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Emergency Department Visits by Nursing Home Residents in the United States

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Abstract

BACKGROUND/OBJECTIVES—The Emergency Department (ED) is an important source of health care for nursing home residents. The objective of this study was to characterize ED use by nursing home residents in the United States (US).

DESIGN—Analysis of the National Hospital Ambulatory Medical Care Survey

SETTING—US Emergency Departments, 2005-2008

PARTICIPANTS—Individuals visiting US EDs, stratified by nursing home and non-nursing home residents.

INTERVENTIONS—None

MEASUREMENTS—We identified all ED visits by nursing home residents. We contrasted the demographic and clinical characteristics between nursing home residents and non-nursing home residents. We also compared ED resource utilization, length of stay and outcomes.

RESULTS—During 2005-2008, nursing home residents accounted for 9,104,735 of 475,077,828 US ED visits (1.9%; 95% CI: 1.8-2.1%). The annualized number of ED visits by nursing home residents was 2,276,184. Most nursing home residents were elderly (mean 76.7 years, 95% CI: 75.8-77.5), female (63.3%), and non-Hispanic White (74.8%). Compared with non-nursing home residents, nursing home residents were more likely have been discharged from the hospital in the prior seven days (adjusted OR 1.4, 95% CI: 1.1-1.9). Nursing home residents were more likely to present with fever (adjusted OR 1.9; 95% CI: 1.5-2.4) or hypotension (systolic blood pressure ≤90

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Conflict of Interest Disclosures:

AUTHOR CONTRIBUTIONS HEW, MNS, RMA and MK conceived and designed the study. HEW acquired data and performed the statistical analysis. All authors participated in interpretation of data. HEW drafted the manuscript, and MNS, RMA and MK participated in critical revision of the manuscript's intellectual content. Dr. Wang had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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mm Hg, OR 1.8; 95% CI: 1.5-2.2). Nursing home patients were more likely to receive diagnostic test, imaging and procedures in the ED. Almost half of nursing home residents visiting the ED were admitted to the hospital. Compared with non-nursing home residents, nursing home residents were more likely to be admitted to the hospital (adjusted OR 1.8; 95% CI 1.6-2.1) and to die (adjusted OR 2.3; 95% CI 1.6-3.3).

CONCLUSIONS—Nursing home residents account for over 2.2 million ED visits annually in the US. Compared with other ED patients, nursing home residents have higher medical acuity and complexity. These observations highlight the national challenges of organizing and delivering ED care to nursing home residents in the US.

Keywords

emergency service; nursing homes; geriatrics

INTRODUCTION

The Emergency Department (ED) often plays an important role in care of nursing home residents, facilitating acute care for unexpected illness or injury as well as providing a pathway for hospital admission.[1-3] Comprised of mostly elderly individuals, nursing home residents may pose challenges for ED clinical management. Nursing home residents often have multiple comorbidities, complex medical histories, cognitive impairment or dementia and limited ability to physiologically compensate for critical illness.[4-9] Limits in vision, hearing and cognition may alter their ability to communicate symptoms, medical history or even basic personal information.[4,5] In addition, information exchange between the nursing home and ED is often poor, complicating care coordination between the two settings.[10-13] Because hospitalization of the elderly presents additional hazards such as increased delirium and falls, and because of the costs of care outside the nursing home are substantial, many institutions have sought opportunities to reduce avoidable ED visits and hospitalizations.[14-16]

Despite its importance in the care of nursing home residents, there are few published national studies characterizing ED use by nursing home residents in the US. Prior descriptions of ED use by nursing home patients have been limited to single EDs or nursing homes or settings outside the US.[3,17-22] Information describing the number, acuity, reasons for presentation, tests and interventions, or outcomes of nursing home residents presenting to the ED could illuminate the national challenges of providing emergency care to this population. In addition, these insights could reveal opportunities for improving quality of nursing home resident care in the ED, hospital or the nursing home, potentially leading to strategies to reduce nursing home resident ED visits and hospitalizations.

In this study we sought to determine the characteristics of Emergency Department visits by nursing home residents in the US.

METHODS

Study Design

This study was approved by the Institutional Review Board of the University of Alabama at Birmingham. We conducted a cross-sectional analysis using data from the National Hospital Ambulatory Medical Care Survey (NHAMCS).[23]

Data Source

Operated by the National Center for Health Statistics, NHAMCS is a national probability sample of ED and outpatient visits at hospitals across the US.[23] The goal of the NHAMCS ED survey is to describe ED visits nationally. Using a four-stage probability design, the survey samples geographically defined areas, hospitals within these areas, emergency service areas within the emergency departments of the hospitals, and patient visits to the emergency services areas. The study systematically selects all patients from selected ED facilities for an assigned four-week period. The National Center for Health Statistics (NCHS) works with each hospital to abstract clinical data from selected charts. For this effort we used the 2005-2008 NHAMCS public-use data set.

Selection of Patients

For this analysis we identified all ED visits by nursing home residents. NHAMCS contains a variable “nursing home origin” that differentiates ED visits by nursing home residents from other individuals. Prior to 2005, NHAMCS combined nursing home residents with those residing in “other institutions,” including prisons, mental hospitals, group homes for the mentally retarded or physically disabled, etc. Beginning in 2005, NHAMCS categorized nursing home residents separately. Because this study focused on nursing home residents (separate from other institutionalized individuals), we opted to limit the analysis to the 2005-2008 data set.

Outcomes and Covariates

We characterized ED visits for nursing home residents and other patients using variables available in the NHAMCS data set. We identified demographic characteristics of ED patients, including age, sex, race, ethnicity, hospital geographic region and population setting, and mode and time of arrival. We used the composite race/ethnicity variable available in the data set. Geographic regions were Northeast, Midwest, West and South. (States of each region are listed in Appendix 1.) Population setting consisted of hospitals in Metropolitan Statistical Areas (MSA) and non-MSAs. Mode of arrival included walk-in, transport by public service (police car, social service vehicle, beach patrol, etc.) and ambulance. We grouped time of arrival to the 8-hour intervals 7 am-3 pm, 3 pm-11 pm, and 11 pm-7 am.

