HEARING INJURIES; NOISE-INDUCED

Army Public Health Center Case Definition for AFHSB Noise Induced Hearing Injury (NIHI) Reports; Includes Tinnitus and Acoustic Trauma

Background

This case definition was developed by the Army Institute of Public Health (AIPH), now called the Army Public Health Center (APHC), in consultation with the DoD Hearing Conservation Working Group and the DoD VA Hearing Center of Excellence for the purpose of epidemiological surveillance of Noise-Induced Hearing Injuries (NIHI). The code set and groupings of hearing injury specific diagnoses used in this case definition are based on the collaborative efforts of DoD and Department of Veterans Affairs (VA) audiologists working together since 2002. [1,2] In 2010, in accordance with DoD Directive 6490-02E *Comprehensive Health Surveillance*[3], AIPH collaborated with the Armed Forces Health Surveillance Center, now called the Armed Forces Health Surveillance Branch (AFHSB) to produce a series of reports on NIHI for the individual Services using this case definition and data stored in the Defense Medical Surveillance System.

Surveillance of NIHI in the military has been a long standing priority. In 2006, an Institute of Medicine (IOM) report estimated the prevalence of noise-induced hearing loss (NIHL) and tinnitus among U.S. military members from World War II through 2005. The report's authors concluded that military hearing conservation programs (HCPs) had not adequately protected the hearing of U.S. service members; they recommended using prospective, longitudinal, epidemiological data to reliably estimate the incidence, prevalence, and severity of NIHL and tinnitus in the U.S. Armed Forces.[4]

In response to the IOM report and to recent recommendations of the Government Accountability Office (GAO)[5], military audiologists and their Department of Veterans Affairs (VA) counterparts have worked to develop standardized outcome metrics for monitoring the effectiveness of HCPs. This collaboration produced a standard set of Department of Defense (DoD) ICD-9-CM coding guidelines designed to improve the quality of data used for reporting and tracking prevalence and incidence rates of noise-induced hearing injury (NIHI). [6] In January 2005, HCP coding guidelines were included in the Military Health System (MHS) coding manual. These guidelines include a minimal essential code set to define a significant threshold shift (STS) outcome from HCP monitoring audiometry.

Clinical Description

The term "noise-induced hearing injuries" is used here to encompass a broad range of conditions that result in damage to the organ of hearing. These injuries and conditions are not hereditary or congenital; rather they are acquired through exposure to noise and often result in chronic hearing loss. A significant proportion of the hearing injuries sustained during military service are preventable.

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[1] Helfer TM, Shields A, Gates KE. Outcomes analysis for hearing conservation programs. *Am J Audiol* 2000, 9: 75-83.
[2] Helfer T, Jordan N, Lee R, Pietrusiak P, et.al. Noise-induced hearing injury and comorbidities among postdeployment US Army soldiers, April 2003 through June 2009. *Am J Audiology*. 2011; 20:1-9.
[3] Directive can be accessed at: http://www.dtic.mil/whs/directives/corres/pdf/649002e.pdf
[4] Humes LE, Joellenbeck LM, Durch JS: Noise and military service: implications for hearing loss and tinnitus. Washington, DC: National Academy Press 2006.
[5] Government Accountability Office, 2011. GAO Report No. 11-114 Hearing loss prevention: improvement to DOD hearing conservation programs could lead to better outcomes.
[6] Helfer T, Canham-Chervak M, Canada S, Mitchener TA. 2008. Noise-induced hearing injury surveillance in the U.S. military, 2003-2005. In: Canham-Chervak M and B Jones, eds. Preventing injuries in the U.S. military: the process, priorities, and epidemiologic evidence. U.S. Army Center for Health Promotion and Preventive Medicine Technical Report No. 12-HF-04MT-08: 3-61-3-69.

Preventive measures include isolating sources of noise, controlling noise transmission, and the consistent wear of appropriate and properly fitted hearing protection (e.g., earplugs, noise muffs, sound-attenuating helmets).[7]

The more widely used term "Noise-Induced Hearing Loss (NIHL)", referring to the condition of hearing loss caused by exposure to occupational and recreational noise, is similar to, though not synonymous with the term "Noise-Induced Hearing Injury" (see *Comments* section below).

Case Definition and Incidence Rules

For surveillance purposes, a case of noise induced hearing injury is defined as:

- *One hospitalization or outpatient medical encounter* with any of the defining diagnoses of noise-induced hearing injury (see ICD9 and ICD10 code lists below) in *any* diagnostic position.

