HCHS/SOL Audiometry Derived Variable Dictionary

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1. Audiometry Derived Variables

1.1 Tympanometric variables

Variables defined: PEAKL, PEAKR, VEAL, VEAR, TWL, TWR, TPPL, TPPR.

Peak compensated static acoustic admittance, often abbreviated as Peak Y_{tm}, is a measure of stiffness of the eardrum. The variables are named PEAKL for the left ear and PEAKR for the right ear. The tympanogram printed by the HCHS tympanometers denotes Peak Y_{tm} units as measured in milliliters (ml), but it is more commonly measured in acoustic millimhos (mmho) , where 1 ml = 1 mmho.

Equivalent ear-canal volume, often abbreviated as V_{ea}, is an estimate of the volume between the tip of the tympanometer probe and the tympanic membrane. The variables are named VEAL for the left ear and VEAR for the right ear. This volume is labeled in milliliters (ml) by the HCHS tympanometers, but more commonly is labeled in cubic centimeters (cc or cm^3).

Tympanogram width, abbreviated TW, is a measurement of the width of the tympanogram halfway between its peak and its tail. The unit of measurement is decaPascals (daPa). The variables are named TWL for the left ear and TWR for the right ear.

Tympanogram peak pressure, abbreviated TPP, is the pressure at which the peak of the tympanogram occurs, and estimates the pressure inside the middle ear. The unit of measurement is decaPascals (daPa). The variables are named TPPL for the left ear and TPPR for the right ear.

EAR Center gradings are used to determine whether data from the original or repeat tympanogram, if done, are used for the final analysis variables. The code is as follows:

```
IF EARA9A = 0 THEN DO;
  PEAKR = TYRA4; VEAR = TYRA3; TWR = TYRA5; TPPR = TYRA2; END;
IF EARA9A = 1 THEN DO;
  PEAKR = TYRA19; VEAR = TYRA18; TWR = TYRA20; TPPR = TYRA17; END;
IF EARA9A = 2 THEN DO;
  PEAKR = .; VEAR = .; TWR = .; TPPR = .; END;

IF EARA9B = 0 THEN DO;
  PEAKL = TYRA11; VEAL = TYRA10; TWL = TYRA12; TPPL = TYRA9; END;
IF EARA9B = 1 THEN DO;
  PEAKL = TYRA27; VEAL = TYRA26; TWL = TYRA28; TPPL = TYRA25; END;
IF EARA9B = 2 THEN DO;
  PEAKL = .; VEAL = .; TWL = .; TPPL = .; END;
```

Source variables

EARA9A. EAR Center tympanogram selection, right ear (0 = Original, 1 = Repeat, 2 = Neither)

EARA9B. EAR Center tympanogram selection, left ear (0 = Original, 1 = Repeat, 2 = Neither)
TYRA2. EAR Center: Tympanogram peak pressure, right ear
TYRA3. EAR Center: Equivalent ear canal volume, right ear
TYRA4. EAR Center: Peak compensated static acoustic admittance, right ear
TYRA5. EAR Center: Tympanogram width, right ear
TYRA9. EAR Center: Tympanogram peak pressure, left ear
TYRA10. EAR Center: Equivalent ear canal volume, left ear
TYRA11. EAR Center: Peak compensated static acoustic admittance, left ear
TYRA12. EAR Center: Tympanogram width, left ear
TYRA17. EAR Center: Repeat tympanogram peak pressure, right ear
TYRA18. EAR Center: Repeat equivalent ear canal volume, right ear
TYRA19. EAR Center: Repeat peak compensated static acoustic admittance, right ear
TYRA20. EAR Center: Repeat tympanogram width, right ear
TYRA25. EAR Center: Repeat tympanogram peak pressure, left ear
TYRA26. EAR Center: Repeat equivalent ear canal volume, left ear
TYRA27. EAR Center: Repeat peak compensated static acoustic admittance, left ear
TYRA28. EAR Center: Repeat tympanogram width, left ear

1.2 Air –conduction and bone-conduction threshold variables

Variables defined: AIR500L, AIR500R, AIR1000L, AIR1000R, AIR2000L, AIR2000R, AIR3000L, AIR3000R, AIR4000L, AIR4000R, AIR6000L, AIR6000R, AIR8000L, AIR8000R, BONE500L, BONE500R, BONE2000L, BONE2000R, BONE4000L, BONE4000R

In general, a pure-tone threshold is the quietest tone that the participant could hear about 50% of the time. Testing was done at 500 to 8000 Hz for air conduction, and at 500, 2000 and 4000 Hz for bone conduction.

EAR Center gradings of thresholds were used if they were non-missing and differed from the original thresholds. Otherwise, the original thresholds were used. The data were then subjected to an extensive data-cleaning process. The SAS code is comprised of more than 2,000 lines, so we summarize the data cleaning steps as follows:

1) Unnecessarily-masked thresholds were set to missing and the unmasked thresholds were used for the frequencies in question.
2) If masking was needed, and there was < 15 dB of effective masking, both masked and unmasked thresholds were set to missing for the frequencies in question, unless, in the case of bone conduction, the air-bone gap had been resolved.
3) If masking was needed, and there was only 15 dB of effective masking, if there was no shift in the threshold in question, the data were kept as they were; if there was a shift, both masked and unmasked thresholds were set to missing at the frequency in question, unless, in the case of bone conduction, the air-bone gap had been resolved.
4) If masking was needed but excessive masking was used, both masked and unmasked thresholds were set to missing for the frequencies in question.