Clinical characteristics included the presence of a fever or hypotension on ED triage, visit to the ED within the prior 72 hours, discharge from the hospital within the prior week, and ED visits related to injury, poisoning or adverse event. Following prior convention, we defined fever as either an elevated temperature ≥100.4 degrees Fahrenheit.[24-26] NHAMCS did not report the route of temperature measurement. We defined hypotension as systolic blood pressure ≤90 mm Hg. NHAMCS does not collect triage respiratory rate or oxygen saturation. We identified the performance of diagnostic (blood or urine) or imaging (x-ray, CT, MRI, ultrasound) tests, procedures (-e.g., intravenous access or endotracheal intubation) and the administration of medications.

Outcomes for each ED visit included length of ED stay, admission to the hospital, admission destination, hospital discharge status, and ED visit diagnoses. Admission destinations included critical care unit, operating room or catheterization lab, and other units. Hospital discharge status included alive, dead and unknown. Data abstractors identify the three most prominent documented diagnoses for each ED visit. The NCHS later converts these diagnoses to International Classification of Disease, ninth edition (ICD-9) codes. Up to three ICD-9 ED diagnoses are recorded for each visit in NHAMCS. NHAMCS does not contain ICD-9 procedural codes.

Data Analysis

We analyzed the data using descriptive statistics, annualizing all frequency estimates. We incorporated sampling design and weight variables to calculate nationally weighted estimates and their corresponding 95% confidence intervals. We used ultimate cluster design (single stage sampling) in variance and 95% confidence interval calculations, utilizing "masked" stratum and primary sampling unit identifiers provided with the NHAMCS public-use data set. Prior efforts have demonstrated that variance estimates using these methods are conservative.[27]

We calculated the national number of ED visits by nursing home residents. We compared demographic and clinical characteristics and outcomes between nursing home and non-nursing home residents. We grouped ED diagnoses by major ICD-9 category. (Specific diagnostic groups listed in Table 3.) We also identified clinically relative secondary diagnostic subgroups; for example, myocardial infarction, stroke, shock and sepsis. (Specific diagnostic groups listed in Table 3.) For the diagnostic subgroup "infection," we used a previously published taxonomy of infection-related ICD-9 codes.[24-26] (Appendix 2)

We compared the proportion of each characteristic between nursing home and non-nursing home residents using univariate odds ratios. Because of the differences in age and sex between nursing home and non-nursing home residents, we repeated the comparisons using logistic regression, adjusting by age decile (<50 years, 50-59, 60-69, 70-79, ≥80), sex, and composite race/ethnicity. Because the National Center for Health Statistics considers inferences based upon fewer than 30 raw observations to be unreliable, we did not calculate unadjusted or adjusted odds ratios for low frequency events.[28] We also performed a sensitivity analysis, repeating the comparisons in the subset of patients age ≥60 years old only. We analyzed data using Stata v.11.2 (Stata, Inc., College Station, Texas).

RESULTS

During 2005-2008 nursing home residents accounted for 9,104,735 of 475,077,828 (1.9%; 95% CI:1.8-2.1%) ED visits in the United States. The annualized number of ED visits by nursing home residents was 2,276,184 (95% CI: 2,045,215-2,507,153)

Most nursing home residents visiting the ED were elderly (mean age 76.7 years, 95% CI: 75.8-77.5), female and non-Hispanic White. (Table 1) Most were treated at EDs located in MSA settings and in the South US geographic region. Over 80% of nursing home residents arrived at the ED by ambulance; compared with non-nursing home residents, nursing home residents were over 13 times more likely to arrive by ambulance. Compared with non-nursing home residents, nursing home residents were more likely to have been discharged from a hospital within the prior seven days (adjusted OR 1.4; 95% CI: 1.1-1.9). Fever and hypotension (SBP≤90 mm Hg) on ED presentation were present in 7% and 8% of nursing home residents, respectively, and were more common than in non-nursing home residents.

Over 90% of nursing home residents received diagnostic tests, over 70% received imaging tests, over 70% underwent procedures, and approximately 70% received medications in the ED. (Table 2) Diagnostic tests, imaging tests and procedures were more common in nursing home residents than other ED patients.

Common ED diagnoses for nursing home residents included infection and sepsis (23.7%), circulatory diseases (20.9%), injury (18.0%), respiratory diseases (15.5%) and genitourinary diseases (14.9%). (Table 3) Common infections affecting nursing home residents included pneumonia, aspiration pneumonitis and other pulmonary infections, and pyelonephritis, kidney and other urinary tract infections. Infections and sepsis were more likely in nursing

home than non-nursing home residents. Nursing home residents were over six times more likely to present with sepsis. Shock and related diagnoses were present in 8.1%. Nursing home residents were more likely to present with seizures, respiratory failure, chronic and acute renal failure, and shock and related conditions. (Table 3)

ED length-of-stay was almost five hours for nursing home residents. (Table 4) Almost half of nursing home residents were admitted to the hospital. Compared with other patients, nursing home residents were almost twice as likely to be admitted to the hospital (adjusted OR 1.8; 1.6-2.0). Approximately 6.9% of admitted nursing home residents died in the hospital. Compared with other patients, admitted nursing home residents were more than twice as likely to die in the hospital (OR 2.3; 95% CI: 1.6-3.3).

When repeating the analysis with patients ≥60 years old only, we observed similar associations between nursing home and non-nursing home residents.

DISCUSSION

Our study provides new national perspectives of ED use by nursing home residents in the US. We found that nursing home residents were prominent users of the ED, accounting for over 2.2 million ED visits annually. Based upon an estimated 1.4 million nursing home residents in the US, our data suggest that each year there are approximately 1.6 ED visits for every nursing home resident in the US.[29,30] While accounting for less than 2% of total ED visits, nursing home residents exhibited higher acuity and were more likely to be admitted to the hospital than non-nursing home residents and exhibited higher mortality. Nursing home residents were also more likely to have been discharged from the hospital within the prior seven days. Nursing home residents were large users of emergency care resources, with higher rates of ambulance transport, diagnostic testing, imaging and procedures, and longer ED length-of-stay.

