Supplemental Appendix A. Copy of unrevised report, annotated to highlight issues.

13/03/2014

Jane Eyre
Newborn Hearing Screening
Level 5

CHRISTCHURCH WOMENS' HOSPITAL

Dear Jane,

Re	**Jack Bean**	**DOB**
08/01/2014		
	567 Titanic Road	**Gender**
Male		
	New Brighton	**NHI Number**
ABC1234		

All words underlined in red were identified by spellcheck as a misspelled word because they are too rare to be in the Microsoft Word dictionary.

All sentences in green exceed 25 words in length.

Thank you for referring Jack who was seen for a diagnostic audiological assessment on 4 March 2014 and 13 March 2014 following a bilateral refer result from his newborn hearing screen. Jack attended both appointments with his mother, Julianne. She reported that she does have some concerns about Jack's hearing as he will not always turn to voices; although he does startle to loud sounds like slamming doors. I understand that Julianne experienced a normal pregnancy and birth that were free of any complications. No ear infections or colds were reported and a family history of hearing loss was denied.

Phrases highlighted in blue indicate passive sentence structure.

Test Results

The following [bracketed terms] are examples of Dale-Chall "unfamiliar words"

04/03/14

[Otoscopic] [examination] [revealed] a [visible] light [reflex] and clear ear [canals] [bilaterally].

Immittance audiometry performed with a 1 kHz probe tone yielded type A tympanograms in both ears, indicative of normal middle ear pressure and compliance. Ipsilateral acoustic reflexes to broadband stimuli were absent at [normal screening levels] (90 dB HL) bilaterally.

Examples of a "concept phrase" that describe an abstract idea.

Auditory Brainstem Response (ABR) audiometry was performed during natural sleep via insert earphones. Reliable responses to 500 Hz tone

Example of a value judgment word.

burst stimuli were identified down to [passing levels] (35 dB eHL) in both ears. Repeatable responses were found at [moderately] elevated levels (50 dB eHL) for 2 kHz tone-pip stimuli in both ears. Follow up testing via unmasked bone conduction produced repeatable responses at passable stimulus levels (30 dB eHL) at 500Hz; and repeatable responses at moderately elevated levels (50 dB eHL) at 2 kHz bilaterally.

Objective measures of cochlear sensory hair cell function via *Distortion Product Otoacoustic Emissions* (DPOAEs) yielded absent emissions between 1.5-8 kHz in both ears. These results were considered to be consistent with the sensorineural hearing loss suggested by the acoustic reflex and ABR findings.

Unfortunately, Jack woke up before we could complete assessment at all necessary frequencies. It was therefore recommended that he return in one week's time for further testing.

13/03/14

Otoscopy revealed a visible light reflex in both ears and clear ear canals.

Immittance audiometry performed with a 1 kHz probe tone yielded type A tympanograms in both ears, indicative of normal middle ear pressure and compliance.

Auditory Brainstem Response (ABR) audiometry was performed during natural sleep via insert earphones. Repeatable responses were found at moderately elevated levels (50 dBeHL) for 1 kHz tone-pip stimuli in both ears; and moderately-severe elevated levels (70 dBeHL) for 4 kHz stimuli bilaterally.

