

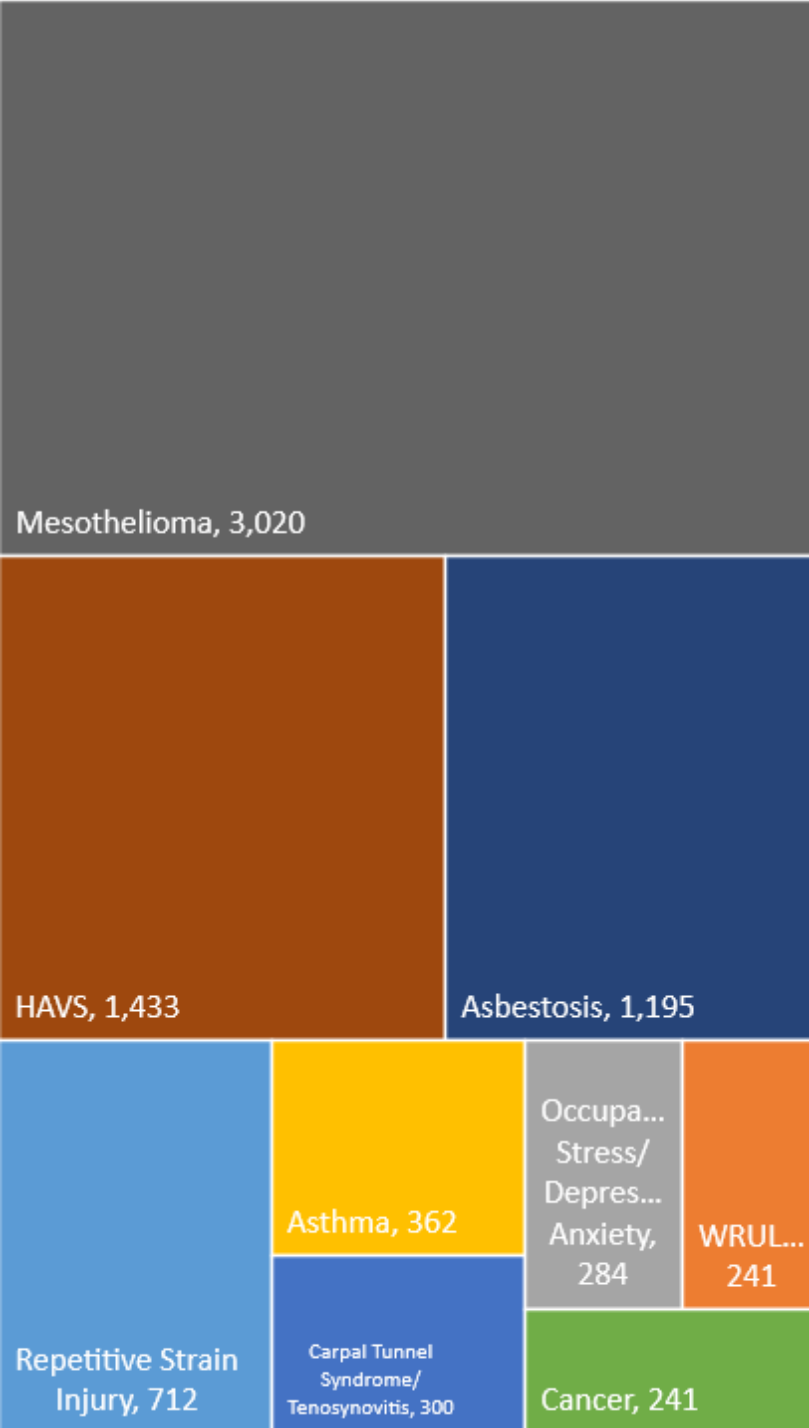
SOM & UKHCA

Noise Health

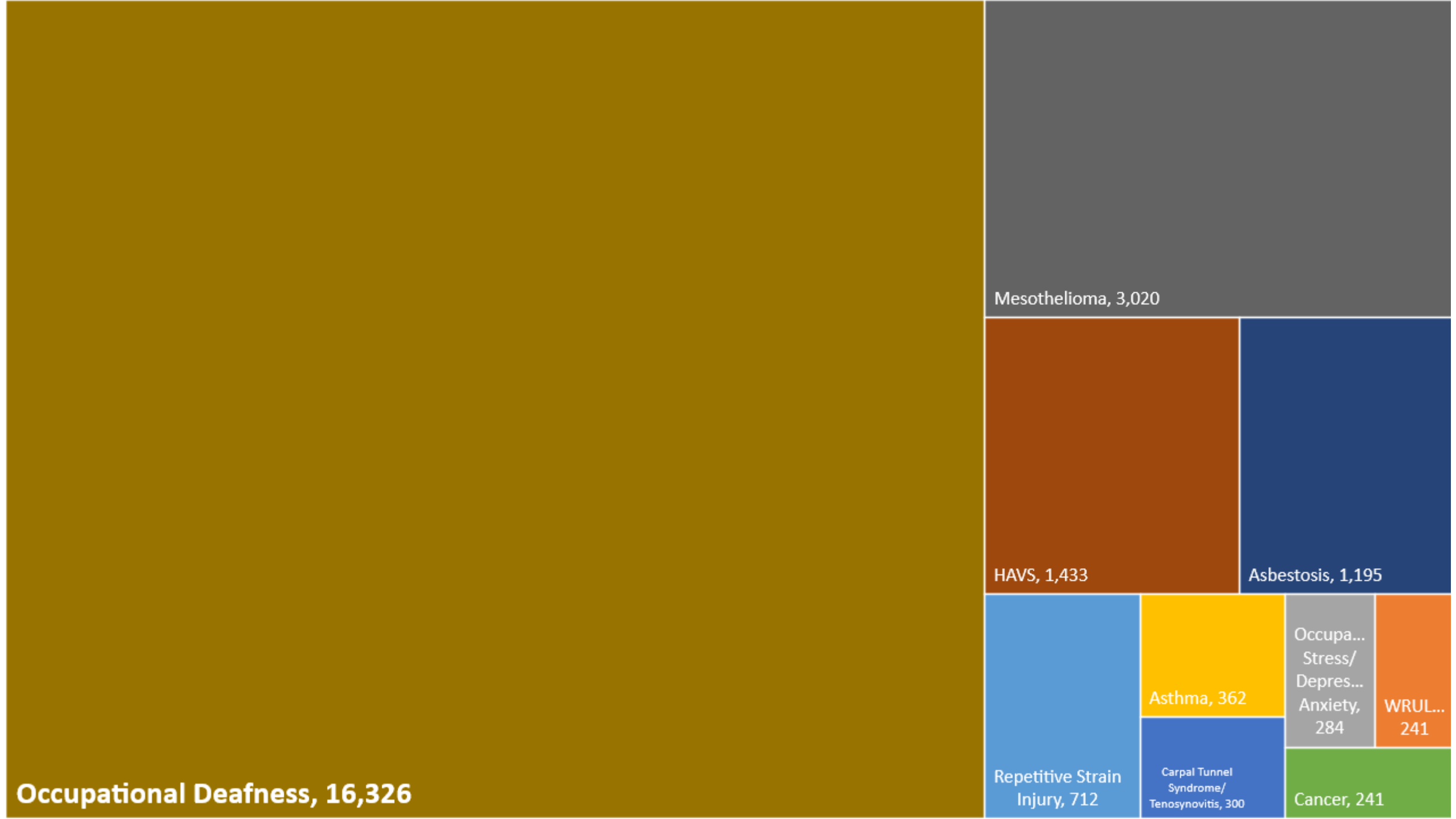
Surveillance Think Tank

---

# These are the diseases where claims are being made and paid



Top 10 Occupational Diseases by Employer Liability Insurance Claim (CRU at DWP)



Mesothelioma, 3,020

HAWS, 1,433

Asbestosis, 1,195

Repetitive Strain  
Injury, 712

Asthma, 362

Carpal Tunnel  
Syndrome/  
Tenosynovitis, 300

Occupational  
Stress/  
Depression/  
Anxiety,  
284

WRUL...  
241

Cancer, 241

Occupational Deafness, 16,326

## Memory Loss & Hearing Loss



Adults with hearing loss develop a significant impairment in their cognitive abilities, **3.2 years sooner** than those with normal hearing.

Those with hearing loss experience a **30% to 40%** greater decline in thinking abilities compared to their counterparts without hearing loss.

## Dementia & Hearing Loss



Mild hearing loss: **2 times** more likely to develop dementia

Moderate hearing loss: **3 times** more likely to develop dementia

Severe hearing loss: **5 times** more likely to develop dementia

---

***Passionate about preserving and promoting the protection of our nations health – through common sense, cost effective, evidenced solutions***



## UK HEARING CONSERVATION ASSOCIATION

Passionate about preserving and promoting the protection of our nation's hearing health

LEARN MORE



<https://hearingconservation.org.uk/>

Linkedin company; uk-hearing-conservation-association

Twitter; @uk\_hearing



# **Noise Health Surveillance**

**Steve Forman**

**Principal Medical Adviser**

**Health and Work Branch, Engagement  
& Policy Division**

**Susan Donnelly**

**Principal Occupational Health  
Inspector**

**Specialist Group, Field Operations  
Division**

# Health surveillance and its importance

---

- Scheme of repeated health checks used to identify work-related ill health
- Health surveillance required when workers remain exposed to health risks, even after controls put in place
- **Why?**
- Early identification of work-related ill health to manage risk for individual and other workers
- Control measures may not always be reliable, despite appropriate checking, training and maintenance
- Also, provides opportunity to discuss health issues, reinforce importance of controls and training



# Controls and health surveillance

---

- Risks created by hazards should be adequately controlled
- Health surveillance is the check for disease
- Complimentary systems



