

Supplementary Table S1. ICD-9 and ICD-10 Diagnosis codes for Hearing Loss

Diagnosis code	Description	ICD
38801	PRESBYACUSIS	ICD-9
3881	NOISE EFFECTS ON INNER EAR	ICD-9
38810	UNSPECIFIED NOISE EFFECTS INNER EAR	ICD-9
38812	NOISE-INDUCED HEARING LOSS	ICD-9
389	HEARING LOSS	ICD-9
3890	CONDUCTIVE HEARING LOSS	ICD-9
38900	UNSPECIFIED CONDUCTIVE HEARING LOSS	ICD-9
38901	CONDUCTIVE HEARING LOSS EXT EAR	ICD-9
38902	CONDUCT HEARING LOSS TYMPAN MEMB	ICD-9
38903	CONDUCTIVE HEARING LOSS, MIDDLE EAR	ICD-9
38904	CONDUCTIVE HEARING LOSS, INNER EAR	ICD-9
38905	CONDUCTIVE HEARING LOSS UNILATERAL	ICD-9
38906	CONDUCTIVE HEARING LOSS BILATERAL	ICD-9
38908	CONDUCTIVE HEARING LOSS COMB TYPES	ICD-9
3891	SENSORINEURAL HEARING LOSS	ICD-9
38910	UNSPEC SENSORINEURAL HEARING LOSS	ICD-9
38911	SENSORY HEARING LOSS BILATERAL	ICD-9
38915	SENSORINEURAL HEARING LOSS UNILAT	ICD-9
38916	SENSORINEURAL HEARING LOSS ASYM	ICD-9
38917	SENSORY HEARING LOSS UNILATERAL	ICD-9
38918	SENSINEURAL HEARING LOSS BILAT	ICD-9
3892	MIX CONDCTIVE&SENSINURAL HEARNG LSS	ICD-9
38920	MIXED HEARING LOSS UNSPECIFIED	ICD-9
38921	MIXED HEARING LOSS UNILATERAL	ICD-9
38922	MIXED HEARING LOSS BILATERAL	ICD-9
H833X9	NOISE EFFECTS INNER EAR UNS EAR	ICD-10
H900	CONDUCTIVE HEARING LOSS BILATERAL	ICD-10
H900	UNKNOWN DIAGNOSIS	ICD-10
H9011	CONDUCT HL UNI RT UNRESTR CONTRALAT	ICD-10
H9011	UNKNOWN DIAGNOSIS	ICD-10
H902	CONDUCTIVE HEARING LOSS UNSPECIFIED	ICD-10
H902	UNKNOWN DIAGNOSIS	ICD-10
H903	SENSORINEURAL HEAR LOSS BILATERAL	ICD-10
H903	UNKNOWN DIAGNOSIS	ICD-10
H9041	SHL UNI RT UNRESTRCT HEAR CONTRALAT	ICD-10
H9041	UNKNOWN DIAGNOSIS	ICD-10
H905	UNKNOWN DIAGNOSIS	ICD-10
H905	UNS SENSORINEURAL HEARING LOSS	ICD-10
H906	MIX CONDCT SENSORINEURAL HL BIL	ICD-10
H906	UNKNOWN DIAGNOSIS	ICD-10
H908	MIX CONDUCTIVE SENSORINEURAL HL UNS	ICD-10
H908	UNKNOWN DIAGNOSIS	ICD-10
H90A31	MIXD C SSSL UL T EAR RSTRD HR CO S	ICD-10
H9110	PRESBYCUSIS UNSPECIFIED EAR	ICD-10
H9110	UNKNOWN DIAGNOSIS	ICD-10

