Hearing Surveillance Chart—a tool for tracking serial audiometry results and predicting future hearing impairment

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Abstract
High frequency hearing loss is related to noise-induced deafness. We decided to develop a method of recording serial audiogram results that would provide an accessible overview of trends for an individual. Health & Safety Executive (HSE) warning and referral levels for high frequency hearing losses were plotted against age. A third line was added to indicate a level of ‘significant’ handicap. This graph is inserted in each individual’s hearing surveillance record. High frequency hearing loss results are plotted for each ear over time. Someone with known hearing loss but minimal deterioration will exceed the HSE warning level at every review, whereas someone with perfect hearing suffering a significant deterioration may not exceed the warning level initially. The latter should be of more concern to their current employer.

Key words
Audiogram; audiometry; hearing impairment; Hearing Surveillance Chart.

Background
Audiometry is well established as an integral part of occupational health surveillance for practitioners dealing with employees who are exposed to significant noise in the workplace. The Health & Safety Executive (HSE) has produced a coding system [1] to provide guidance for action on individual audiogram results. The codes relate to a change in the sum of either high or low frequency losses since previous audiogram (HSE1), a significant difference between these sums for each ear (HSE2), the sums for each ear exceeding the referral level (HSE3) or the warning level (HSE4) or a normal result (HSE5).

The Occupational Health Service for the Northern Ireland Civil Service provides hearing surveillance for ~1000 employees who are engaged in a variety of industries such as roads, water, forestry and agriculture. Our occupational health nurse specialists carry out hearing assessments, including audiograms, yearly for the first 3 years and then three-yearly thereafter, providing no abnormalities are identified. On the basis of the HSE coding they refer cases to their medical colleagues for advice.

Many modern audiometers automatically calculate the HSE code. While this is useful to highlight potential problems at each point in time, it does not provide an easily accessible overview of an individual employee’s hearing history. It is not an ordinal scale and the code numbers do not relate directly to the severity of hearing loss.

We therefore decided to develop a way of recording serial audiogram results that illustrated the trend in an individual's hearing over time. Our main concern with noise induced hearing loss is a decrease at the higher frequencies (3, 4 and 6 kHz—particularly 4 kHz) and whether or not this deterioration continues. Some individuals can suffer hearing impairment even when noise control measures are adequate and personal protection equipment is being used properly.
**Action**

The graph was produced by plotting HSE warning and referral levels for the sum of the hearing loss at 3, 4 and 6 kHz against age. The line AB represents the warning level and the line CD represents the referral level. A third line has been added (EF) to indicate significant handicap using the following points [2]:

- $35 \times 3$ dB loss at 18 years of age—needing ENT surgery or hearing aid;
- $45 \times 3$ dB loss at 35 years of age—difficulty hearing a conversational voice;
- $60 \times 3$ dB loss at 60 years of age—difficulty hearing a loud voice.

We normally print the lines in green, amber and red, respectively.

In Figure 1 the line KL shows that a 10 dB loss every 3 years sustained over a working life will eventually result in a significant handicap. Conversely, the line MN shows that a loss of $<10$ dB every 5 years is consistent with a normal deterioration with age.

We include a copy of this graph in each individual’s hearing record and plot their high frequency hearing loss sum for each ear against age. This provides a visual record of their progress and a reminder of significant thresholds. It also aids discussion with the individual concerned and can assist us in advising our health and safety colleagues.

In Figure 2 the line WX shows the record of an individual with known hearing loss but minimal deterioration whereas the line YZ represents an individual with a significant deterioration over a short time span. For clarity, results are shown for one ear only. The former would exceed the HSE warning level at every review, whereas the latter might not attract attention initially but is clearly more vulnerable and needs investigation.

**Conclusion**

This graph provides an overview of the most important aspect of an individual’s hearing surveillance with regard to noise-induced deafness. We find it easier to recognize trends and estimate future impairment when information is presented in graphic form. Advice regarding the risks of continued noise exposure at work and the future need for audiometry can be based on this. We offer this as a simple tool for summarizing serial audiometry results and predicting future hearing impairment.

**References**