for visiting services or the need for patients to travel large distances. In particular, the take up rate will be higher to the extent:

- governments reduce funding of rural visiting services, in favour of teleradiology as a more cost effective, yet clinically effective alternative;

[38] Based on RANZCR 2000 workforce survey. See Australian Medical Workforce Advisory Committee (2001), *The Specialist Radiology Workforce in Australia*, AMWAC Report 2001.4, Sydney (page 35)

[39] For example, in the context of a MRI service in the United States, Davis assumed savings of US$40 per case with the move to a filmless system, as well as a US$10 per case saving in courier costs. See Davis, M., *Teleradiology in rural imaging centres*, Journal of Telemedicine and Telecare, Volume 3, Number 3, 1997.

- radiologists in the public and private sectors offer teleradiology services to rural patients, given the existence of an extensive, reliable broadband network; and
- patients demand access to teleradiology sessions as a cheaper, more convenient alternative than travelling large distances or waiting for a visiting service.

The take up rate will be lower to the extent:

- governments impose policy or regulatory restrictions on the use of teleradiology;
- governments decide to fund rural visiting services or physical delivery of images in favour of teleradiology; and
- radiologists do not offer teleradiology services to rural patients, despite the existence of an extensive broadband network, due to reluctance to use new technology, or concerns over clinical effectiveness.

Defining cost savings related to travel and time

With various degrees of quantification, a number of studies have suggested that there are cost savings available from the use of teleradiology services.[40]

This section attempts to quantify the savings related to direct travel costs and the opportunity costs of time, whether they are borne by the patient or visiting radiologist. Cost savings are calculated per consultation and then applied to the number of eligible teleradiology consultations estimated previously.

Cost savings from teleradiology depend on the conventional method of delivering the service. For example, if patients normally travel to a major regional centre, they

[40] See for example, Bergmo, T.S., *An economic analysis of teleradiology versus a visiting radiologist service,* Journal of Telemedicine and Telecare, Volume 2, Number 3, 1996; Hayward, T. and Mitchell, J., *The cost-effectiveness of teleradiology at the Women's and Children's Hospital in Adelaide,* Journal of Telemedicine and Telecare, Volume 6, Supplement 1, 2000; and Davis, M., *Teleradiology in rural imaging centres*, Journal of Telemedicine and Telecare, Volume 3, Number 3, 1997.

may gain via lower travel costs. Alternatively, a visiting radiologists service may avoid travel costs being incurred by a large number of patients. However, the health service would incur additional costs in respect of the radiologist, such as travel and accommodation, and the opportunity cost of time.

Cost savings - patients travel to the radiologist

Potential travel cost and time savings accruing to the patients will largely depend on the mode of transport and the distance travelled, using the same method as for telepsychiatry. Cost savings are calculated as shown in table 3.3.5.

The cost savings shown in table 3.3.5 relate to savings per adult consultation in the level 3 case. For patients under the age of 14 we have assumed they are accompanied by a parent or guardian when travelling to a consultation. This adds additional time opportunity cost savings for the adult (and travel cost savings in the case of plane travel, but not car travel).

Table 3.3.5 – Estimated cost savings per consultation due to avoided travel to the radiologist, by State/Territory.

Before Broadband

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Average kilometres travel	75.00	200.00	200.00	200.00	400.00	100.00	200.00	200.00
Cost per km	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Average flight cost	-	-	-	-	-	-	-	-
Direct travel cost	**44.25**	**118.00**	**118.00**	**118.00**	**236.00**	**59.00**	**118.00**	**118.00**
Average speed (kmph)	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
75% AWE	15.02	15.02	15.02	15.02	15.02	15.02	15.02	15.02
Travel time (hours)	0.94	2.50	2.50	2.50	5.00	1.25	2.50	2.50
Time opportunity cost ($)	**14.08**	**37.55**	**37.55**	**37.55**	**75.10**	**18.78**	**37.55**	**37.55**

After broadband

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Average kilometres travel	25.00	50.00	50.00	50.00	50.00	50.00	100.00	100.00
Cost per km	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Average flight cost	-	-	-	-	-	-	-	-
Direct travel cost	**14.75**	**29.50**	**29.50**	**29.50**	**29.50**	**29.50**	**59.00**	**59.00**
Average speed (kmph)	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
75% AWE	15.02	15.02	15.02	15.02	15.02	15.02	15.02	15.02
Travel time (hours)	0.31	0.63	0.63	0.63	0.63	0.63	1.25	1.25
Time opportunity cost ($)	**4.69**	**9.39**	**9.39**	**9.39**	**9.39**	**9.39**	**18.78**	**18.78**

Cost savings

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Direct Travel Cost Saving ($)	**29.50**	**88.50**	**88.50**	**88.50**	**206.50**	**29.50**	**59.00**	**59.00**
Travel Time Cost Saving	**9.39**	**28.16**	**28.16**	**28.16**	**65.71**	**9.39**	**18.78**	**18.78**
Total cost saving ($)	**38.89**	**116.66**	**116.66**	**116.66**	**272.21**	**38.89**	**77.78**	**77.78**

Cost savings - visiting radiologist service

The savings, in terms of saved time and travel accommodation costs will depend on the number of visits and the number of consultations performed as part of each visit.