Supplementary Table S2. Procedure Codes for Hearing Aids

Procedure Codes	Description
92590	HEARING AID EXAM, ONE EAR
92591	HEARING AID EXAM, BOTH EARS
92592	HEARING AID CHECK, ONE EAR
92593	HEARING AID CHECK, BOTH EARS
92594	ELECTRO HEARNG AID TEST, ONE
92595	ELECTRO HEARNG AID TST, BOTH
L8690	AUDITORY OSSEOINTEGRTD INT/EXT COMP
L8691	AUDITORY OSSEOINTEGRTD EXT SND REPL
L8692	AUDITORY OSSEOINTEGRAT DEV BDY WORN
L8693	AUD OSSEOINTEGRATED DEVC ABUT REPL
V5010	ASSESSMENT FOR HEARING AID
V5011	FIT/ORIENTATION/CHECK HEARING AID
V5014	REPAIR/MODIFICATION OF HEARING AID
V5020	CONFORMITY EVALUATION
V5030	HEAR AID MONAURL BDY WRN AIR CONDUCT
V5040	HEAR AID MONAURL BDY WORN BN CONDUCT
V5050	HEARING AID MONAURAL IN THE EAR
V5060	HEARING AID MONAURAL BEHIND THE EAR
V5070	GLASSES AIR CONDUCTION
V5080	GLASSES BONE CONDUCTION
V5090	DISPENSING FEE UNSPEC HEARING AID
V5091	UNSPECIFIED HEARING AID(NO
V5100	HEARING AID BILATERAL BODY WORN
V5110	DISPENSING FEE BILATERAL
V5120	BINAURAL BODY
V5130	BINAURAL IN THE EAR
V5140	BINAURAL BEHIND THE EAR
V5150	BINAURAL GLASSES
V5160	DISPENSING FEE BINAURAL
V5170	HEARING AID CROS IN THE EAR
V5180	HEARING AID CROS BEHIND THE EAR
V5190	HEARING AID CROS GLASSES
V5200	DISPENSING FEE CROS
V5210	HEARING AID BICROS IN THE EAR
V5220	HEARING AID BICROS BEHIND THE EAR
V5230	HEARING AID BICROS GLASSES
V5240	DISPENSING FEE BICROS
V5241	DISPNS FEE MONAURL HEARING AID TYPE
V5242	HEARING AID ANALOG MONAURAL CIC
V5243	HEARING AID ANALOG MONAURAL ITC
V5244	HEARING AID PROG ANALOG MONAURL CIC
V5245	HEARING AID PROG ANALOG MONAURL ITC
V5246	HEARING AID PROG ANALOG MONAURL ITE
V5247	HEARING AID PROG ANALOG MONAURL BTE
V5248	HEARING AID ANALOG BINAURAL CIC
V5249	HEARING AID ANALOG BINAURAL ITC
V5250	HEARING AID PROG ANALOG BINAURL CIC

V5251	HEARING AID PROG ANALOG BINAURL ITC
V5252	HEARING AID PROG BINAURAL ITE
V5253	HEARING AID PROG BINAURAL BTE
V5254	HEARING AID DIGITAL MONAURAL CIC
V5255	HEARING AID DIGITAL MONAURAL ITC
V5256	HEARING AID DIGITAL MONAURAL ITE
V5257	HEARING AID DIGITAL MONAURAL BTE
V5258	HEARING AID DIGITAL BINAURAL CIC
V5259	HEARING AID DIGITAL BINAURAL ITC
V5260	HEARING AID DIGITAL BINAURAL ITE
V5261	HEARING AID DIGITAL BINAURAL BTE
V5262	HEARING AID DISPBL TYPE MONAURAL
V5263	HEARING AID DISPBL TYPE BINAURAL
V5264	EAR MOLD/INSERT NOT DISPBL ANY TYPE
V5265	EAR MOLD/INSERT DISPOSABLE ANY TYPE
V5266	BATTERY FOR USE IN HEARING DEVICE
V5267	HA/ALD/SUPP/ACCESS NOT O/W SPEC
V5298	HEARING AID NOC
V5299	HEARING SERVICE MISCELLANEOUS
V5336	REPR/MOD AUGMENTATIV CMNCT SYS/DEVC