# Setting up health surveillance

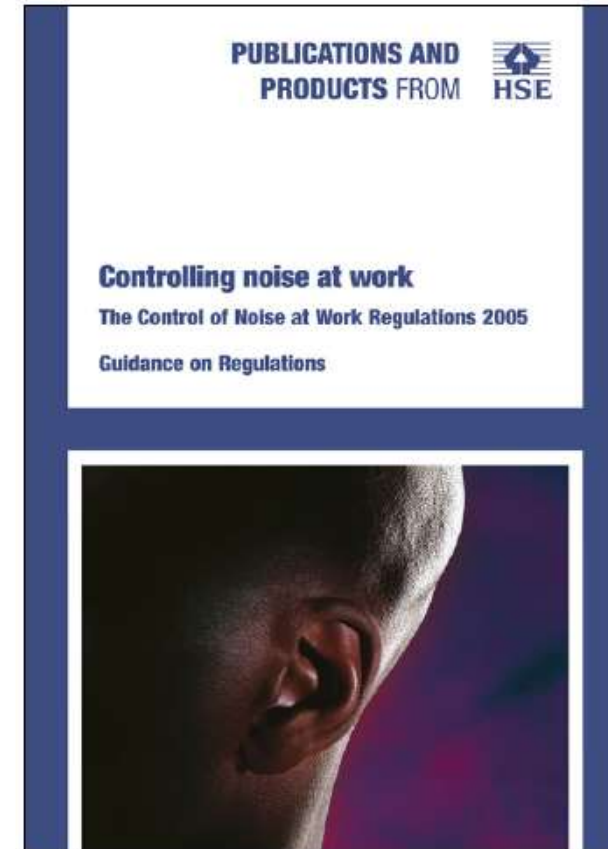
---

- Consult with employees and their representatives
- Understanding duties, purpose and possible outcomes
- Clear procedure on management of cases
- Use of grouped results

# Control of Noise at Work Regulations 2005

---

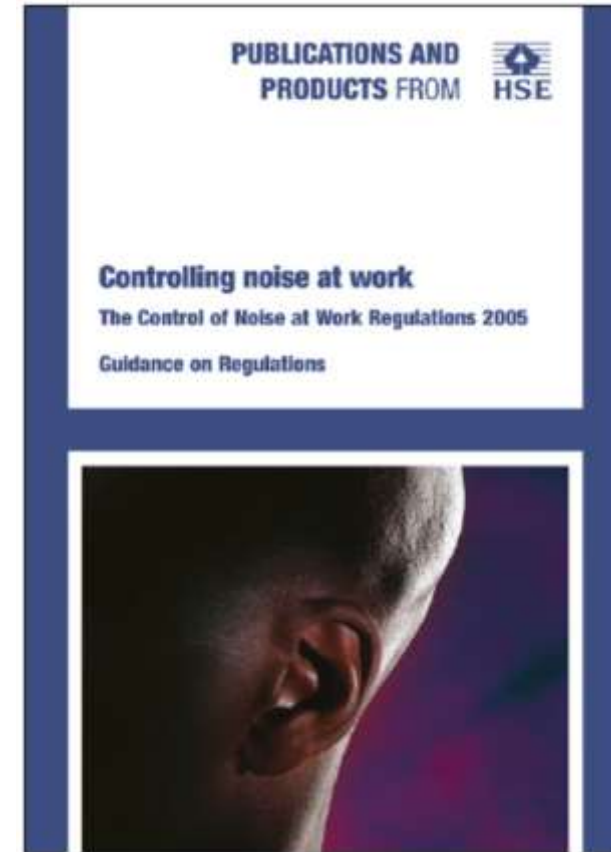
- Updated guidance published in 2021
- No changes to legal framework



## Regulation 9(1)

---

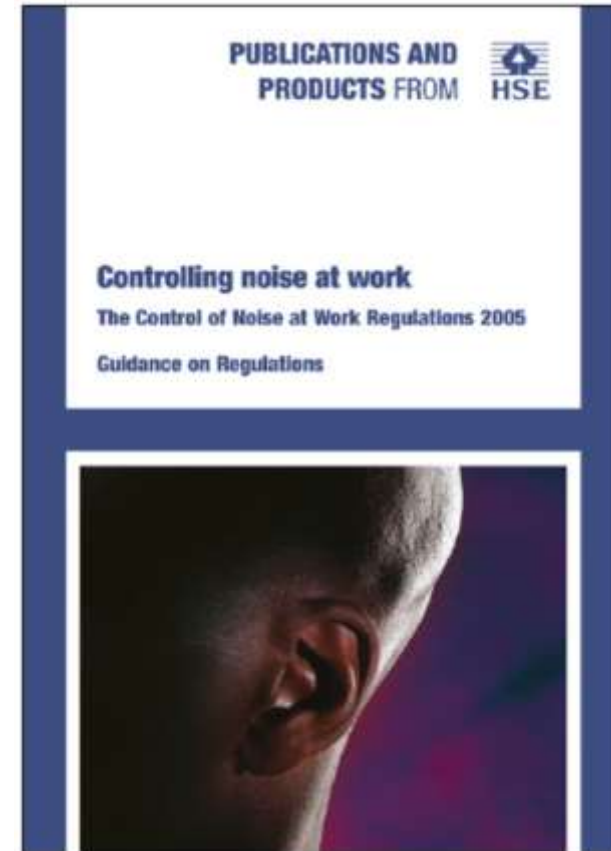
If the risk assessment indicates that there is a risk to the health of his employees who are, or are liable to be, exposed to noise, the employer shall ensure that such employees are placed under suitable health surveillance, which shall include testing of their hearing.



## Regulation 9(4)

---

Where, as a result of health surveillance, an employee is found to have identifiable hearing damage the employer shall ensure that the employee is examined by a doctor and, if the doctor or any specialist to whom the doctor considers it necessary to refer the employee considers that the damage is likely to be the result of exposure to noise, the employer shall:



## Regulation 9(4) - continued

---

- (a) ensure that a suitably qualified person informs the employee accordingly;
- (b) review the risk assessment;
- (c) review any measure taken to comply with regulations 6, 7 and 8, taking into account any advice given by a doctor or occupational health professional, or by the enforcing authority;
- (d) consider assigning the employee to alternative work where there is no risk from further exposure to noise, taking into account any advice given by a doctor or occupational health professional; and
- (e) ensure continued health surveillance and provide for a review of the health of any other employee who has been similarly exposed.

# Worker referral and employer feedback

---

- In accordance with Regulation 9(4), a system should be put in place for referral to a doctor to consider whether hearing damage identified through health surveillance is likely to be the result of exposure to noise
- Must ensure provision of feedback to the employer to enable them to review their risk assessment, review their control measures to establish whether they are protective and review the health of other employees similarly exposed
- Occupational health provider used by the employer to provide health surveillance would need to demonstrate they can refer relevant cases to a doctor and provide appropriate feedback to the employer

# Noise health surveillance

---

- Questionnaire
- Audiogram



# Audiograms

---

- Must be performed competently
- Must be interpreted competently
- May show other abnormalities besides possible NIHL
- Where possible NIHL suspected, worker must be examined by a doctor
- Examination by a doctor may be paper based if they have all relevant information available to fully consider if worker likely to have hearing damage due to noise

# Categorisation scheme

<i>Category</i>	<i>NIHL seen on audiogram?</i>	<i>Calculation<sup>†</sup></i>	<i>Action</i>
<b>1 Acceptable hearing ability</b>	No*	Sum of hearing levels at 1, 2, 3, 4 and 6 kHz	Repeat health surveillance at next routine interval
<b>2 Mild hearing loss</b>	Stable NIHL may be present <sup>+</sup>	Sum of hearing levels at 1, 2, 3, 4 and 6 kHz	Consider earlier repeat health surveillance than routine, taking into account factors such as extent of hearing loss
<b>3 Significant hearing loss or new/ progressive NIHL</b>	Yes, newly identified or progressive NIHL may be present (this category may also include more severe but stable NIHL)	Sum of hearing levels at 1, 2, 3, 4 and 6 kHz	Refer for medical assessment. Timing of next health surveillance depends on outcome of assessment
<b>4 Rapid hearing loss<sup>+</sup></b> Reduction in hearing level of 30 dB or more, within 3 years or less	Possible	Sum of hearing levels at 3, 4 and 6 kHz	Refer for medical assessment. Timing of next health surveillance depends on outcome of assessment

\* If NIHL is or may be present, the worker cannot be Category 1.

+ By definition at least one previous audiogram must be available for comparison.

† Compare value with figure given for appropriate age band and gender in Table 13.

# Health records

---

- Must be kept by employer for each worker under health surveillance
- Should include fitness for work, any restrictions and timescale for next review
- Should not include confidential medical information

# Where health surveillance goes wrong

---

- Health surveillance not performed by employer
- Inadequate health surveillance by OH provider
  - Testing performed incorrectly
  - Results incorrectly interpreted
  - Serial results not considered
  - Inadequate understanding of workplace
- OH provider not communicating outcome of health surveillance
- Employer not acting on outcome of health surveillance

# Noise Health Surveillance Challenges & Current Position

---

DR RON MCCAIG & CLARE FORSHAW

A solid orange horizontal bar at the bottom of the slide.

# Back in 2005....

And even before that!

Directive 2003/10/EC of the European Parliament and of the Council of 6 February 2003 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise) (Seventeenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) [View full text](#)

[Previous](#) [Next](#)

## DIRECTIVE 2003/10/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 February 2003

on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise)

(Seventeenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 137(2) thereof,

Having regard to the proposal from the Commission<sup>(1)</sup>, submitted after consultation with the Advisory Committee on Safety, Hygiene and Health Protection at Work,

Having regard to the opinion of the Economic and Social Committee<sup>(2)</sup>,

Having consulted the Committee of the Regions,

Acting in accordance with the procedure laid down in Article 251 of the Treaty<sup>(3)</sup>, in the light of the part not approved by the Conciliation Committee on 8 November 2002,

Whereas

- (1) Under the Treaty, the Council may adopt, by means of directives, minimum requirements for encouraging improvements, especially in the working environment, to guarantee a better level of protection of the health and safety of workers. Such directives are to avoid imposing administrative, financial and legal constraints in a way which would hinder the creation and development of small and medium-sized undertakings.
- (2) While, in accordance with the Treaty, the Directive does not prevent any Member State from maintaining or introducing more stringent protective measures, its implementation should not serve to justify any regression in relation to the situation which already prevails in each Member State.
- (3) Council Directive 89/100/EEC of 12 May 1989 on the protection of workers from the risks related to exposure to noise at work<sup>(4)</sup> needs to be revised for its implementation.

