



ear science institute australia

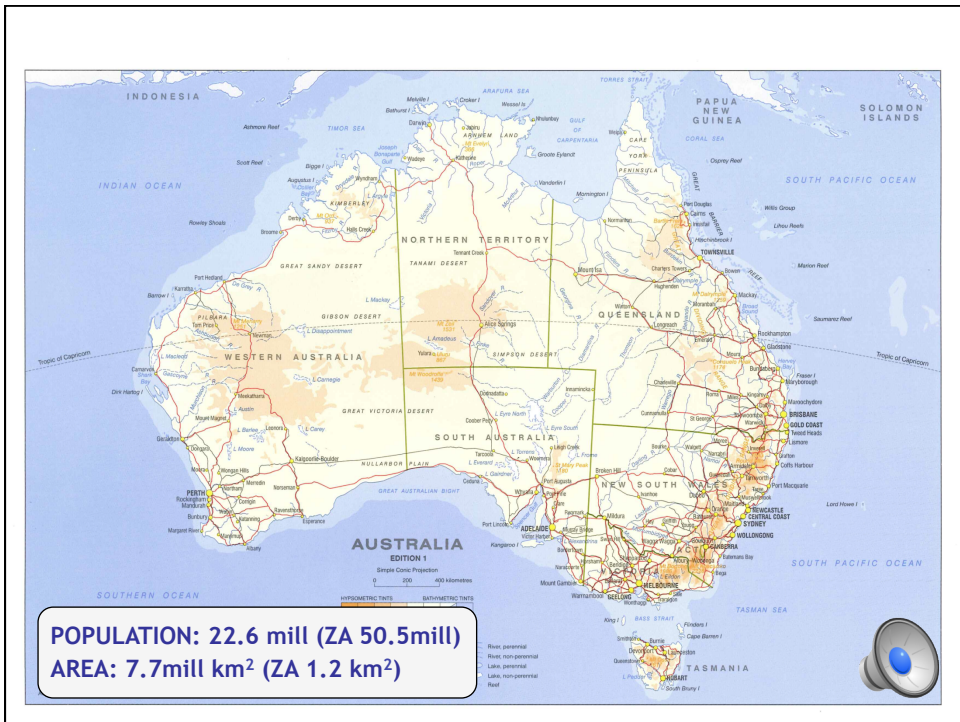
Ear and hearing telehealth An Australian perspective

Robert Eikelboom

Adj Professor - Ear Science Centre, UWA
Head eHealth Group - Ear Science Institute Australia
Extraordinary Professor- Dept of Communication Pathology, Uni of Pretoria



Global Telehealth Conference 2012




1930s



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1879



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S. Aronson, *The Lancet on the Telephone 1876-1975*, *Medical History*, 21(1977):69-87.




The tyranny of distance

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Sea Routes to and from Australia, c. 1800.

The Great Circle Route, 1850s.


Blainey G, The tyranny of distance, Sun Books, Melbourne, 1969.



The Overland Telegraph and the East-West lines

— The Overland Telegraph Line, 1870-72
- - - The East-West Line, 1873-77

ay have gain. If




Sunday 22nd February, 1874

The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.

✘

'This Station has been attacked by natives at 8. Stapleton has been mortally wounded, one of the men, named John Franks, just died from wounds. Civilised Native Boy has had three spear wounds. Mr Flint, assistant operator one spear wound in leg, not serious. Full particulars in morning.'



Northern Territory Times and Gazette (Darwin, NT : 1873 - 1927), Friday 27 February 1874, page 3

Murders by the Natives at Barrow Creek.
The Monday last intelligence was received by Mr. Little of freighted travellers assembled by natives at Barrow Creek Telegraph Station, which is very near the centre of the continent, and one of the most isolated places along the whole of the Overland Telegraph line. The intelligence received is as follows:—
"February 22nd, 1874.
"The Barrow Creek Telegraph Station was attacked by natives at 8 p.m. on Monday, and John Franks, one of the station men, killed; Mr. Stapleton, the station-master, seriously wounded; Mr. Flint, the assistant, slightly; and a friendly native very seriously; and a few natives sitting outside the building among the men taking to flight, and one of the natives, when a large body of others rushed from among and commenced throwing spears.
"The cause of attack is supposed to have been for the purpose of obtaining furs, which had been refused by the natives—except the aged infirm, and those that worked during the earlier part of the day.
"Mr. Stapleton, the station-master, has since died, and the wounded native, we believe, is not likely to recover. Of course there is no medical aid within hundreds of miles of Barrow Creek, and there is also no aid of any other kind nearer than the next station—Alice Springs on the north, and Tennant Creek on the north. The position, therefore, of the assistant station-master, who is wounded, is something deplorable until such time as he can receive assistance from other places.
"The Alice Springs station, in the MacDonnell Ranges, is the best place undoubtedly for giving help, and no doubt Mr. Todd has already, by telegram, Mr. Todd has already, by telegram, despatched a party from that place. The reason why he could do so effectively is that there is a large signalling station at Alice Springs, where Messrs. Bagot and Gilbert have taken up land, and therefore a few men with horses, if necessary, could be obtained from the squatters to accompany any of the Telegraph people who might be sent to the scene of the outrage at Barrow Creek.
"From the Port Darwin end of the line there is nothing that can be done unless Mr. Todd be able to send along one or two men from Tennant Creek. But the fact is all the stations are short-handed, considering how much they are exposed to attacks from hostile natives; and few were often exposed when the line was being constructed that loss of life would ensue if stations were left in the centre of the continent with only four or five men at each place. This, we believe, was felt to be the case by the authorities, and at once done it was proposed to strengthen the telegraph stations by giving pastoral lands in the neighbourhood to any persons who would stock, them and occupy them. But the idea was abandoned, and the telegraph people were apparently becoming so familiar with the natives that all fear as to their want of more protection has since been gradually dying away.
"Mr. Watson, however, who used to be station-master at Barrow Creek, had no confidence in the natives. He stopped at the station for a fortnight about eighteen months ago when crossing the continent, and ascertained from him that the blacks had not only a threatening manner on several occasions to people who were not looking for horses; and he therefore kept them at a distance from the station, and was very careful about his horses. The building for the telegraph operators and their men was then just occupied. It was a good solid stone house, covered with an iron roof, and was so built that the only entrance was behind, where there were large gates, which, on horse-roads, left no means of