5) If an air-conduction threshold needed masking but masking was not done, the air-conduction and bone-conduction thresholds for that frequency were set to missing so that users do not rely only on the bone-conduction threshold.
6) If a bone-conduction threshold needed masking but was not done, the bone-conduction threshold at that frequency was set to missing.
7) Thresholds obtained on days with excessive ambient noise measurements in the booth were set to missing.

After this process, the final thresholds were calculated, using masked thresholds if available, otherwise using unmasked thresholds. When a tone was unheard by a participant, the threshold was set to 5 dB above the maximum output possible for the transducer/frequency combination used.

The above process was followed to obtain the final threshold variables, which are measured in 5 dB steps. Final variable names indicate air conduction (AIR) or bone conduction (BONE), frequency in Hz (eg., 1000), and ear (L or R).

Source variables:

AUDA1. Transducer used, right ear.
AUDA3A. Unmasked air-conduction threshold at 500 Hz, right ear.
AUDA3B. Masked air-conduction threshold at 500 Hz, right ear.
AUDA3C. Masking level used for air-conduction threshold at 500 Hz, right ear.
AUDA3D. Unmasked bone-conduction threshold at 500 Hz, right ear.
AUDA3E. Masked bone-conduction threshold at 500 Hz, right ear.
AUDA3F. Masking level used for bone-conduction threshold at 500 Hz, right ear.
AUDA4A. Unmasked air-conduction threshold at 1000 Hz, right ear.
AUDA4B. Masked air-conduction threshold at 1000 Hz, right ear.
AUDA4C. Masking level used for air-conduction threshold at 1000 Hz, right ear.
AUDA5A. Unmasked air-conduction threshold at 2000 Hz, right ear.
AUDA5B. Masked air-conduction threshold at 2000 Hz, right ear.
AUDA5C. Masking level used for air-conduction threshold at 2000 Hz, right ear.
AUDA5D. Unmasked bone-conduction threshold at 2000 Hz, right ear.
AUDA5E. Masked bone-conduction threshold at 2000 Hz, right ear.
AUDA5F. Masking level used for bone-conduction threshold at 2000 Hz, right ear.
AUDA6A. Unmasked air-conduction threshold at 3000 Hz, right ear.
AUDA6B. Masked air-conduction threshold at 3000 Hz, right ear.
AUDA6C. Masking level used for air-conduction threshold at 3000 Hz, right ear.
AUDA7A. Unmasked air-conduction threshold at 4000 Hz, right ear.
AUDA7B. Masked air-conduction threshold at 4000 Hz, right ear.
AUDA7C. Masking level used for air-conduction threshold at 4000 Hz, right ear.
AUDA7D. Unmasked bone-conduction threshold at 4000 Hz, right ear.
AUDA7E. Masked bone-conduction threshold at 4000 Hz, right ear.
AUDA7F. Masking level used for bone-conduction threshold at 4000 Hz, right ear.
AUDA8A. Unmasked air-conduction threshold at 6000 Hz, right ear.
AUDA8B. Masked air-conduction threshold at 6000 Hz, right ear.
AUDA8C. Masking level used for air-conduction threshold at 6000 Hz, right ear.

AUDA9A. Unmasked air-conduction threshold at 8000 Hz, right ear.
AUDA9B. Masked air-conduction threshold at 8000 Hz, right ear.
AUDA9C. Masking level used for air-conduction threshold at 8000 Hz, right ear.
AUDA10. Transducer used, left ear.
AUDA12A. Unmasked air-conduction threshold at 500 Hz, left ear.
AUDA12B. Masked air-conduction threshold at 500 Hz, left ear.
AUDA12C. Masking level used for air-conduction threshold at 500 Hz, left ear.
AUDA12D. Unmasked bone-conduction threshold at 500 Hz, left ear.
AUDA12E. Masked bone-conduction threshold at 500 Hz, left ear.
AUDA12F. Masking level used for bone-conduction threshold at 500 Hz, left ear.
AUDA13A. Unmasked air-conduction threshold at 1000 Hz, left ear.
AUDA13B. Masked air-conduction threshold at 1000 Hz, left ear.
AUDA13C. Masking level used for air-conduction threshold at 1000 Hz, left ear.
AUDA14A. Unmasked air-conduction threshold at 2000 Hz, left ear.
AUDA14B. Masked air-conduction threshold at 2000 Hz, left ear.
AUDA14C. Masking level used for air-conduction threshold at 2000 Hz, left ear.
AUDA14D. Unmasked bone-conduction threshold at 2000 Hz, left ear.
AUDA14E. Masked bone-conduction threshold at 2000 Hz, left ear.
AUDA14F. Masking level used for bone-conduction threshold at 2000 Hz, left ear.
AUDA15A. Unmasked air-conduction threshold at 3000 Hz, left ear.
AUDA15B. Masked air-conduction threshold at 3000 Hz, left ear.
AUDA15C. Masking level used for air-conduction threshold at 3000 Hz, left ear.
AUDA16A. Unmasked air-conduction threshold at 4000 Hz, left ear.
AUDA16B. Masked air-conduction threshold at 4000 Hz, left ear.
AUDA16C. Masking level used for air-conduction threshold at 4000 Hz, left ear.
AUDA16D. Unmasked bone-conduction threshold at 4000 Hz, left ear.
AUDA16E. Masked bone-conduction threshold at 4000 Hz, left ear.
AUDA16F. Masking level used for bone-conduction threshold at 4000 Hz, left ear.
AUDA17A. Unmasked air-conduction threshold at 6000 Hz, left ear.
AUDA17B. Masked air-conduction threshold at 6000 Hz, left ear.
AUDA17C. Masking level used for air-conduction threshold at 6000 Hz, left ear.
AUDA18A. Unmasked air-conduction threshold at 8000 Hz, left ear.
AUDA18B. Masked air-conduction threshold at 8000 Hz, left ear.
AUDA18C. Masking level used for air-conduction threshold at 8000 Hz, left ear.
AURA3A. EAR Center: Unmasked air-conduction threshold at 500 Hz, right ear.
AURA3B. EAR Center: Masked air-conduction threshold at 500 Hz, right ear.
AURA3C. EAR Center: Masking level used for air-conduction threshold at 500 Hz, right ear.
AURA3D. EAR Center: Unmasked bone-conduction threshold at 500 Hz, right ear.
AURA3E. EAR Center: Masked bone-conduction threshold at 500 Hz, right ear.
AURA3F. EAR Center: Masking level used for bone-conduction threshold at 500 Hz, right ear.
AURA4A. EAR Center: Unmasked air-conduction threshold at 1000 Hz, right ear.
AURA4B. EAR Center: Masked air-conduction threshold at 1000 Hz, right ear.
AURA4C. EAR Center: Masking level used for air-conduction threshold at 1000 Hz, right ear.
AURA5A. EAR Center: Unmasked air-conduction threshold at 2000 Hz, right ear.