# Back in 2005....

---

- Expectation that all audiograms would be inspected and assessed
- Categorisation system revamped
  - Evidence based
  - Logical
  - Gender sensitive
  - Compatible with previous approach
  - Allowed comparison of grouped results over time
- Referrals to doctors to be made on an “as needed” basis

# Recent changes

- Interpretation of audiogram (NIHL seen on audiogram)
- Referral to a ‘doctor’ for diagnosis

**Table 12** The HSE categorisation scheme

<i>Category</i>	<i>NIHL seen on audiogram?</i>	<i>Calculation†</i>	<i>Action</i>
<b>1 Acceptable hearing ability</b>	No*	Sum of hearing levels at 1, 2, 3, 4 and 6 kHz	Repeat health surveillance at next routine interval
<b>2 Mild hearing loss</b>	Stable NIHL may be present <sup>+</sup>	Sum of hearing levels at 1, 2, 3, 4 and 6 kHz	Consider earlier repeat health surveillance than routine, taking into account factors such as extent of hearing loss
<b>3 Significant hearing loss or new/ progressive NIHL</b>	Yes, newly identified or progressive NIHL may be present (this category may also include more severe but stable NIHL)	Sum of hearing levels at 1, 2, 3, 4 and 6 kHz	Refer for medical assessment. Timing of next health surveillance depends on outcome of assessment
<b>4 Rapid hearing loss<sup>+</sup></b> Reduction in hearing level of 30 dB or more, within 3 years or less	Possible	Sum of hearing levels at 3, 4 and 6 kHz	Refer for medical assessment. Timing of next health surveillance depends on outcome of assessment

\* If NIHL is or may be present, the worker cannot be Category 1.

+ By definition at least one previous audiogram must be available for comparison.

† Compare value with figure given for appropriate age band and gender in Table 13.



# What is meant by “diagnosis”

---

- Where as a result of health surveillance the employee has identifiable hearing loss the diagnosis of NIHL must be confirmed by a doctor (unless the competent adviser is a doctor). L108 Controlling noise at work 2021 Appendix 4 Para 21
- Diagnosis: clinical or administrative - if x do y
- Diagnostic criteria: not specified
- Issues: consistency, competence, cost

# Position Statement April 2023

---

- Aims to provide some level of clarity for current implementation of the guidance
- Aims to answer the most pertinent questions raised so far
- Raises maybe more questions than the answers it provides....

# Summary of Position Statement

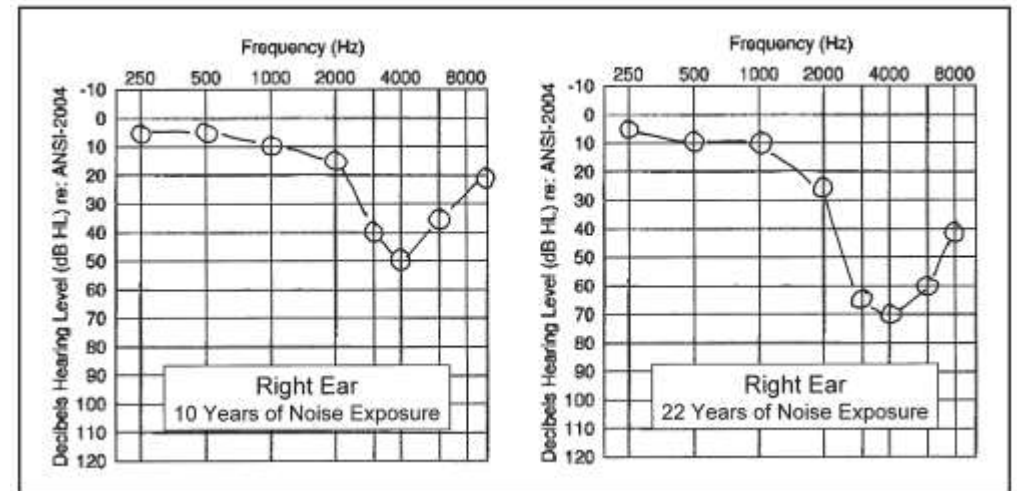
---

- Clarification that not a diagnostic methodology BUT process to look for indications of NIHL
- Provides guidance on information to review in order to make this judgement
- Clarification on when to refer to an OH Doctor
- Details what the referral may look like (i.e. can be paper based)
- Defines what information is needed back from the referral process

# Summary of Position Statement

---

- What are indications of NIHL
- What is NIHL as seen on an audiogram
- Referral for other issues not considered NIHL



# Outstanding Issues

---

- Competency
- Suitability of current HSE Categorisation Scheme
- Lack of tiered approach
- Accredited training
- Fitness for continued exposure

# Data Collection

---

- OH reporting scheme
- Baseline data
- Categorisation outcome vs Audiogram indication
- Cost benefit of referral

# Questions

---

# Training for Industrial Audiometry

---

ROBERT RENDALL





# Audiogram Interpretation

Melanie Brewster  
Clinical Physiologist (Audiologist)  
RCCP 1529

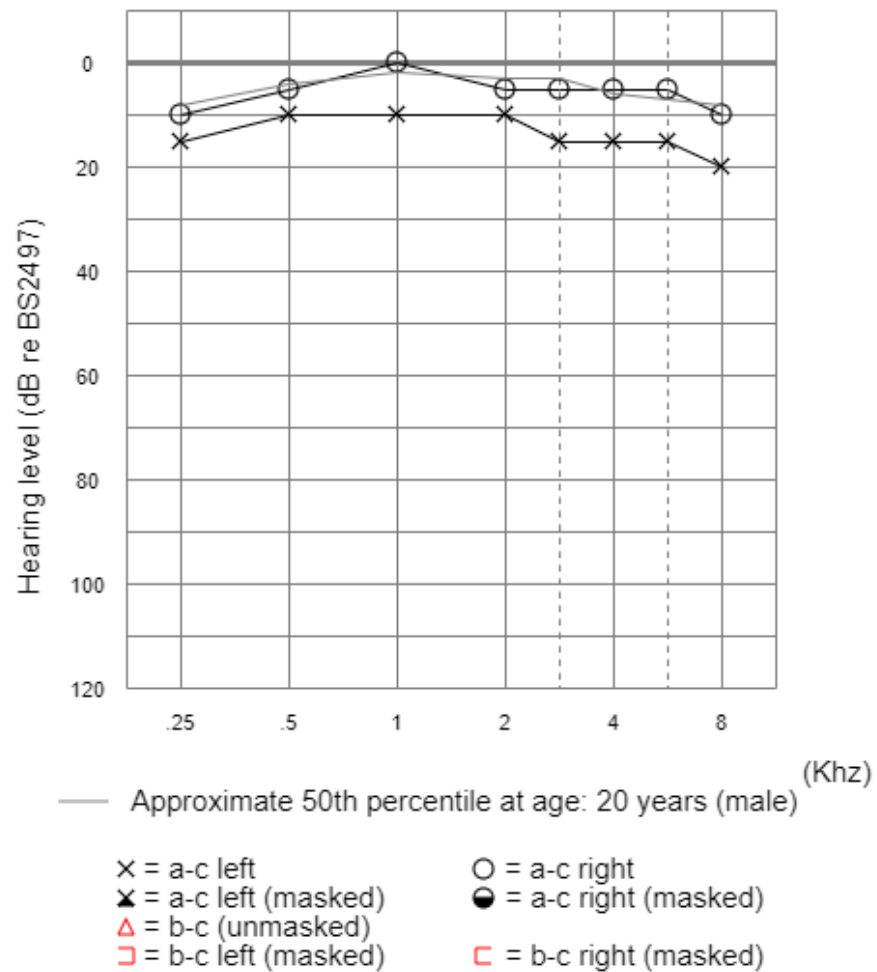
## Normal vs age 20

### Normal Age 20

Date of Birth: 13-05-2002

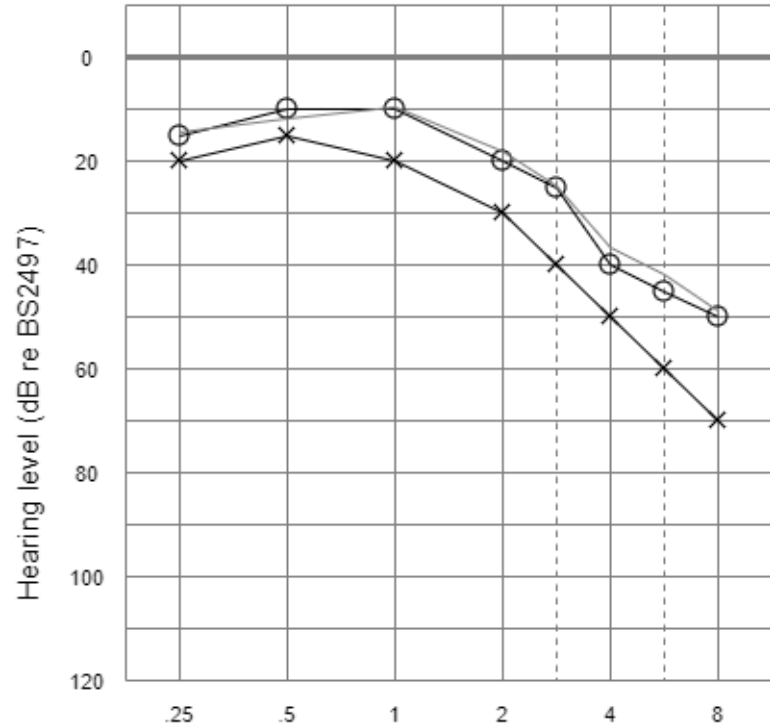
Client: Industrial Diagnostics Company

Assessor: Melanie Brewster



Right - on 50th percentile normal for age  
 Left - within interquartile range normal for age