We assume that the visiting radiologist travels to the patients at the same average distance and mode of travel assumed for each state in the case of patients travelling above). Similarly, patient travel costs to the medical imaging and transmission centre are roughly the same as the distance that would have been travelled previously to the imaging centre of the visiting radiologist. We also assume the visiting radiologist:

- Performs 55 consultations per day;

- Spends 3 days at the non-metropolitan centre;
- Is paid accommodation and meal allowance equal to the ATO 'reasonable amount' ($170.60 per day).[41]
- Travel time, measured by the radiologist's wage is estimated at $250 per hour.

Cost savings are calculated as shown in table 3.3.6.

Table 3.3.6 – Estimated cost savings per consultation due to replacement of visiting radiologist service, by State/Territory.

[41] Based on the 2003-04 'reasonable amount' that can be claimed by employee taxpayers for accommodation and meal expenses incurred when visiting 'other country centres' without providing substantiating documentation. For more information see *Taxation Ruling TR2003/7 Income tax: reasonable allowance amounts for the 2003-2004 income year.*

Before Broadband

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Average kilometres travel	75.00	200.00	200.00	200.00	400.00	100.00	200.00	200.00
Cost per km	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Average flight cost	-	-	-	-	-	-	-	-
Direct travel cost	**44.25**	**118.00**	**118.00**	**118.00**	**236.00**	**59.00**	**118.00**	**118.00**
Average speed (kmph)	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Specialist wage ($)	250.00	250.00	250.00	250.00	250.00	250.00	250.00	250.00
Travel time (hours)	0.94	2.50	2.50	2.50	5.00	1.25	2.50	2.50
Time opportunity cost ($)	**234.38**	**625.00**	**625.00**	**625.00**	**1250.00**	**312.50**	**625.00**	**625.00**
Plus accomodation and meals per day	170.60	170.60	170.60	170.60	170.60	170.60	170.60	170.60
Number of visiting days	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Number of consultations per day	56.00	56.00	56.00	56.00	56.00	56.00	56.00	56.00
Number of consultations per visit	168.00	168.00	168.00	168.00	168.00	168.00	168.00	168.00
Additional cost	**511.80**	**511.80**	**511.80**	**511.80**	**511.80**	**511.80**	**511.80**	**511.80**
Additional cost per consultation	3.05	3.05	3.05	3.05	0.00	3.05	3.05	3.05

After broadband

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Average kilometres travel	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Cost per km	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Average flight cost	-	-	-	-	-	-	-	-
Direct travel cost	**5.90**	**5.90**	**5.90**	**5.90**	**5.90**	**5.90**	**5.90**	**5.90**
Average speed (kmph)	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00
Specialist wage ($)	250.00	250.00	250.00	250.00	250.00	250.00	250.00	250.00
Travel time (hours)	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Time opportunity cost ($)	**41.67**	**41.67**	**41.67**	**41.67**	**41.67**	**41.67**	**41.67**	**41.67**

Cost savings per consultation

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Direct Travel Cost Saving ($)	**0.23**	**0.67**	**0.67**	**0.67**	**1.37**	**0.32**	**0.67**	**0.67**
Travel opportunity cost and allowance saving ($)	**4.19**	**6.52**	**6.52**	**6.52**	**10.24**	**4.66**	**6.52**	**6.52**
Total cost saving ($)	**4.42**	**7.19**	**7.19**	**7.19**	**11.61**	**4.97**	**7.19**	**7.19**

Total cost savings from teleradiology

Aggregating across Australia yields a total estimated cost saving (level 3 in net present value terms over ten years) of around $211 million from the use of teleradiology.

3.4 FETAL TELEULTRASOUND

Fetal teleultrasound is a subset of teleradiology, referring to the transmission and interpretation of obstetric ultrasound images between a primary and secondary site. The use of ultrasound to detect fetal anomalies in utero is standard practice in

Australia. However, where there is a suspected anomaly, the mother is normally referred to a specialist tertiary centre. In particular:[42]

> *Referral is required to a tertiary unit with a multidisciplinary team of specialists, including maternal fetal medicine subspecialists, neonatologists, paediatric cardiologists, neonatal surgeons, geneticists and genetic counsellors.*

A major teleultrasound service exists linking fetal medicine specialists at the Mater Mother's Hospital in Brisbane with the Kirwan Hospital for Women in Townsville. Rather than transporting patients to Brisbane, the facility allows remote access to maternal fetal medicine sub-specialists, to accurately and quickly determine management options in cases of suspected fetal anomalies.