AURA5B. EAR Center: Masked air-conduction threshold at 2000 Hz, right ear.
AURA5C. EAR Center: Masking level used for air-conduction threshold at 2000 Hz, right ear.
AURA5D. EAR Center: Unmasked bone-conduction threshold at 2000 Hz, right ear.
AURA5E. EAR Center: Masked bone-conduction threshold at 2000 Hz, right ear.
AURA5F. EAR Center: Masking level used for bone-conduction threshold at 2000 Hz, right ear.
AURA6A. EAR Center: Unmasked air-conduction threshold at 3000 Hz, right ear.
AURA6B. EAR Center: Masked air-conduction threshold at 3000 Hz, right ear.
AURA6C. EAR Center: Masking level used for air-conduction threshold at 3000 Hz, right ear.
AURA7A. EAR Center: Unmasked air-conduction threshold at 4000 Hz, right ear.
AURA7B. EAR Center: Masked air-conduction threshold at 4000 Hz, right ear.
AURA7C. EAR Center: Masking level used for air-conduction threshold at 4000 Hz, right ear.
AURA7D. EAR Center: Unmasked bone-conduction threshold at 4000 Hz, right ear.
AURA7E. EAR Center: Masked bone-conduction threshold at 4000 Hz, right ear.
AURA7F. EAR Center: Masking level used for bone-conduction threshold at 4000 Hz, right ear.
AURA8A. EAR Center: Unmasked air-conduction threshold at 6000 Hz, right ear.
AURA8B. EAR Center: Masked air-conduction threshold at 6000 Hz, right ear.
AURA8C. EAR Center: Masking level used for air-conduction threshold at 6000 Hz, right ear.
AURA9A. EAR Center: Unmasked air-conduction threshold at 8000 Hz, right ear.
AURA9B. EAR Center: Masked air-conduction threshold at 8000 Hz, right ear.
AURA9C. EAR Center: Masking level used for air-conduction threshold at 8000 Hz, right ear.
AURA12A. EAR Center: Unmasked air-conduction threshold at 500 Hz, left ear.
AURA12B. EAR Center: Masked air-conduction threshold at 500 Hz, left ear.
AURA12C. EAR Center: Masking level used for air-conduction threshold at 500 Hz, left ear.
AURA12D. EAR Center: Unmasked bone-conduction threshold at 500 Hz, left ear.
AURA12E. EAR Center: Masked bone-conduction threshold at 500 Hz, left ear.
AURA12F. EAR Center: Masking level used for bone-conduction threshold at 500 Hz, left ear.
AURA13A. EAR Center: Unmasked air-conduction threshold at 1000 Hz, left ear.
AURA13B. EAR Center: Masked air-conduction threshold at 1000 Hz, left ear.
AURA13C. EAR Center: Masking level used for air-conduction threshold at 1000 Hz, left ear.
AURA14A. EAR Center: Unmasked air-conduction threshold at 2000 Hz, left ear.
AURA14B. EAR Center: Masked air-conduction threshold at 2000 Hz, left ear.
AURA14C. EAR Center: Masking level used for air-conduction threshold at 2000 Hz, left ear.
AURA14D. EAR Center: Unmasked bone-conduction threshold at 2000 Hz, left ear.
AURA14E. EAR Center: Masked bone-conduction threshold at 2000 Hz, left ear.
AURA14F. EAR Center: Masking level used for bone-conduction threshold at 2000 Hz, left ear.

AURA15A. EAR Center: Unmasked air-conduction threshold at 3000 Hz, left ear.
AURA15B. EAR Center: Masked air-conduction threshold at 3000 Hz, left ear.
AURA15C. EAR Center: Masking level used for air-conduction threshold at 3000 Hz, left ear.
AURA16A. EAR Center: Unmasked air-conduction threshold at 4000 Hz, left ear.
AURA16B. EAR Center: Masked air-conduction threshold at 4000 Hz, left ear.
AURA16C. EAR Center: Masking level used for air-conduction threshold at 4000 Hz, left ear.
AURA16D. EAR Center: Unmasked bone-conduction threshold at 4000 Hz, left ear.
AURA16E. EAR Center: Masked bone-conduction threshold at 4000 Hz, left ear.
AURA16F. EAR Center: Masking level used for bone-conduction threshold at 4000 Hz, left ear.
AURA17A. EAR Center: Unmasked air-conduction threshold at 6000 Hz, left ear.
AURA17B. EAR Center: Masked air-conduction threshold at 6000 Hz, left ear.
AURA17C. EAR Center: Masking level used for air-conduction threshold at 6000 Hz, left ear.
AURA18A. EAR Center: Unmasked air-conduction threshold at 8000 Hz, left ear.
AURA18B. EAR Center: Masked air-conduction threshold at 8000 Hz, left ear.
AURA18C. EAR Center: Masking level used for air-conduction threshold at 8000 Hz, left ear.