The observations of this series highlight broader questions regarding the appropriateness of ED visits by nursing home residents. Hospitalization of the elderly may result in a spectrum of unwanted effects such as reduced muscle strength, vasomotor instability, reduce ventilatory capacity, and the increased risks of acute delirium or falls.[14,15] In addition, significant costs are associated with health care delivered outside of the nursing home setting.[16,31] Many authors have evaluated the appropriateness or preventable nature of nursing home resident ED visits or hospitalizations, pointing to the similar assessment or care that could be provided in the nursing home setting.[32-40] For example, in a review of 200 nursing home resident hospitalizations, Ouslander, et al. found that 67% were potentially avoidable.[40]

While not directly evaluating the appropriateness of ED referral or hospitalization, our study offers several relevant observations. The most prominent observation was that nursing home residents were more likely than non-nursing home residents to have been discharged from the hospital within the prior seven days. While the higher readmission rate may represent the natural progression of disease, it may also reflect inadequate or incomplete hospital treatment, inadequate coordination of care between hospital and nursing homes, or inadequate advanced care planning involving discussions with nursing home residents and their family members about goals of care and the benefits and risks of specific medical treatments and repeat hospitalizations. On the other hand, our study also underscores the high acuity of nursing home patients presenting to the ED, with comparatively higher prevalence of injury, fever, hypotension, shock, sepsis and hospital admission than other ED patients. Many of these high acuity cases may benefit from theexpert diagnostic and stabilizing care offered by the ED. While organized systems of nursing home-based care

may prevent some ED visits, the ED will still play an important role in caring for the sickest nursing home residents.

Early diagnosis, primary and preventive care could play key roles in reducing nursing home resident ED visits. For example, almost quarter of the nursing home resident ED visits were associated with infections. Early involvement of physicians or physician extenders could advance infection diagnosis and treatment to the earliest stages of disease. Intrator, et al. found that at nursing homes with special care units and more physicians and physician extenders, residents were less likely to be hospitalized.[41] Evercare programs in the United Kingdom and United States have utilized nurse practitioner-coordinated intensive primary care to reduce ED visits and hospitalizations.[42,43] Ouslander, et al. found that a multi-component intervention could reduce the number of hospital admissions for nursing home residents.[44]

Most previous descriptions of ED use by nursing home patients have been limited to single EDs or nursing homes or settings outside the US.[3,17-22] An abstract utilized NHAMCS data prior to 2005, when the survey aggregated nursing home residents with other institutionalized residents (prisons, mental hospitals, groups homes for mentally retarded or physically disabled, etc).[45] The 2004 National Nursing Home Survey provided limited perspectives of nursing home resident ED use, finding that eight percent of US nursing home residents (123,600) had an ED visit in the previous 90 days.[36] Our contrasting study identified a much higher number of annual ED visits by nursing home residents, and the additional data elements of the NHAMCS data set allowed deeper descriptions of the ED course and hospital outcomes of this population.

Our observations underscore the acuity and complexity of nursing home residents as well as the ED clinical and operational challenges posed by these individuals. Many ED clinicians may not feel comfortable caring for older patients, and many EDs are not structured to care for older adults.[14,46] One potential strategy to improve nursing home resident care is to organize ED care regionally in a manner similar to current systems of major trauma, ST-segment myocardial infarction and stroke care with the goal of improved outcomes.[47-49] With adequate triage guidance, ambulances could potentially transport nursing home residents to centers with expertise in and resources to support specialty nursing home resident care. The transition of care and medical information is often a challenge in the transfer of nursing home residents to the ED.[10] Established community patterns of nursing home to ED referral could also help to enhance care coordination for these patients. Descriptions of specialized Geriatric Emergency Departments and consult teams exist, but there are only limited evaluations of their effectiveness.[50-54]

Limitations of this study include the retrospective nature and the probability sample design of the NHAMCS data set. However, the methodology of the NHAMCS study is rigorous, and the data set has been widely used in similar analyses for over 15 years.[24,55,56] While we estimated the number of nursing home residents visiting the ED, due to the absence of individual identifiers, we could not estimate rates of ED use. Although we associated initial presentation with final patient outcome, the data set did not contain adequate variables to fully account for important confounders.

While a focus of Medicare and a potential measure of care quality, the NHAMCS data did not have information on 30-day readmissions.[57,58] While we were able to study 7-day readmissions, because NHAMCS did not have individual identifiers, we could not determine the diagnoses of prior hospitalizations nor patterns of readmission by individual nursing home residents.

There were fewer nursing home resident ED visits in the West geographic region of the US. We attribute this observation to the smaller nursing home population in the Western US, which has the lowest number of nursing homes, nursing home beds and nursing home residents.[59]

Because NHAMCS collects only three diagnoses per patient, we may have missed additional relevant conditions that were not reported. Abstractors may have varied in the selection and identification of ED diagnoses. There was no way to independently validate the NHAMCS classification of nursing home resident. While our study characterized ED visits, we could not determine the appropriateness or preventable nature of these visits.

CONCLUSION

In the United States nursing home residents comprise over 2.2 million ED visits annually. Compared with non-nursing home residents, nursing home residents have higher medical acuity and complexity. These observations highlight the national challenges of organizing and delivering ED care to nursing home residents in the US and support alternate models for the emergency care of this population.

Appendix

APPENDIX 1:

APPENDIX 2:

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TABLE 1

Characteristics of Emergency Department Visits by US Nursing Home Residents, 2005-2008

Odds ratios for nursing home vs. non-nursing home, unadjusted and adjusted for age-decile, sex, and race and ethnicity category.

