

## "Distance to Nearest Hospital" Files

NAMCS and NHAMCS (1999 to 2009)

### Data Available from the National Center for Health Statistics Research Data Center (<http://www.cdc.gov/rdc/>)

#### Purpose

The purpose of this file is to provide the straight line distance, in statutory miles, to the nearest eligible hospital for each patient visit in the National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS) for the years 1999 through 2009. Since a hospital could both be eligible and not have an Emergency Department (ED), two distance variables were created: (1) distance to the nearest eligible hospital and (2) distance to the nearest eligible hospital with an ED.

#### Methods

Distances were calculated using the patient ZIP code variable (PATZIP) from the internal NAMCS/NHAMCS visit files and the street address from the NHAMCS Hospital frame file. Only hospitals with an average length of stay for all patients of less than 30 days (short-stay) or hospitals whose specialty was general (medical or surgical) or children's general were considered eligible for inclusion in the NHAMCS sampling frame. A second distance was calculated for those hospitals that possessed a 24-hour Emergency Department. On average, 86.2 % of the hospitals in the eligible hospital frame had an ED.

The distance between patient ZIP code coordinates and the hospital coordinates was calculated using the great circle distance formula:

$$d = 3963 \times \arccos \left[ \sin \left( \frac{\textit{latitude}_1}{57.2958} \right) \times \sin \left( \frac{\textit{latitude}_2}{57.2958} \right) + \cos \left( \frac{\textit{latitude}_1}{57.2958} \right) \times \cos \left( \frac{\textit{latitude}_2}{57.2958} \right) \right. \\ \left. \times \cos \left( \frac{\textit{longitude}_1}{57.2958} - \frac{\textit{longitude}_2}{57.2958} \right) \right]$$

where  $d$  is distance and *latitude* and *longitude* are in decimal form. A distance was calculated for each unique, valid patient ZIP code for that survey year and each of the eligible hospitals within the frame for that year. The minimum distance was then selected from the set of all calculated distances for each unique ZIP code.

For visits, latitude and longitude coordinates were identified using the centroid of the patient's ZIP code. The coordinates from these centroids are from the SAS ZIP file Version 9.2 (Cary, NC). For the years 1999 to 2009, 4.8 % of the patient zip codes were found to be missing or invalid and distances were not available. In total, 37,853 of 1,029,486 unweighted observations (3.7 %) do not have distance data. Table 1 provides unweighted distance missingness by year.

Geocoding of the hospital frame file was performed by the Department of Housing and Urban Development. Street address validation and coding was done using Pitney Bowes Group 1 Code-1 Plus Version 3.4 (Stamford, CT). Geocoding was performed using Pitney Bowes Group 1 Geographic Coding Plus Version 5.2 (Stamford, CT). In some cases, the latitude and longitude of the street address for the hospital could not be ascertained. For these hospitals, the latitude and longitude of the hospital was determined using either the 9-digit or 5-digit ZIP code centroid<sup>1</sup>. Tables 2a and 2b list the percentage of distances calculated using the ZIP code versus street-level distances by year for eligible hospitals and eligible hospitals with an ED, respectively. A centroid variable called 'quality' is included in the file to indicate whether the street address or the 9-digit or 5-digit ZIP code centroid was used.

Table 3a provides weighted summary statistics for the distance to the nearest eligible hospital by year. Table 3b lists the same information for the subset of ED-equipped hospitals by year.

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<sup>1</sup> The ZIP+4 centroid provides a latitude and longitude for the assigned street segment of the ZIP code. While less accurate than a 'rooftop'-based latitude and longitude, it is considered more accurate than the centroid of the 5 digit ZIP code.