The fact that teleultrasound is not as well established as telepsychiatry or teleradiology is partly due to the fact it requires relatively high bandwidth. Real time teleultrasound has advantages over still images or videotape review, as more certain diagnosis is possible by guiding the sonographer to capture different views. As such, rollout of broadband infrastructure provides the opportunity to increase the use of fetal teleultrasound to improve services to those in rural and regional Australia.

Existing pregnancy ultrasound consultations

We have estimated the number of pregnancy ultrasound consultations directly from Census data in the model.

The number of pregnancies which received an ultrasound in each SSD was calculated by taking the number of 0 to 4 year olds, dividing by 5 (to get the number of 0 year olds) and then lagging by one year to estimate the number of pregnancies in each financial year.

We have assumed the number of pregnancy ultrasound consultations per mother is 1.9[43]. This may underestimate the number of ultrasounds as not all pregnancies which receive an ultrasound come to term.

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[42] See Chan, F.Y., Soong, B. et al, *Realtime fetal ultrasound by telemedicine in Queensland. A successful venture?* Journal of Telemedicine and Telecare, Volume 7, Supplement 2, 2001.

Clinical effectiveness and patient satisfaction

As a type of radiology, ultrasound services do not necessarily require a face-to-face consultation between the medical specialist and the patient, with the sonographer capturing the image on-site, before transmission to specialists at the tertiary centre.

Similarly, subject to normal quality assurance procedures such as adequate supervision, capturing of the image by appropriately qualified personnel and quality image resolution between acquisition and final display, the RANZCR supports the use of teleultrasound.

Existing access to tertiary units specializing in fetal medicine

The existing distribution of obstetrics and gynaecology sub-specialists, usually employed in tertiary centres, is skewed towards capital cities and metropolitan areas. For example, as at 1998, of the 23 obstetrics and gynaecology ultrasound sub-specialists in Australia, only 4.3 per cent were located outside a metropolitan area. Similarly, none of the 10 Maternal Fetal Medicine sub-specialists were located outside a metropolitan area.[44]

For the purpose of the model, we have assumed that the patient currently travels to the specialist centre in a capital city.

Defining cost savings related to travel and time

Like the other telehealth applications, there are potential cost savings in terms of travel cost and time savings. For example, in the context of 90 consultations performed as part of the teleultrasound service between Brisbane and Townsville, a study by Chan et al estimated, via a 'crude cost-benefit calculation' that the ISDN-based service resulted in a net saving of $6,340 flowing from avoided patient travel costs.

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[43] Based on *Perinatal Data Collection*, Queensland Health, data extracted 23 April 2003 for the Number of Mothers by Number of Ultrasound Scans, Queensland, 2000 and 2001, prepared by Client Services Unit, Health Information Centre.

[44] Australian Medical Workforce Advisory Committee (1998), *The Obstetrics and Gynaecology Workforce in Australia*, AMWAC Report 1998.6, Sydney (page 80). See Part B of the report for more detail on the Obstetrics and Gynaecology Sub-specialist Workforce.

Consistent with the methodology for the previous telehealth applications, cost savings are calculated per consultation and then applied to the number of consultations, where patients would have otherwise been physically referred to the tertiary centre.

Cost savings - patients travel to the tertiary referral centre

Of the total population of pregnancy ultrasound consultations, we have allowed for 5 per cent involving suspected fetal anomalies, such that they are currently referred to a specialist tertiary centre in a capital city.

Potential travel cost and time savings accruing to the patients will largely depend on the mode of transport and the distance travelled. For other telehealth applications, we have assumed that adult patients travel alone (even though some will travel with a companion). However, given the nature of fetal teleultrasound and the interest of both parents, cost saving are based on the patient and their partner travelling to the consultation in the before broadband case. This adds additional time opportunity cost savings (and travel cost savings in the case of plane travel, but not car travel). Calculations in the level 3 case are shown in table 3.4.1.

Table 3.4.1 – Estimated cost savings per consultation due to avoided travel to the maternal tertiary referral centre, by State/Territory.

Before Broadband

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Average kilometres travel	100.00	250.00	400.00	400.00	600.00	100.00	200.00	200.00
Cost per km	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Average flight cost (2 adults)	0.00	0.00	0.00	0.00	0.00	0.00	700.00	900.00
Direct travel cost	**59.00**	**147.50**	**236.00**	**236.00**	**354.00**	**59.00**	**818.00**	**1018.00**
Average speed (kmph)	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
75% AWE (2 adults)	30.04	30.04	30.04	30.04	30.04	30.04	30.04	30.04
Travel time (hours)	1.25	3.13	5.00	5.00	7.50	1.25	6.50	7.00
Time opportunity cost ($)	**37.55**	**93.88**	**150.20**	**150.20**	**225.30**	**37.55**	**195.26**	**210.28**