National Library of Australia <http://nla.gov.au/nla.news-article1142485>

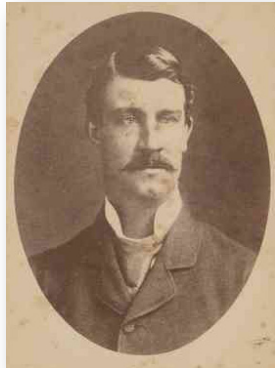
Northern Territory Times and Gazette (Darwin, NT : 1873 - 1927), Friday 27 February 1874

Monday 23rd February, 1874

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✘

- '... We are informed by Mr. Todd that during Sunday night Dr. Charles Gosse at his request attended at the Telegraph Office and gave instruction as to the proper treatment of the wounded'



National Library of Australia <http://nla.gov.au/nla.news-article1142485>

Monday 23rd February, 1874

- *'... and up to about 11 o'clock all were progressing favorably. Later in the day, however, a change for the worse took place in Mr. Stapleton's condition, and notwithstanding all the aid that it was possible to render him, he sank under the effect of his injuries, and died, very quietly, at a quarter to 6 o'clock in the evening.'*



Muddyboots, Bonzle.com



Monday 23rd February, 1874

to Barrow Creek. One of the telegraph men was dead, and another was dying, and so the wife of the dying man was hurried to the Adelaide office where, according to a journalist of the day, she heard 'the exhortations by wire of her husband – distant 1200 miles, the wire at his very bed side – each bidding an eternal adieu to the other by the click of the instrument'.

Mr. Stapleton, the Stationmaster, was also fatally injured. He was wounded in the left side, the size of the wound being reported to be about an inch broad and three inches deep. He also received a nasty injury in the left thigh. The first reports announced that Mr. Stapleton was mortally wounded; but subsequently it was hoped that a decided improvement had taken place in his case, his pains being eased by the kindness of Dr. C. Gosse, who, at the instance of Mr. Todd, attended at the head office to prescribe for the patients.

Mr. J. L. Stapleton, we regret to report, died on Monday afternoon. Dr. Gosse gave full medical instructions up to near the officer's end, and when he appeared to be getting worse, Mrs. Stapleton, who resides at North Adelaide, was sent for by Mr. Todd. She conversed with her fast-sinking husband by wire, and while messages were still being sent from here asking for further information, a telegram came announcing his decease. Mr. Stapleton, who was an

South Australian Register, 28 Feb 1874





Remote WA 13th August, 1917


✘ The image above is a screenshot of an internet browser. It does not have enough memory to open the image for the first time. It may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.

- Jimmy Darcy - internal injuries after fall from horse.
- Taken to Fred Tuckett - telegraphist at Halls Creek, who had some 1st aid training
- Dr John Holland in Kalgoorlie diagnosed rupture of urethra
- Operation needed
- Conducted by Tucker using morphia, pocket knife and razor, under instruction over Morse code

OPERATION BY A LAYMAN
 Perth, August 13
 A remarkable operation was performed by Postmaster Tuckett of Halls Creek on a man named Darcy who was injured by a fall from a horse. Dr. Holland instructed Mr. Tuckett by telegraph what to do, and the latter carried out an operation with the razor, and although Darcy's condition was very serious he is progressing. The doctor left by the Moira on Thursday for Hall's Creek.

RFDS - 1929

- Inspiration for John Flynn to set up the RFDS in 1929
- Alfred Traeger - engineer and experimenter in Adelaide
- Developed the pedal-powered wireless
- 1932 - keyboard


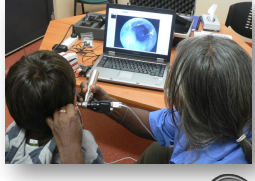



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Today

Necessity is the mother of invention
?Plato

- Our situations encourage us to innovate
- The most basic means of telecommunication can be used for telemedicine
- Use what you have at your disposal - people, networks, equipment



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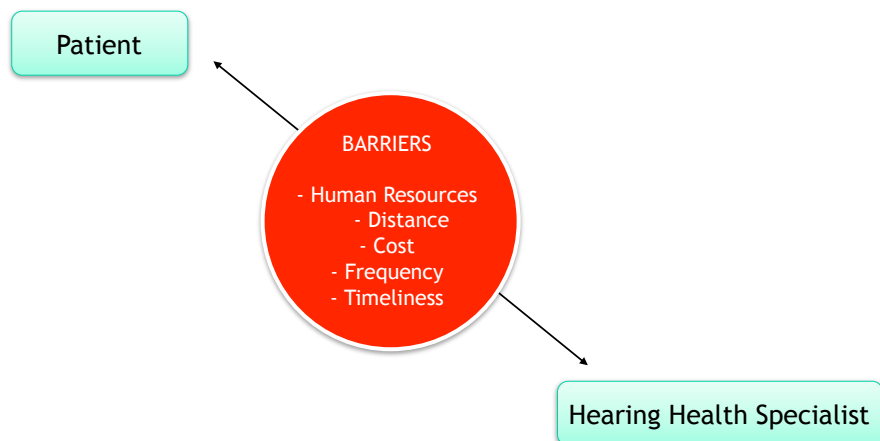