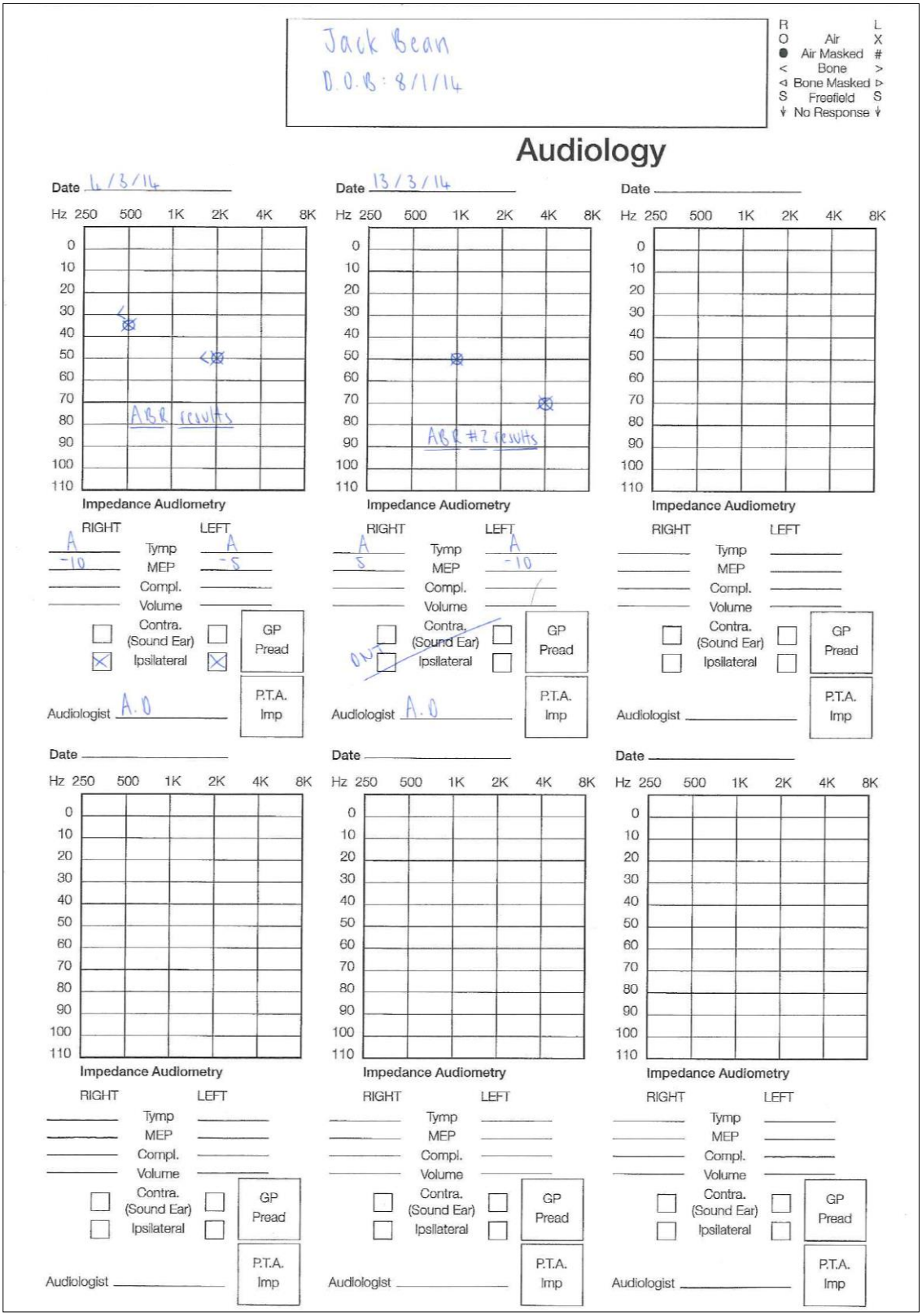
Summary and recommendations:

[Overall, the results of these two assessments are consistent with normal to essentially normal hearing in the low frequencies, sloping to a moderately-severe sensorineural hearing loss in both ears]. As discussed with Julianne, I have made an onward referral to Triton Paediatric Hearing Aid Services to discuss amplification and rehabilitation options. A referral has also been made to the Ear, Nose and Throat Department at Christchurch Public Hospital (CPH) for their opinion and assessment of Jack's hearing loss. Jack has also been referred to the Paediatric and Ophthalmology departments at CPH for evaluation. Finally, I have referred Jack to the Advisers on Deaf Children to evaluate and discuss his hearing needs at home and in future educational settings.

We look forward to meeting Jack and his family on the 21 March 2014 to further discuss the management of his hearing. Should you have any questions or concerns regarding today's results and/or Jack's hearing, please do not hesitate to contact me.

Kind regards,

Ashleigh Donald
Master of Audiology Student


Jack Bean
D.O.B: 8/1/14
R O Air X
Air Masked #
< Bone >
Bone Masked
S Freefield S
No Response
Audiology
Date 4/3/14
Date 13/3/14
Date
Hz 250 500 1K 2K 4K 8K
0 10 20 30 40 50 60 70 80 90 100 110
ABR results
ABR #2 results
Impedance Audiometry
RIGHT LEFT
Tymp
MEP
Compl.
Volume
Contra. (Sound Ear)
Ipsilateral
GP Pread
P.T.A. Imp
Audiologist A.D

Appendix B

Copy of revised report, annotated to highlight improvements

13/03/2014

Julie Twist
567 Titanic Road
New Brighton
Christchurch

Dear Julie,

Re	**Jack Bean**	**DOB**	**08/01/2014**
	567 Titanic Road	**Gender**	**Male**
	New Brighton	**NHI Number**	**ABC1234**

Thank you for bringing Jack in to have his hearing tested on 4 March and 13 March 2014. Jack came to us because he did not pass his newborn hearing screen.