After broadband

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Average kilometres travel	25.00	50.00	50.00	50.00	50.00	50.00	100.00	100.00
Cost per km	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Average flight cost	-	-	-	-	-	-	-	-
Direct travel cost	**14.75**	**29.50**	**29.50**	**29.50**	**29.50**	**29.50**	**59.00**	**59.00**
Average speed (kmph)	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
75% AWE (2 adults)	30.04	30.04	30.04	30.04	30.04	30.04	30.04	30.04
Travel time (hours)	0.31	0.63	0.63	0.63	0.63	0.63	1.25	1.25
Time opportunity cost ($)	**9.39**	**18.78**	**18.78**	**18.78**	**18.78**	**18.78**	**37.55**	**37.55**

Cost savings

	Tas	Vic	NSW	SA	NT	ACT	QLD	WA
Direct Travel Cost Saving ($)	**44.25**	**118.00**	**206.50**	**206.50**	**324.50**	**29.50**	**759.00**	**959.00**
Travel Time Cost Saving ($)	**28.16**	**75.10**	**131.43**	**131.43**	**206.53**	**18.78**	**157.71**	**172.73**
Total cost saving ($)	**72.41**	**193.10**	**337.93**	**337.93**	**531.03**	**48.28**	**916.71**	**1131.73**

Proportion of cases clinically suitable for treatment by telehealth

Not all of the current consultations referred to a specialist tertiary centre will be suitable for telehealth, and like the other teleradiology applications, the exact take-up of teleradiology over a ten year period, with the availability of an extensive broadband network is uncertain and difficult to judge. In particular, even after the teleultrasound examination, some will still be physically referred to the tertiary centre for management. However, we have allowed for a 25 per cent[45] reduction in

[45] Based on the Queensland experience, Chan et al report a 24 per cent reduction in physical transfers, while Fisk et al report a 31 per cent reduction in transfers between the Isle of Wight and London. See Chan, F.Y., Soong, B. et al, *Realtime fetal ultrasound by telemedicine in Queensland. A successful venture?* Journal of Telemedicine and Telecare, Volume 7, Supplement 2, 2001 and Fisk, N.M. et al

physical referrals. In total, cost savings from fetal teleultrasound have been applied to a base of around 1,800 consultations per annum.

Fetal telemedicine: six month pilot of real-time ultrasound and video consultation between the Isle of Wight and London, British Journal of Obstetrics and Gynaecology, 1996 Nov; 103 (11).

Total cost savings from fetal teleultrasound

Aggregating across Australia yields a total estimated cost saving (level 3 in net present value terms over ten years) of around $10 million from the use of fetal teleultrasound.

3.5 OTHER TELEHEALTH APPLICATIONS

The preceding analysis is relatively conservative to the extent it focuses on the benefits from telepsychiatry, teleradiology and fetal teleultrasound. These are relatively well established in Australia and presently constitute the bulk of telehealth activity. As such, the prospect of more widespread use of these delivery methods is more certain, with the availability of an extensive broadband network.

However, there are a number of other Australian telehealth applications that we have not attempted to quantify, given their earlier stage of development and data limitations. Further telehealth services that may make use of the broadband network include ophthalmology, dermatology, pathology, cardiology and diabetes management. Depending on the existing method of delivering these services, there may be further cost savings from the broadband network, and a larger amount of activity to defray the cost of the infrastructure.

3.6 INTANGIBLE AND OTHER UNQUANTIFIED BENEFITS

There are a range of less tangible benefits from the use of telehealth that we have not quantified. However, simply because they are difficult to quantify does not mean they are insignificant.

It is in the nature of many health services that patients will experience distress associated with their medical condition, including uncertainty regarding their diagnosis, treatment options and future wellbeing. Rapid access to a second opinion can avoid unnecessary anxiety for the patient and their family.

The availability of telehealth services can also significantly reduce the stress and inconvenience of travelling large distances to visit a medical specialist. In the absence of a telehealth service, the patient may need to take time off work, organise childcare or be otherwise inconvenienced.

For example, fetal teleultrasound can provide more rapid, certain advice to parents at a particularly stressful time, regarding the health of their fetus. Hayward and Mitchell[46] give an example where the transfer of a pregnant woman was avoided in remote South Australia:

> *A pregnant woman was scanned at a remote country hospital and was thought to need urgent flight transfer and premature delivery of her baby for a malignant mass in the fetus. Using teleradiology, the images were reviewed by the WCH [Women's and Children's Hospital] obstetric radiologist and discussed at a multidisciplinary meeting. The likely diagnosis was changed and the patient was followed up locally, with a coordinated care approach also involving the WCH specialists.*

Telehealth services may also result in a reduction in overall health care costs if faster intervention prevents an escalation in the severity of a patient's condition, or greater continuity of care results in better health outcomes.