1.3 Air-bone gap variables

Variables defined: GAPL, GAPR, and GAP

These three variables indicate whether or not the participant had an air-bone gap in the left ear (GAPL), right ear (GAPR), or either ear (GAP). An air-bone gap is defined as an air-conduction threshold that is at least 15 dB worse (higher) than the corresponding bone-conduction threshold. Air-bone gap variables from thresholds obtained on days with excessive ambient noise measurements in the booth at 500 Hz were set to missing if an air-bone gap was noted only at 500 Hz. The air-bone gap variables are calculated for each ear/frequency combination, and then combined as follows:

```
*MAKE VARIABLES FOR TONES NOT HEARD;

  *R, TDH-50;
  IF AURA1 = 0 THEN DO;
    IF AIR500R = 125 THEN NAIR500R = 1; ELSE IF AIR500R NE . THEN NAIR500R = 0;
          IF AIR2000R = 125 THEN NAIR2000R = 1; ELSE IF AIR2000R NE . THEN NAIR2000R = 0;
          IF AIR4000R = 125 THEN NAIR4000R = 1; ELSE IF AIR4000R NE . THEN NAIR4000R = 0;
END;

  *L, TDH-50;
  IF AURA10 = 0 THEN DO;
    IF AIR500L = 125 THEN NAIR500L = 1; ELSE IF AIR500L NE . THEN NAIR500L = 0;
          IF AIR2000L = 125 THEN NAIR2000L = 1; ELSE IF AIR2000L NE . THEN NAIR2000L = 0;
          IF AIR4000L = 125 THEN NAIR4000L = 1; ELSE IF AIR4000L NE . THEN NAIR4000L = 0;
END;

  *R, ER3A;
  IF AURA1 = 1 THEN DO;
    IF AIR500R = 115 THEN NAIR500R = 1; ELSE IF AIR500R NE . THEN NAIR500R = 0;
          IF AIR2000R = 120 THEN NAIR2000R = 1; ELSE IF AIR2000R NE . THEN NAIR2000R = 0;
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          IF AIR4000R = 120 THEN NAIR4000R = 1; ELSE IF AIR4000R NE . THEN NAIR4000R = 0;
END;

  *L, ER3A;
  IF AURA10 = 1 THEN DO;
    IF AIR500L = 115 THEN NAIR500L = 1; ELSE IF AIR500L NE . THEN NAIR500L = 0;
          IF AIR2000L = 120 THEN NAIR2000L = 1; ELSE IF AIR2000L NE . THEN NAIR2000L = 0;
          IF AIR4000L = 120 THEN NAIR4000L = 1; ELSE IF AIR4000L NE . THEN NAIR4000L = 0;
END;

  *BONE;
  IF BONE500R = 70 THEN NBONE500R = 1; ELSE IF BONE500R NE . THEN NBONE500R = 0;
  IF BONE500L = 70 THEN NBONE500L = 1; ELSE IF BONE500L NE . THEN NBONE500L = 0;
  IF BONE2000R = 85 THEN NBONE2000R = 1; ELSE IF BONE2000R NE . THEN NBONE2000R = 0;
  IF BONE2000L = 85 THEN NBONE2000L = 1; ELSE IF BONE2000L NE . THEN NBONE2000L = 0;
  IF BONE4000R = 80 THEN NBONE4000R = 1; ELSE IF BONE4000R NE . THEN NBONE4000R = 0;
  IF BONE4000L = 80 THEN NBONE4000L = 1; ELSE IF BONE4000L NE . THEN NBONE4000L = 0;



*CALCULATE AIR-BONE GAPS;

  IF AIR500R NE . AND BONE500R NE . THEN DO;
    IF NAIR500R = 0 AND NBONE500R = 0 THEN DO;
            IF (AIR500R-BONE500R) GE 15 THEN GAP500R = 1; ELSE GAP500R = 0; END;
          IF NAIR500R = 0 AND NBONE500R = 1 THEN GAP500R = .;
          IF NAIR500R = 1 AND NBONE500R = 0 THEN GAP500R = 1;
          IF NAIR500R = 1 AND NBONE500R = 1 THEN GAP500R = .; END;
  IF AIR500R NE . AND BONE500R = . AND BONE500L NE . THEN DO;
    IF NAIR500R = 0 AND NBONE500L = 0 THEN DO;
       IF (AIR500R-BONE500L) GE 15 THEN GAP500R = .; ELSE GAP500R = 0; END;
    IF NAIR500R = 0 AND NBONE500L = 1 THEN GAP500R = .;
          IF NAIR500R = 1 AND NBONE500L = 0 THEN GAP500R = .;
          IF NAIR500R = 1 AND NBONE500L = 1 THEN GAP500R = .; END;
  IF AIR500R NE . AND BONE500R = . AND BONE500L = . THEN GAP500R = .;
  IF AIR500R = . THEN GAP500R = .;

  IF AIR500L NE . AND BONE500L NE . THEN DO;
    IF NAIR500L = 0 AND NBONE500L = 0 THEN DO;
            IF (AIR500L-BONE500L) GE 15 THEN GAP500L = 1; ELSE GAP500L = 0; END;
          IF NAIR500L = 0 AND NBONE500L = 1 THEN GAP500L = .;
          IF NAIR500L = 1 AND NBONE500L = 0 THEN GAP500L = 1;
          IF NAIR500L = 1 AND NBONE500L = 1 THEN GAP500L = .; END;
  IF AIR500L NE . AND BONE500L = . AND BONE500R NE . THEN DO;
    IF NAIR500L = 0 AND NBONE500R = 0 THEN DO;
       IF (AIR500L-BONE500R) GE 15 THEN GAP500L = .; ELSE GAP500L = 0; END;
    IF NAIR500L = 0 AND NBONE500R = 1 THEN GAP500L = .;
          IF NAIR500L = 1 AND NBONE500R = 0 THEN GAP500L = .;
          IF NAIR500L = 1 AND NBONE500R = 1 THEN GAP500L = .; END;
  IF AIR500L NE . AND BONE500L = . AND BONE500R = . THEN GAP500L = .;
  IF AIR500L = . THEN GAP500L = .;

  IF AIR2000R NE . AND BONE2000R NE . THEN DO;
