Supplementary Material

I. Nationwide Inpatient Sample General Description

NIS contains clinical and nonclinical data elements for each hospital stay, including: primary and secondary diagnoses and procedures; patient demographic characteristics (e.g., sex, age, race, median household income for ZIP code); hospital characteristics (e.g., ownership); expected payment source; TC; discharge status; LOS; severity and comorbidity measures. Many of these variables were included in the NIS core file which contains discharge-level data along with AHA hospital file which contain hospital characteristics and weights data.

Noteworthy changes occurred to the sampling design of NIS as of 1998, which included the following: (1) Revising definitions of the strata variables; (2) Excluding rehabilitation hospitals from the NIS hospital universe; (3) Changing the calculation of hospital universe discharges for the weights. Between 1998 and 2002, the number of hospitals included in the sample covered 13 more States, thus going from a 22-State to a 35-State geographical coverage. The initial number of States included in 1988 was limited to 8. After 2002, no new States were added.

2012 NIS was redesigned to improve national estimates, making them more precise. Three major changes were made to this wave forward: (a) Sample design was modified so that the NIS would be a sample of discharge records from all HCUP-participating hospitals, rather than sampling the hospitals themselves from which all discharges would be retained; (b) The 2012 NIS forward uses the definitions of hospitals and discharges supplied by the statewide data organizations that contribute to HCUP, as opposed to definitions used by the AHA Annual Survey; (c) The 2012 NIS forward removed State and hospital identifiers and other data elements to enhance confidentiality.

II: ICD-9-CM Diagnostic Criteria for Alzheimer's Disease

The International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) list three definitions and clinical criteria: (1) "A disabling degenerative disease of the nervous system occurring in middle-aged or older persons and characterized by dementia and failure of memory for recent events, followed by total incapacitation and death. Types of the Alzheimer syndrome are differentiated by the age of onset and genetic characteristics. The early onset form (the mean age of the onset of symptoms between the ages of 40 and 60 y) and the late onset form (the onset of symptoms after the age of 60 y). Three forms are identified: ad-1, ad-2, ad-3. Some of the clinical characteristics of the Alzheimer syndrome are similar to those of the pick syndrome." (2) "A progressive, neurodegenerative disease characterized by loss of function and death of nerve cells in several areas of the brain leading to loss of cognitive function such as memory and language". (3) Neurodegenerative disorder of the central nervous system resulting in progressive loss of memory and intellectual functions; begins in the middle or later years; characterized by brain lesions such as neurofibrillary tangles and neuritic plaques [5].

III. Top Ranked ICD-9-CM Procedures and Algorithm for Procedure Type and Group

III.1. Top 10 ranked procedures among principally diagnosed AD admissions with at least one procedure (N=19,209)*

ICD-9-CM code	Label	N*	%*	Rank
"8703"	Computerized axial tomography of head	3,042	15.8	1
"9425"	Other psychiatric drug therapy	1,369	7.1	2
"0331"	Spinal tap	1,189	6.2	3
"8627"	Nail debridement	1,174	6.1	4
"9444"	Other group therapy	1,147	6.0	5
"4311"	Percutaneous gastrostomy	1,109	5.8	6
"8891"	Brain MRI	1,077	5.6	7
"9904"	Transfusion of packed cells	972	5.1	8
"9339"	Other physical therapy	864	4.5	9
"8872"	Diagnostic ultrasound of heart	848	4.4	10

*Frequencies are based on an analysis of the PR database summing over 15 possible procedures for each ICD-9-CM code and are unweighted.

III.2. Procedure types among principally diagnosed AD admissions with at least one procedure (N=19,209)*