The following report gives the results from both of these appointments. We have tried to write these in a way that is easy to understand. You will also find a copy of the medical report sent to other experts involved in Jack's care. We have added a glossary to this report to help you understand the terms used.

Outlining what parents can expect from the report.

Included a summary earlier in the report.

What did we find?

Use of question headings throughout the report to help parents find the information they want to know.

Our results show us that Jack has "near normal hearing sloping to a moderately-severe hearing loss" in both ears. This means that Jack has normal or near normal hearing for [low, bass-like sounds] in both ears. For [higher, treble-like sounds], Jack's hearing drops to a moderately-severe hearing loss in both ears. Our results point to this being a [lasting, or permanent], hearing loss.

Explanation of the configuration of the child's hearing loss by explaining frequency in common language.

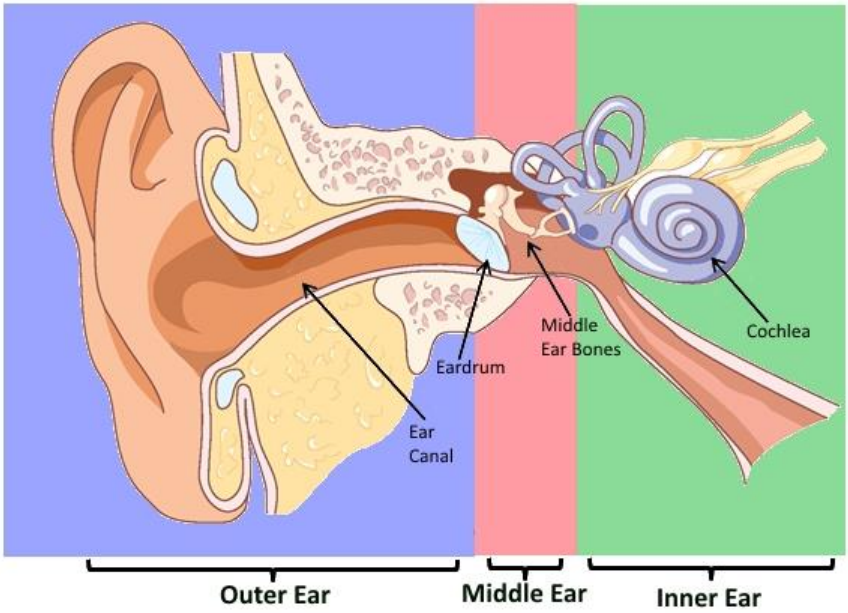
Explained that the hearing loss is permanent using common words instead of the term sensorineural

Please see the hearing chart on page 5 to help you understand how we describe hearing loss.

Can you tell me the results of each test?

We have given the results of each test in the order we did them at the first appointment. We have also colour coded each test to match the picture below. This helps show what part of the ear each test was looking at.

Explanation of how the results will be ordered; linking of appointment to report.



Inclusion of a figure to label the different parts of the ear and use of colour to distinguish the outer, middle and inner ear. Figure is clearly labelled and surrounded by relevant text.

Headings are coloured to match the figure above to show what part of the ear each test is assessing.

1. Otoscopy

First, we looked inside Jack's ears. Both of his eardrums looked normal and healthy. We found that this was the same at both appointments.

2. Tympanometry

[Next, we checked how Jack's eardrums were working. To do this, we placed a rubber tip inside his ear and sent a small puff of air down the canal. This made Jack's eardrum move back and forth.] Our machine measured this movement and drew a shape like a ["mountain"]. [We call this a type "A". This told us that both of Jack's eardrums were moving normally on both days we tested them.]

Example of test procedure explanation.

Use of language common to the appointment to help parents connect their experience during the appointment to the information contained in the report.

3. Acoustic reflex testing

With the rubber tip in place, we also tested a reflex in Jack's ears. The reflex causes two tiny muscles in the middle ear to tense in response to sounds. During this test, we play different [beeps] to see if they trigger the reflex. This can give us helpful information about Jack's hearing.

At the first appointment, we played beeps at a "screening" [volume]. This volume should [trigger a reflex] if the hearing is normal. In Jack's case, we found that this volume was not [loud] enough to trigger the reflex in either ear. This result agrees with Jack having a hearing loss.

We did not do this test at the second appointment.

Clear explanation of what this result actually means.

Use of common language to explain a challenging concept.