    IF NAIR2000R = 0 AND NBONE2000R = 0 THEN DO;
            IF (AIR2000R-BONE2000R) GE 15 THEN GAP2000R = 1; ELSE GAP2000R = 0; END;
          IF NAIR2000R = 0 AND NBONE2000R = 1 THEN GAP2000R = .;
          IF NAIR2000R = 1 AND NBONE2000R = 0 THEN GAP2000R = 1;
          IF NAIR2000R = 1 AND NBONE2000R = 1 THEN GAP2000R = .; END;
  IF AIR2000R NE . AND BONE2000R = . AND BONE2000L NE . THEN DO;
    IF NAIR2000R = 0 AND NBONE2000L = 0 THEN DO;
       IF (AIR2000R-BONE2000L) GE 15 THEN GAP2000R = .; ELSE GAP2000R = 0; END;
    IF NAIR2000R = 0 AND NBONE2000L = 1 THEN GAP2000R = .;
          IF NAIR2000R = 1 AND NBONE2000L = 0 THEN GAP2000R = .;
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        IF NAIR2000R = 1 AND NBONE2000L = 1 THEN GAP2000R = .; END;
 IF AIR2000R NE . AND BONE2000R = . AND BONE2000L = . THEN GAP2000R = .;
 IF AIR2000R = . THEN GAP2000R = .;

 IF AIR2000L NE . AND BONE2000L NE . THEN DO;
   IF NAIR2000L = 0 AND NBONE2000L = 0 THEN DO;
           IF (AIR2000L-BONE2000L) GE 15 THEN GAP2000L = 1; ELSE GAP2000L = 0; END;
        IF NAIR2000L = 0 AND NBONE2000L = 1 THEN GAP2000L = .;
        IF NAIR2000L = 1 AND NBONE2000L = 0 THEN GAP2000L = 1;
        IF NAIR2000L = 1 AND NBONE2000L = 1 THEN GAP2000L = .; END;
 IF AIR2000L NE . AND BONE2000L = . AND BONE2000R NE . THEN DO;
   IF NAIR2000L = 0 AND NBONE2000R = 0 THEN DO;
      IF (AIR2000L-BONE2000R) GE 15 THEN GAP2000L = .; ELSE GAP2000L = 0; END;
   IF NAIR2000L = 0 AND NBONE2000R = 1 THEN GAP2000L = .;
        IF NAIR2000L = 1 AND NBONE2000R = 0 THEN GAP2000L = .;
        IF NAIR2000L = 1 AND NBONE2000R = 1 THEN GAP2000L = .; END;
 IF AIR2000L NE . AND BONE2000L = . AND BONE2000R = . THEN GAP2000L = .;
 IF AIR2000L = . THEN GAP2000L = .;

 IF AIR4000R NE . AND BONE4000R NE . THEN DO;
   IF NAIR4000R = 0 AND NBONE4000R = 0 THEN DO;
           IF (AIR4000R-BONE4000R) GE 15 THEN GAP4000R = 1; ELSE GAP4000R = 0; END;
        IF NAIR4000R = 0 AND NBONE4000R = 1 THEN GAP4000R = .;
        IF NAIR4000R = 1 AND NBONE4000R = 0 THEN GAP4000R = 1;
        IF NAIR4000R = 1 AND NBONE4000R = 1 THEN GAP4000R = .; END;
 IF AIR4000R NE . AND BONE4000R = . AND BONE4000L NE . THEN DO;
   IF NAIR4000R = 0 AND NBONE4000L = 0 THEN DO;
      IF (AIR4000R-BONE4000L) GE 15 THEN GAP4000R = .; ELSE GAP4000R = 0; END;
   IF NAIR4000R = 0 AND NBONE4000L = 1 THEN GAP4000R = .;
        IF NAIR4000R = 1 AND NBONE4000L = 0 THEN GAP4000R = .;
        IF NAIR4000R = 1 AND NBONE4000L = 1 THEN GAP4000R = .; END;
 IF AIR4000R NE . AND BONE4000R = . AND BONE4000L = . THEN GAP4000R = .;
 IF AIR4000R = . THEN GAP4000R = .;

 IF AIR4000L NE . AND BONE4000L NE . THEN DO;
   IF NAIR4000L = 0 AND NBONE4000L = 0 THEN DO;
           IF (AIR4000L-BONE4000L) GE 15 THEN GAP4000L = 1; ELSE GAP4000L = 0; END;
        IF NAIR4000L = 0 AND NBONE4000L = 1 THEN GAP4000L = .;
        IF NAIR4000L = 1 AND NBONE4000L = 0 THEN GAP4000L = 1;
        IF NAIR4000L = 1 AND NBONE4000L = 1 THEN GAP4000L = .; END;
 IF AIR4000L NE . AND BONE4000L = . AND BONE4000R NE . THEN DO;
   IF NAIR4000L = 0 AND NBONE4000R = 0 THEN DO;
      IF (AIR4000L-BONE4000R) GE 15 THEN GAP4000L = .; ELSE GAP4000L = 0; END;
   IF NAIR4000L = 0 AND NBONE4000R = 1 THEN GAP4000L = .;
        IF NAIR4000L = 1 AND NBONE4000R = 0 THEN GAP4000L = .;
        IF NAIR4000L = 1 AND NBONE4000R = 1 THEN GAP4000L = .; END;
 IF AIR4000L NE . AND BONE4000L = . AND BONE4000R = . THEN GAP4000L = .;
 IF AIR4000L = . THEN GAP4000L = .;


IF GAP500R = 1 OR GAP2000R = 1 OR GAP4000R = 1 THEN GAPR = 1;
   ELSE IF GAP500R = 0 OR GAP2000R = 0 OR GAP4000R = 0 THEN GAPR = 0;

 *MISSING IF ONLY 500 HZ GAP IN PRESENCE OF EXCESSIVE AMBIENT NOISE;
 IF NOISEPROB500 = 1 AND GAP500R = 1 AND GAP2000R NE 1 AND GAP4000R NE 1 THEN DO;
   GAP500R = .; GAPR = .; END;


 IF GAP500L = 1 OR GAP2000L = 1 OR GAP4000L = 1 THEN GAPL = 1;
   ELSE IF GAP500L = 0 OR GAP2000L = 0 OR GAP4000L = 0 THEN GAPL = 0;

 *MISSING IF ONLY 500 HZ GAP IN PRESENCE OF EXCESSIVE AMBIENT NOISE;
 IF NOISEPROB500 = 1 AND GAP500L = 1 AND GAP2000L NE 1 AND GAP4000L NE 1 THEN DO;
   GAP500L = .; GAPL = .; END;
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```
IF GAPR = 1 OR GAPL = 1 THEN GAP = 1;
  ELSE IF GAPR = 0 OR GAPL = 0 THEN GAP = 0;
```