**NORMAL age 63**  
 Date of Birth: 03-08-1960  
 Client: Industrial Diagnostics Company  
 Assessor: Melanie Brewster



— Approximate 50th percentile at age: 62 years (male) (Khz)

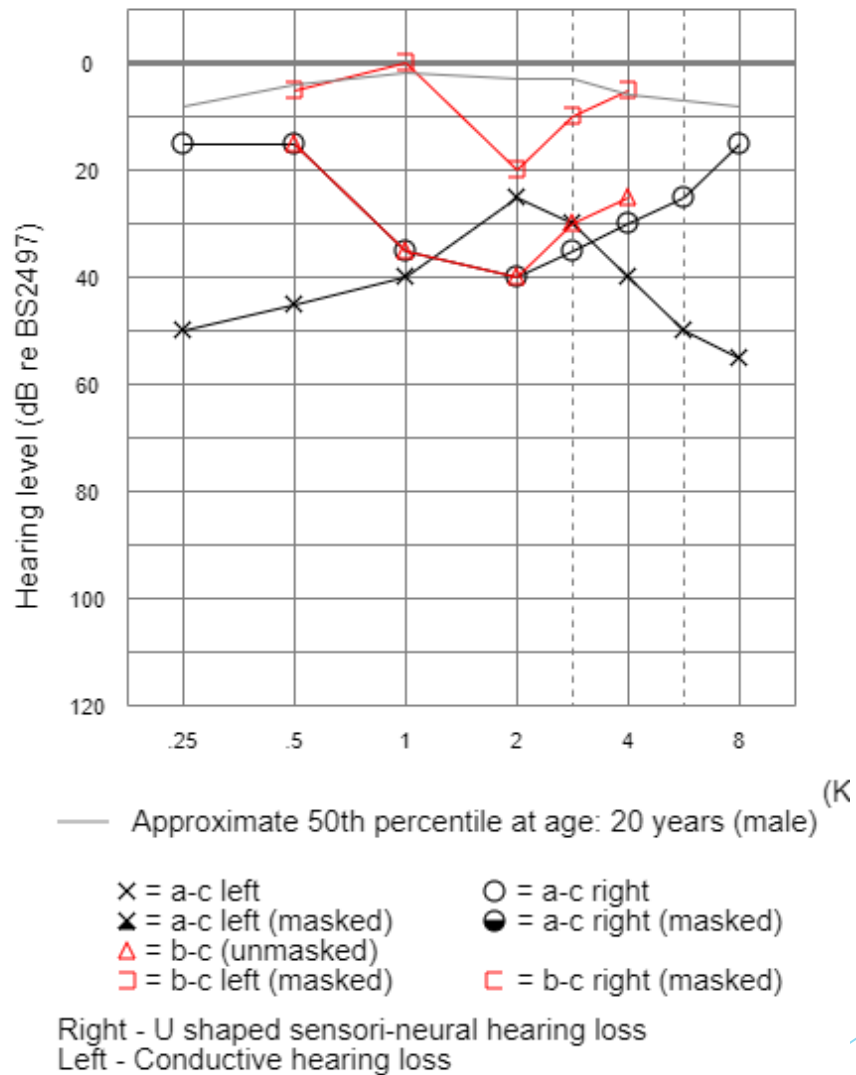
- x = a-c left
- o = a-c right
- x = a-c left (masked)
- o = a-c right (masked)
- Δ = b-c (unmasked)
- = b-c left (masked)
- = b-c right (masked)

Right - On 50th percentile normal for age  
 Left - within inter-quartile range normal for age

## Normal vs age 63

# Medical

Date of Birth: 13-05-2002  
 Client: Industrial Diagnostics Company  
 Assessor: Melanie Brewster

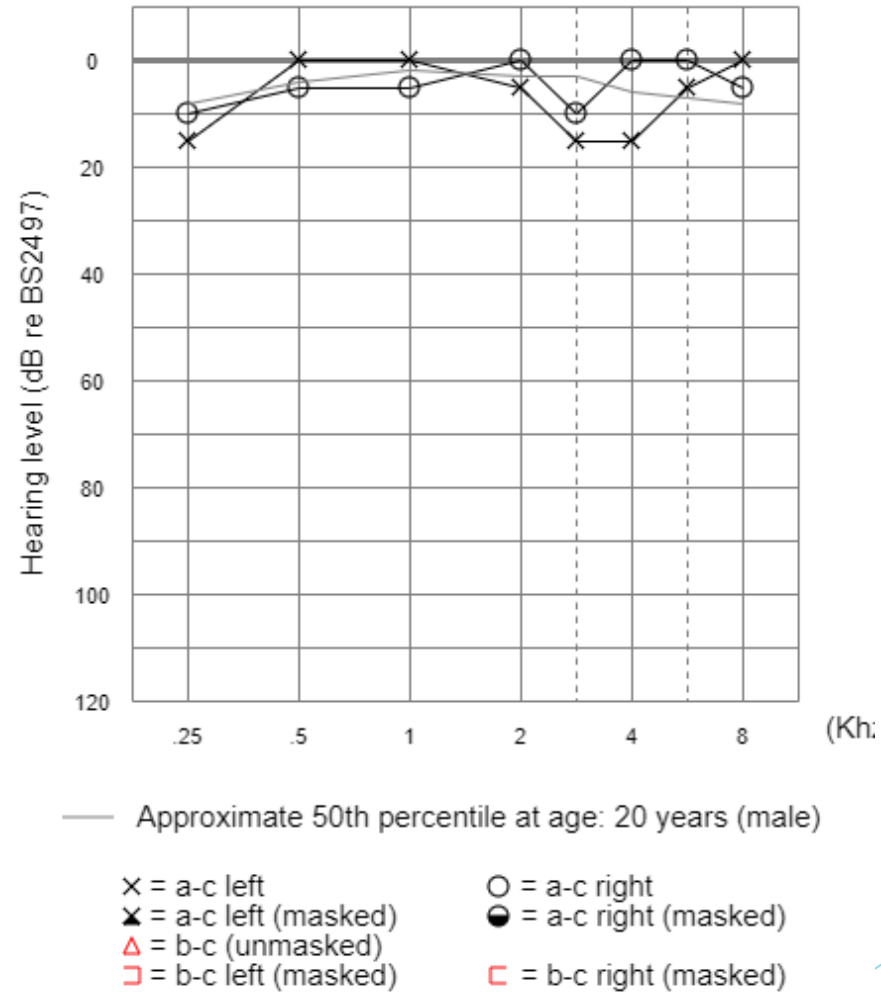


Date of Birth: 13-05-2002  
Client: Industrial Diagnostics Company  
Assessor: Melanie Brewster

## First sign of NIHL

Right - earliest audiogram where NIHL can be identified. Isolated notch at 3 or 4 kHz

Left - Early NIHL involving 3 and 4kHz



Early NIHL

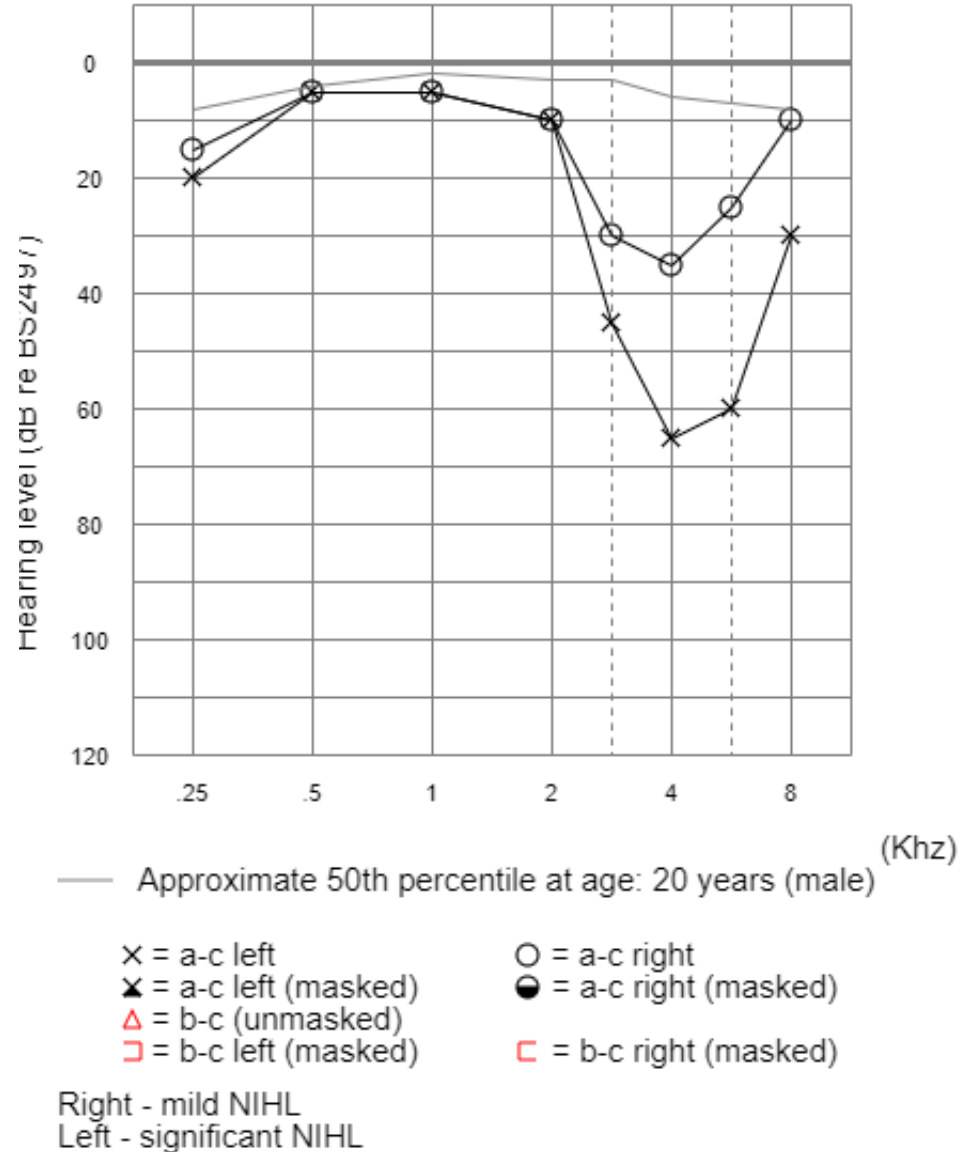
Date of Birth: 13-05-2002  
Client: Industrial Diagnostics Company  
Assessor: Melanie Brewster