While Jack was asleep, we tested his hearing in two ways:

4. Distortion Product Otoacoustic Emissions (DPOAEs) test.

This test measures how well a part of Jack's inner ear works. To test this, we [play different beeps] into Jack's ear. If everything is working normally, we can [measure soft sounds back from his inner ear]. It is important that childr are very [still and quiet] when we do this test.

On the 4/3/14, we did not measure any sounds back from Jack's inner ear when we played the beeps. This result suggests that at least some of Jack's inner ear is not working normally.

Reinforcement of information parents are likely to have been told during the appointment.

5. Auditory Brainstem Response (ABR) test

Use of phrase audiologist likely to have used during appointment.

The ABR is our [most reliable way of testing hearing in infants]. To start, we put some sticky pads on Jack's head. We then played Jack some sounds through both earphones and a small [box behind his ear]. The sticky pads helped us detect whether Jack heard each sound. We found that:

Explanation of the meaning behind the term "near-normal".

Use of a lettering system to help differentiate the ABR results.

a) Jack could hear low pitch, bass-like tones (500 Hz) at a normal or near-normal loudness in both ears. [Unfortunately, we cannot say for sure that Jack's hearing is normal at this pitch. This is because the ABR cannot measure hearing at these very quiet levels. At worst, Jack may have a mild hearing loss at this pitch. As Jack gets older, we will be able to do other tests to give us a better idea of his hearing at this pitch.]

Inclusion of both the actual frequencies tested and a common language explanation.

b) We needed to increase the loudness to a "moderate" level for Jack to hear middle pitch sounds (1000 Hz and 2000 Hz) in both ears. [This is about the same loudness as a dishwasher, or people talking in a quiet room.]

c) We needed to turn the volume up to a "moderately-severe" loudness for Jack to hear high pitch sounds (4000 Hz) in both ears. [This is about the same loudness as a vacuum cleaner or people talking in a restaurant.]

Inclusion of personalised common sound examples to offer some context to these value judegment descriptors of the HI.

d) Jack's hearing was similar when we played sounds through the box and the earphones. This means he has a [**sensorineural**] hearing loss. This is a [**permanent**] type of hearing loss.

Use of both techncial audiology term and common language. Bolding to reinforce permanent nature of HI.

In summary:

1. Both of Jack's ears looked normal and healthy.
2. Jack's eardrums were moving normally in both ears.
3. Jack had muscle reflexes in both ears. However, we needed to make the volume louder to trigger them.
4. Jack's inner ear did not produce its own sounds to all of the beeps played.
5. For Jack to hear middle- and high-pitched sounds we needed to increase the volume.

Colour-coded and numbered summary of each of the test

The Audiogram- what does it show?

On page 7 you will find Jack's audiogram. This shows the softest level Jack could hear at different pitches.

- Each circle shows how well Jack heard when we played sounds to his right ear through earphones.
- Each cross shows how well Jack heard when we played sounds to his left ear through earphones.
- The triangles show how Jack heard when we played sound through the box behind his ear.