Response format: 0 = No
1 = Yes

Source variables:

AUDA1.	Transducer used, right ear.
AUDA10.	Transducer used, left ear.
AIR500L.	Air-conduction threshold at 500 Hz, left ear.
AIR500R.	Air-conduction threshold at 500 Hz, right ear.
AIR2000L.	Air-conduction threshold at 2000 Hz, left ear.
AIR2000R.	Air-conduction threshold at 2000 Hz, right ear.
AIR4000L.	Air-conduction threshold at 4000 Hz, left ear.
AIR4000R.	Air-conduction threshold at 4000 Hz, right ear.
BONE500L.	Bone-conduction threshold at 500 Hz, left ear.
BONE500R.	Bone-conduction threshold at 500 Hz, right ear.
BONE2000L.	Bone-conduction threshold at 2000 Hz, left ear.
BONE2000R.	Bone-conduction threshold at 2000 Hz, right ear.
BONE4000L.	Bone-conduction threshold at 4000 Hz, left ear.
BONE4000R.	Bone-conduction threshold at 4000 Hz, right ear.
NOISEPROB500.	A variable that indicates that this participant was tested on a day when there was excessive ambient noise at 500 Hz in the test booth. (1 = Yes, 0 = No).

1.4 Pure-tone average variables

Variables defined: PTAB, PTAL, PTAR, and PTAW

These variables represent the pure-tone averages of hearing thresholds at 500, 1000, 2000 and 4000 Hz for the better ear (PTAB), left ear (PTAL), right ear (PTAR), and worse (either) ear (PTAW). The pure-tone averages calculated from thresholds obtained on days with excessive ambient noise measurements in the booth were set to missing. The pure-tone averages are calculated as follows:

```
PTAR = (AIR500R+AIR1000R+AIR2000R+AIR4000R)/4;
PTAR = PTAR*100; PTAR = FLOOR(PTAR); PTAR = PTAR/100;

PTAL = (AIR500L+AIR1000L+AIR2000L+AIR4000L)/4;
PTAL = PTAL*100; PTAL = FLOOR(PTAL); PTAL = PTAL/100;

PTAW = MAX(PTAR,PTAL);

IF (PTAR > PTAL AND PTAL NE .) OR (PTAR = . AND PTAL NE .) THEN PTAB = PTAL;
  ELSE PTAB = PTAR;
```

Source variables

AIR500L.	Air-conduction threshold at 500 Hz, left ear.
AIR500R.	Air-conduction threshold at 500 Hz, right ear.
AIR1000L.	Air-conduction threshold at 1000 Hz, left ear.
AIR1000R.	Air-conduction threshold at 1000 Hz, right ear.
AIR2000L.	Air-conduction threshold at 2000 Hz, left ear.
AIR2000R.	Air-conduction threshold at 2000 Hz, right ear.
AIR4000L.	Air-conduction threshold at 4000 Hz, left ear.
AIR4000R.	Air-conduction threshold at 4000 Hz, right ear.

1.5 Hearing impairment variables

Variables defined: HEARINGLOSSB, HEARINGLOSSL, HEARINGLOSSR, and HEARINGLOSSW.