## NIHL

Right - mild (extent of bulge 30dB or less)

Left - significant (extent of bulge >30dB)

Noncomplex NIHL - must be against a normal baseline audiogram

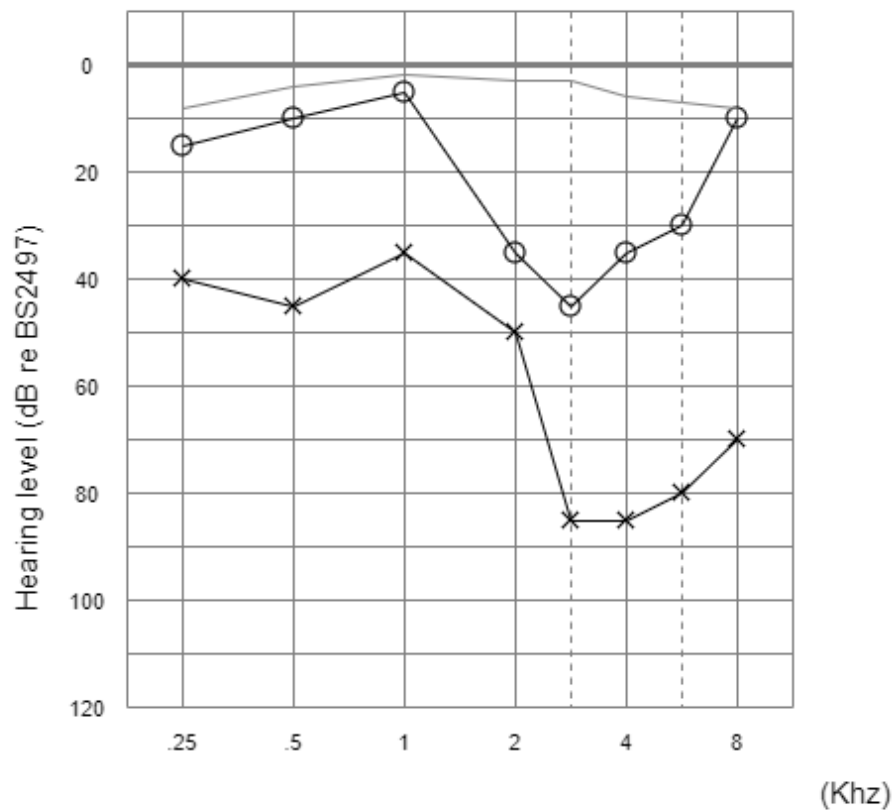


## Complex cases

Right - audiometric notch fundamentally involves 2kHz

Left - audiometric notch on a non normal baseline audiogram

Medical Age 20  
 Date of Birth: 13-05-2002  
 Client: Industrial Diagnostics Company  
 Assessor: Melanie Brewster



— Approximate 50th percentile at age: 20 years (male)

- X = a-c left
- ✕ = a-c left (masked)
- △ = b-c (unmasked)
- ◻ = b-c left (masked)
- = a-c right
- = a-c right (masked)
- ◻ = b-c right (masked)

Right - complex case - 2k involvement  
 Left - complex case - non-normal baseline audiogram

# Proposed revision to Classification System

- ▶ HSE 1 - Normal vs age (within interquartile range)
  - ▶ HSE 2 - Mild NIHL (extent of notch or bulge 30dB or less)
  - ▶ HSE 3 - Significant NIHL (extent of loss >30dB)
  - ▶ HSE 4 - Worsening NIHL (extent of notch > by 10dB or more)
  - ▶ HSE U - Medical or complex case
- 
- ▶ Classification (Interpretation) - balance of probability based on ac only



# A TIERED APPROACH: A REVIEW OF THE EVIDENCE

Dr Finola Ryan

SOM NIHL Think Tank

May 4<sup>th</sup>, 2023

# A TIERED APPROACH

How and when to use

Questionnaires

Clinical evaluation

Tests

Using the right test for the right reason

Copyright 2009 by Randy Glasbergen.  
w.glasbergen.com

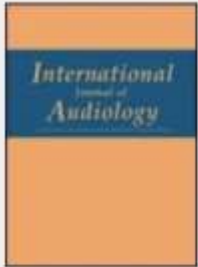


**“If you hadn’t done those tests to find out what’s wrong with me, I’d still be healthy”**

# PURE TONE AUDIOMETRY: A GOLD STANDARD?



**International Journal of Audiology** >  
Volume 55, 2016 - Issue 8



**International Journal of Audiology** >  
Volume 55, 2016 - Issue 8

Original Article

## Development of in-noise hearing tests and noise and sound

Harvey Dillon, Elizabeth Fr  
Pages 463-471 | Received 14 Oct

Original Article

## Validating self-reported symptoms and otoacoustic emissions audiometry

Sofie Fredriksson, Oscar  
Pages 454-462 | Received 03 Jun 20



## Otolaryngologic Clinics of North America

Volume 45, Issue 5, October 2012, Pages 941-958



## Evidence-Based Practice: Management of Adult Sensorineural Hearing Loss

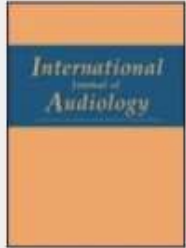
Justin K. Chau MD<sup>a</sup>, John J.W. Cho MD<sup>b</sup>, Dieter K. Fritz MD<sup>a</sup>

# PROS

- Found to produce accurate thresholds and assess the integrated functioning of the components of the auditory system
- Can help rule out age related HL and an age correction can be applied (Ali, Morgan, & Ali, 2014; Kirchner et al., 2012).

## CONS

- Large-scale screening is often time consuming and expensive
- PTA is unable to detect early hearing loss (Venet, Campo, Rumeau, Thomas, & Parietti-Winkler, 2014)
- PTA is susceptible to manipulation (Rickards & De Vidi, 1995)
- The test-retest variability of pure tone thresholds at 6 and 8 kHz is inferior to that at other frequencies (Flamme et al., 2014, Lapsley-Miller, Reed, Robinson, & Perez, 2018)
- Not all individuals exposed to excessive noise will exhibit audiometric notches (Hsu, Wu, Chang, Lee, & Hsu, 2013).



**International Journal of Audiology** >

Volume 55, 2016 - Issue 8

Original Article

## **Validating self-reporting of hearing-related symptoms against pure-tone audiometry, otoacoustic emission, and speech audiometry**

Sofie Fredriksson , Oscar Hammar, Lennart Magnusson, Kim Kähäri & Kerstin Persson Waye

Pages 454-462 | Received 03 Jun 2015, Accepted 07 Apr 2016, Published online: 19 May 2016

- Self-report questionnaire
- Occupational noise exposure
- Sensitivity >85% (95% CI 56 - 100)
- Specificity >70% (95% CI 55 to 84)

# THAT BRINGS US TO OAEs

DPAOE more sensitive than PTA =  
more useful in pre-clinical stage

*but* individuals don't always follow the same  
pattern as the group as a whole



Original Article

## Otoacoustic emissions in a hearing conservation program: General applicability in longitudinal monitoring and the relation to changes in pure-tone thresholds

Hiske W. Helleman  Eleonora J.M. Jansen & Wouter A. Dreschler

Pages 410-419 | Received 12 Mar 2009, Accepted 01 Dec 2009, Published online: 02 Mar 2010

ORIGINAL ARTICLE

International Tinnitus Journal. 2012;17(1):77-82.

### Otoacoustic emissions in normal-hearing workers exposed to different noise doses

Marlene Escher Boger<sup>1</sup>  
André Luiz Lopes Sampaio<sup>2</sup>  
Carlos Augusto Costa Pires de Oliveira<sup>3</sup>

# THAT BRINGS US TO OAEs

DPAOE more sensitive than PTA =  
more useful in pre-clinical stage

*but* individuals don't always follow the same  
pattern as the group as a whole



International Journal of Audiology >

Volume 49, 2010 - Issue 6

Original Article

## Otoacoustic emissions in a hearing conservation program: General applicability in longitudinal monitoring and the relation to changes in pure-tone thresholds

Hiske W. Helleman  Eleonora J.M. Jansen & Wouter A. Dreschler

Pages 410-419 | Received 12 Mar 2009, Accepted 01 Dec 2009, Published online: 02 Mar 2010

ORIGINAL ARTICLE

International Tinnitus Journal. 2012;17(1):77-82.