Supplementary Table S3. ICD-9 and ICD-10 Diagnosis codes for Alzheimer’s and Dementia, Anxiety and Depression, and Fall

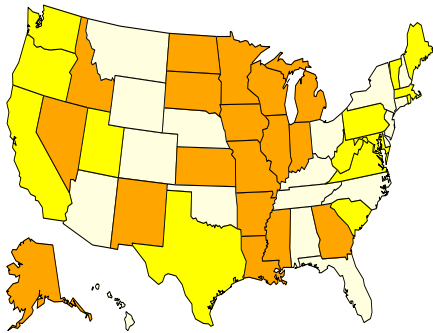
<i>Diagnosis code</i>	<i>Description</i>	<i>ICD Version</i>
290	DEMENTIAS	9
2900	SENILE DEMENTIA, UNCOMPLICATED	9
29010	PRESENILE DEMENTIA, UNCOMPLICATED	9
29011	PRESENILE DEMENTIA WITH DELIRIUM	9
29012	PRESENILE DEMENTIA W/DLUSIONL FTUR	9
29013	PRESENILE DEMENTIA W/DPRSV FEATURES	9
29020	SENILE DEMENTIA W/DLUSIONL FEATURES	9
29021	SENILE DEMENTIA W/DPRSV FEATURES	9
2903	SENILE DEMENTIA WITH DELIRIUM	9
2904	VASCULAR DEMENTIA	9
29040	VASCULAR DEMENTIA UNCOMPLICATED	9
29041	VASCULAR DEMENTIA WITH DELIRIUM	9
29042	VASCULAR DEMENTIA WITH DELUSIONS	9
29043	VASCULAR DEMENTIA W/DEPRESSED MOOD	9
29282	DRUG-INDUCED PERSISTING DEMENTIA	9
29410	DEMENTIA CCE W/O BEHAV DISTURB	9
29411	DEMENTIA CCE W/BEHAV DISTURBANCES	9
29420	DEMENTIA UNS W/O BEHAV DISTURBANCE	9
29421	DEMENTIA UNS W/BEHAVORL DISTURBANCE	9
296	EPISODIC MOOD DISORDERS	9
300	ANXIETY DISSOCIATIVE&SOMATOFORM D/O	9
30000	ANXIETY STATE, UNSPECIFIED	9
30001	PANIC DISORDER WITHOUT AGORAPHOBIA	9
30002	GENERALIZED ANXIETY DISORDER	9
30009	OTHER ANXIETY STATES	9
311	DEPRESSIVE DISORDER NEC	9
3310	ALZHEIMERS DISEASE	9
F01	VASCULAR DEMENTIA	10
F0150	VASC DEMENTIA W/OUT BEHAVIORAL DIST	10
F0151	VASC DEMENTIA WITH BEHAVIORAL DIST	10
F02	DEMENTIA OTH DISEAS CLASS ELSW	10
F0280	DEMENTIA OTH DISEAS W/O BHVRL DIST	10
F0281	DEMENTIA OTH DISEASE W/BEHAVRL DIST	10
F03	UNSPECIFIED DEMENTIA	10
F0390	UNS DEMENT W/O BEHAVIORAL DIST	10
F0391	UNS DEMENT W/BEHAVIORAL DISTURBANCE	10
F04	AMNESTIC D/O DUE KNOWN PHYSIO COND	10
F05	DELIRIUM DUE KNOWN PHYSIOLOG COND	10
F06	OTH MENTAL D/O DUE PHYSIO COND	10
F07	PERSONLTY & BEHVRL D/O PHYSIO COND	10
F09	UNS MENTAL D/O DUE PHYSIO COND	10
F1997	OTH PSYCHOACTV USE UNS IND DEMENTIA	10
F22	DELUSIONAL DISORDERS	10
F30	MANIC EPISODE	10