Incidence rules:

For individuals who meet the case definition:

- The incidence date is considered the date of the first hospitalization or outpatient medical encounter that includes a defining diagnosis of noise-induced hearing injury.
- An individual is considered an incident case only *once per lifetime*.
- If analysis requires counts of individuals with an incident diagnosis in a specific hearing injury category, an individual is allowed one incident event per category per lifetime.

Exclusions:

- None

Codes

The following ICD9 and ICD10 codes are included in the case definition for noise-induced hearing injury:

Injury Category

Condition	ICD-10-CM Codes	ICD-9-CM Codes
Sensorineural hearing loss	H90.3 (sensorineural hearing loss, bilateral)	389.11 (sensory hearing loss, bilateral)
		389.18 (sensorineural hearing loss, bilateral

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[7] Army Medical Surveillance Activity. Noise-induced Hearing Loss among Men, U.S. Armed Forces, 1998-1999. *Medical Surveillance Monthly Report (MSMR).* 2001 March; 7(3): 12-15.

	H90.5 (unspecified sensorineural hearing loss)	389.10 (sensorineural hearing loss, unspecified)
	H90.4 (sensorineural hearing loss, unilateral with unrestricted hearing on the contralateral side)	389.15 (sensorineural hearing loss, unilateral) 389.17 (sensory hearing loss, unilateral)
	- H904.1 (sensorineural hearing loss, unilateral, *right* ear, with unrestricted hearing on the contralateral side)	
	- H904.2 (sensorineural hearing loss, unilateral, *left* ear, with unrestricted hearing on the contralateral side)	
	Translated code too broad for inclusion. See comments.	389.16 (sensorineural hearing loss, *asymmetrical*)
Noise-induced hearing loss	*H83.3 (noise effects on inner ear)*	388.10 (noise effects on inner ear, unspecified) 388.12 (noise induced hearing loss)
	- H83.3X1 (noise effects on *right* inner ear)	
	- H83.3X2 (noise effects on *left* inner ear, unspecified ear)	
	- H83.3X3 (noise effects on inner ear, *bilateral* ear)	
	- H83.3X9 (noise effects on inner ear, *unspecified* ear)	
	S09.31 (primary blast injury of ear)	388.11 (acoustic trauma, explosive, to ear) *Note: ICD9 388.11 does not translate directly to ICD10 S09.31; see "Code Set Determination and Rationale" below for explanation.*
	- S09.311 (primary blast injury of *right* ear)	
	- S09.311A (primary blast injury of *right* ear, initial encounter)	
	S09.312 (primary blast injury of *left* ear)	
	- S09.312A (primary blast injury of *left* ear, initial encounter)	
	S09.313 (primary blast injury of ear, *bilateral*)	
	- S09.313A (primary blast injury of ear, *bilateral*, initial encounter)	
	S09.319 (primary blast injury of *unspecified* ear)	
	- S09.319A (primary blast injury of *unspecified* ear, initial encounter)	
Tinnitus	*H93.1 (tinnitus)*	*388.3 (tinnitus)*
	- H93.11 (tinnitus, *right* ear)	388.30 (tinnitus, unspecified)
	- H93.12 (tinnitus, *left* ear)	

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	- H93.13 (tinnitus, b*ilateral* ear) - H93.19 (tinnitus, unspecified ear)	388.31 (subjective tinnitus) 388.32 (objective tinnitus)
Significant threshold shift	R94.120 (abnormal auditory function study)	794.15 (nonspecific abnormal auditory function studies)

Development and Revisions

- In November of 2015 the case definition was updated to include ICD10 codes.

- This case definition was developed in October 2011 by the Army Institute of Public Health in consultation with the DoD Hearing Conservation Working Group and the DoD VA Hearing Center of Excellence. Military and Department of Veterans Affairs' audiologists with extensive clinical and population health surveillance experience, in collaboration with AFHSC staff, contributed to the development. The definition is used for annual and quarterly descriptive epidemiological reports on the frequencies and rates of NIHI and related injuries among U.S. active duty military personnel and was used for a *Medical Surveillance Monthly Report (MSMR)* article in June 2011.[8]

Case Definition and Incidence Rule Rationale

- The case definition and incidence rules may be modified to address unique questions being addressed by special analyses.