## Otoacoustic emissions in normal-hearing workers exposed to different noise doses

Marlene Escher Boger<sup>1</sup>  
André Luiz Lopes Sampaio<sup>2</sup>  
Carlos Augusto Costa Pires de Oliveira<sup>3</sup>



International Journal of Audiology >

Volume 51, 2012 - Issue 5

Original Articles

## Overall versus individual changes for otoacoustic emissions and audiometry in a noise-exposed cohort

Hiske W. Helleman  & Wouter A. Dreschler

Pages 362-372 | Received 13 May 2011, Accepted 21 Dec 2011, Published online: 21 Mar 2012



# OTHER TESTS: AUTOMATIC AUDIOMETRY



## E-RESEARCH ARTICLES

### **Identification of Conductive Hearing Loss Using Air Conduction Tests Alone**

### **Reliability and Validity of an Automatic Test Battery**

Convery, Elizabeth<sup>1,2</sup>; Keidser, Gitte<sup>1,2</sup>; Seeto, Mark<sup>1,2</sup>; Freeston, Katrina<sup>1,2</sup>; Zhou, Dan<sup>1,2</sup>; Dillon, Harvey<sup>1,2</sup>

[Author Information](#) ☺

*Ear and Hearing* 35(1):p e1-e8, January/February 2014. | DOI: 10.1097/AUD.0b013e31829e058f

# OTHER TESTS: WAHTS



**International Journal of Audiology** >

Volume 56, 2017 - Issue sup1: Making Sound Waves: Selected papers from the 2016 Annual Conference of the National Hearing Conservation Association

Original Article

## Going wireless and booth-less for hearing testing in industry

Deanna K. Meinke , Jesse A. Norris, Brendan P. Flynn & Odile H. Clavier

Pages 41-51 | Received 04 Nov 2016, Accepted 07 Nov 2016, Published online: 15 Dec 2016

 Download citation

 <https://doi.org/10.1080/14992027.2016.1261189>



# OCCUPATIONAL EARCHECK (OEC)

International Archives of Occupational and Environmental Health (2018) 91:877–885  
<https://doi.org/10.1007/s00420-018-1332-5>

ORIGINAL ARTICLE



## Accuracy of an internet-based speech-in-noise hearing screening test for high-frequency hearing loss: incorporating automatic conditional rescreening

Marya Sheikh Rashid<sup>1</sup> · Wouter A. Dreschler<sup>1</sup>

Received: 3 October 2017 / Accepted: 26 June 2018 / Published online: 29 June 2018  
© The Author(s) 2018

International Journal of Audiology >

Volume 56, 2017 - Issue 11



Original Article

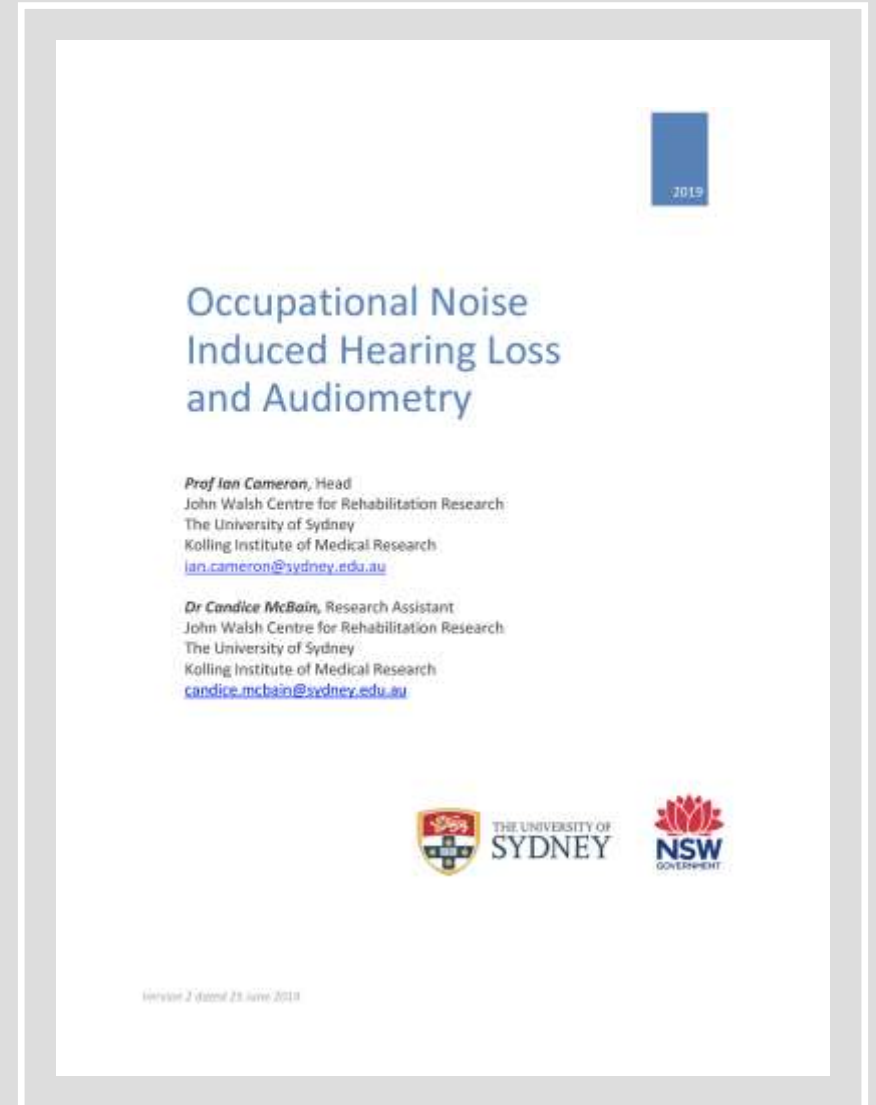
## Laboratory evaluation of an optimised internet-based speech-in-noise test for occupational high-frequency hearing loss screening: Occupational Earcheck

Marya Sheikh Rashid ✉, Monique C.J. Leensen, Jan A.P.M. de Laat & Wouter A. Dreschler

Pages 844-853 | Received 21 Jan 2016, Accepted 15 May 2017, Published online: 06 Jun 2017

# RAPID REVIEW CONCLUSION

“Conducting hearing screening using more time and cost efficient tests to identify people who are in need of additional more conventional testing is supported by contemporary research”



# REFERENCES

- Ali, S., Morgan, M., & Ali, U. I. (2014). Is it reasonable to use 1 and 8 kHz anchor points in the medico-legal diagnosis and estimation of noise-induced hearing loss? *Clinical Otolaryngology*, 40, 255-259. doi: 10.1111/coa.12362
- Boger, M. E., Sampaio, A. L. L., & de Oliveira, C. A. C. P. (2012). Otoacoustic emissions in normal-hearing workers exposed to different noise doses. *International Tinnitus Journal*, 17, 77-82.
- Cameron, I., & McBain, C. (2019) Occupational Noise Induced Hearing Loss and Audiometry. New South Wales Government. Available at [https://www.sira.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0006/603429/Occupational-Noise-Induced-Hearing-Loss-and-Audiometry-rapid-review.pdf](https://www.sira.nsw.gov.au/__data/assets/pdf_file/0006/603429/Occupational-Noise-Induced-Hearing-Loss-and-Audiometry-rapid-review.pdf)
- Chau, J. K., Cho, J. J. W., & Fritz, D. K. (2012). Evidence-based practice: Management of adult sensorineural hearing loss. *Otolaryngologic Clinics of North America*, 45, 941-958. doi: 10.1016/j.otc.2012.06.002
- Convery, E., Keidser, G., Seeto, M., Freeston, K., Zhou, D., & Dillon, H. (2014). Identification of conductive hearing loss using air conduction tests alone: Reliability and validity of an automatic test battery. *Ear and Hearing*, 35, 1-8. doi: 10.1097/AUD.0b13e31829e058f
- Dillon, H., Beach, E. F., Seymour, J., Carter, L., & Golding, M. (2016). Development of Telscreen: a telephone-based speech-in-noise hearing screening test with a novel masking noise and scoring procedure. *International Journal of Audiology*, 55(8), 463-471. doi: 10.3109/14992027.2016.1172268
- Flamme, G. A., Stephenson, M. R., Deiters, K. K., Hessenauer, A., VanGessel, D., Geda, K., Wyllys, K., & McGregor, K. (2014). Short-term variability of pure-tone thresholds obtained with TDH-39P earphones. *International Journal of Audiology*, 53(02), s5-15. doi: 10.3109/14992027.2013.857435
- Fredriksson, S., Hammar, O., Magnusson, L., Kahari, K., & Wayne, K. P. (2016). Validating self-reporting of hearing-related symptoms against pure-tone audiometry, otoacoustic emission, and speech audiometry. *International Journal of Audiology*, 55(8), 454-462. doi: 10.1080/14992027.2016.1177219
- Helleman, H. W., & Dreschler, W. A. (2012). Overall versus individual changes for otoacoustic emissions and audiometry in a noise-exposed cohort. *International Journal of Audiology*, 51(5), 362-372. doi: 10.3109/14992027.2011.653447
- Helleman, H. W., Jansen, E. J. M., & Dreschler, W. A. (2010). Otoacoustic emissions in a hearing conservation program: General applicability in longitudinal monitoring and the relation to changes in pure-tone thresholds. *International Journal of Audiology*, 49, 410-419. doi: 10.3109/14992020903527616
- Hsu, T.Y., Wu, C.C., Chang, J.G., Lee, S.Y., & Hsu, C.J. (2013). Determinants of bilateral audiometric notches in noise-induced hearing loss. *The Laryngoscope*, 123, 1005-1010. doi: 10.1002/lary.23686
- Kirchner, D. B., Evenson, E., Dobie, R. A., Rabinowitz, P., Crawford, J., Kopke, R., & Hudson, W. (2012). Occupational noise-induced hearing loss. *Journal of Management*, 54(1), 106-108. doi: 10.1097/JOM.0b013e318242677d
- Lapsley-Miller, J. A., Reed, C. M., Robinson, S. R., & Perez, Z. D. (2018). Pure-tone audiometry with forward pressure level calibration leads to clinically-relevant improvements in test-retest reliability. *Ear and Hearing*, 39(5), 946-957. doi: 10.1097/AUD.0000000000000555
- Meinke, D. K., Norris, J. A., Flynn, B., & Clavier, O. H. (2018). Going wireless and booth-less for hearing testing in industry. *International Journal of Audiology*, 56, 41-51. doi: 10.1080/14992027.2016.1261189
- Rashid, M. S., & Dreschler, W. A. (2018). Accuracy of an internet-based speech-in-noise hearing screening test for high-frequency hearing loss: Incorporating automatic conditional rescreening. *International Archives of Occupational and Environmental Health*, 91, 877-885. doi: 10.1007/s00420-018-1332-5
- Rashid, M. S., Leensen, M. C. J., de Laat, J. A. P. M., & Drescher, W. A. (2017). Laboratory evaluation of an optimised internet-based speech-in-noise test for occupational high-frequency hearing loss screening: Occupational earcheck. *International Journal of Audiology*, 56(11), 844-853. doi: 10.1080/14992027.2017.1333634
- Rickards, F. W., & De Vidi, S. (1995). Exaggerated hearing loss in noise induced hearing loss compensation claims in victoria. *The Medical Journal of Australia*, 163(7), 360-363. doi: 10.5694/j.1326-5377.1995.tb124629.x
- Venet, T., Campo, P., Rumeau, C., Thomas, A., & Parietti-Winkler, C. (2014). One-day measurement to assess the auditory risks encountered by noise-exposed workers. *International Journal of Audiology*, 53, 737-744. doi: 10.3109/14992027.2014.913210