Ear Health in rural and remote Australia


- High incidence of chronic ear disease, often >25%
- Up to 90% with HL
- Poor service delivery; no resident ENTs or audiologists
- Low socio-economic environment



Referral Pathways in remote areas



TELEMEDICINE JOURNAL AND e-HEALTH
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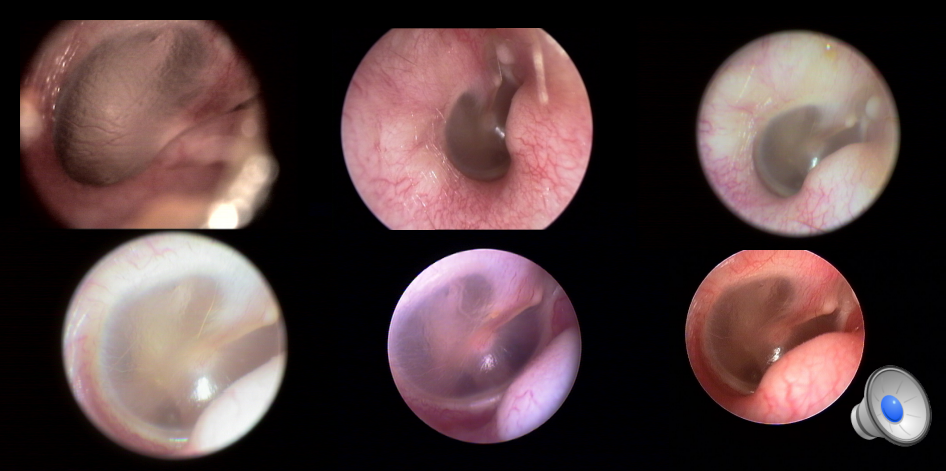
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Video-otoscopes

Evaluation of Video-Otoscopes Suitable for Tele-Otology

MATHEW N. MBAO, ROBERT H. EIKELBOOM, MARCUS D. ATLAS, and MARK GALLOP

➤ Quality, safety, ease of use





Validation

- 69 patients
- 9 months to 15 years
- Various ear conditions
- Agreement between diagnosis and recommendations ($p < 0.001$)

International Journal of Pediatric Otorhinolaryngology (2009) 49, 739–744

ELSEVIER

International Journal of Pediatric Otorhinolaryngology
www.elsevier.com/locate/journal

Validation of tele-otology to diagnose ear disease in children

Robert H. Eikelboom^{a,b,*}, Mathew N. Mbaob^b, Harvey L. Coates^{b,c}, Marcus D. Atlas^{a,b}, Mark A. Gallop^a





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Training and Support

A tele-otology course as a means of addressing the shortage of primary health care physicians in Aboriginal communities

Dinh Q, Eikelboom RH, Atlas MA, Weber S, Mba MN, Gallop MA
HIC2003 RACGP12CC Handbook of Abstracts, (eds E Coiera, C Simpson), Health Informatics Society of Australia and Royal Australian College of General Practitioners, Brunswick East, Australia. 92-93. ISBN 0 9751013 07 (DEST DETYA E1 Standard)

- Training in otoscopy, tympanometry, screening audiometry, primary ear health care.
- Ongoing support essential


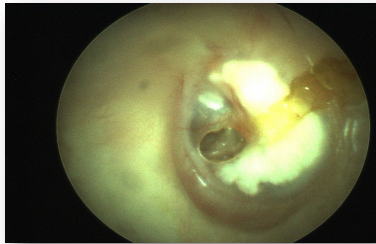


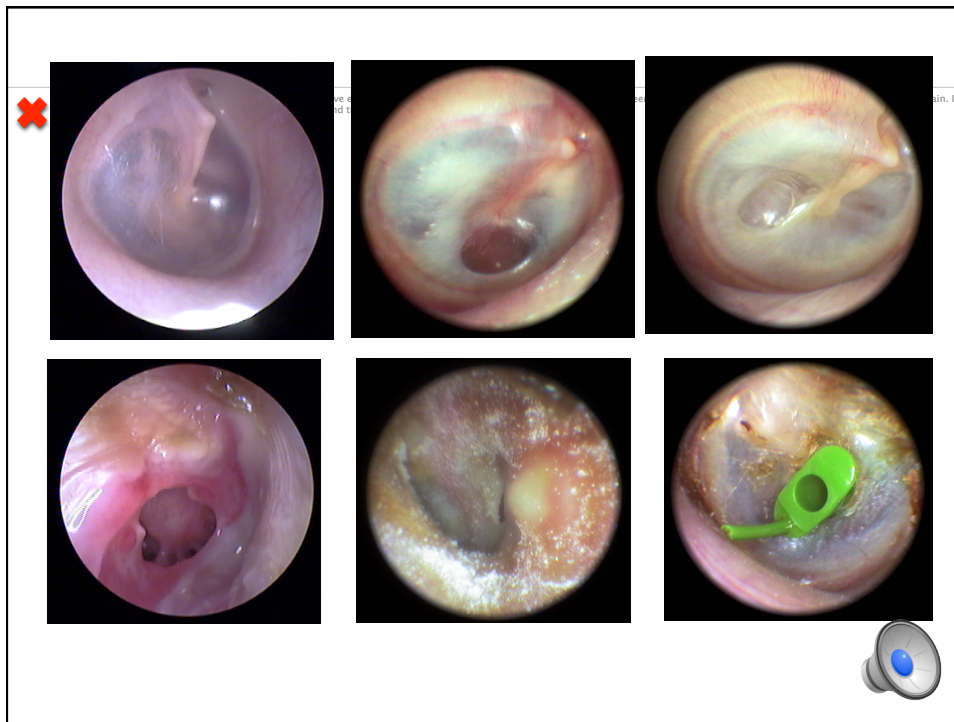
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Kids ears - do you know what you are looking at?