Code Set Determination and Rationale

- There is no comparable ICD10 code for ICD9 388.11 (acoustic trauma, explosive, to ear). ICD9 code 388.11 translates to ICD10 code H91.8X (other specified hearing loss) which is considered by APHC to be too broad for inclusion in this code set. In October of 2016, in an effort to capture cases of explosion or blast-related acoustic trauma, ICD10 code S09.31- (primary blast injury of ear) was added to the ICD10 code set. The ICD10 code for acoustic trauma was selected by audiologists and clinicians at the APHC, the DOD Hearing Center of Excellence, and the DOD Hearing Conservation and Readiness Working Group. No retroactive changes to the ICD9 code set were made at this time. For investigators interested in hearing injuries associated with blasts or head trauma, see *Comments* section below.

- ICD9 code 389.16 (sensorineural hearing loss, *asymmetrical*) translates to ICD10 code H90.5 (unspecified sensorineural hearing loss). ICD10 H90.5 is not included in the code set because the code is too broad; it does not specify asymmetrical hearing loss which is an important diagnostic distinction for sensorineural hearing loss.

- The code sets used for NIHI have evolved since 2002. The differences among the code sets found in the literature are a testimony to this evolution.[2-7] The original code sets were developed to capture medical encounters that could be used to routinely monitor HCP audiometry clinical outcomes. These code sets have been used in several epidemiological studies and peer-reviewed articles. [9, 10, 11]

[8] Armed Forces Health Surveillance Center. Noise-Induced Hearing Injuries, Active Component, U.S. Armed Forces, 2007-2010. *Medical Surveillance Monthly Report (MSMR).* 2011 June; 18(6): 7-10.
[9] Helfer T, Canham-Chervak M, Canada S, Mitchener TA. Epidemiology of hearing impairment and noise-induced hearing injury among US military personnel, 2003-2005. *Am J Prev Med*. 2010; 38(1S):S71-S77.

- The code set and groupings of hearing injury specific diagnoses used in this case definition are a subset of the broader code set used as a "Watch List" for post deployment NIHI and comorbidities.[2]

- The Watch List for post deployment NIHI and co-morbidities, first developed in 2007 by analysts at the US Army Center for Health Promotion and Preventive Medicine (USACHPPM), now the APHC, includes additional ICD9 codes for mild traumatic brain injury (mTBI), posttraumatic stress disorder (PTSD), speech-language pathologies, tympanic membrane perforations and other disorders of interest related to head trauma. [2]

- ICD9 codes for tinnitus are included in the code set because in a military occupational environment the condition is likely due to noise or blast exposure.[4] The tinnitus code group was also included to address recommendations from the IOM and GAO reports [3,4] and to provide data on the condition to the VA for hearing health service planning purposes.

- The ICD9 codes for ear drum perforation and mixed hearing loss listed below were included in the code table in the June 2011 MSMR article. These codes were used for additional analyses on blast-related comorbidities and are not part of this case definition.

  Ear drum perforation: ICD9 codes 384.20 (perforation of tympanic membrane unspecified), 384.20 (perforation of tympanic membrane unspecified), 384.21 (central perforation of tympanic membrane), 384.22 (attic perforation of tympanic membrane), 384.23 (other marginal perforation of tympanic membrane), 384.24 (multiple perforations of tympanic membrane), 384.25 (total perforation of tympanic membrane), 384.81 (atrophic flaccid tympanic membrane), 384.82 (atrophic nonflaccid tympanic membrane), 384.9 (unspecified disorder of tympanic membrane), 385.23 (discontinuity or disorder of ear ossicles).

  Mixed hearing loss: ICD9 codes 389.20 (mixed hearing loss, unspecified), 389.21 (mixed hearing loss, unilateral, 389.22 (mixed hearing loss, bilateral).

- The following procedure codes were included in the code table in the June 2011 MSMR article. These codes are used for additional analyses for the annual report only, are not part of this case definition, and are not used for regular MSMR reports: CPT codes: 92552 (pure tone audiometry (threshold) air only), 0208T (threshold audiogram [pure tone] automated), 92555 (speech audiometry threshold), 92556 (speech audiometry threshold, with speech recognition), 92557 (comprehensive audiometry threshold evaluation and speech recognition), 92559 (audiometric testing of groups).

Reports

AFHSB reports on noise-induced hearing injuries in the following reports:

- Periodic *MSMR* reports on Noise-Induced Hearing Injuries.
- Annual and Quarterly: detailed AFHSB DoD and Service-specific reports on NIHI for APHC and other Services' surveillance hubs.