Characteristic	Nursing Home Residents (n=2,276,184 annual ED visits)		Non-Nursing Home Residents (n=116,493,273 annual ED visits)		Odds Ratio Nursing Home vs. Non-Nursing Home		Odds Ratio Nursing Home vs. Non-Nursing Home Adjusted for Age-Decile, Sex, Race/Ethnicity	
	%	(95% CI)	%	(95% CI)	OR	(95% CI)	OR	(95% CI)
Age (mean, 95% CI)	76.7	(75.8-77.5)	35.9	(35.2-36.3)	*† 40.8	(39.8-41.8)	† N/A	
Sex								
Female	63.3	(60.9-65.6)	54.0	(53.5-54.5)	Ref	---	† N/A	
Male	36.7	(34.4-39.1)	46.0	(45.5-46.5)	0.7	(0.6-0.8)		
Race and Ethnicity								
Non-Hispanic White	74.8	(71.5-77.9)	61.0	(58.4-63.5)	Ref	---	† N/A	
Non-Hispanic Black	16.4	(13.7-19.4)	22.2	(19.7-24.9)	0.6	(0.5-0.7)		
Hispanic	6.2	(4.4-8.7)	13.2	(11.4-15.2)	0.4	(0.3-0.5)		
Asian, Hawaiian, Pacific Islander, American Indian, Alaskan, Multiple Races	2.6	(1.8-3.8)	3.7	(3.1-4.3)	0.6	(0.4-0.8)		
Hospital Geographic Region								
Northeast	23.5	(19.6-27.8)	18.8	(16.7-21.2)	‡ 1.7	(1.3-2.2)	‡ 1.7	(1.3-2.1)
Midwest	25.1	(20.7-30.1)	22.4	(18.7-26.6)	‡ 1.5	(1.2-1.9)	‡ 1.6	(1.3-2.0)
South	37.9	(33.0-43.1)	40.3	(36.2-44.7)	‡ 1.3	(1.0-1.6)	‡ 1.6	(1.3-2.0)
West	13.6	(11.0-16.6)	18.4	(14.8-22.7)	Ref	---	Ref	---
Hospital Metropolitan Location								
MSA	80.8	(69.6-88.6)	84.7	(75.7-90.8)	Ref	---	Ref	---
Non-MSA	19.2	(11.4-30.4)	15.3	(9.2-24.3)	‡ 1.3	(1.1-1.6)	1.1	(0.9-1.3)
Mode of Arrival								
Walk-In	12.9	(11.2-14.8)	78.8	(77.7-79.9)	Ref	---	Ref	---
Public Service	3.1	(2.2-4.4)	1.7	(1.4-2.0)	‡ 11.4	(8.0-16.2)	‡ 12.6	(8.8-17.9)
Ambulance	80.3	(77.6-82.7)	14.3	(13.5-15.1)	‡ 34.4	(29.3-40.2)	‡ 13.6	(11.6-16.0)

Characteristic	Nursing Home Residents (n=2,276,184 annual ED visits)		Non-Nursing Home Residents (n=116,493,273 annual ED visits)		Odds Ratio Nursing Home vs. Non-Nursing Home		Odds Ratio Nursing Home vs. Non-Nursing Home Adjusted for Age-Decile, Sex, Race/Ethnicity	
	%	(95% CI)	%	(95% CI)	OR	(95% CI)	OR	(95% CI)
Unknown	3.7	(2.6-5.2)	5.2	(4.6-5.9)	ǂ4.4	(3.1-6.1)	ǂ3.4	(2.5-4.6)
Time of Arrival								
7a-3p	44.4	(41.1-47.8)	39.7	(39.1-40.2)	Ref	---	Ref	---
3p-11p	39.8	(36.3-43.4)	44.5	(43.8-45.2)	ǂ0.8	(0.7-0.9)	1.0	(0.9-1.3)
11p-7a	15.8	(13.2-18.7)	15.9	(15.3-16.4)	0.9	(0.7-1.1)	1.3	(0.981.0-1.6)
Seen at Emergency Department Within Prior 72 Hours								
No	82.5	(79.7-84.9)	80.4	(77.4-83.0)	Ref	---	Ref	---
Yes	3.0	(2.3-3.8)	3.6	(3.4-3.8)	0.8	(0.6-1.0)5)	1.0	(0.7-1.3)
Unknown	14.6	(12.2-17.3)	16.0	(13.4-19.1)	0.9	(0.7-1.1)	0.9	(0.8-1.1)
Discharged from Hospital Within Prior 7 Days								
No	60.8	(56.1-65.4)	63.2	(59.7-66.6)	Ref	---	Ref	---
Yes	4.0	(3.2-5.1)	2.1	(1.9-2.3)	ǂ2.0	(1.5-2.6)	ǂ1.4	(1.1-1.9)
Unknown	35.1	(30.6-39.9)	34.7	(31.3-38.2)	1.1	(0.9-1.2)	1.0	(0.9-1.1)
Fever on ED Triage (Temperature <96.8 or ≥100.4°F)								
No	92.9	(91.4-94.2)	94.4	(94.1-94.7)	Ref	---	Ref	---
Yes	7.1	(5.8-8.6)	5.6	(5.3-5.9)	ǂ1.3	(1.04-1.6)	ǂ1.9	(1.5-2.4)
Hypotension on ED Triage (Systolic Blood Pressure <90 mmHg)								
No	92.0	(90.7-93.2)	91.1	(90.3-92.0)	Ref	---	Ref	---
Yes	8.0	(6.8-9.3)	8.9	(8.0-9.7)	0.9	(0.7-1.1)	ǂ1.8	(1.5-2.2)

Ref = referent category. ED = Emergency Department. MSA = metropolitan statistical area. OR = Odds Ratio. CI = Confidence Interval.

*Mean difference and 95% confidence interval.

†Odds ratios for age, sex, race and ethnicity not adjusted.

[‡] Significant at p<0.05.