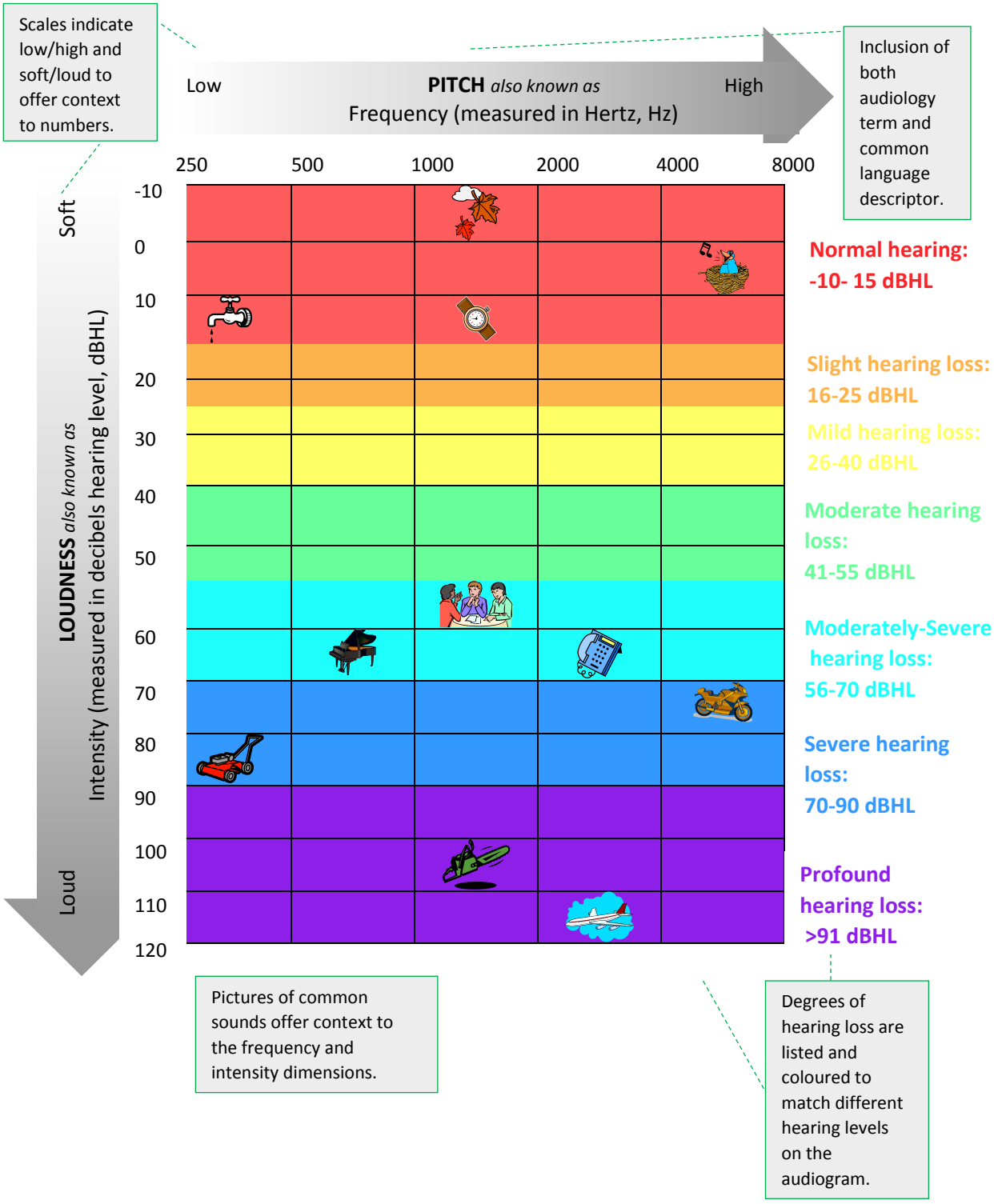
Explanation of the symbols used on the audiogram.

Explanation of frequency and intensity axes on audiogram using common language.

The numbers along the side of the graph show how loud the sound is. Loudness is measured in decibels. Very quiet sounds are at the top of the graph, and very loud sounds are at the bottom. The numbers along the top of the graph show the pitch of the sound. Pitch increases from the bass-like sounds on the left side of the graph to the treble sounds on the right side.

The picture below shows this information. Different levels of hearing loss are also shown on the right hand side of the graph. We have included some common sounds that are at a similar loudness level. [For example, a person with a severe hearing loss may not hear the phone ring.]

Example of how individuals with different degrees of HI may not be able to hear particular sounds.


Scales indicate low/high and soft/loud to offer context to numbers.
Low
PITCH also known as
Frequency (measured in Hertz, Hz)
High
Inclusion of both audiology term and common language descriptor.
250
500
1000
2000
4000
8000
Soft
LOUDNESS also known as
Intensity (measured in decibels hearing level, dBHL)
Loud
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Normal hearing:
-10- 15 dBHL
Slight hearing loss:
16-25 dBHL
Mild hearing loss:
26-40 dBHL
Moderate hearing loss:
41-55 dBHL
Moderately-Severe hearing loss:
56-70 dBHL
Severe hearing loss:
70-90 dBHL
Profound hearing loss:
>91 dBHL
Pictures of common sounds offer context to the frequency and intensity dimensions.
Degrees of hearing loss are listed and coloured to match different hearing levels on the audiogram.

What do we do now?

Another summary reiterates the main finding.

As you have read, [Jack has a moderate to moderately severe hearing loss in the middle to high pitches. This is a lasting hearing loss.] [Because of this, Jack may not develop normal speech and language without the help of a device like hearing aids.]

Brief mention of what this result may mean for Jack.

Therefore, we have referred Jack to the Children's Hearing Aid Services. They will contact you to arrange a time to talk about the best way we can help Jack to hear. An Adviser of Deaf Children will also be in touch with you. All of these people are here to support Jack and your family in any way we can.