[10]Helfer T, Jordan N, Lee, R. Postdeployment hearing loss in U.S. Army soldiers seen at audiology clinics from April 1, 2003 through March 31, 2004. *Am J Audiology.* 2005; 14:161-168.
[11] Jordan N, Lee R, Helfer, T. Noise-induced hearing injury (NIHI) among Army active duty soldiers deployed to the central command area of operations (CENTCOM AOR). *Seminars in Hearing.* 2009; 30:28-37.

Review

Oct 2016	Case definition reviewed and updated by the Army Surveillance Satellite at the Army Public Health Center and approved by AFHSB.
Nov 2015	Case definition reviewed and updated by the Army Surveillance Satellite at the Army Public Health Center (Prov) and approved by the AFHSB Surveillance Methods and Standards (SMS) working group.
Oct 2012	Case definition reviewed and adopted by the AFHSC Surveillance Methods and Standards (SMS) working group.
Mar 2010	Case definition developed by the AIPH in collaboration with the DoD Hearing Conservation Working Group and the DoD VA Hearing Center of Excellence.

Comments

- *Noise-Induced Hearing Loss:* Noise-induced hearing loss is a sensorineural hearing deficit that begins at the higher frequencies (3,000 to 6,000 Hz) and develops gradually as a result of chronic exposure to excessive sound levels. Although the loss is typically symmetric, noise from sources such as firearms or sirens may produce an asymmetric loss. Exposure to potentially harmful sound levels may occur in the workplace[12], during recreational activities (e.g., snowmobiling, motorcycle riding) and during exposure to other nonoccupational sources of noise (e.g., chain saws, power tools, amplified music).[13] Clinically, NIHL begins with a temporary threshold shift (TTS) with the extent of the shift related to noise intensity, frequency, and temporality. Sound levels greater than 80dBA have potential to cause damage. High frequency noise is more damaging than low frequency noise and continuous noise is more damaging than intermittent.[14] Hearing loss due to noise can be temporary or permanent and may be associated with tinnitus (ringing in the ears).

- Investigators interested in additional hearing injuries possibly associated with blasts or head injury may wish to consider the following codes for inclusion in the code set.

Injury Category

Condition	ICD-10-CM Codes	ICD-9-CM Codes
Noise-induced hearing loss	*S04.6 (injury of acoustic nerve)*	951.5 (injury to acoustic nerve)
	- S04.60 injury of acoustic nerve, *unspecified* side)	
	- S04.60XA injury of acoustic nerve, *unspecified* side, initial encounter)	
	- S04.61 (injury of acoustic nerve, *right* side)	
	- S04.61XA (injury of acoustic nerve, *right* side, initial encounter)	

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[12] Occupational noise-induced hearing loss. ACOM Noise and Hearing Conservation Committee. *J Occup Med*. 1989; 31:996.
[13] Meyer-Bisch C. Epidemiological evaluation of hearing damage related to strongly amplified music (personal cassette players, discotheques, rock concerts): high definition audiometric survey on 1,364 subjects. *Audiology*. 1996; 35:121–42.
[14] Pourbakht A, Yamsoba T. Cochlear damage caused by continuous and intermittent noise exposure. *Hear Res*. Apr 2003: 1781 (1-2):70-78.

	- S04.62 (injury of acoustic nerve, *left* side)	
	- S04.62 (injury of acoustic nerve, *left* side, initial encounter)	
	S09.30 (unspecified injury of middle and inner ear)	872.6 (open wound of ear, other specified parts of ear, *without mention of complication)* - 872.62 (open wound of ossicles) - 872.63 (open wound of eustachian tube) - 872.64 (open wound of cochea) _____ 872.7 (open wound of ear, other specified parts of ear, *complicated*) - 872.72 (open wound of ossicles) - 872.73 (open wound of eustachian tube) - 872.74 (open wound of cochlea)
	- S09.301 (unspecified injury of *right* middle and inner ear)	
	- S09.301A (unspecified injury of *right* middle and inner ear, initial encounter)	
	- S09.302 (unspecified injury of *left* middle and inner ear)	
	- S09.302A (unspecified injury of *left* middle and inner ear, initial encounter)	
	S09.309 (unspecified injury of *unspecified* middle and inner ear)	
	- S09.309A (unspecified injury of *unspecified* middle and inner ear, initial encounter)	