F32	MAJ DEPRESS D/O SINGLE EPISODE	10
F329	MAJ DEPRESS D/O SINGLE EPIS UNS	10
F33	MAJ DEPRESS D/O RECURRENT	10
F34	PERSISTENT MOOD AFFECT DISORDERS	10
F39	UNSPECIFIED MOOD AFFECTIVE DISORDER	10
F40	PHOBIC ANXIETY DISORDERS	10
F41	OTHER ANXIETY DISORDERS	10
F418	OTHER SPECIFIED ANXIETY DISORDERS	10
F419	ANXIETY DISORDER UNSPECIFIED	10
F42	OBSESSIVE-COMPULSIVE DISORDER	10
F43	REACTION SEVERE STRESS & ADJUST D/O	10
F4323	ADJUST D/O MIXED ANX & DEPRESS MOOD	10
F44	DISSOCIATIVE & CONVERSION DISORDERS	10
F54	PSYCHOL BEHVR FACTR D/O DZ CLS ELSW	10
G300	ALZHEIMERS DISEASE WITH EARLY ONSET	10
G301	ALZHEIMERS DISEASE WITH LATE ONSET	10
G309	ALZHEIMERS DISEASE UNSPECIFIED	10

Figure S1. Heat Maps of Incidence Rates of Hearing Aid Use, Alzheimer's disease and/or Dementia, Anxiety and/or Depression, and Injurious Fall Within 52 States

S1A

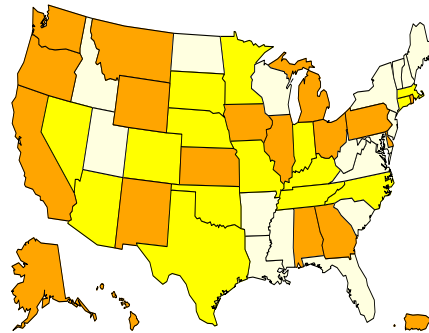
Unadjusted Incidence Rate of Hearing aids use within 3 years of Hearing loss



Incidence Rate of Hearing aids use < 3.8% 3.8% - 8.5% > 8.5%
Source: CInformatics Data

S1B

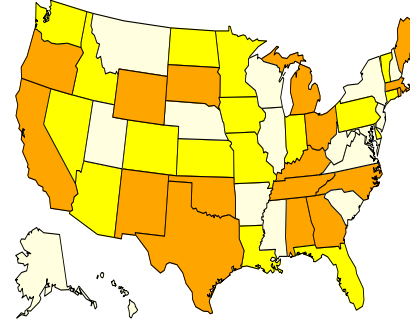
Unadjusted Incidence Rate of Alzheimer & Dementia within 3 years of Hearing loss



Incidence Rate of Alzheimer & Dementia < 11.6% 11.6% - 15.3% > 15.3%
Source: CInformatics Data

S1C

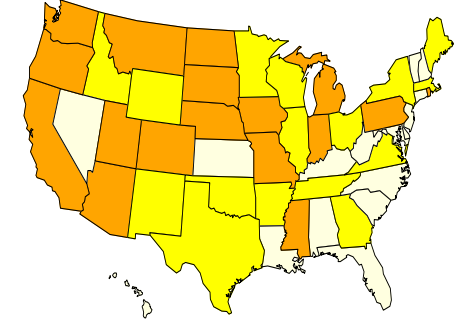
Unadjusted Incidence Rate of Anxiety & Depression within 3 years of Hearing loss



Incidence Rate of Anxiety & Depression < 33.0% 33.0% - 36.0% > 36.0%
Source: CInformatics Data

S1D

Unadjusted Incidence Rate of Falls within 3 years of Hearing loss



Incidence Rate of Falls < 9.6% 9.6% - 13.0% > 13.0%
Source: CInformatics Data

Supplementary Table S4. Summary Statistics of the State-specific Proportions of the Outcome of Interests

N	Mean	Std Dev	Sum	Minimum	Maximum	Label
52	8.44226	8.45347	438.99768	1.09890	38.75740	Proportion of Hearing aids usage
53	14.32907	6.24933	759.44095	6.38298	50.00000	Proportion of patients with Alzheimer and/or Dementia
52	34.08645	4.13830	1772	23.40426	40.50633	Proportion of patients with Anxiety and/or Depression
51	11.71018	3.41530	597.21927	4.34783	20.28053	Proportion of patients with Falls