Workforce issues


- Training opportunities
- Lack of peer-group support
- Distance from city
- High staff turnover
- Difficult working conditions
- Large workload - many other health concerns






Kids ears — do you know what you are looking at?


- Assessment of 25 Tympanic membrane images
- 134 participants - nurses (37%), audiologists (25%), GPs (17%)
- Identification from a list e.g. perforation, discharge, normal, retraction
- Recommendation for management




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Kids ears – do you know what you are looking at?

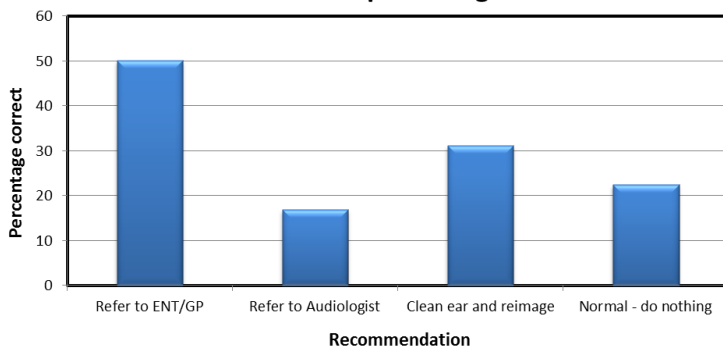
Sensitivity		
Low <0.4	Medium 0.4-0.6	High >0.6
Discharge	Scarring of ear drum	Grommet
Retraction	Inflammation	Foreign object in ear canal
Wax (not obscuring ear drum)	Effusion (fluid behind ear drum)	Perforation
Wax (obscuring ear drum)	Image too poor	
Normal		




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Kids ears – do you know what you are looking at?

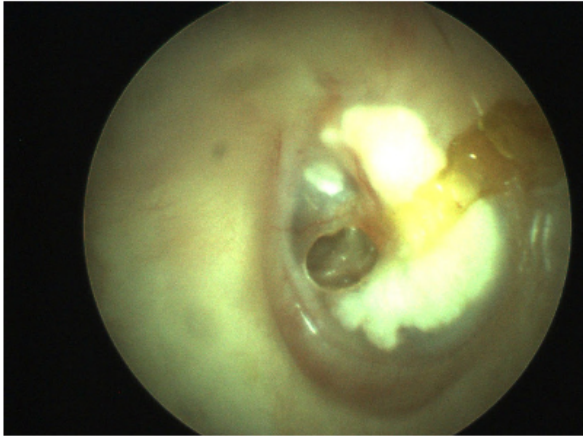
Recommendation - percentage correct



Recommendation	Percentage correct
Refer to ENT/GP	50
Refer to Audiologist	17
Clean ear and reimage	31
Normal - do nothing	22



Question from "Kid's Ears: do you know what you are looking at?"



Choose all that apply

- Scarring
- Retraction
- Obstruction
- Discharge
- Normal ear
- Healed perforation
- Grommet
- Perforation

Choices

Learners who answered the entire question correctly

0%

Breakdown by individual choice:

Your Choice	Answer Key	Choices	Responses
▶	✓	Scarring	0%
	✗	Retraction	25%
	✗	Obstruction	25%
▶	✓	Discharge	75%
	✗	Normal ear	0%
	✗	Healed perforation	25%
	✗	Grommet	0%
▶	✓	Perforation	50%
Total			100% (N = 4)

Explanation

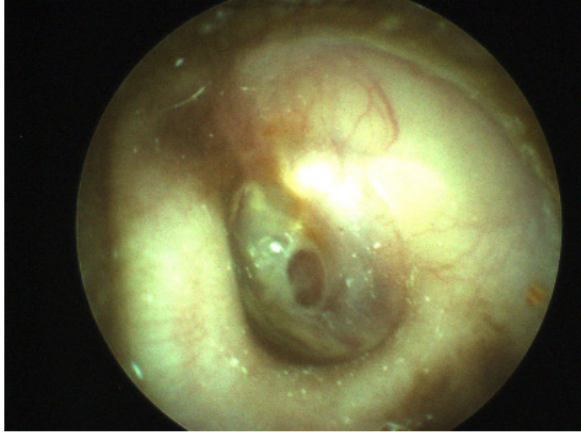
There is a perforation with discharge and scarring.
Clean ear and refer to doctor or ENT.

Results

Congratulations, your answers are correct!

This question will be resent on 03/18/13

Question from "Kid's Ears: do you know what you are looking at?"