TABLE 2

Diagnostic and Imaging Tests, and Interventions for Emergency Department Visits by US Nursing Home Residents, 2005-2008

Odds ratios for nursing home vs. non-nursing home, unadjusted and adjusted for age-decile, sex, and race and ethnicity category.

Characteristic	Nursing Home Residents (n=2,276,184 annual ED visits)		Non-Nursing Home Residents (n=116,493,273 annual ED visits)		Odds Ratio Nursing Home vs. Non-Nursing Home		Odds Ratio Nursing Home vs. Non-Nursing Home Adjusted for Age-Decile, Sex, Race/Ethnicity	
	%	(95% CI)	%	(95% CI)	OR	(95% CI)	OR	(95% CI)
Performance of Diagnostic Screening Tests in ED								
No	7.6	(6.4-8.9)	28.2	(26.7-29.8)	Ref	---	Ref	---
Yes	92.4	(91.1-93.6)	71.8	(70.2-73.3)	ǂ4.8	(4.1-5.7)	ǂ1.9	(1.6-2.2)
Unknown	0.8	(0.1-1.5)	2.1	(1.8-2.5)	1.4	(0.6-3.2)	1.0	(0.5-2.0)
Performance of Imaging Tests in ED								
No	28.2	(25.9-30.5)	55.8	(54.7-56.9)	Ref	---	Ref	---
Yes	71.8	(69.5-74.1)	44.2	(43.1-45.3)	ǂ3.2	(2.9-3.6)	ǂ1.5	(1.3-1.7)
X-ray								
No	14.6	(12.7-16.8)	22.3	(21.4-23.2)	Ref	---	Ref	---
Yes	85.4	(83.2-87.3)	77.7	(76.8-78.6)	ǂ1.7	(1.4-2.0)	ǂ1.3	(1.1-1.5)
CT Scan								
No	65.0	(61.5-68.4)	71.8	(70.7-72.9)	Ref	---	Ref	---
Yes	35.0	(31.6-38.5)	28.2	(27.1-29.3)	ǂ1.4	(1.2-1.6)	1.0	(0.9-1.2)
MRI								
No	99.3	(98.7-99.6)	98.7	(98.6-98.9)	Ref	---	Ref	---
Yes	**0.7	(0.4-1.3)	1.3	(1.1-1.4)	**N/A0.6	(0.3-1.0)	**N/A0.5	(0.3-0.8)
Ultrasound								
No	97.2	(96.1-98.0)	93.3	(92.7-93.8)	Ref	---	Ref	---
Yes	2.8	(2.0-3.9)	6.7	(6.2-7.3)	ǂ0.4	(0.3-0.6)	ǂ0.7	(0.5-0.991.0)
Performance of Procedures in ED								

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Characteristic	Nursing Home Residents (n=2,276,184 annual ED visits)		Non-Nursing Home Residents (n=116,493,273 annual ED visits)		Odds Ratio Nursing Home vs. Non-Nursing Home		Odds Ratio Nursing Home vs. Non-Nursing Home Adjusted for Age-Decile, Sex, Race/Ethnicity	
	%	(95% CI)	%	(95% CI)	OR	(95% CI)	OR	(95% CI)
No	28.2	(25.7-30.9)	51.5	(49.1-53.8)	Ref	---	Ref	---
Yes	71.8	(69.1-74.3)	48.5	(46.2-50.9)	ǂ2.7	(2.4-3.0)	ǂ1.6	(1.4-1.7)
Provision of Medications in ED								
No	28.5	(26.1-31.0)	20.9	(19.9-21.9)	Ref	---	Ref	---
Yes	69.2	(66.4-71.9)	77.0	(76.0-78.1)	ǂ0.66	(0.59-0.73)	ǂ0.76	(0.68-0.84)
Unknown	2.2	(1.4-3.5)	2.1	(1.7-2.5)	0.798	(0.50-1.3)	0.768	(0.42-1.10)

Ref = referent category. ED = Emergency Department. MSA = metropolitan statistical area. OR = Odds Ratio. CI = Confidence Interval.

* Mean difference and 95% confidence interval.

ǂ Significant at p<0.05.

** Based upon fewer than 30 raw observations - estimate considered unreliable; ORs not calculated for these variables.[28]

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TABLE 3

Diagnoses of Emergency Department Visits by US Nursing Home Residents, 2005-2008

Odds ratios for nursing home vs. non-nursing home, unadjusted and adjusted for age-decile, sex, and race and ethnicity category.