For example the availability of broadband may accelerate the implementation of comprehensive, national electronic health records (including x-rays and other graphics). Providing up to date information regarding medical history, past treatment, current prescriptions and allergies may have a number of benefits. For example, more accurate patient information may reduce the incidence of adverse drug interactions or over-prescribing of medicines, as well as avoiding the duplication of pathology or other tests.

Similarly, there are likely to be efficiencies in a range of administrative functions with the availability of a broadband network connecting health care facilities. For example, there may be savings from conducting administrative meetings between health care centres via videoconferencing rather than in person and greater use of electronic patient referrals and billing. In addition, a substantial administrative benefit of broadband is likely to be the savings in long distance phone call costs from using Voice over Internet Protocol (VoIP). However, NOIE and Access Economics were unable to obtain data on current expenditures by hospitals on long distance phone calls, so could not include an estimate of VoIP savings in this report.

[46] Hayward, T. and Mitchell, J., *The cost-effectiveness of teleradiology at the Women's and Children's Hospital in Adelaide,* Journal of Telemedicine and Telecare, Volume 6, Supplement 1, 2000.

Impacts such as these may result in cost savings and improvements in the efficiency and effectiveness of health services. As a result, there may be considerable additional benefits from broadband connectivity, beyond those quantified and included in our analysis.

3.7 INCREASED ACCESS TO HEALTH SERVICES

The preceding analysis assumes that telehealth is used as an alternative mechanism to deliver existing health care services. It does not take into account the potential increase in utilisation of health services in rural and regional Australia flowing from greater access to specialist medical services.

As previously stated, there is considerable variation in the utilisation of medical services between metropolitan and non-metropolitan areas. The lower utilisation in non-metropolitan Australia is largely related to the lower availability of specialist medical services in these areas, particularly the scarcity of private providers. For example, in relation to private psychiatric services, the National Mental Health report[47] noted:

> *People resident in non-metropolitan areas, particularly those in rural and remote communities, continue to have least access, and are less than half as likely to receive services from a private psychiatrist than people residing in capital cities. When people in rural and remote areas do see private psychiatrists, they are likely to have only two-thirds as many consultations.*

While GPs in rural and remote areas may seek to provide care given the lack of access to specialist psychiatrists, it is also well documented that there is a shortage of GPs in rural and remote areas. So it is most unlikely that the GP workforce has been able to meet all the needs.

The introduction of a widespread broadband network connecting residents in non-metropolitan Australia to medical specialists around the country could be expected

[47] Based on Medicare claims data from 1992-93 to 1999-00. See Commonwealth Department of Health and Ageing, 2002, *National Mental Health Report 2002: Seventh Report. Changes in Australia's Mental Health Services under the First Two Years of the Second National Mental Health Plan 1998-2000. Commonwealth of Australia.* (page 128).

to increase the quantum of medical services, above the existing, constrained level. However, the magnitude of such an increase is uncertain.

It is often argued that increased utilisation of health services in non-metropolitan areas is appropriate, and a net benefit to society, especially if it is simply delivering the same level of service to rural residents that exists in urban areas. Indeed, the desire to increase access to mental health services in rural and regional Australia was part of the policy rationale for listing telepsychiatry services on the Medicare Benefits Schedule.

However, while increasing access to health services via telehealth may provide benefits to patients (and governments as a relatively cost effective means of delivering greater levels of health care) it is not costless. That said, the net costs are not so easy to estimate. For example, better access to counselling via telepsychiatry services may increase the use of prescription pharmaceuticals but generate offsetting savings in hospitalisation. That would imply that one level of government (federal) may bear the brunt of the cost increases while another (States) may enjoy the cost savings.

There could be net budgetary implications for governments, and impacts on the rest of the economy that are not well captured within a partial equilibrium, cost benefit analysis framework. For example, were there large increases in health expenditure, that may impact on prices and draw resources away from other sectors of the economy. In particular (in the absence of greater private contributions) greater health care funding would involve a redirection of funds away from other areas of government expenditure. Alternatively, additional health services could be funded via higher government debt or increased levels of taxation, with both options having flow on effects in the rest of the economy.

While these broader economic impacts could be estimated in a computable general equilibrium (CGE) model, the overall impact on economic welfare would remain uncertain. CGE models are based within the national accounting framework, which does not capture the less tangible benefits from increased health care - such as increased patient wellbeing as would be measured by more quality years of life - unless they are reflected in market transactions, or values are explicitly ascribed to the health benefits.

Ultimately, decisions regarding the appropriate level of overall funding and access to health care are a matter for governments to determine as part of the political process, and are beyond the scope of this report.

4. BENEFITS OF BROADBAND ROLLOUT – EDUCATION AND TRAINING APPLICATIONS

Videoconferencing facilities connected to broadband are also suitable for education and training activities in the health sector.