Pearson Correlation Coefficients				
Prob > r under H0: Rho=0				
	Hearing aids	Alzheimer and/or Dementia	Anxiety and/or Depression	Falls
Proportion of hearing aids	1.00000	-0.02036 0.8861	-0.10737 0.4487	0.20991 0.1393
Proportion of patients with Alzheimer and/or dementia		1.00000	0.37334 0.0064	0.34900 0.0121
Proportion of patients with anxiety and/or depression			1.00000	0.21180 0.1357
Proportion of patients with injurious falls				1.00000

Supplementary Table S5. Propensity Matched Adjusted Hazard Ratios for Developing Aging-related Morbidities Among Patients with Hearing Loss Who Used Hearing Aids Compared with Those Without Hearing Aids*

Aging-related Morbidities	Sample Size	Hazard Ratio (95% Confidence Interval)
Alzheimer or Dementia	22,300	0.82 (0.745, 0.903)
Anxiety or Depression	22,300	0.84 (0.800, 0.884)
Falls	22,300	0.89 (0.817, 0.986)

* Propensity score matching performed by using multivariable logistic regression to calculate a propensity score and a caliper matching algorithm with caliper size of 0.001 without replacement in a 1:1 match.

** 95% confidence intervals were calculated using Cox proportional hazards regression models.

Supplementary Table S6. Cox Regression Results for Alzheimer's Disease or Dementia

Parameter	Parameter Estimate	Standard Error	Chi-Square	P Value	Hazard Ratio
Age 71-75	0.7119	0.05816	149.8264	<.0001	2.038
Age 76-80	1.29842	0.0544	569.6487	<.0001	3.664
Age 80+	2.00856	0.05091	1556.3307	<.0001	7.453
Female	0.04432	0.02407	3.391	0.0656	1.045
Asian	-0.03347	0.07136	0.22	0.6391	0.967
Black	0.20788	0.04744	19.2054	<.0001	1.231
Hispanic	0.10333	0.04128	6.2645	0.0123	1.109
Unknown/Missing	-0.02135	0.04378	0.2379	0.6257	0.979
East North-central	-0.05203	0.06852	0.5767	0.4476	0.949
East South-central	0.26216	0.08774	8.9274	0.0028	1.3
Middle Atlantic	-0.02378	0.07331	0.1052	0.7457	0.977
Mountain	-0.07472	0.06487	1.3268	0.2494	0.928
Pacific	-0.18365	0.06061	9.1807	0.0024	0.832
South Atlantic	-0.02685	0.06282	0.1826	0.6691	0.974
Unknown Region	0.00807	0.10563	0.0058	0.9391	1.008
West North-central	-0.13141	0.06602	3.9624	0.0465	0.877
West South-central	-0.07062	0.0673	1.1011	0.294	0.932
Hearing Aid	-0.19302	0.04055	22.6619	<.0001	0.824
Diabetes	0.20497	0.02984	47.1793	<.0001	1.227
Hypertension	0.10597	0.02694	15.4731	<.0001	1.112
Obesity	-0.27619	0.04042	46.6886	<.0001	0.759
Cardiovascular Condition	0.39381	0.02525	243.2047	<.0001	1.483
Hypercholesterolemia	-0.02245	0.02429	0.8547	0.3552	0.978

Note: Likelihood Ratio: Chi-Square=4371.12; DF=23; P < 0.0001; Wald: Chi-Square=3630.94; DF=23; P < 0.0001.