These dichotomous variables indicate hearing impairment, defined as a pure tone average > 25 dB. Hearing impairment variables calculated from thresholds obtained on days with excessive ambient noise measurements in the booth were set to missing if the relevant PTA was > 25 and ≤ 30 dB. The hearing impairment variables are calculated for the better ear (HEARINGLOSSB), left ear (HEARINGLOSSL), right ear (HEARINGLOSSR), and worse (either) ear (HEARINGLOSSW) as follows:

```
IF PTAR > 25 THEN HEARINGLOSSR = 1; ELSE IF PTAR NE . THEN HEARINGLOSSR = 0;
IF PTAL > 25 THEN HEARINGLOSSL = 1; ELSE IF PTAL NE . THEN HEARINGLOSSL = 0;
IF PTAW > 25 THEN HEARINGLOSSW = 1; ELSE IF PTAW NE . THEN HEARINGLOSSW = 0;
IF PTAB > 25 THEN HEARINGLOSSB = 1; ELSE IF PTAB NE . THEN HEARINGLOSSB = 0;
```

Response format: 0 = No
1 = Yes

Source variables

PTAB Pure-tone average at 500, 1000, 2000 and 4000 Hz, better ear
PTAL Pure-tone average at 500, 1000, 2000 and 4000 Hz, left ear
PTAR Pure-tone average at 500, 1000, 2000 and 4000 Hz, right ear
PTAW Pure-tone average at 500, 1000, 2000 and 4000 Hz, worse (either) ear

1.6 Possible perforation variables

Variables defined: POSSIBLE_PERFL, POSSIBLE_PERFR, POSSIBLE_PERF.

These variables indicate evidence of possible perforation of the tympanic membrane, based on the tympanometric measure V_{ea}. Variables are calculated for the left ear (POSSIBLE_PERFL), right ear (POSSIBLE_PERFR), and either ear (POSSIBLE_PERF). The code is as follows:

```
IF VEAR GE 3 THEN POSSIBLE_PERFR = 1; ELSE IF VEAR NE . THEN POSSIBLE_PERFR = 0;
IF VEAL GE 3 THEN POSSIBLE_PERFL = 1; ELSE IF VEAL NE . THEN POSSIBLE_PERFL = 0;
IF POSSIBLE_PERFR = 1 OR POSSIBLE_PERFL = 1 THEN POSSIBLE_PERF = 1;
  ELSE IF POSSIBLE_PERFR NE . OR POSSIBLE_PERFL NE . THEN POSSIBLE_PERF = 0;
```

Response format: 0 = No
1 = Yes

Source variables

VEAL. Tympanogram equivalent ear canal volume (V_{ea}), left ear.

VEAR. Tympanogram equivalent ear canal volume (V_{ea}), right ear.

1.7 Possible impaction variables

Variables defined: POSSIBLE_IMPACTIONL, POSSIBLE_IMPACTIONR, POSSIBLE_IMPACTION.

These variables indicate evidence of possible impaction of the ear canal due to earwax. This evidence may come through otoscopy, tympanometry, or both. Variables are calculated for the left ear (POSSIBLE_IMPACTIONL), right ear (POSSIBLE_IMPACTIONR), and either ear (POSSIBLE_IMPACTION). The code is as follows:

```
  DEBRISR = OTOA4;
  DEBRISL = OTOA11;

  IF DEBRISR = 3 OR (PEAKR = 0 AND VEAR < 1.0 AND VEAR NE . AND (VEAL-VEAR>0.5))
    THEN POSSIBLE_IMPACTIONR = 1; ELSE IF DEBRISR NE . OR VEAR NE .
    THEN POSSIBLE_IMPACTIONR = 0;

  IF DEBRISL = 3 OR (PEAKL = 0 AND VEAL < 1.0 AND VEAL NE . AND (VEAR-VEAL>0.5))
    THEN POSSIBLE_IMPACTIONL = 1; ELSE IF DEBRISL NE . OR VEAL NE .
    THEN POSSIBLE_IMPACTIONL = 0;

  IF POSSIBLE_IMPACTIONR = 1 OR POSSIBLE_IMPACTIONL = 1 THEN POSSIBLE_IMPACTION = 1;
    ELSE IF POSSIBLE_IMPACTIONR NE . OR POSSIBLE_IMPACTIONL NE . THEN POSSIBLE_IMPACTION
= 0;
```

Response format: 0 = No
1 = Yes

Source variables

OTOA4. Amount of cerumen in ear canal, right ear.
OTOA11. Amount of cerumen in ear canal, left ear.
PEAKR. Tympanogram Peak Y_{tm}, right ear.
VEAR. Tympanogram equivalent ear canal volume (V_{ea}), right ear.
PEAKL. Tympanogram Peak Y_{tm}, left ear.
VEAL. Tympanogram equivalent ear canal volume (V_{ea}), left ear.

