

# OPEN ACCESS GUIDE TO AUDIOLOGY AND HEARING AIDS FOR OTOLARYNGOLOGISTS



## MOBILE PHONE / CELL PHONE AUDIOMETRY

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Applications to assess hearing using mobile devices are available for free. *Unitron* devised such an application called *uHear* that performs a hearing screening test. It is used on mobile Apple operated devices. The mobile device emits pure tones at different frequencies and can test both ears sequentially and individually. Apart from the hearing screening test there is also a speech-in-noise test and a questionnaire available about the individual's hearing performance profile. However, for testing hearing sensitivity only the first test is done.

### Hardware and software requirements

- Suitable Apple mobile devices: *iPhone*, *iPod Touch* and *iPad*
- *Apple-endorsed insert headphones* (earbuds) are provided with the device, though any compatible head-phones with built-in background noise that eliminators can be used
- *uHear* application: free download from the *iTunes* website, or from *Apple App Store*

### Accuracy

In an as yet unpublished study by *Peer and Fagan*, the accuracy of the *uHear/iPhone* results was compared to a formal audiogram in waiting room, quiet room and sound booth environments. The findings were reported through kappa statistical analysis (*Table 1*).

Kappa Values	Agreement / comparison
<0.2	Poor
0.21-0.4	Fair
0.41-0.6	Moderate
0.61-0.8	Good
0.81-1.0	Very Good

*Table 1: Kappa values reflect agreement between uHear/iPhone and formal audiograms*

'Good' and 'very good' correlation implies high sensitivity for the test. The study revealed that:

- When evaluated in a soundproof room and compared to a formal audiogram the *uHear/iPhone* was highly sensitive for detecting high frequency hearing loss and moderately sensitive for detecting low frequency hearing loss. In a quiet room it was highly sensitive only for high frequency hearing loss. (P values all <0.05)
- Accuracy is affected by the testing environment
  - Soundproof booth
    - Low frequency: fair/moderate
    - High frequency: good/very good
  - Quiet room
    - Low frequency: fair/moderate
    - High frequency: moderate/good
  - Waiting room: Poor

It is likely, though not yet validated, that simple occlusive ear muffs (*Figure 1*) placed over the ear buds may improve accuracy by blocking background noise. Such preliminary tests have been done and shown positive results also for the lower frequencies (*C. Laurent, personal communication*).



*Figure 1: Example of commercially available occlusive ear muffs*

## Limitations

It is not a substitute for and cannot match the accuracy of a formal audiogram done by a trained audiologist, but it can be used as a screening tool for detecting high frequency hearing loss, especially in resource limited settings. Limitations include the following:

- Inaccurate for low frequencies
- Must be performed in a quiet room or a soundproof room
- Uses pure tones, not speech audiometry, and therefore may be less reliable than the gold standard of testing done by audiologists
- Does not distinguish between conductive and sensorineural hearing loss
- Because it uses ear buds it is not ideal for patients with otorrhoea
- Instructions are in English: Non-English speakers need a translator to explain the steps of the test

## Advantages

- Self-administered
- No specialised skill or expertise required
- Easy and simple
- Takes 6 minutes
- Information recorded on the mobile device and displayed immediately for assessment
- Can be used on multiple *Apple* devices (*iPhone, iPad, iPod Touch*)

## Indications

Because it is most accurate for high frequency hearing loss, it is recommended to screen those at risk of developing high frequency sensorineural hearing loss

- Ototoxic drugs e.g. MDR-TB (Multi-Drug Resistant Tuberculosis) therapy, chemotherapy, HAART (Highly Active Anti-Retroviral) therapy
- Presbycusis

- Screening children in the classroom
- Where no other audiology services are available

## How to perform the test

1. The test takes 6 minutes to complete
2. Select a testing environment as previously mentioned
3. Check that the ear buds are properly inserted in the ear canals
4. The right ear is tested first, then the left
5. Start the test by touching “Hearing Sensitivity” on the screen (*Figure 2*)
6. When the slightest sound is heard, the patient taps the screen
7. Once the test has been completed, enter the patient’s details
8. The iPhone device plots an audiogram (*Figure 3*)



Figure 2: Initial screen view



Figure 3: Audiogram

## Useful Links

**Download application from iTunes:**  
<http://itunes.apple.com/us/app/uhear/id309811822?mt=8>

**Additional information about the application from Unitron developer:**  
[http://unitron.com/unitron/global/en/consumer/your\\_hearing-c/steps\\_to\\_better\\_hearing/selfassessment.html](http://unitron.com/unitron/global/en/consumer/your_hearing-c/steps_to_better_hearing/selfassessment.html)

**Demonstration how to perform the test:**  
<http://www.youtube.com/watch?v=AbJW5rLw54c>

*Editors' Note: Should readers know of similar mobile phone audiometry applications of which the accuracy has been validated, please email details to [johannes.fagan@uct.ac.za](mailto:johannes.fagan@uct.ac.za)*

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