Characteristic	Nursing Home Residents (n=2,276,184 annual ED visits)		Non-Nursing Home Residents (n= 116,493,273 annual ED visits)		Odds Ratio Nursing Home vs. Non-Nursing Home		Odds Ratio Nursing Home vs. Non-Nursing Home Adjusted for Age-Decile, Sex, Race/Ethnicity	
	%	(95% CI)	%	(95% CI)	OR	(95% CI)	OR	(95% CI)
001-139.9 Infectious and Parasitic Diseases	3.6	(2.6-4.6)	4.4	(4.2-4.7)	0.8	(0.6-1.1)	ǂ1.7	(1.2-2.3)
140-239.9 Neoplasms	1.4	(0.98-2.10)	0.6	(0.5-0.7)	ǂ2.5	(1.6-3.8)	1.2	(0.7-1.8)
240-279.9 Endocrine, Nutritional and Metabolic Diseases, and Immunity Disorders	13.2	(11.78-14.87)	4.4	(4.2-4.6)	ǂ3.3	(2.9-3.7)	ǂ1.6	(1.4-1.8)
250-250.9, 251.0-251.2 Diabetic, Hyperglycemic and Hypoglycemic Conditions	4.1	(3..02-5.24)	1.6	(1.5-1.7)	ǂ2.6	(2.0-3.5)	ǂ1.5	(1.1-2.0)
280-289.9 Diseases of the Blood and Blood-Forming Organs	3.8	(2.9-4.6)(3.0-4.7)	1.2	(1.1-1.3)	ǂ3.2	(2.4-4.1)	ǂ1.4	(1.1-1.8)
290-319.9 Mental Disorders	9.8	(8..43-11.45)	5.5	(5.2-5.8)	ǂ1.9	(1.6-2.2)	ǂ2.6	(2.1-3.2)
320-359.9 Diseases of the Nervous System	3.8	(2.8-4.8)(2.9-5.0)	3.4	(3.1-3.6)	1.1	(0.9-1.5)	ǂ1.4	(1.1-2.0)
345-345.91, 649.40-649.44, 779.0, 780.3-780.39 - Epilepsy, Seizures and Convulsions	1.3	(0.98-2.01.9)	1.1	(0.991.0-1.21)	1.3	(0.8-1.9)	ǂ2.3	(1.5-3.6)
360-389.9 Diseases of the Sense Organs (-e.g, Eyes, Ears)	**0.6	(0.3-0.910)	4.4	(4.2-4.7)	**0.1N/A	(0.1-0.2)	**0.4N/A	(0.2-0.6)
390-459.9 Diseases of the Circulatory System	20.9	(18.54-23.64)	6.6	(6.2-7.0)	ǂ3.7	(3.2-4.4)	1.1	(0.9-1.2)
410-414.9 Acute Myocardial Infarction and Ischemic Heart Disease	2.7	(1.7-3.69-3.8)	1.2	(1.0-1.3)	ǂ2.3	(1.6-3.4)	0.7	(0.5-1.1)
426-427.9 - Dysrhythmias	4.2	(3.32-5.21)	0.95	(0.879-1.04)	ǂ4.6	(3.6-5.8)	1.2	(0.9-1.5)
425, 425.1-425.2, 425.4-425.9, 428-428.9 Acute Heart Failure and Cardiomyopathies	5.4	(4.2-6.63-6.8)	0.94	(0.879-1.03)	ǂ6.0	(4.7-7.6)	1.2	(0.98(1.0-1.5)
430-437.9 Hemorrhagic and Thrombotic Stroke	3.0	(2.3-4.02-3.9)	0.7	(0.6-0.8)	ǂ4.5	(3.3-6.1)	1.1	(0.8-1.5)
460-519.9 Diseases of the Respiratory System	15.5	(13.6-17.4)(13.7-17.5)	13.7	(13.2-14.1)	1.2	(1.00.99-1.3)	ǂ1.3	(1.1-1.5)
464-466.19, 480-488.9, 507-507.8, 510-510.9,	9.3	(7.9-10.68.0-10.7)	6.2	(5.9-6.65)	ǂ1.5	(1.3-1.8)	ǂ1.6	(1.3-1.9)

Characteristic	Nursing Home Residents (n=2,276,184 annual ED visits) %	(95% CI)	Non-Nursing Home Residents (n= 116,493,273 annual ED visits) %	(95% CI)	Odds Ratio Nursing Home vs. Non-Nursing Home OR	(95% CI)	Odds Ratio Nursing Home vs. Non-Nursing Home Adjusted for Age-Decile, Sex, Race/Ethnicity OR	(95% CI)
513-513.1 Pneumonia, Aspiration Pneumonitis and Other Infections								
490-493.92 Asthma, COPD and Chronic Bronchitis	2.5	(1.89-3.43)	4.0	(3.8-4.2)	ǂ0.6	(0.5-0.8)	ǂ0.7	(0.5-0.9)
518.5, 518.81-518.85, 799.0-799.1 Asphyxia and Respiratory Failure	2.9	(2.2-4.02.0-3.9)	0.40.38	(0.32-0.44)	ǂ8.0	(5.6-11.5)	ǂ2.6	(1.8-3.7)
520-579.9 Diseases of the Digestive System	8.4	(7.1-9.87)	8.4	(8.1-8.6)	1.0	(0.8-1.2)	0.9	(0.8-1.1)
580-629.9 Diseases of the Genitourinary System	14.9	(13.21-16.87)	7.1	(6.9-7.4)	ǂ2.3	(2.0-2.6)	ǂ1.8	(1.5-2.1)
584-586 - Acute and Chronic Renal Failure	33.0	(2.2-3.8)	0.5	(0.4-0.6)	ǂ6.4	(4.8-8.6)	ǂ2.3	(1.6-3.2)
590-590.9, 599.0 Pyelonephritis, kidney and urinary tract infections	10.0	(8.3-11.65-11.8)	3.0	(2.9-3.1)	ǂ3.6	(3.0-4.3)	ǂ2.2	(1.8-2.7)
630-679.9 Complications of Pregnancy, Childbirth, and the Puerperium	**99.80.2	(99.5-100.1)(0.05-0.85)	98.41.6	(98.3-98.5)(1.5-1.7)	**0.1N/A	(0.0-0.5)	**1.1N/A	(0.3-4.6)
680-709.9 Diseases of the Skin and Subcutaneous Tissue	3.4	(2.5-4.2)(2.6-4.3)	4.9	(4.7-5.1)	ǂ0.7	(0.5-0.9)	1.0	(0.8-1.4)
681-686.9 Cellulitis and skin infections	2.1	(1.4-2.8)(1.5-2.9)	3.1	(3.0-3.3)	ǂ0.7	(0.5-0.9)	0.9	(0.6-1.3)
710-739.9 Diseases of the Musculoskeletal System and Connective Tissue	4.5	(3.3-5.6)(3.4-5.8)	7.7	(7.4-8.0)	ǂ0.6	(0.4-0.7)	ǂ0.5	(0.4-0.7)
740-759.9 Congenital Anomalies	**0.0	(0.0-0.0)	0.10.15	(0.12-0.192)	**N/A		**N/A	
760-779.9 Certain Conditions Originating in the Perinatal Period	**0.0	(0.0-0.0)	0.10.07	(0.1-0.1)(0.05-0.09)	**N/A		**N/A	
780-799.9 Symptoms, Signs, and Ill-Defined Conditions	31.0	(28.54-33.65)	25.5	(24.6-26.3)	ǂ1.3	(1.2-1.5)	ǂ0.8	(0.7-1.00.97)
780.0-780.2, 780.97 Syncope, Coma and Altered Mental Status	5.3	(4.21-6.54)	1.5	(1.4-1.6)	ǂ3.7	(3.0-4.6)	ǂ1.3	(1.05-1.7)
276.5-276.52, 458-458.9, 785.5-785.51, 785.59, 958.4, 995.0, 999.4 Shock, Hypovolemia, Dehydration, Hypotension and Anaphylaxis	8.1	(6.8-9.49-9.5)	1.6	(1.5-1.7)	ǂ5.4	(4.5-6.5)	ǂ2.6	(2.0-3.2)
800-950.9 Injury	18.0	(16.4-19.7)	23.8	(23.3-24.3)	ǂ180.7	(16.4-19.7)(0.6-0.8)	23.80.9	(23.3-24.3)(0.8-1.01)
800-804.9, 850.-854.9, 959.0-959.09	2.1	(1.3-2.8)(1.4-3.0)	1.9	(1.8-2.0)	1.1	(0.7-1.6)	1.1	(0.7-1.7)