Procedure type	Label	Sub-type	ICD-9 codes
1	Cardiovascular disease (CVD)/Blood	CVD procedure	"0031" "0033" "0054" "0061" "0063" "0066" "0074" "0102" "0387" "3601" "3604" "3606" "3607" "3612" "3615" "3722" "3726" "3727" "3728" "3734" "3771" "3772" "3775" "3776" "3779" "3781" "3782" "3783" "3785" "3786" "3787" "3798" "3812" "3818" "3821" "3891" "3893" "3895" "3897" "3898" "3899" "3927" "3929" "3931" "3932" "3942" "3943" "3949" "3950" "3952" "3961""3962" "3963" "3969" "3971" "3972"
		Blood	"0040""0041""3995""3998""4011""4019" "4023""4029""4069""4131"
		Blood transfusion/related procedures	"9605" "9607" "9903" "9904" "9905" "9907" "9908" "9909" "9910" "9911""9914" "9915" "9917" "9918" "9919" "9920" "9921" "9922" "9923" "9925" "9926" "9928" "9929" "9933" "9936" "9938" "9939" "9952" "9955" "9959" "9975" "9977"
		CVD evaluation	"8941" "8944" "8945" "8946" "8947" "8948" "8949" "8950" "8951" "8952" "8954" "8959"
		Blood evaluation	"8960" "8961" "8964" "8965" "8966" "8968" "9132"
		Microscopic evaluation	"9002" "9052" "9059" "9081" "9125" "9133" "9139" "9146" "9163"
2	Brain	Brain procedures	"0111" "0112" "0113" "0114" "0118" "0124" "0128" "0131" "0139" "0207"
		Spinal tap	"0331"
		Head/brain imaging	"8701" "8702" "8703" "8704" "8705" "8706" "8709" "8711" "8717" "8721" "8722" "8724" "8871" "8891" "9211" "9212"
3	Neuro	Neurophysiological evaluation	"8901" "8902" "8903" "8904" "8905" "8906" "8909" "8914" "8915" "8915" "8919" "9301" "9308"

		Neuropsychological evaluation	"9401" "9402" "9408" "9409" "9411" "9412" "9413" "9419" "9422" "9423" "9423" "9424""9425" "9427" "9429" "9431" "9433" "9435" "9437" "9438" "9439" "9441" "9442" "9444" "9449" "9452"
		Alcohol/drug rehab	"9462" "9465" "9466"
4	Sensory/dental	Eye	"0013" "0820" "0842" "0852" "0881" "0889" "1341" "1371" "9535"
		Ear	"0184" "1809" "1812" "1829" "1871" "1879" "2001" "2009" "2059" "9652"
		Nose	"0211" "0222" "2102" "2103" "2109" "2121" "2122" "2131" "2132" "2169" "2171" "2181" "2188" "2189" "2219" "2263" "2264" "9621"
		Tooth/mouth	"0032" "0311" "3129" "3142" "3322" "3323" "3324" "3326" "3327" "3393" "3404" "3409" "3423" "3425" "3491" "3492" "9602" "9604" "9656"
5	Skin/muscle/bone	Bone	"7674" "7676" "7693" "7695" "7748" "7749" "7756" "7767" "7768" "7769" "7779" "7781" "7803" "7805" "7849" "7852" "7855" "7861" "7863" "7867" "7869" "7901" "7902" "7903" "7904" "7906" "7907" "7911" "7912" "7914" "7915" "7931" "7932" "7935" "7936" "7939" "7951" "7971" "7903" "7904" "7906" "7907" "7911" "7912" "7914" "7915" "7931" "7932" "7935" "7936" "7939" "7951" "7971" "7974" "7975" "7976" "7978" "8035" "8036" "8051" "8073" "8098" "8107" "8151" "8152" "8162" "8165" "8166" "8191" "8192" "8193"
		Soft tissue/muscle	"8302" "8303" "8309" "8321" "8339" "8342" "8344" "8345" "8363" "8365" "8394" "8395" "8396"
		Amputation	"843" "8402" "8411" "8415" "8417"
		Breast	"8511" "8512" "8519" "8521" "8523" "8541" "8543"
		Skin	"863" "864" "8601" "8603" "8604" "8605" "8607" "8609" "8611" "8622" "8623" "8627" "8628" "8659" "8663" "8665" "8667" "8669" "8672" "8673" "8674" "8689" "8696"