Where can I go for more information?

Outlines the next step in plain language.

You can call the hospital if you want to talk about any of these results further. You can also have a look at some of these helpful websites:

Web addresses and brief overview of three sites where parents can go for further information

1. http://www.audiologyonline.com/articles/what-parents-should-know-about-1163
   This link helps answer some common questions that parents have after finding out their child has a hearing loss.

2. https://www.entnet.org/content/childrens-hearing-loss
   This link explains the different health professionals you may work with.

3. http://www.asha.org/aud/Facts-about-Pediatric-Hearing-Loss/
   This link gives good facts about hearing loss in children. The website supports the facts with research results.

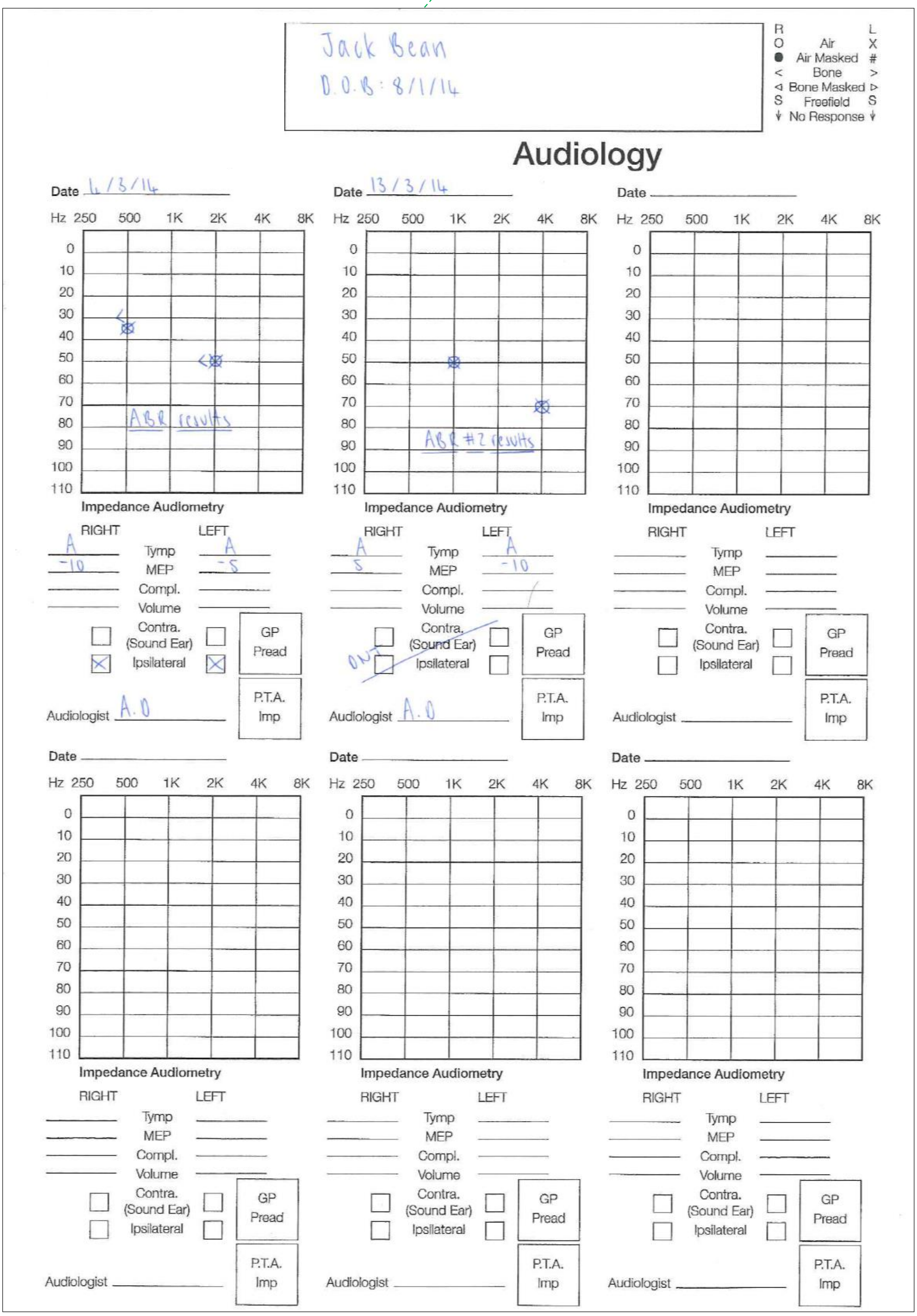
You will be given plenty of extra information and resources during your next few appointments.