# **Preventative Audiology**

-

# **Health Surveillance**

Mr Rob Shephard  
Clinical Audiologist

# What is Audiometry?



## Hearing Test – Puretone Audiometry

Alexander Graham Bell

Patented Audimeter 1879



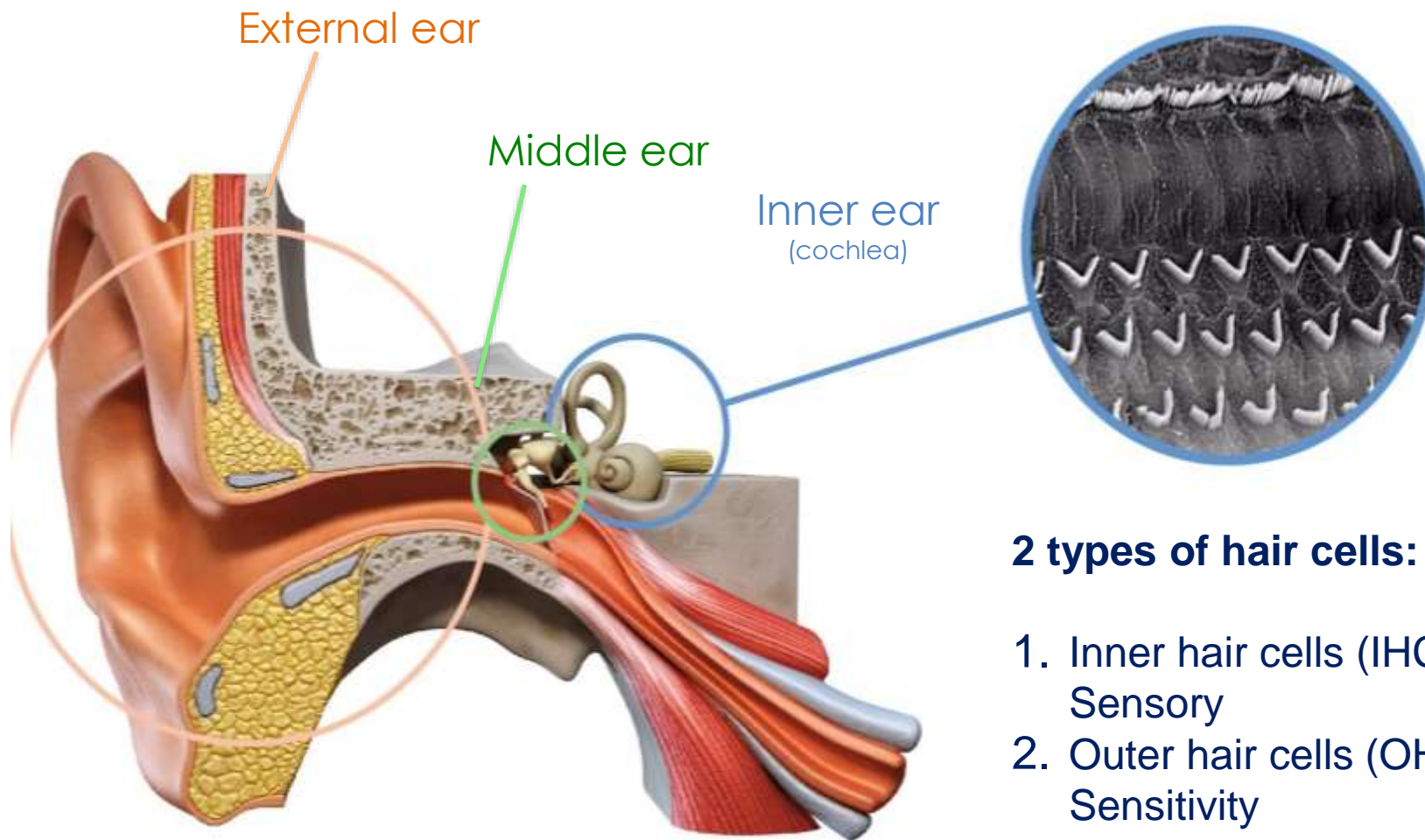


## What is Audiometry?



- Requires sound proof environment
- Adequate instruction, genuine compliance
- Subjective behavioural test
- Measure of the complete auditory pathway
- Not sensitive to early cochlea damage





## 2 types of hair cells:

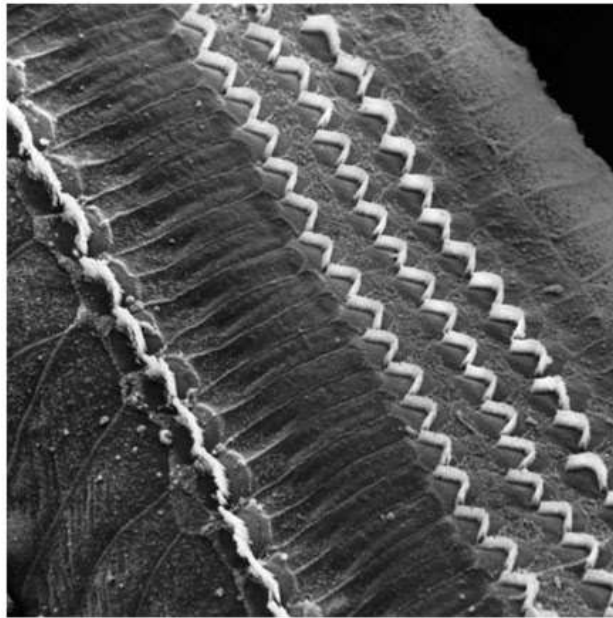
1. Inner hair cells (IHC)  
Sensory
2. Outer hair cells (OHC)  
Sensitivity

## Damage to Outer Hair Cells

Early stages of OHC damage can result in:-

- Tinnitus
- Hyperacusis
- Difficulties communicating especially in background noise

30% – 50 % of OHCs can be destroyed before audiometric hearing loss is measurable