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	%	(95% CI)	%	(95% CI)	OR	(95% CI)	OR	(95% CI)
Head and brain injuries								
805-806.9, 952.-952.9 Spinal cord injuries	**0.4	(0.12-0.97)	0.20.15	(0.1-0.2)(0.12-0.18)	**2.8N/A	(1.3-6.2)	**1.2N/A	(0.5-2.7)
860.-869.9 Chest, abdomen and pelvis injuries	**0.01	(0.0-0.100)	0.10.11	(0.1-0.1)(0.09-0.14)	**0.1N/A	(0.0-1.0)	**0.2N/A	(0.0-1.2)
807-839.9, 885-887.7, 895-897.7, 900-904.9, 925-929 Extremity fractures and injuries	5.4	(4.2-6.5)(4.3-6.6)	3.8	(3.6-3.9)	ǂ1.4	(1.1-1.8)	1.1	(0.9-1.5)
940-949.9 Burns	**0.14	(-0.00.07-0.45)-0.3)	0.43	(0.4-0.5)(0.39-0.48)	**0.3N/A	(0.1-1.1)	**0.7N/A	(0.2-2.1)
960-989.9 Poisonings and Toxic Effects	**0.3	(0.1-0.6)	0.90.94	(0.9-1.0)(0.86-1.02)	**0.3N/A	(0.1-0.6)	**N/A0.9	(0.9-1.0)
996-999.9 Complications of Medical Care	1.1	(0.6-1.6)	0.50.51	(0.5-0.6)(0.46-0.57)	ǂ2.2	(1.4-3.5)	1.3	(0.8-2.1)
Infection (including lung, kidney, skin infections and sepsis - see Appendix 2 for ICD-9 code ranges)	23.7	(21.3-26.21)	16.5	(16.1-16.9)	ǂ1.6	(1.4-1.8)	ǂ1.6	(1.4-1.8)
003.1, 022.3, 031.2, 038-038.9, 040.82, 422.92, 449, 659.3, 670.20-670.24, 673.3, 771.81, 771.83, 785.52, 790.7, 995.90-995.94 Sepsis, Septicemia, Bacteremia and Septic Shock	3.8	(2.8-4.9)	0.20.23	(0.2-0.3)(0.19-0.26)	ǂ17.6	(13.1-23.6)	ǂ6.2	(4.1-9.5)

Ref = referent category. ED = Emergency Department. MSA = metropolitan statistical area. OR = Odds Ratio. CI = Confidence Interval.

ǂSignificant at p<0.05.

**Based upon fewer than 30 raw observations - estimate considered unreliable; ORs not calculated for these variables.[28]

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TABLE 4

Outcomes of Emergency Department Visits by US Nursing Home Residents, 2005-2008

Odds ratios for nursing home vs. non-nursing home, unadjusted and adjusted for age-decile, sex, and race and ethnicity category.

Characteristic	Nursing Home Residents (n=2,276,184 annual ED visits)		Non-Nursing Home Residents (n=116,493,273 annual ED visits)		Odds Ratio Nursing Home vs. Non-Nursing Home		Odds Ratio Nursing Home vs. Non-Nursing Home Adjusted for Age-Decile, Sex, Race/Ethnicity	
	%	(95% CI)	%	(95% CI)	OR	(95% CI)	OR	(95% CI)
Length of ED Stay (minutes, 95% CI)	289	(270-309)	199	(193-206)	*‡90	(73-107)	*‡48	(26-60)
Admitted to Hospital								
No	51.8	(48.6-54.9)	86.9	(86.0-87.7)	Ref	---	Ref	---
Yes	48.2	(45.1-51.4)	13.1	(12.3-14.0)	‡6.2	(5.5-6.9)	‡1.8	(1.6-2.0)
Admission Destination (of admitted patients)								
Critical Care Unit	19.5	(16.4-23.0)	15.5	(13.9-17.2)	‡1.3	(1.01-1.6)	1.2	(0.961.0-1.5)
Operating Room/Cath Lab	1.2	(0.7-2.2)	5.2	(4.6-5.9)	‡0.2	(0.1-0.4)	‡0.4	(0.2-0.7)
Other Bed/Unit	79.3	(75.8-82.4)	79.4	(77.5-81.1)	Ref	---	Ref	---
Discharge Outcome (of admitted patients)								
Alive	81.2	(77.2-84.7)	86.4	(83.7-88.6)	Ref	---	Ref	---
Dead	6.9	(5.2-9.0)	1.9	(1.7-2.2)	‡3.8	(2.7-5.3)	‡2.3	(1.6-3.3)
Unknown	11.9	(8.7-16.0)	11.7	(9.5-14.4)	1.1	(0.8-1.4)	1.0	(0.8-1.4)

ED = Emergency Department. MSA = metropolitan statistical area. OR = Odds Ratio. CI = Confidence Interval.