Table 1. Missing Distance Values Due to Missing or Invalid Patient ZIP codes by Year (Unweighted)

<b>Year</b>	<b>Survey</b>	<b>Total Observations</b>	<b>Number Missing</b>	<b>Percent Missing</b>
1999	NAMCS	20,760	959	4.62
	NHAMCS – ED	21,103	1,192	5.65
	NHAMCS – OPD	29,487	934	3.17
2000	NAMCS	27,369	1,232	4.50
	NHAMCS – ED	25,622	1,111	4.34
	NHAMCS – OPD	27,510	1,093	3.97
2001	NAMCS	24,281	865	3.56
	NHAMCS – ED	34,546	1,426	4.13
	NHAMCS – OPD	33,567	1,373	4.09
2002	NAMCS	28,738	1,194	4.15
	NHAMCS – ED	37,337	1,621	4.34
	NHAMCS – OPD	35,586	1,563	4.39
2003	NAMCS	25,288	1,212	4.79
	NHAMCS – ED	40,253	1,267	3.15
	NHAMCS – OPD	34,492	869	2.52
2004	NAMCS	25,286	785	3.10
	NHAMCS – ED	36,589	1,101	3.01
	NHAMCS – OPD	31,783	924	2.91
2005	NAMCS	25,665	1,046	4.08
	NHAMCS – ED	33,605	1,329	3.95
	NHAMCS – OPD	29,975	905	3.02
2006	NAMCS	29,392	1,449	4.93
	NHAMCS – ED	35,849	1,214	3.39
	NHAMCS – OPD	35,105	1,527	4.35
2007	NAMCS	32,778	1,590	4.85
	NHAMCS – ED	35,490	1,474	4.15
	NHAMCS – OPD	34,473	991	2.87
2008	NAMCS	28,741	1,006	3.50
	NHAMCS – ED	34,134	1,356	3.97
	NHAMCS – OPD	33,908	693	2.04
2009	NAMCS	32,281	857	2.65
	NHAMCS – ED	34,942	1,045	2.99
	NHAMCS – OPD	33,551	650	1.94

Table 2a. Distance Calculations Performed Using Hospital ZIP Code Centroid by Year (Unweighted) – Eligible Hospitals

<b>Year</b>	<b>Survey</b>	<b>Distance Frame Size</b>	<b>Percent calculated with ZIP+4 Centroids</b>	<b>Percent calculated with ZIP Centroids</b>
1999	NAMCS	19,801	4.38	4.33
	NHAMCS – ED	19,911	5.18	5.38
	NHAMCS – OPD	28,553	4.35	5.17
2000	NAMCS	26,137	3.75	3.73
	NHAMCS – ED	24,511	3.37	4.50
	NHAMCS – OPD	26,417	3.53	4.55
2001	NAMCS	23,416	3.83	5.15
	NHAMCS – ED	33,120	4.38	5.07
	NHAMCS – OPD	32,194	3.56	4.72
2002	NAMCS	27,544	4.94	2.21
	NHAMCS – ED	35,716	4.45	2.32
	NHAMCS – OPD	34,023	3.82	1.81
2003	NAMCS	24,076	4.15	1.82
	NHAMCS – ED	38,986	5.10	2.71
	NHAMCS – OPD	33,623	3.25	2.09
2004	NAMCS	24,501	4.33	2.07
	NHAMCS – ED	35,488	5.26	2.23
	NHAMCS – OPD	30,859	4.53	2.08
2005	NAMCS	24,619	5.50	2.38
	NHAMCS – ED	32,276	5.27	2.23
	NHAMCS – OPD	29,070	4.78	1.64
2006	NAMCS	27,943	5.82	2.54
	NHAMCS – ED	34,635	4.93	2.35
	NHAMCS – OPD	33,578	4.67	2.04
2007	NAMCS	31,188	4.66	2.21
	NHAMCS – ED	34,016	5.00	2.20
	NHAMCS – OPD	33,482	4.34	1.65
2008	NAMCS	27,735	5.37	2.65
	NHAMCS – ED	32,778	6.14	2.62
	NHAMCS – OPD	33,215	4.71	2.17
2009	NAMCS	31,424	5.33	1.97
	NHAMCS – ED	33,897	6.79	2.00
	NHAMCS – OPD	32,901	4.81	1.94