Reassurance that additional information will follow.

Kind regards,

Ashleigh Donald
Master of Audiology Student

Inclusion of Jack's personal audiogram for parents to refer to. Interpretation should be aided using the audiogram figure included on page 5.



13/03/2014

Inclusion of unrevised report for parent's records or to further supplement their understanding.

Jane Eyre
Newborn Hearing Screening
Level 5
CHRISTCHURCH WOMENS' HOSPITAL

Dear Jane,

Re	**Jack Bean**	**DOB**	**08/01/2014**
	567 Titanic Road	**Gender**	**Male**
	New Brighton	**NHI Number**	**ABC1234**

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Test Results

04/03/14

Otoscopic examination revealed a visible light reflex and clear ear canals in both ears.

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We look forward to meeting Jack and his family on the 21 March 2014 to further discuss the management of his hearing loss. Should you have any questions or concerns regarding today's results and/or Jack's hearing, please do not hesitate to contact me.

Kind regards,

Ashleigh Donald
Master of Audiology Student

9

Inclusion of a glossary which defines and explains the unfamiliar terminology used in the unrevised report above.

Glossary

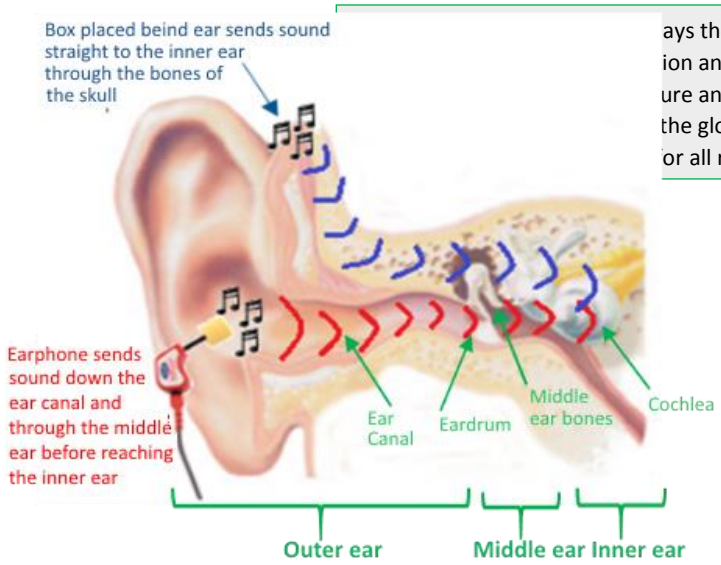
Acoustic reflex- This reflex causes two muscles in the middle ear to tense in response to sounds. In infants, we try to trigger this reflex by playing a sound at a standard volume. If the reflex is triggered at this volume we say it is present. If there is no reflex to this volume of sound we say it is absent. The presence or absence of a reflex can give us important information about a child's hearing.

Auditory brainstem response (ABR)- This test measures your child's hearing while they are sleeping or sedated. We normally play sounds both through earphones, and also through a small box placed behind the ear. Your child will also have small sticky pads (electrodes) placed on their forehead and behind their ears. These allow us to measure the activity from their ear to their brain in response to sound. We use this activity to work out the softest volume of sound your child can hear in each ear across a range of pitches.

Bilateral- Relating to both ears.

Bone conduction- This is where sound travels to the inner ear through the bones of the skull. We test hearing in this way by placing a small box on the bone behind the ear. This vibrates the bone, allowing sound to be heard. Bone conduction lets us test the hearing of the inner ear alone.
Bone conduction is different to air conduction. During air conduction, sound travels down the ear canal to the eardrum, through the middle ear and then reaches the inner ear. Air conduction is tested through earphones.
The picture below shows these two pathways of hearing. Air conduction is in blue and bone conduction is in red.

ays the
ion and bone
ure and
the glossary
or all reports.



Pathways of air conducted and bone conducted sound.

Cochlear sensory hair cell- The cochlea is the inner organ of hearing. It is the snail-shaped object in the picture above. Inside the cochlea are thousands of tiny hair cells. The job of these hair cells is to change sound into nerve signals to be sent to the brain. Because these hair cells are so delicate, they can be easily damaged. Damaged hair cells can result in a hearing loss.