Choose all that apply

- Discharge
- Healed perforation
- Retraction
- Normal ear
- Grommet
- Scarring
- Obstruction
- Perforation

Choices

Learners who answered the entire question correctly

25%

Breakdown by individual choice:

Your Choice	Answer Key	Choices	Responses
	X	Discharge	25%
▶	✓	Healed perforation	50%
	X	Retraction	0%
	X	Normal ear	0%
	X	Grommet	0%
▶	X	Scarring	25%
	X	Obstruction	0%
	X	Perforation	50%
Total			100% (N = 4)

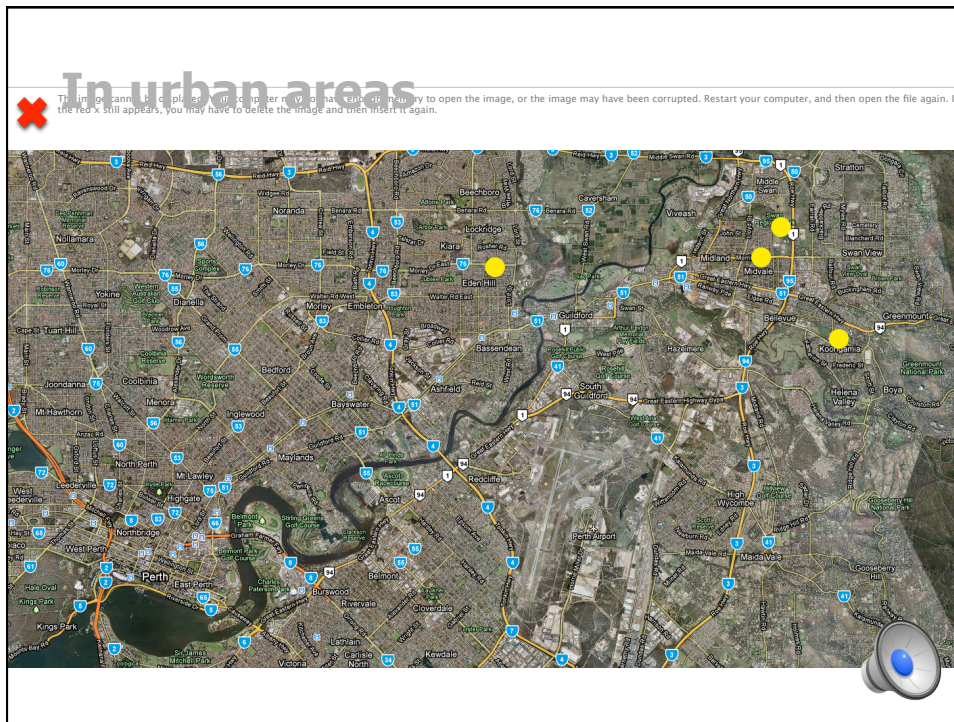
Explanation

This is a healed perforation.


Results

Sorry, your answers are only partially correct!

This question will be resent on 03/08/13






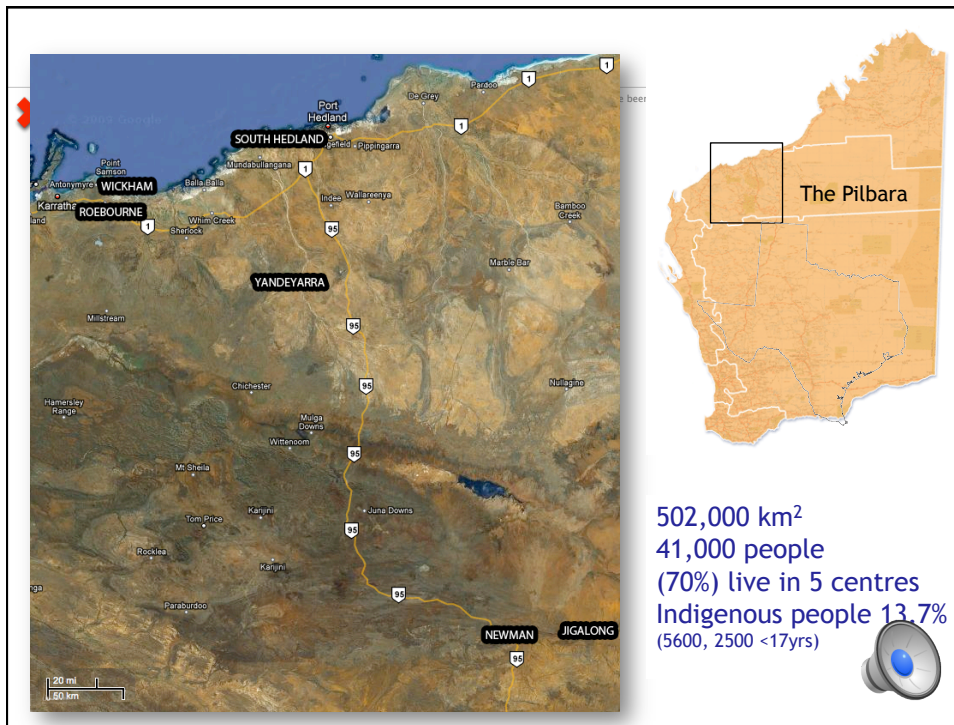
Referral pathway

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Barriers

- Access to GP services difficult
- Access to ENT even more difficult
- Little feedback to screeners





Economic benefits



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Costs	Benefits
Set-up	Less outpatient clinics
Training and maintenance	Less subsidised travel
Operating and staff	Less time off work
Consumables and drugs	Hospitalisation avoided
	Incarceration avoided
	Greater productivity
	Tax generated
	Reduced burden of disease