6	Respiratory/Gastro-intestinal (GI)	Respiratory procedure	"0032" "0311" "3129" "3142" "3322" "3323" "3324" "3326" "3327" "3393" "3404" "3409" "3423" "3425" "3491" "3492" "9602" "9604" "9656"
		GI procedure	"4414""4422" "4432" "4443" "4461" "4464" "4469" "4512" "4513""4514""4516""4516""4522" "4523" "4524""4525""4530""4541""4542""4543" "4562" |"4573" "4574" "4575""4576""4593""4610" "4611""4613""4620" "4632" "4639" "4682" "4685""4719" "4822" "4823""4824" |"4832""4836" "4875" "4881" "4901""4904" "4921""4923""4931""4941""4945""4946" "9608" "9609" "9633" "9638" "9639"
		Liver procedure	"5011" "5012" "5029" "5091" "5101" "5110" "5114" "5122" "5123" "5136" "5143" "5151" "5179" "5185" "5186" "5187" "5188" "5193"
		Pancreas procedure	"5211"
		Abdomen	"540" "5411" "5421" "5423" "5424" "5451" "5459" "5461" "5464" "5491" "5498"
		Respiratory/GI evaluation	"8932" "8934" "8937" "8938" "8939"
7	Genito-urinary (GU)	GU procedure	"0055" "560" "570" "585" "586" "595" "598" "610" "623" "640" "684" "708" "713" "5503" "5523" "5592" "5593" "5631" "5691" "5711" "5717" "5718" "5732" "5733" "5749" "5781" "5791" "5792" "5794" "5795" "5823" "5831" "5839" "5899" "5994" "6011" "6021" "6029" "6061" "6094" "6651" "6812" "6816" "6909" "7021" "9618" "9648" "9649" "9995"
		GU evaluation	"8922" "8923" "8924" "8926" "8929"
8	Injection/device	Injection	"0014" "0017" "0309" "0329" "0343" "0353" "0370" "0371" "0379" "0391" "0392" "0403"
		Implant/insert Device removal/replacement	"0293" "0294" "0296" "9702" "9703" "9704" "9712" "9714" "9723" "9729" "9735" "9738" "9739" "9749" "9751" "9762" "9764" "9774" "9782" "9783" "9788" "9789" "9802" "9803" "9811" "9815" "9817" "9819" "9821" "9825"

9	Other procedures	Other NOS	"0481" "0492" "0531" "0539" "9999"
		Thyroid	"0232" "0611"
		Imaging, other	"8737" "8739" "8741" "8744" "8749" "8753" "8761" "8763" "8766" "8769" "8771" "8773" "8776" "8777" "8778" "8779" "8801" "8802" "8803" "8811" "8814" "8819" "8821" "8822" "8823" "8826" "8827" "8828" "8829" "8831" "8838" "8841" "8842" "8843" "8844" "8845" "8847" "8848" "8849" "8851" "8853" "8856" "8857" "8861" "8862" "8865" "8867" "8868" "8872" "8873" "8874" "8875" "8877" "8879" "8892" "8893" "8894" "8895" "8896" "8897" "8898" "9201" "9202" "9203" "9204" "9205" "9214" "9215" "9218" "9219"
		Other evaluation	"897"
		Physical therapy	"9224" "9226" "9227" "9229"
		Other therapy	"8907" "9351" "9352" "9353" "9354" "9354" "9356" "9357" "9359" "9365" "9367" "9372" "9374" "9375" "9381" "9382" "9383" "9384" "9389" "9659" "9981" "9984" "9998"