Conductive hearing loss- This type of hearing loss is seen when the hearing by bone conduction is better than the hearing by air conduction. It is caused by a problem in the outer or middle ear, while the inner ear is normal. This type of hearing loss will often go away by itself if it is caused by your child's cold. In other children the hearing can be improved by surgery (such as putting in grommets). Sometimes this type of hearing loss can also be permanent.

dBeHL- We measure hearing in this unit. It is known as "decibels estimated hearing level". Decibels are the unit we measure the loudness of sound in. "Hearing Level" is the decibel scale that we measure hearing loss in. It lets us compare the hearing of one person to the hearing of an average normal-hearing person. "Estimated" means that the ABR test results have been changed slightly to be the best estimate of your child's actual hearing.

Distortion product otoacoustic emissions- Healthy hair cells within the cochlea respond to sound by producing soft sounds of their own. These soft sounds are known as otoacoustic emissions. We can measure them by playing beeps through a small tip placed in the ear. This lets us see if the hair cells are working. "Distortion product" refers to the type of sound we are measuring.

Frequency/ frequencies- This is the pitch of a sound. It is measured as the number of sound wave vibrations per second. The unit for this measurement is the Hertz (Hz). When sound waves vibrate quickly, high frequency sounds like bird chirping or a siren are heard. When sound waves vibrate slowly, low frequency sounds like thunder, drums or a motorbike are heard. Humans can hear a range of frequencies from about 20 Hz to 20,000 Hz. We normally test hearing between 250 Hz to 8000 Hz because most of the sounds of speech are in this range.

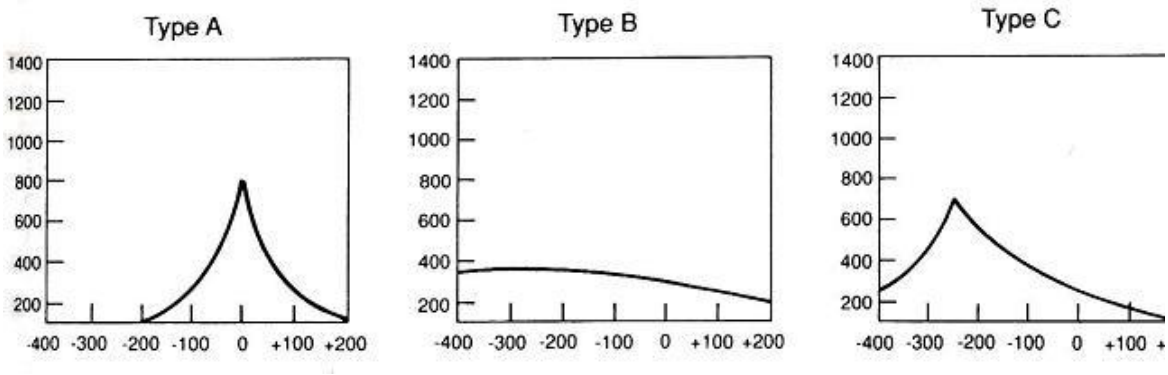
Immittance audiometry- Immittance audiometry is another name for tympanometry. Tympanometry is a test done to check that your child's eardrum and middle ear are working normally. A small puff of air is sent into the ear canal, causing the eardrum to move back and forward. Our machine measures this movement and draws a shape. Different types of shapes can tell us different things about your child's eardrum and middle ear. The pictures below show these shapes.

Including different tymanogram types in the glossary further ensures the glossary can function as a universal document. In addition, it can act as a reference for parents if their child's tympanometry results change in the future.

Type A- Your audiologist may have referred to this as a "mountain" or a peaked shape. This means that the eardrum is at a normal position and is moving well.

Type B- Your audiologist may have referred to this type as a "river" or a flat line. Sometimes this means that there is a problem in the middle ear which is stopping the eardrum from moving normally. This is often seen when there is fluid behind the eardrum, like in "glue ear". In other children it can mean that there is a hole in the eardrum.

Type C- This shape still has a "Mountain" peak, but it is moved to the left a bit. This means that the eardrum is being "sucked back" towards the middle ear. This shape means that the tube which connects the back of the throat to the nose (the Eustachian tube) is not working normally. This is often the case when your child has a cold, or is getting over one.



Light reflex- This is a sign of a healthy eardrum.

Otoscopy- This is a visual check of the outer ear and eardrum.

Sensorineural hearing loss- This type of hearing loss is seen when the hearing by bone conduction is the same as the hearing by air conduction. A problem in the cochlea or hearing nerve causes the hearing loss. This type of loss is permanent.

Tympanogram- see immittance audiometry