For example, the Royal Australian and New Zealand College of Psychiatrists recognises the use of videoconferencing to facilitate education and training of psychiatrists:[48]

> *The use of videoconferencing for educational support (via traditional didactic lectures, case discussions or individual supervision) of healthcare professionals in rural and remote regions has become well accepted and established.*
>
> *This can occur in point to point connections between the teacher/supervisor and the 'student', or can be a multipoint or 'bridged' link up linking a number of distant sites to a lecture or supervisor…videoconferencing is currently being used as a means of providing RANZCP accredited supervision for psychiatric trainees, when locally based supervisors are not readily available.*

We have based our estimate of the potential benefits from education and training applications on the number of health professionals and associate professionals by statistical subdivision, extracted from the 2001 Census.

The ABS classification of health care workers are divided into:

- Professionals such as Medical professionals and Nursing professionals; and
- Associate professionals such as enrolled Nurses.

For health care workers in non-metropolitan SSDs, we have assumed that each person currently travels once per year to a capital city for a education or training session, and stays 2 nights, with appropriate accommodation and meals allowance.

[48] The Royal Australian and New Zealand College of Psychiatrists, *Telepsychiatry, position statement #44,* October 2002.

We have calculated travel cost savings per person and time savings based on Average Weekly Earnings.

Proportion of education and training sessions undertaken via broadband

We have assumed that, of these education and training sessions, 33 per cent are undertaken using broadband, with people still travelling to the capital city the remainder of the time.

Total cost savings from education and training applications

Aggregating across Australia yields a total estimated cost saving (level 3 in net present value terms over ten years) of around $153 million from education and training applications.

5. GROSS IMPACT OF ACCELERATED ROLLOUT OF BROADBAND IN HOSPITALS

The preceding analysis has been used to derive an estimate of the *gross* impact of accelerated rollout of broadband in the health sector. That is, the impact of delivering clinical or education services via broadband rather than conventional methods (such as travel by patients or medical staff). It implicitly assumes that telehealth does not currently exist. The net impact of accelerated rollout (taking into account current telehealth activity) is examined in section 6.

Based on the expectation that broadband investments have a life span of 10 years (and 4 years for the terminating equipment), the net present value costs and benefits of the gross impact have been calculated over a 10 year life cycle.

The calculations are based on an immediate take up, but there may also be a ramp up period in the first 12-18 months which may slightly delay some of the benefits.

5.1 SUMMARY OF GROSS COSTS AND BENEFITS

The following table summarises the *gross* costs and benefits from the rollout of broadband in the health sector.

Table 51.1 – Summary of Gross costs and benefits of broadband rollout to hospital, net present value results, 2003-04 to 2012-13.

	Level 1 & 2	Level 3	Level 4	Level 5
	($'000)	($'000)	($'000)	($'000)
Telepsychiatry benefits	71,507	91,798	103,722	103,722
Fetal teleultrasound benefits	8,332	9,719	10,606	10,606
Teleradiology benefits	14,379	210,665	312,500	312,500
Training benefits	135,614	152,589	163,062	163,062
Total Benefits	**229,832**	**464,771**	**589,889**	**589,889**
Total Costs	**143,336**	**269,282**	**617,453**	**873,250**
Total Net Benefit	**86,496**	**195,489**	**-27,564**	**-283,361**

Cost savings increase across the levels as the broadband network expands, reflecting the shorter travel distances of patients or medical practitioners. That is, cost savings are greater where broadband rollout is more comprehensive, as rural patients travel a shorter distance to visit a telehealth facility.

The results show that level 3 (connecting major hospitals in each statistical sub-division) provides the greatest net benefit. Conversely, diminishing returns are evident under the more extensive networks envisaged in level 4 and 5, as the marginal cost of expanding the network is not justified by the marginal benefits, so overall net benefit declines.

Results for level 1 and 5 are shown for illustration purposes. No benefits are shown at level one, as only hospitals in capital cities are connected (and non-metropolitan hospitals are not). There are no additional benefits in expanding the network from level 4 to level 5 as we have not incorporated any further travel cost or time savings at the margin from expanding the network to all hospitals, as opposed to connecting the major hospital in every town, although this comes at an increased cost.

6. NET IMPACT OF ACCELERATED ROLLOUT OF BROADBAND IN HOSPITALS

The results in section 5.1 reveal that the Level 3 case (linking the major hospitals in each statistical sub-division) is estimated to provide the largest net benefit. As such, the remainder of the report will present further results focussing on level 3.

This section extends the cost benefit analysis further, by taking into account existing telehealth activity to estimate the net impact of accelerated rollout of broadband in health.

A number of telehealth programs exist at the state level, focussed on delivering health services to communities in rural and regional Australia. The last comprehensive stocktake of telehealth activity in Australia was performed in 2001 by the Australian New Zealand Telehealth Committee[49]. A summary of the type of connections and telehealth activities in each of State and Territory, collated by the Telehealth Committee, appears at Appendix A. We have drawn on this data, as well as more current data compiled in consultation with Commonwealth and State Departments of Health to model existing telehealth services.