Table 2b. Distance Calculations Performed Using Hospital ZIP Code Centroid by Year (Unweighted) – Eligible Hospitals with an ED

<b>Year</b>	<b>Survey</b>	<b>Distance Frame Size</b>	<b>Percent calculated with ZIP+4 Centroids</b>	<b>Percent calculated with ZIP Centroids</b>
1999	NAMCS	19,801	4.76	4.21
	NHAMCS – ED	19,911	5.56	5.25
	NHAMCS – OPD	28,553	4.62	5.17
2000	NAMCS	26,137	4.37	3.44
	NHAMCS – ED	24,511	4.01	3.71
	NHAMCS – OPD	26,417	3.91	3.63
2001	NAMCS	23,416	4.54	4.99
	NHAMCS – ED	33,120	5.10	4.91
	NHAMCS – OPD	32,194	4.15	4.59
2002	NAMCS	27,544	5.51	1.83
	NHAMCS – ED	35,716	4.62	2.29
	NHAMCS – OPD	34,023	3.99	1.52
2003	NAMCS	24,076	4.47	1.50
	NHAMCS – ED	38,986	5.16	2.55
	NHAMCS – OPD	33,623	3.27	1.83
2004	NAMCS	24,501	4.64	1.70
	NHAMCS – ED	35,488	5.82	2.19
	NHAMCS – OPD	30,859	4.85	1.98
2005	NAMCS	24,619	5.84	2.09
	NHAMCS – ED	32,276	5.45	1.95
	NHAMCS – OPD	29,070	4.93	1.49
2006	NAMCS	27,943	6.08	2.12
	NHAMCS – ED	34,635	5.17	2.21
	NHAMCS – OPD	33,578	4.80	1.62
2007	NAMCS	31,188	4.52	1.25
	NHAMCS – ED	34,016	5.27	2.07
	NHAMCS – OPD	33,482	4.52	1.25
2008	NAMCS	27,735	5.59	2.12
	NHAMCS – ED	32,778	6.52	2.34
	NHAMCS – OPD	33,215	4.46	1.50
2009	NAMCS	31,424	5.64	1.46
	NHAMCS – ED	33,897	7.19	1.70
	NHAMCS – OPD	32,901	5.28	1.10

Table 3a. Distance in Miles to the Nearest Hospital by Year (Weighted) – Eligible Hospitals

<b>Year</b>	<b>Quartile</b>	<b>NAMCS</b>	<b>NHAMCS-ED</b>	<b>NHAMCS-OPD</b>
1999	25 <sup>th</sup>	1.190	0.949	0.974
	50 <sup>th</sup>	2.427	2.070	1.984
	75 <sup>th</sup>	4.998	4.355	4.355
2000	25 <sup>th</sup>	1.123	1.075	0.962
	50 <sup>th</sup>	2.277	2.180	1.999
	75 <sup>th</sup>	4.881	4.690	4.507
2001	25 <sup>th</sup>	1.201	1.044	0.867
	50 <sup>th</sup>	2.395	2.119	1.841
	75 <sup>th</sup>	4.877	4.412	4.066
2002	25 <sup>th</sup>	1.228	1.090	0.952
	50 <sup>th</sup>	2.483	2.139	1.926
	75 <sup>th</sup>	5.255	4.650	4.102
2003	25 <sup>th</sup>	1.172	1.076	0.911
	50 <sup>th</sup>	2.316	2.138	1.852
	75 <sup>th</sup>	4.883	4.896	4.254
2004	25 <sup>th</sup>	1.290	1.013	0.917
	50 <sup>th</sup>	2.560	2.092	1.902
	75 <sup>th</sup>	5.094	4.535	4.460
2005	25 <sup>th</sup>	1.297	1.105	1.018
	50 <sup>th</sup>	2.652	2.218	2.211
	75 <sup>th</sup>	5.565	4.746	4.743
2006	25 <sup>th</sup>	1.218	1.049	0.974
	50 <sup>th</sup>	2.501	2.115	2.053
	75 <sup>th</sup>	5.051	4.512	4.426
2007	25 <sup>th</sup>	1.322	1.076	0.952
	50 <sup>th</sup>	2.574	2.155	2.024
	75 <sup>th</sup>	5.194	4.535	4.526
2008	25 <sup>th</sup>	1.302	1.131	1.020
	50 <sup>th</sup>	2.604	2.333	2.168
	75 <sup>th</sup>	5.120	4.980	4.869
2009	25 <sup>th</sup>	1.297	1.081	0.974
	50 <sup>th</sup>	2.578	2.198	2.168
	75 <sup>th</sup>	5.131	4.726	5.097

