

Amplified Stethoscopes: Hearing Instrument Programming Considerations

A.U. Bankaitis, PhD, FAAA

Vice President
Oaktree Products, Inc.
St. Louis, MO

Medical professionals rely on auscultation to routinely examine the status of the circulatory, respiratory, and/or gastrointestinal systems. Auscultation is defined as listening to internal sounds of the body and represents an essential component in the delivery of healthcare services. The procedure is accomplished through the use of a stethoscope, a medical device specifically designed to enable physicians, nurses, and other medical professionals to detect and analyze heart, lung, and/or bowel sounds for purposes of differential diagnosis. For medical professionals with hearing loss, performing auscultation while wearing hearing instruments requires a collaborative effort between the medical practitioner and the audiologist to ultimately secure a successful outcome. The purpose of this white paper is to outline hearing instrument programming considerations as it relates to auscultation.

Frequency and Intensity Characteristics of Auscultation:

While there appears to be some discrepancy regarding the exact frequencies of various internal body sounds, breath/lung sounds may range from 70 Hz to 4000 Hz (Cardionics, 2008) with most falling below 2000 Hz (Noland, 2009). The most critical breath/lung sounds used for differential diagnosis fall in the 200 Hz to 600 Hz frequency range (Abrams, 1987). In contrast, heart sounds fall in the 20 Hz to 650 Hz frequency range (Rennert, Morris, & Barrere, 2004), although the most essential heart sounds for differential diagnosis fall in the 70 Hz to 120 Hz frequency range (Noland, 2009; Cardionics, 2008).

In the absence of intensity data of body sounds, attempts were made to quantify breath/lung sounds from CD recordings provided by an amplified stethoscope manufacturer. Due to limitations associated with access to calibration data of recordings and associated specifications related to microphone and instrumentation methods, the most accurate information available is the general statement that breath/lung and/or heart sounds are very soft sounds.

Hearing Instrument Programming Considerations for Medical Professionals Motivated to Use Hearing Instruments with an Amplified Stethoscope:

Often times the listening needs of the practitioner as dictated by audiometric configuration will significantly differ from the listening needs of that same practitioner for routine auscultation procedures. As visually portrayed in Figure 1, while the various audiometric configurations dictate a high frequency emphasis program for optimizing speech, audiologists will need to be prepared to provide a low frequency emphasis program for medical professionals with hearing loss since both breath/lung and heart sounds are low frequency sounds. Specifically, as indicated by the different shaded areas, lung sounds may range up through about 4000 Hz although the

most important breath/lung will fall in the blue shaded area; similarly, the red shaded area represents the most important frequency range for heart sounds.

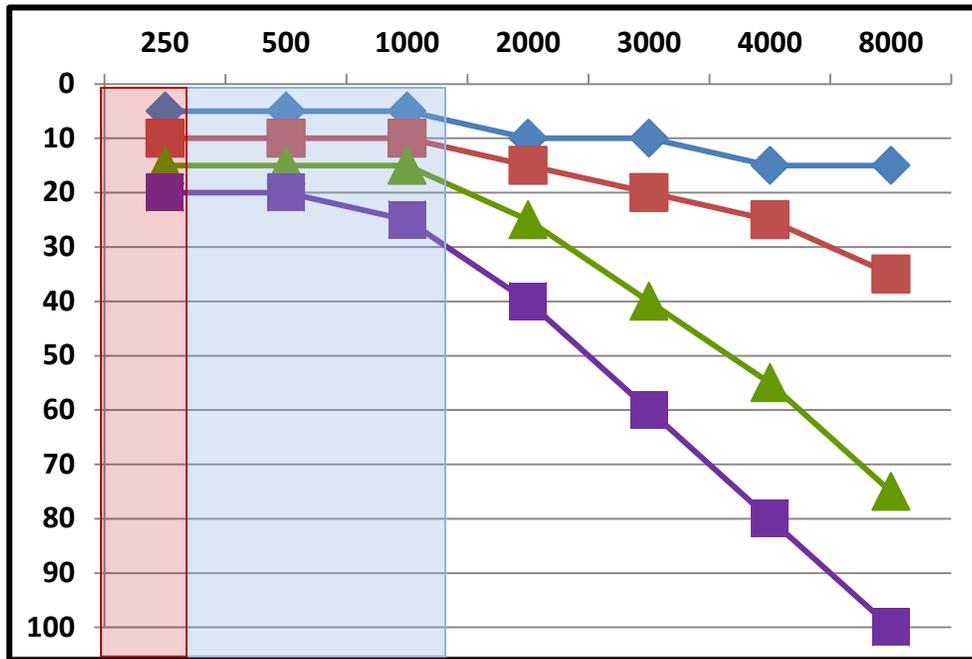


Figure 1: audiometric configurations representing high-frequency hearing loss with shaded areas reflecting critical frequencies for performing auscultation

Furthermore, the intensity of both breath/lung and heart sounds are extremely soft. Ideally, a hearing instrument utilizing Wide Dynamic Range Compression would be beneficial. Experimenting with compression ratios in the low frequencies whereby adjustments are made to yield a 2:1 or 3:1 compression ratio despite the presence of normal low frequency hearing may be beneficial.

General Recommendations:

- Create a separate auscultation program for the medical professional
- The frequency response of the auscultation program must maintain a low frequency emphasis, regardless of audiometric hearing needs
 - Set low frequency settings as low as possible (100-250 Hz) since critical breath/lung and heart sounds range from 200-600Hz and 70 to 120 Hz respectively
- Recognize that the intensity of these same sounds is very soft
 - Even in the presence of normal low-frequency hearing, if possible, adjust WDRC ratios to 2:1 or 3:1

References:

Abrams, J. (1987). *Essentials of cardiac physical diagnosis*. Philadelphia: Lea & Febiger.

Cardionics (2008, April). *Use of Phonak Savia hearing aids with E-scope electronic stethoscope*. (Technical Information Bulletin issued by Cardionics, www.cardionics.com).

Noland, M. (2009, September). *Stethoscopes and hearing aids* (Technical white paper issued by Cardionics, www.cardionics.com).

Rennert, N., Morris, F. & Barrere, C. (2004, February). How to cope with scopes: stethoscope selection and use with hearing aids and CIs. *Hearing Review*, p. 34-38.