6.1 MEASURING INCREMENTAL BENEFITS

To derive the net impact of broadband rollout in the model, we need to deduct the benefits already accruing to society from existing telehealth activity, as well as deduct the avoided costs as organisations have access to the new infrastructure.

To specify the model, we mapped the distribution of existing telehealth centres by SSD, based on available data. We then identified the number of eligible telehealth and education and training sessions derived in sections 3 and 4 of the gross scenario. Where ISDN currently exists, a weighting of 40 per cent was applied to reflect lower levels of telehealth activity.

Existing telehealth sites mainly rely on ISDN connections which involve relatively large variable costs (around $90 per hour) and low fixed costs, which discourages

[49] Australian New Zealand Telehealth Committee, *Proceedings of Telehealth Think Tank, Melbourne 2000, Fact Sheet 3: Telehealth Activity in Australasia Today,* 2000.

frequent usage. Assuming that existing utilisation is around 40 per cent of gross scenario utilisation is likely to be conservative. The gross scenario is a large intervention, involving widespread access to broadband connectivity, at a low variable cost (but high fixed cost).

As part of the gross scenario, of the consultations servicing people in non-metropolitan areas:

- some are serviced by medical specialists residing in non-metropolitan areas;
- some are serviced by a metropolitan medical specialist as part of a visiting service; and
- the remainder travel to visit a specialist in a major regional centre or metropolitan area

Potential cost savings were derived as telehealth provides an alternative delivery mechanism for existing visiting services, or patient travel.

Under the net scenario, these cost savings are reduced to the extent there is existing telehealth activity (as, for example, people travel the same distance to their local videoconferencing centre before and after the broadband rollout). As such, theses benefits have been deducted, in proportion to the number of existing telehealth consultations, at the 40 per cent utilisation rate. There is no adjustment to the gross cost savings from replacing visiting services, as they coexist with current telehealth services.

However, compared to the existing situation, a benefit is derived in the form of the avoided ISDN charges, once the service is replaced by broadband. We have incorporated this cost saving at a rate of $45 per telepsychiatry and teleultrasound consultation (assuming ISDN charges of $90 per hour and a half hour consultation). ISDN savings from each teleradiology service were assumed to be $7.50 (five minute data transfer time per consultation)

The costs in the gross scenario include provision for terminating equipment (videoconferencing equipment, software etc) of $30,000 per hospital. However, many hospital already have terminating equipment that may be compatible with the new broadband network and still have a remaining useful life. A 50 per cent saving

per hospital ($15,000) through existing terminating equipment has been incorporated in the net scenario, for those facilities with existing ISDN connectivity.

6.2 SUMMARY OF NET COSTS AND BENEFITS

The following table summarises the *net* costs and benefits from the rollout of broadband in the health sector.

Table 6.2.1 – Summary of net additional costs and benefits of broadband rollout to hospitals, net present value results, 2003-04 to 2012-13 (level 3).

	Level 3
	($'000)
Psychiatry Benefits	105,934
Ultrasound Benefits	5,633
Radiology Benefits	140,445
Training	114,601
Total Benefits	**366,612**
Total Costs	**176,663**
Total Net Benefit	**189,949**

The net benefit under the net impact scenario is lower than the net benefit reported under the gross scenario. This reflects the fact that there are fewer travel and time cost savings (as existing patients currently derive the benefit of telehealth). However, this is partially offset by ISDN savings compared to broadband, and the higher utilisation rate (number of consultations) following broadband rollout. That is, compared to the gross scenario there are:

- Already savings from existing telehealth services;
- Relatively large ISDN savings;
- Relatively low utilisation of telehealth with ISDN, compared to extensive broadband connectivity; and
- Savings flowing from the use of existing terminating equipment.

6.3 SPEED OF BROADBAND ROLLOUT AND EFFECT ON NET IMPACT

The quantum of cost and benefits will also be affected by the speed of broadband rollout. Slower rollout of broadband infrastructure delays the accruing of some costs and benefits. These delays influence the net present value results. Three timing scenarios are shown below, with broadband rollout occurring over 2, 4 or 8 years.

Table 6.4.1 – Speed of broadband rollout and effect on net benefit, net present value results (level3).

NPV ('000) - discount rate 6%	Net Benefit	Cost of delaying
Rollout immediately	$189,949	-
Rollout takes 2 years	$160,959	$28,990
Rollout takes 4 years	$131,969	$57,980
Rollout takes 8 years	$102,979	$86,970

It is difficult to judge the pace of rollout that might occur over the next few years without further intervention. Governments are gradually increasing the number of broadband connections to hospitals. If it were to take 4 to 8 years for all Level 3 hospitals to be connected at the current pace of rollout, an intervention by government to accelerate the rollout of broadband in hospitals is likely to generate a net economic benefit in the order of $58 million to $87 million.