Table 3b. Distance in Miles to the Nearest Hospital by Year (Weighted) – Eligible Hospitals with an ED

<b>Year</b>	<b>Quartile</b>	<b>NAMCS</b>	<b>NHAMCS-ED</b>	<b>NHAMCS-OPD</b>
1999	25 <sup>th</sup>	1.241	0.985	1.018
	50 <sup>th</sup>	2.526	2.149	2.120
	75 <sup>th</sup>	5.304	4.644	4.692
2000	25 <sup>th</sup>	1.216	1.156	0.996
	50 <sup>th</sup>	2.437	2.332	2.185
	75 <sup>th</sup>	5.262	5.084	4.856
2001	25 <sup>th</sup>	1.278	1.103	0.905
	50 <sup>th</sup>	2.529	2.224	1.948
	75 <sup>th</sup>	5.161	4.735	4.507
2002	25 <sup>th</sup>	1.327	1.202	1.038
	50 <sup>th</sup>	2.737	2.393	2.157
	75 <sup>th</sup>	5.710	5.084	4.512
2003	25 <sup>th</sup>	1.253	1.135	0.927
	50 <sup>th</sup>	2.570	2.377	2.029
	75 <sup>th</sup>	5.328	5.262	4.535
2004	25 <sup>th</sup>	1.382	1.081	0.941
	50 <sup>th</sup>	2.774	2.279	2.147
	75 <sup>th</sup>	5.501	4.741	4.735
2005	25 <sup>th</sup>	1.347	1.182	1.096
	50 <sup>th</sup>	2.803	2.402	2.383
	75 <sup>th</sup>	5.908	5.017	5.143
2006	25 <sup>th</sup>	1.278	1.131	1.071
	50 <sup>th</sup>	2.729	2.272	2.219
	75 <sup>th</sup>	5.340	4.697	4.710
2007	25 <sup>th</sup>	1.424	1.133	1.020
	50 <sup>th</sup>	2.792	2.392	2.233
	75 <sup>th</sup>	5.909	4.818	4.872
2008	25 <sup>th</sup>	1.405	1.227	1.071
	50 <sup>th</sup>	2.838	2.480	2.365
	75 <sup>th</sup>	5.815	5.262	5.445
2009	25 <sup>th</sup>	1.378	1.173	1.044
	50 <sup>th</sup>	2.898	2.443	2.480
	75 <sup>th</sup>	5.628	5.069	5.757

## Appendix

### Distance to the Nearest Hospital File Description

Variable name	Description
patzip	Patient ZIP Code 5 character string variable with leading zeros
year	Year of Survey 1999 – 2009
quality	Indicator as to whether or not the Hospital street address, 9 digit ZIP, or 5 digit ZIP code centroid was used to calculate distance to an eligible hospital 1 – Street-Level Latitude and Longitude 2 – 9 digit ZIP Code Centroid 3 – 5 digit ZIP Code Centroid
quality_ed	Indicator as to whether or not the Hospital street address, 9 digit ZIP, or 5 digit ZIP code centroid was used to calculate distance to an eligible hospital with an ED 1 – Street-Level Latitude and Longitude 2 – 9 digit ZIP Code Centroid 3 – 5 digit ZIP Code Centroid
hosp_mindist	Distance to the nearest hospital (in miles)
ed_mindist	Distance to the nearest hospital with an ED (in miles)