An economic analysis of telehealth in the Pilbara, Western Australia

Conclusions

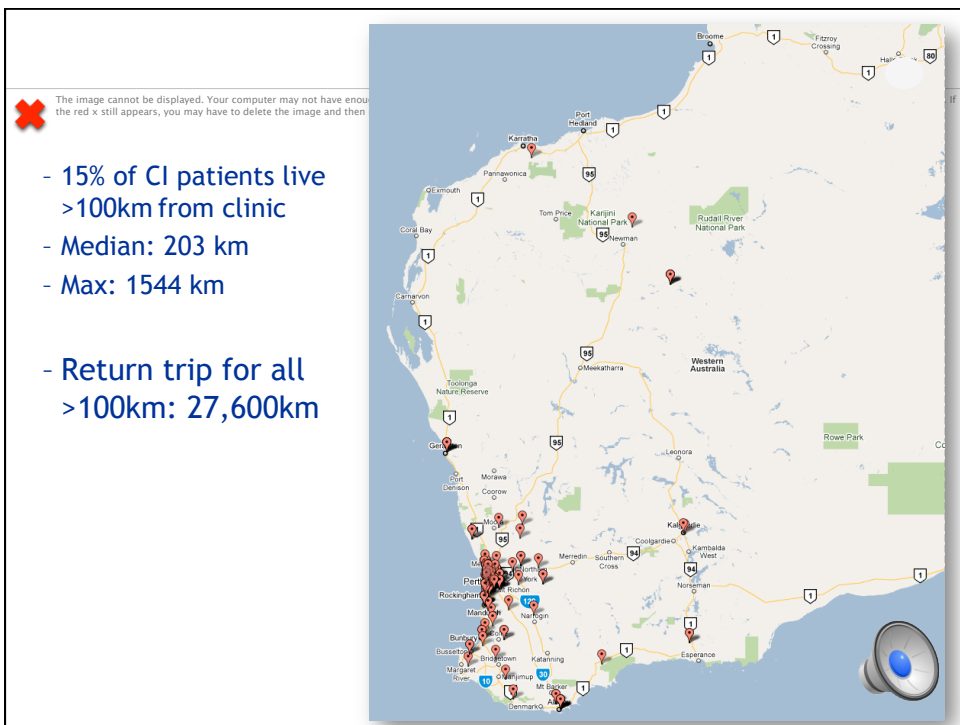


The red x still appears, you may have to delete the image and then insert it again.

Robert Henry EIKELBOOM^{a,b,1}, Raoul CRAEMER^{a,b,c}, Isabelle ELLIS^d,
Terrence McMANUS^{a,b}, Ann LARSON^d, Marcus David ATLAS^{a,b}

- 25.3:1 Benefit to cost ratio
- Economic benefit to community (2500 children)
 - \$72mill over 25 years
- Extrapolating to:
 - All indigenous <17yrs in (very) remote regions: \$393mill
 - All indigenous <17yrs in WA: \$716mill





Drivers



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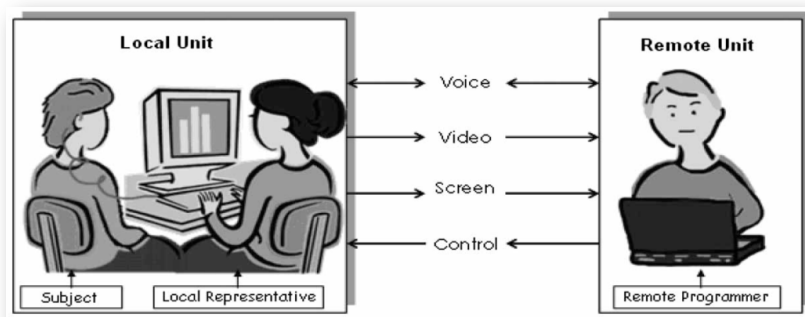
- Approx 15% of CI patients live >2hrs drive from city, many much further.
- Patients need multiple visits in first year, then at least annually.
- Growing demand - need for smart practices
- People in rural/remote areas are
 - Keen to avoid travel
 - Familiar with telehealth and/or happy to use technology