6.4 SENSITIVITY ANALYSIS

The estimates contained in this report are sensitive to the assumptions and data underpinning the analysis. As previously described, the national estimate is not a business case, and necessarily involves a number of simplifying assumptions regarding the costs and benefits. A common feature of cost benefit analysis of this sort is the inclusion of sensitivity analysis, to illustrate the sensitivity of results to key assumptions.

Table 6.5.1 shows the percentage change in the value of the net benefit for a 10 per cent change in the key parameter. The sensitivity analysis focuses on the downside risk, for example, the negative impact that an increase in the cost of laying cable would have on the results.

Table 6.5.1 – Sensitivity analysis: impact on total net benefit of changes in key assumptions (level 3).

	Decreases NPV by (%)
Total Net Benefit	
Training costs increase by 10% (all hospital sizes)	0.89%
System management costs increase by 10% (all hospital sizes)	1.18%
Satellite Costs increase by 10% (fixed and recurrent)	0.05%
Terminating equipment costs increase by 10%	0.45%
Cable costs increase by 10%	6.73%
End point technology savings by having ISDN Decrease by 10%	0.08%
Per hour cost savings of using broadband instead of ISDN Decrease by 10%	2.68%
Broadband use (%) decrease by 10% (psychiatry)	5.58%
Broadband use (%) Decrease by 10% (ultrasound)	0.30%
Broadband use (%) Decrease by 10% (radiology)	7.39%
Broadband use (%) Decrease by 10% (training)	6.03%
ISDN utilisation increase by 10%	1.66%
Defer total benefits by one year	10.93%
Patient opportunity cost of time decrease by 10% (AWE)	2.34%
Specialist opportunity cost of time decrease by 10%	0.96%
Travel distances and time decrease by 10%	10.44%

As shown above, the results are most sensitive to deferring total benefits, changes in travel distances and time, utilisation rates for the telehealth applications and training and cable costs.

7. CONCLUSION

The analysis in this report indicates that a carefully planned, extensive broadband network connecting major health care facilities has the potential to generate net economic benefits to Australia by enhancing the delivery of health services.

A notable result of the analysis is the finding that ubiquitous broadband (broadband connecting every hospital) is not optimal. This result is not surprising. Like other forms of infrastructure, there is a point (level 3 in our analysis) where the additional infrastructure and other costs of expanding the network are larger than the additional benefits, in terms of quantifiable savings to the economy. Indeed, it highlights the importance of developing business cases to assess the marginal costs and benefits of individual investment decisions.

While the report has focussed on the more readily quantifiable benefits of common telehealth applications and education and training, intangible and unquantified benefits such as improved patient satisfaction and administrative savings would provide further benefits.

Access Economics

November 2003

APPENDIX A

Telehealth Applications in 2001

This information is based on the telehealth applications in 2001 listed at www.telehealth.org.au. This is the most recent publicly available data. Access Economics updated this data in mid-2003, based on feedback and discussions with all State and Territory health departments.

Given the rapid pace of development in the telehealth area, the lack of any systematic collection of data on the extent of telehealth rollout makes it difficult to monitor trends. The 2003 snapshot by Access Economics indicates the pace of broadband rollout has been mixed.

	Provision in 2001
New South Wales	• 384kbps ISDN videoconferencing used for all current applications. • Mainly used for psychiatry, diabetes, imaging services, pathology and training. • Sydney hospitals such as RPA and Sydney Children's Hospital provide services to regional hospitals throughout NSW such as Broken Hill, Wagga Wagga Lismore and Dubbo (and many others).
Victoria	• 384kbps ISDN videoconferencing used for all current applications. • Mainly used for psychiatry, training and a general range of hospital applications. • Mainly used to connect large metro hospitals to many smaller regional hospitals.
Qld	• 128kbps ISDN PC-based videoconferences. A few places have higher speed connections, but almost all are 128kbps. • Mainly used for psychiatry, imaging services, and training. • Mainly large metro hospitals in Brisbane, Cairns and Bundaberg providing services to many smaller regional hospital throughout Queensland
SA	• Mostly 256kbps and 384kbps PictureTel equipment. • Used for a range of renal, psychiatry, rehabilitation, imaging services and training. • Used for at-home care of dialysis patients in the metro area, out patient care. • Also used to link smaller regional hospitals to specialists in major metro-area hospitals.
WA	• Videoconferencing equipment. • Currently rollout provides psychiatry services to 35 regional locations. • A pilot program underway to provide a wider range of telehealth services.
Tasmania	• 384kbps ISDN videoconferencing used for all current applications. • Mainly used for palliative care, drug counselling, diabetes and training. • Mainly used to link major metro-area and Melbourne hospitals with smaller

	regional hospitals in Tasmania
ACT	• None currently available
Northern Territory	• No NT-based services currently available • Some services available via connections to South Australia.