Supplementary Table S7. Cox Regression Results for Anxiety or Depression

Parameter	Parameter Estimate	Standard Error	Chi-Square	P Value	Hazard Ratio
Age 71-75	0.7119	0.05816	149.8264	<.0001	2.038
Age 76-80	1.29842	0.0544	569.6487	<.0001	3.664
Age 80+	2.00856	0.05091	1556.3307	<.0001	7.453
Female	0.04432	0.02407	3.391	0.0656	1.045
Asian	-0.03347	0.07136	0.22	0.6391	0.967
Black	0.20788	0.04744	19.2054	<.0001	1.231
Hispanic	0.10333	0.04128	6.2645	0.0123	1.109
Unknown/Missing	-0.02135	0.04378	0.2379	0.6257	0.979
East North-central	-0.05203	0.06852	0.5767	0.4476	0.949
East South-central	0.26216	0.08774	8.9274	0.0028	1.3
Middle Atlantic	-0.02378	0.07331	0.1052	0.7457	0.977
Mountain	-0.07472	0.06487	1.3268	0.2494	0.928
Pacific	-0.18365	0.06061	9.1807	0.0024	0.832
South Atlantic	-0.02685	0.06282	0.1826	0.6691	0.974
Unknown Region	0.00807	0.10563	0.0058	0.9391	1.008
West North-central	-0.13141	0.06602	3.9624	0.0465	0.877
West South-central	-0.07062	0.0673	1.1011	0.294	0.932
Hearing Aid	-0.19302	0.04055	22.6619	<.0001	0.824
Diabetes	0.20497	0.02984	47.1793	<.0001	1.227
Hypertension	0.10597	0.02694	15.4731	<.0001	1.112
Obesity	-0.27619	0.04042	46.6886	<.0001	0.759
Cardiovascular Condition	0.39381	0.02525	243.2047	<.0001	1.483
Hypercholesterolemia	-0.02245	0.02429	0.8547	0.3552	0.978

Note: Likelihood Ratio: Chi-Square=2291.13; DF=23; P < 0.0001; Wald: Chi-Square=2277.60; DF=23; P < 0.0001.

Supplementary Table S8. Cox Regression Results for Injurious Fall

Parameter	Parameter Estimate	Standard Error	Chi-Square	P Value	Hazard Ratio
Age 71-75	0.42334	0.05071	69.6994	<.0001	1.527
Age 76-80	0.78765	0.04817	267.3381	<.0001	2.198
Age 80+	1.38522	0.04403	989.5951	<.0001	3.996
Female	0.4028	0.02548	249.9524	<.0001	1.496
Asian	-0.22554	0.07774	8.4172	0.0037	0.798
Black	-0.15887	0.05822	7.4467	0.0064	0.853
Hispanic	-0.03338	0.04295	0.6039	0.4371	0.967
Unknown/Missing	-0.11308	0.04539	6.2056	0.0127	0.893
East North-central	0.02983	0.0734	0.1651	0.6845	1.03
East South-central	0.09581	0.10073	0.9047	0.3415	1.101
Middle Atlantic	0.03015	0.07898	0.1457	0.7026	1.031
Mountain	0.40914	0.06677	37.5469	<.0001	1.506
Pacific	0.06486	0.06465	1.0064	0.3158	1.067
South Atlantic	-0.24348	0.0697	12.2042	0.0005	0.784
Unknown Region	0.18052	0.10866	2.7601	0.0966	1.198
West North-central	0.03793	0.06996	0.2939	0.5877	1.039
West South-central	-0.10496	0.07334	2.048	0.1524	0.9
Hearing Aid	-0.13762	0.04121	11.1548	0.0008	0.871
Diabetes	0.21099	0.03084	46.8168	<.0001	1.235
Hypertension	0.13632	0.02788	23.906	<.0001	1.146
Obesity	0.05039	0.0367	1.8858	0.1697	1.052
Cardiovascular Condition	0.44573	0.02613	290.9209	<.0001	1.562
Hypercholesterolemia	-0.00536	0.02506	0.0457	0.8306	0.995

Note: Likelihood Ratio: Chi-Square=3324.65; DF=23; P < 0.0001; Wald: Chi-Square=3088.00; DF=23; P < 0.0001.