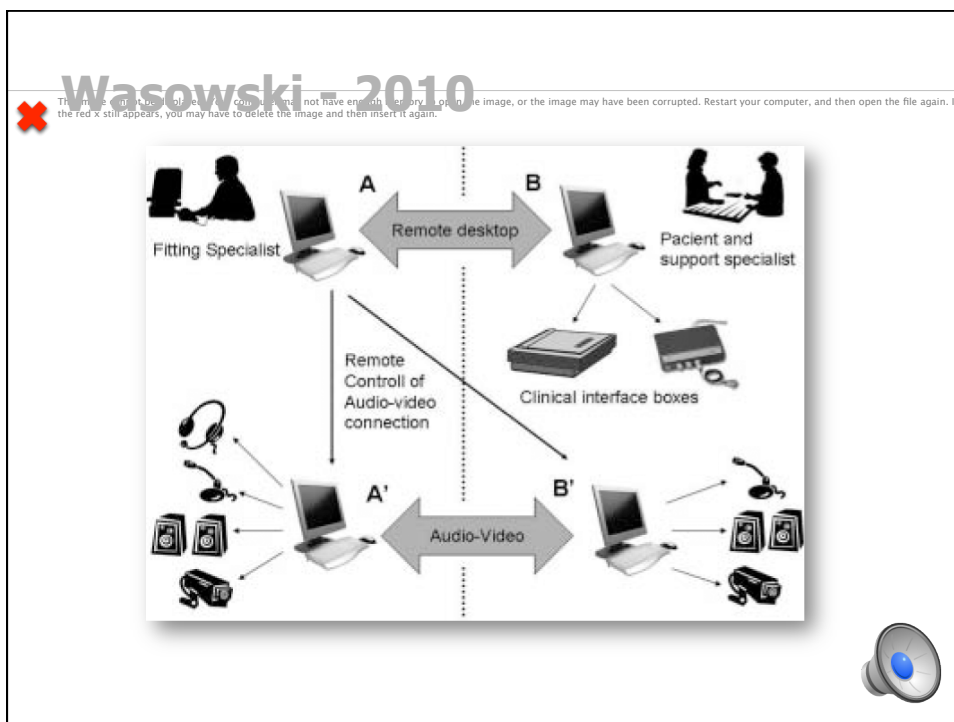
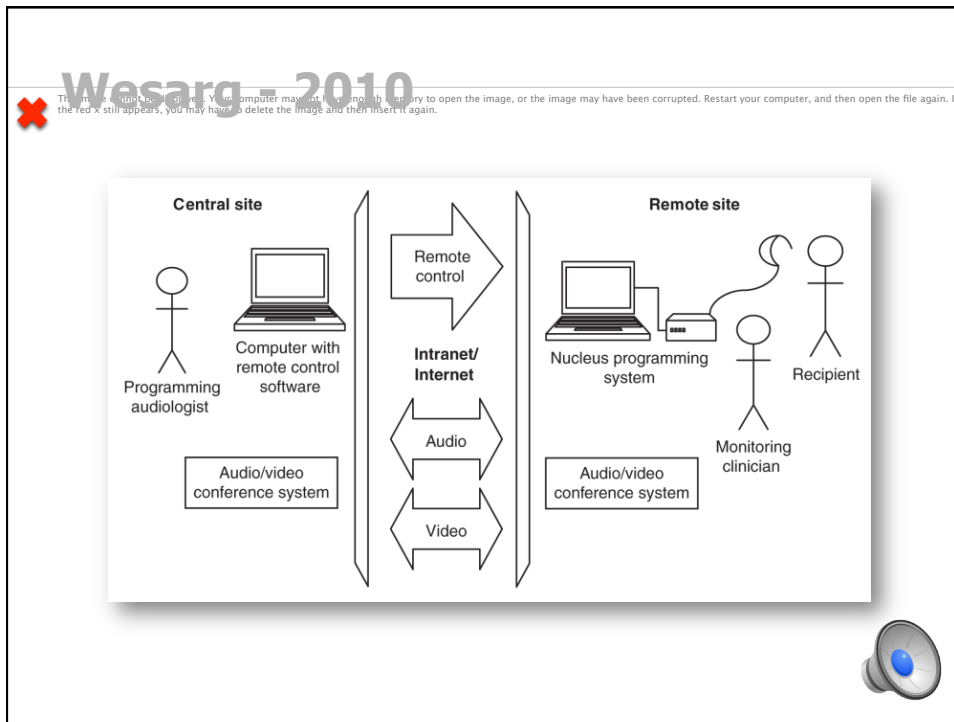


Ramos - 2009



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Conclusions

- Need demonstrated
- Concept proven


BUT

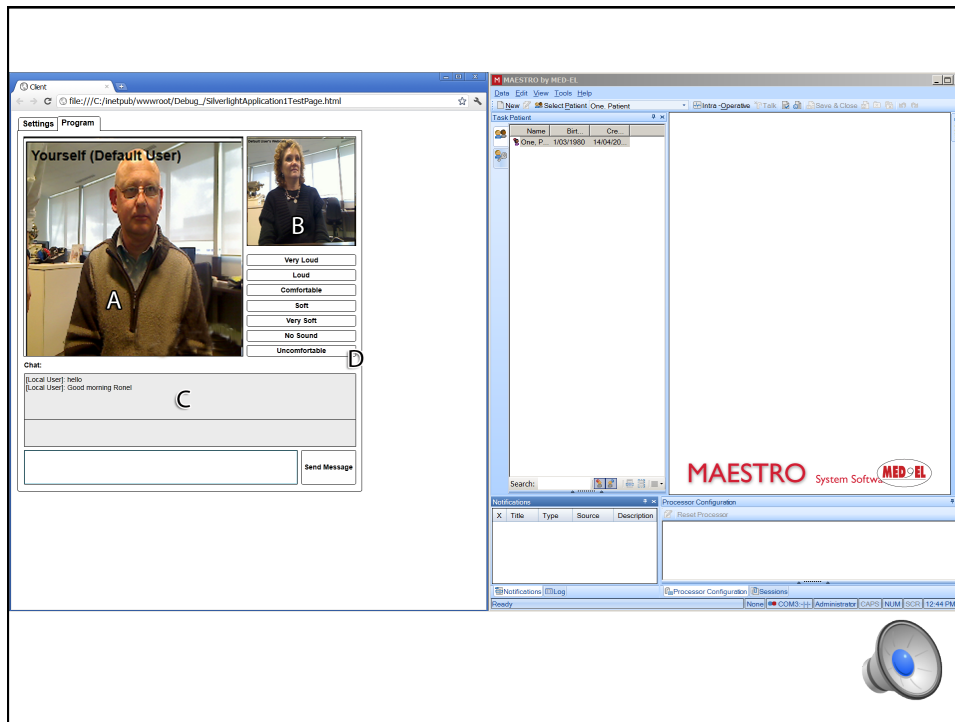
- Reliance on expertise at remote site
 - Cannot be left to patient/carer
- Little integration of technologies
- Questions: bandwidth, video/voice integration, patient acceptance, efficiency, other functionality



What we are doing

- Building a turnkey system, requiring little patient involvement in setup
- Validation with local and rural patients and clinicians





Results - 1

 If a red X appears in the top left corner of the image, your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red X still appears, you may have to delete the image and then insert it again.