Supplementary Table 1. Characteristics and hospitalization outcomes of study sample of discharges ≥60y with principal diagnosis as AD by procedure status; NIS 2002-2012.
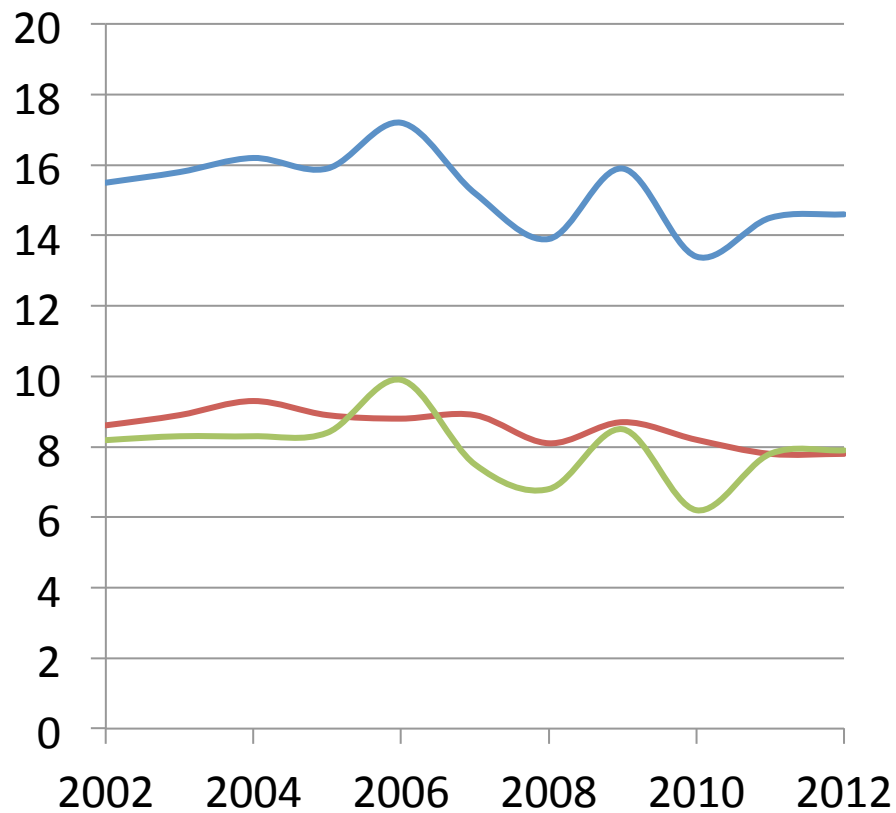
	Procedure status		
	No procedure	Any procedure	p-value*
Weighted N	512,341	92,300	
Hospitalization outcomes			
TC, $	20,401±375	32,610±820	**<0.001**
LOS, days	1.6±0.1	2.1±0.1	**0.001**
MR, %	9.20±0.15	10.76±0.25	**<0.001**
Patient-level characteristics			
Age, y (Mean±SE)	81.4±0.1	80.1±0.1	**0.001**
Female, (%±SE)	60.0±0.0	57.6±0.5	**<0.001**
Race, (%±SE) †			**<0.001**
White	83.1±1.0	73.9±1.3	
Black	9.1±0.5	14.4±0.7	
Hispanic	4.1±0.3	6.4±0.6	
Asian	0.6±0.0	1.0±0.1	
Native American	0.5±0.1	0.5±0.2	
Other	2.6±0.3	4.0±0.1	
Income quartiles, (%±SE)			
I	29.4±1.0	27.1±1.3	<0.001
II	26.0±0.6	23.5±0.7	
III	23.7±0.6	23.2±0.7	
IV	20.9±0.8	26.3±1.2	
Insurance status, (%±SE)			
Medicare	90.7±0.3	90.9±0.6	**0.005**
Medicaid	1.3±0.1	2.0±0.3	
Private insurance	6.1±0.2	5.5±0.3	
Self-pay	0.1±0.0	0.8±0.2	
No charge	0.1±0.1	0.0±0.0	
Other	0.1±0.1	0.8±0.1	
Admission day			
Weekday	82.8±0.2	81.6±0.4	**0.006**
Weekend	17.2±0.2	18.4±0.4	
Total co-morbidities (0-27)	2.25±0.02	2.45±0.02	**<0.001**
Charlson co-morbidity index			**<0.001**
0	47.6±0.4	44.5±0.5	
1	27.5±0.2	27.9±0.4	
2	24.9±0.4	27.5+±0.5	
Hospital-level characteristics			
Region of Hospital			
Northeast	18.4±1.2	32.0±1.9	**<0.001**

Midwest	28.7±1.5	20.7±1.7	
South	43.0±1.6	34.5±1.8	
West	10.0±0.8	12.9±1.3	
Bed Size			
Small	17.5±1.4	13.5±1.5	**0.042**
Medium	27.2±1.5	29.5±1.7	
Large	55.4±1.6	57.0±2.0	
Location/teaching status			
Rural	21.5±1.3	14.2±1.7	**<0.001**
Urban, non-teaching	46.1±1.6	41.8±1.9	
Urban, teaching	32.4±1.5	44.1±2.0	

LOS, length of stay; MR, mortality risk; TC, total charges.

*Based on design-based F-test from linear regression models for continuous characteristics with procedure status as the predictor or design-based F-test from a cross-tabulation of two categorical variables (categorical characteristic and procedure status).

[†] Data was available on a Weighted N of 477,933 of the 604,641 for the race variable. All other variables had <5% missing data.