*Mean difference and 95% confidence interval.

‡Significant at p<0.05.

**Based upon fewer than 30 raw observations - estimate considered unreliable; ORs not calculated for these variables.[28]

Elements of Financial/Personal Conflicts	*Author 1 Henry Wang		Author 2 Manish Shah		Author 3 Richard Allman		Etc. Meredith Kilgore	
	Yes	No	Yes	No	Yes	No	Yes	No
Employment or Affiliation		X		X		X		X
Grants/Funds		X		X		X		X
Honoraria		X		X		X		X
Speaker Forum		X		X		X		X
Consultant		X		X		X		X
Stocks		X		X		X		X
Royalties		X		X		X		X
Expert Testimony		X		X		X		X
Board Member		X		X		X		X
Patents		X		X		X		X
Personal Relationship		X		X		X		X

APPENDIX 1

Hospital Geographic Regions Defined By the National Hospital Ambulatory Care Survey (NHAMCS)

Region	States
Northeast	Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont
Midwest	Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin
South	Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia
West	Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming

APPENDIX 2
Emergency Department Diagnosis Codes Denoting Infection

International Classification of Diseases, ninth edition (ICD-9) codes associated with an infection.[24-26]

Infection Category	ICD-9 Code	ICD-9 Code Description
Parasitic	001	Cholera
	002	Typhoid/paratyphoid fever
	003	Other salmonella infection
	004	Shigellosis
	005	Other food poisoning
	008	Intestinal infections due to Escherichia coli
	008.1	Intestinal infections due to Arizona group of paracolon bacillus
	008.2	Intestinal infections due to Aerobacter aerogenes
	008.3	Intestinal infections due to Proteus (mirabilis morganii)
	008.4	Intestinal infections due to unspecified bacteria
	008.5	Bacterial enteritis, unspecified
	009	Ill-defined intestinal infection
	013	CNS tuberculosis
	018	Miliary tuberculosis
	020	Plague
	021	Tularemia
	022	Anthrax
	023	Brucellosis
	024	Glanders
	025	Melioidosis
	026	Rat-bite fever
	027	Other bacterial zoonoses
	032	Diphtheria
	033	Whooping cough
	034	Streptococcal throat/scarlet fever
	035	Erysipelas
	036	Meningococcal infection
	037	Tetanus
	038	Septicemia
	039	Actinomycotic infections
	040	Other bacterial diseases
	041	Bacterial infection in other diseases not specified
	098	Gonococcal infections
	100	Leptospirosis
	101	Vincent’s angina
	112	Candidiasis, of mouth
	112.4	Candidiasis, of lung
	112.5	Candidiasis, disseminated

Infection Category	ICD-9 Code	ICD-9 Code Description
	112.8	Candidiasis, of other specified sites
	114	Coccidioidomycosis
	115	Histoplasmosis
	116	Blastomycotic infection
	117	Other mycoses
	118	Opportunistic mycoses
Nervous	320	Bacterial meningitis
	321	Cryptococcal meningitis
	321.1	Meningitis in other fungal diseases
	324	CNS abcess
	325	Phlebitis of intracranial sinus
	360	Purulent endophthalmitis
	376	Acute inflammation of orbit
	380.14	Malignant otitis externa
	383	Acute mastoiditis
Circulatory	420.99	Acute pericarditis due to other specified organisms
	421	Acute or subacute endocarditis
Respiratory	461	Acute sinusitis
	462	Acute pharyngitis
	463	Acute tonsillitis
	464	Acute laryngitis/tracheitis
	465	Acute upper respiratory infection of multiple sites/not otherwise specified
	475	Peritonsillar abscess
	481	Pneumococcal pneumonia
	482	Other bacterial pneumonia
	485	Bronchopneumonia with organism not otherwise specified
	486	Pneumonia, organism not otherwise specified
	491.21	Acute exacerbation of obstructive chronic bronchitis
	494	Bronchiectasis
	510	Empyema
	513	Abscess of lung and mediastinum
Digestive	522.5	Periapical abscess without sinus
	522.7	Periapical abscess with sinus
	526.4	Inflammatory conditions of the jaw
	527.3	Abscess of the salivary glands
	528.3	Cellulitis and abscess of oral soft tissue
	540	Acute appendicitis
	541	Appendicitis not otherwise specified
	542	Other appendicitis
	562.01	Diverticulitis of the small intestine without hemorrhage
	562.03	Diverticulitis of the small intestine with hemorrhage

Infection Category	ICD-9 Code	ICD-9 Code Description
	562.11	Diverticulitis of colon without hemorrhage
	562.13	Diverticulitis of colon with hemorrhage
	566	Abscess of the anal and rectal regions
	567	Peritonitis
	569.5	Intestinal abscess
	569.61	Infection of colostomy or enterostomy
	569.83	Perforation of intestine
	572	Abscess of liver
	572.1	Portal pyemia
	575	Acute cholecystitis
Genitourinary	590	Kidney infection
	599	Urinary tract infection not otherwise specified
	601	Prostatic inflammation
	604	Orchitis and epididymitis
	614	Female pelvic inflammation disease
	615	Uterine inflammatory disease
	616.3	Abscess of Bartholin’s gland
	616.4	Other abscess of vulva
Pregnancy	634	Spontaneous abortion, complicated by genital tract and pelvic infection
	635	Legally induced abortion, complicated by genital tract and pelvic infection
	636	Illegally induced abortion, complicated by genital tract and pelvic infection
	637	Unspecified abortion, complicated by genital tract and pelvic infection
	638	Failed attempted abortion, complicated by genital tract and pelvic infection
	639	Complications following abortion and ectopic and molar pregnancies
	646.6	Infections of genitourinary tract in pregnancy
	658.4	Infection of amniotic cavity
	670	Major puerperal infection
	675.1	Abscess of breast
Skin	681	Cellulitis, finger/toe
	682	Other cellulitis or abscess
	683	Acute lymphadenitis
	685	Pilonidal cyst, with abscess