1.8 HHIASCORE (Hearing Handicap Inventory for Adults—Screening version total score)

The Hearing Handicap Inventory for Adults—Screening version is a 10-question inventory designed to assess the extent to which a participant younger than age 65 feels handicapped by a hearing problem. Each of the 10 questions is coded as 0 = No (0 points toward the total score), 1 = Sometimes (2 points), and 2 = Yes (4 points). The total score ranges from 0 to 40, with higher scores indicating more handicap. The total score is calculated as follows:

```
  HHIASCORE = 0;

  IF HHEA3 = . OR HHEA4 = . OR HHEA5 = . OR HHEA6 = . OR HHEA7 = .
    OR HHEA8 = . OR HHEA9 = . OR HHEA10 = . OR HHEA11 = . OR HHEA12 = .
       THEN HHIASCORE = .;

  IF HHEA3 = 2 THEN HHIASCORE = HHIASCORE + 4; IF HHEA3 = 1 THEN HHIASCORE = HHIASCORE +
2;
  IF HHEA4 = 2 THEN HHIASCORE = HHIASCORE + 4; IF HHEA4 = 1 THEN HHIASCORE = HHIASCORE +
2;
  IF HHEA5 = 2 THEN HHIASCORE = HHIASCORE + 4; IF HHEA5 = 1 THEN HHIASCORE = HHIASCORE +
2;
  IF HHEA6 = 2 THEN HHIASCORE = HHIASCORE + 4; IF HHEA6 = 1 THEN HHIASCORE = HHIASCORE +
2;
  IF HHEA7 = 2 THEN HHIASCORE = HHIASCORE + 4; IF HHEA7 = 1 THEN HHIASCORE = HHIASCORE +
2;
  IF HHEA8 = 2 THEN HHIASCORE = HHIASCORE + 4; IF HHEA8 = 1 THEN HHIASCORE = HHIASCORE +
2;
  IF HHEA9 = 2 THEN HHIASCORE = HHIASCORE + 4; IF HHEA9 = 1 THEN HHIASCORE = HHIASCORE +
2;
  IF HHEA10 = 2 THEN HHIASCORE = HHIASCORE + 4; IF HHEA10 = 1 THEN HHIASCORE = HHIASCORE
+ 2;
  IF HHEA11 = 2 THEN HHIASCORE = HHIASCORE + 4; IF HHEA11 = 1 THEN HHIASCORE = HHIASCORE
+ 2;
  IF HHEA12 = 2 THEN HHIASCORE = HHIASCORE + 4; IF HHEA12 = 1 THEN HHIASCORE = HHIASCORE
+ 2;
```

Source variables

HHEA3. A hearing problem causes participant to feel embarrassed when meeting new people.
HHEA4. A hearing problem causes participant to feel frustrated when talking to family members.
HHEA5. A hearing problem causes participant difficulty hearing/understanding coworkers, clients, or customers.
HHEA6. A hearing problem causes participant to feel handicapped.
HHEA7. A hearing problem causes participant difficulty when visiting friends, relatives, or neighbors.
HHEA8. A hearing problem causes participant difficulty in the movies or theater.
HHEA9. A hearing problem causes participant to have arguments with family members.
HHEA10. A hearing problem causes participant difficulty when listening to TV or radio.

HHEA11. Hearing difficulty limits or hampers participant's personal or social life.
HHEA12. A hearing problem causes participant difficulty when in a restaurant with relatives or friends.

1.9 HHIESCORE (Hearing Handicap Inventory for the Elderly—Screening version total score)

The Hearing Handicap Inventory for the Elderly—Screening version is a 10-question inventory designed to assess the extent to which a participant aged 65 years or more feels handicapped by a hearing problem. Each of the 10 questions is coded as 0 = No (0 points toward the total score), 1 = Sometimes (2 points), and 2 = Yes (4 points). The total score ranges from 0 to 40, with higher scores indicating more handicap. The total score is calculated as follows:

```
HHIESCORE = 0;

IF HHEA13 = . OR HHEA14 = . OR HHEA15 = . OR HHEA16 = . OR HHEA17 = .
  OR HHEA18 = . OR HHEA19 = . OR HHEA20 = . OR HHEA21 = . OR HHEA22 = .
          THEN HHIESCORE = .;

IF HHEA13 = 2 THEN HHIESCORE = HHIESCORE + 4; IF HHEA13 = 1 THEN HHIESCORE = HHIESCORE
          + 2;
IF HHEA14 = 2 THEN HHIESCORE = HHIESCORE + 4; IF HHEA14 = 1 THEN HHIESCORE = HHIESCORE
          + 2;
IF HHEA15 = 2 THEN HHIESCORE = HHIESCORE + 4; IF HHEA15 = 1 THEN HHIESCORE = HHIESCORE
          + 2;
IF HHEA16 = 2 THEN HHIESCORE = HHIESCORE + 4; IF HHEA16 = 1 THEN HHIESCORE = HHIESCORE
          + 2;
IF HHEA17 = 2 THEN HHIESCORE = HHIESCORE + 4; IF HHEA17 = 1 THEN HHIESCORE = HHIESCORE
          + 2;
IF HHEA18 = 2 THEN HHIESCORE = HHIESCORE + 4; IF HHEA18 = 1 THEN HHIESCORE = HHIESCORE
          + 2;
IF HHEA19 = 2 THEN HHIESCORE = HHIESCORE + 4; IF HHEA19 = 1 THEN HHIESCORE = HHIESCORE
          + 2;
IF HHEA20 = 2 THEN HHIESCORE = HHIESCORE + 4; IF HHEA20 = 1 THEN HHIESCORE = HHIESCORE
          + 2;
IF HHEA21 = 2 THEN HHIESCORE = HHIESCORE + 4; IF HHEA21 = 1 THEN HHIESCORE = HHIESCORE
          + 2;
IF HHEA22 = 2 THEN HHIESCORE = HHIESCORE + 4; IF HHEA22 = 1 THEN HHIESCORE = HHIESCORE
          + 2;
```

Source variables

HHEA13. A hearing problem causes participant to feel embarrassed when meeting new people.
HHEA14. A hearing problem causes participant to feel frustrated when talking to family members.
HHEA15. Participant has difficulty hearing when someone speaks in a whisper.
HHEA16. A hearing problem causes participant to feel handicapped.
HHEA17. A hearing problem causes participant difficulty when visiting friends, relatives, or neighbors.
HHEA18. A hearing problem causes participant to attend religious services less often than preferred.

HHEA19. A hearing problem causes participant to have arguments with family members.
HHEA20. A hearing problem causes participant difficulty when listening to TV or radio.
HHEA21. Hearing difficulty limits or hampers participant's personal or social life.
HHEA22. A hearing problem causes participant difficulty when in a restaurant with relatives or friends.