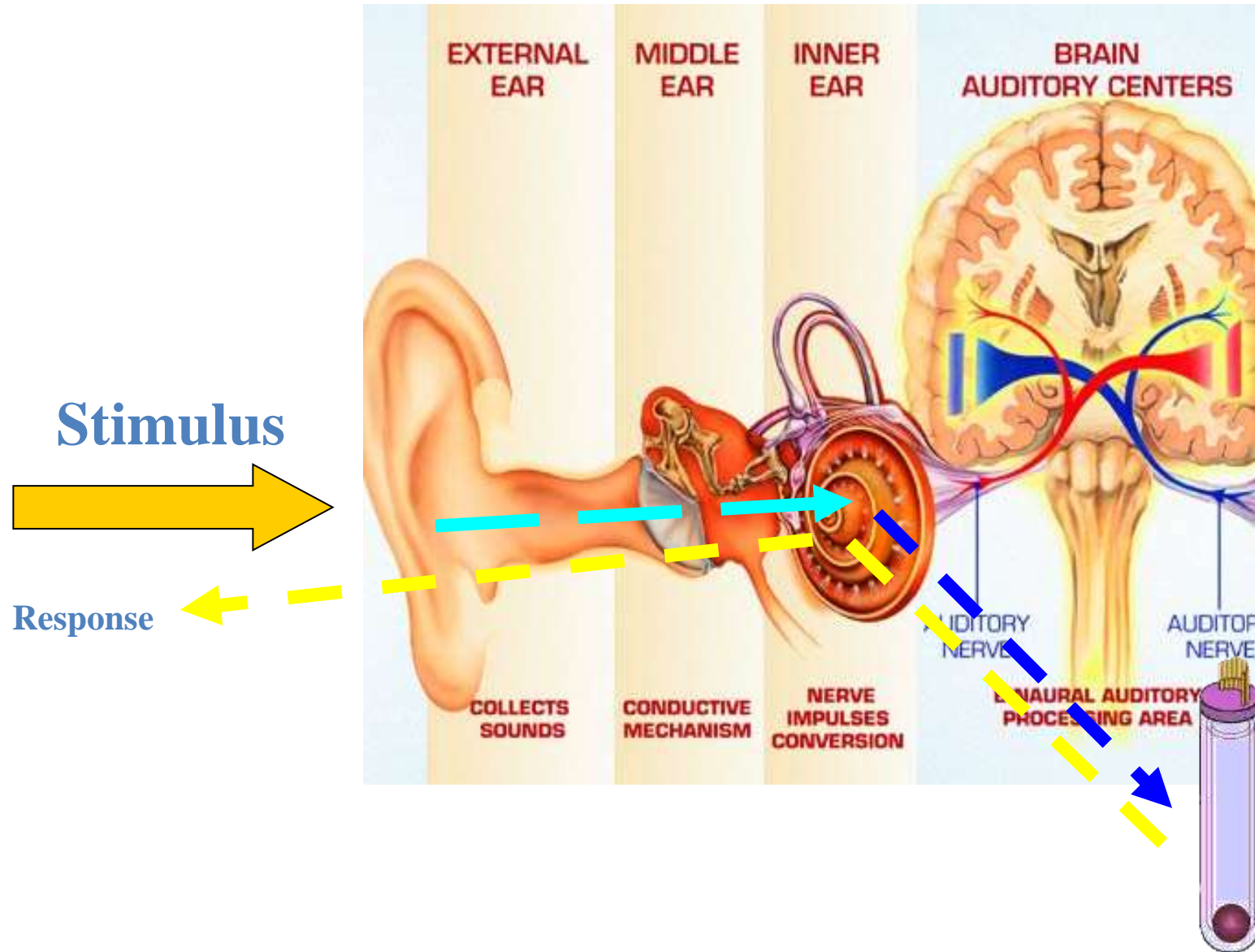


Intact cochlea



Damaged cochlea

# Otoacoustic Emissions – O.A.E.



# Otoacoustic Emissions – O.A.E.

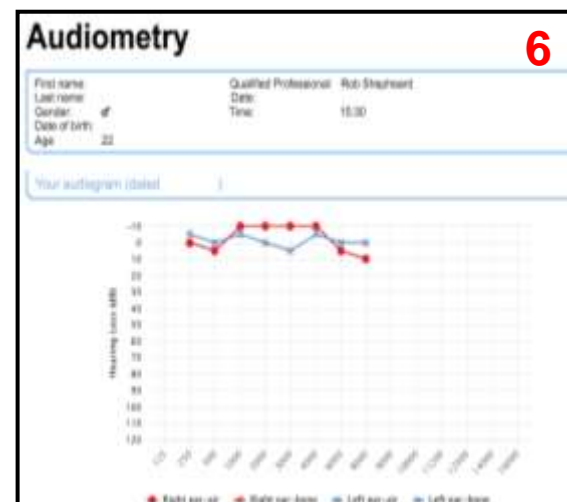
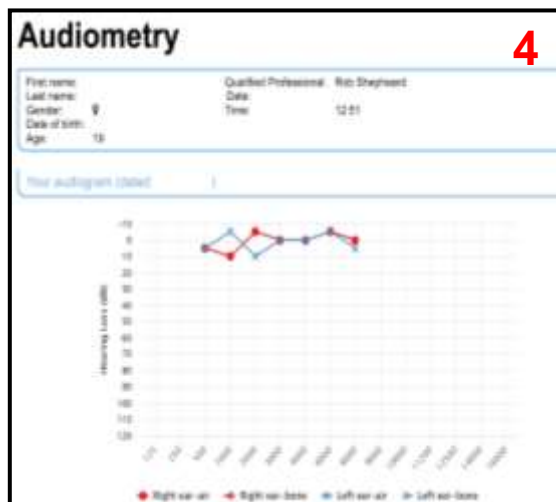
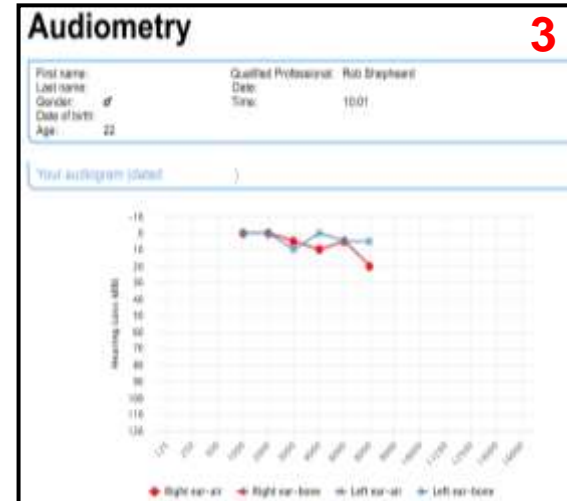
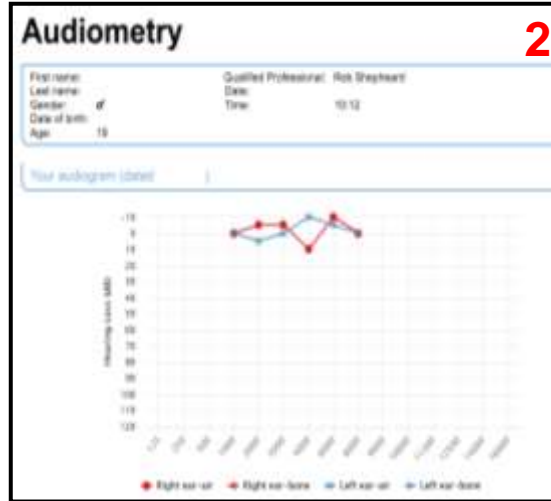
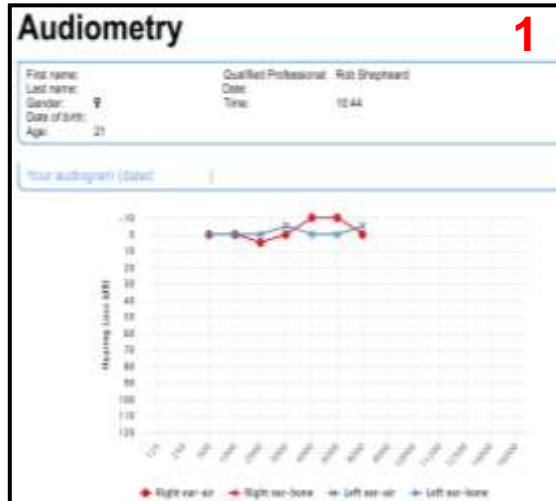
- Objective test, no participation required
- Needs only quiet environment
- Only tests the vulnerable OHC structures first damaged by sound
- Sensitive to small changes in OHC function





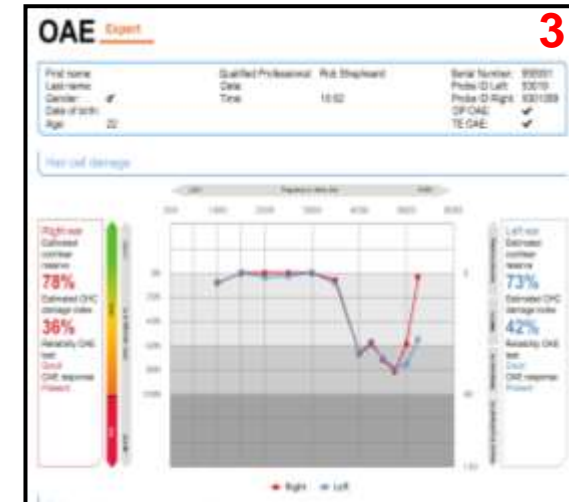
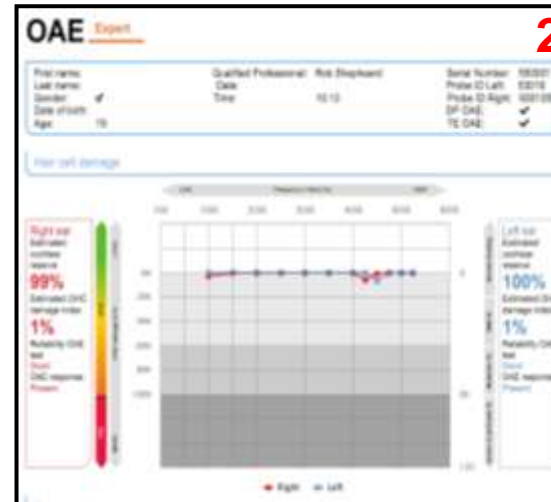
# Audiometry as an indicator of exposure

- 3 subjects: 10 + years exposure, NO PPE, tinnitus (2 with bilateral tinnitus, 1 with unilateral tinnitus)
- 3 subjects: 10 + years exposure, PPE worn, no hearing damage



# OAE as an early indicator of exposure

- 3 subjects: 10 + years exposure, NO PPE, tinnitus (2 with bilateral tinnitus, 1 with unilateral tinnitus)
- 3 subjects: 10 + years exposure, PPE worn, no hearing damage



# Traditional pure-tone audiometry v OAE

	Traditional	OAE
Detects very early signs of hearing damage so hearing conservation programme can be updated to prevent further damage	No	Yes
Easily understood evaluation of hearing damage (% damage)	No	Yes
Employee motivational “urgency”	No	Yes
Objective evaluation of hearing damage (participation unnecessary)	No	Yes
No specialist quiet booths required (OAE just needs a quiet office)	No	Yes
Complies with regulatory health surveillance requirements	Yes*	Yes



# British Society of Audiology

## Recommended Procedure – Clinical Application of Otoacoustic Emissions February 2023

“Hearing monitoring to assess cochlear damage caused by ototoxic agents or noise (including hearing conservation programmes)”

“DPOAEs allow for earlier identification of cochlear damage (at the high frequency basal end of the basilar membrane) before it is evident through routine audiometry”

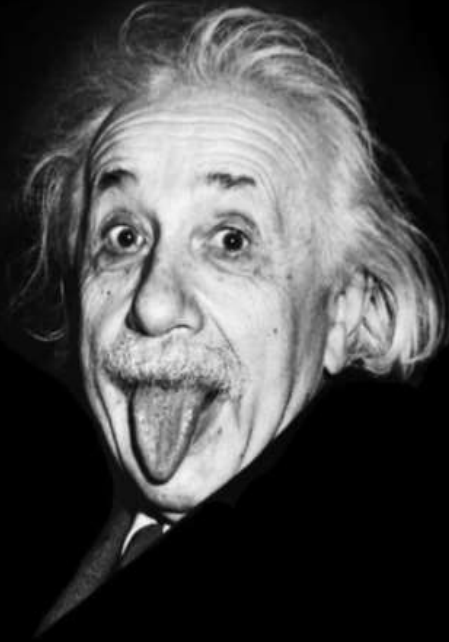
“Chronic exposure to high levels of sound or even short duration exposure to transient high impact sound initially produces outer hair cell dysfunction that is detected with OAE” monitoring.

“Decreases in OAE amplitude with sound exposure are typically detected before hearing loss is documented with pure tone audiometry. Because of their sensitivity to sound induced cochlear dysfunction, OAEs are well suited for monitoring persons at risk of noise or music induced hearing loss”



"Insanity is doing the  
same thing over and  
over again and expecting  
different results"

*Albert Einstein*



# Questions

---

# Next Steps

---

- Face to Face forum
- Delphi Process
- Working groups
  - Data
  - Tiered approach
  - Competence
  - 'Diagnostic' criteria

Many Thanks!

---