- Integration of technologies
 - Video, voice, chat, response feedback
- No special installation required for patient
 - Runs on commonly available platforms
- DIB controlled from remote site
- Implant audiologist and patient demand



Results - 2



If you see a red X in the top left corner of the image, it means your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red X still appears, you may have to delete the image and then insert it again.

- Bandwidth limitations
- i.e. Optimal settings for
 - Image compression (quality)
 - Image codecs
 - Image size
 - Frame rate
 - Voice quality
 - Voice codecs
- Synchronising of voice and video



Tablet computers



The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.



Tablet computers/smart phones



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Electronic surveys



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Implant Centre

- Abbreviated Profile of Hearing Aid Benefit (APHAB)
- Pre-TRQ
- Tinnitus Reaction Questionnaire (TRQ)
- Signed Sided Deafness Questionnaire (SSQ)
- Munich Music Questionnaire (not yet in use)



Electronic surveys



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Hearing Clinics

- International Outcome Inventory-Hearing Aids (IOI-HA)
- Characteristics of Amplification Tool Survey (COAT)
- Hearing Aid Selection Guide
- Client Satisfaction Survey
- Marketing Questionnaire



CI Database


✘ The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.

ESIA - Hearing Implant Database

Name: DOB: Gender:

Date: Appointment type:


Condition - noise	Ear	- user configuration	Level	Score	S/N
<input checked="" type="radio"/> Quiet <input type="radio"/> Adaptive Noise	<input checked="" type="radio"/> Right <input type="radio"/> Left <input type="radio"/> Both	CI Alone	65	100	<input type="text"/>
<input checked="" type="radio"/> Quiet <input type="radio"/> Adaptive Noise	<input type="radio"/> Right <input checked="" type="radio"/> Left <input type="radio"/> Both	HA Alone	65	44	<input type="text"/>
<input checked="" type="radio"/> Quiet <input type="radio"/> Adaptive Noise	<input type="radio"/> Right <input type="radio"/> Left <input checked="" type="radio"/> Both	CIHA contra	65	100	<input type="text"/>
<input type="radio"/> Quiet <input type="radio"/> Adaptive Noise	<input type="radio"/> Right <input type="radio"/> Left <input type="radio"/> Both				<input type="text"/>



Electronic surveys and algorithms

✘ The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.

- Voice outcome, Chronic Sinusitis, Epworth Sleepiness Scale, Reflux Symptom Index
- EORTC - head and neck cancer
- Kentala - Meniere's disease, vestibular neuronitis, labyrinthitis, BPPV
- Gent - taste and smell



New Patient | Symptom list | Patient Report | **Reset changes** | Name: Robinson, Robin | Search | Log Out


Otoscopic Signs

- [Abscess or furunculosis in the ear canal](#)
- [Aural polyp or polypoid mass in the ear canal](#)
- [Blisters/vesicles in the ear canal](#)
- [Bony stenosis of the ear canal](#)
- [Cerumen/wax plug obscuring entire ear canal](#)
- [Debris in the ear canal](#)
- [Ear canal erythema](#)
- [Ear canal oedema](#)
- [Excoriation or maceration of the ear canal](#)
- [Granulation tissue in the ear canal](#)
- [Hemotympanum \(blood in the tympanic cavity\)](#)
- [Mass/tumour \(pearly white\) visible behind tympanic membrane](#)
- [Mass/tumour \(vascular\) visible behind the tympanic membrane](#)
- [Mass/tumour in the ear canal](#)
- [Mycelium or spores in the ear canal](#)

Category	Condition	Ranking
A	Exostosis of the Ear Canal	1.00
	Tympanosclerosis	0.57
B	Cholesteatoma (Acquired)	0.47
	Osteoma of the Ear canal	0.44
C	Presbycusis	0.46
	Foreign Body in the Ear Canal	0.24
D	Cholesteatoma (Congenital)	0.17
	Zahnsgenic Complications	0.56
	Malignant Otitis Externa	0.46

Questions on Otoscopic Signs

A: Most likely
 B: Other conditions ranked
 C: Most unlikely conditions
 D: Ranking




Ear and Hearing Telehealth in Australia

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- Large unmet need for services
- High prevalence of ear disease and hearing loss
- Telehealth has huge potential
 - Diagnosis of disease and HL
 - Advice to local primary care providers
 - Support and training of rural workforce; building capacity
 - Services to remote workforces
 - Management of HL (HA fitting)
 - Support/counseling of patients



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The team

- W/Prof Marcus Atlas
- Prof De Wet Swanepoel
- Prof Peter Friedland
- Dr Mathew Mbaio
- Mark Gallop
- Dr Shahpar Motakef
- Gemma Upson
- Nicky Linton
- Dr Dunay Taljaard
- Jacki Ward
- Prof Isabelle Ellis
- Olive Joseph
- Prof Timothy Skinner
- Raoul Creamer
- Dr Tim Marr
- Samuel Chang
- Cathy Sucher
- Leigh Goggin
- Vesna Maric



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