

By Daniel J. Pallin, Matthew B. Allen, Janice A. Espinola, Carlos A. Camargo Jr., and J. Stephen Bohan

DOI: 10.1377/hlthaff.2012.0951
HEALTH AFFAIRS 32,
NO. 7 (2013): 1306–1312
©2013 Project HOPE—
The People-to-People Health
Foundation, Inc.

THE CARE SPAN

Population Aging And Emergency Departments: Visits Will Not Increase, Lengths-Of-Stay And Hospitalizations Will

Daniel J. Pallin (dpallin@partners.org) is director of research in the Department of Emergency Medicine at Brigham and Women's Hospital, in Boston, Massachusetts.

Matthew B. Allen is a medical student at the Perelman School of Medicine, University of Pennsylvania, in Philadelphia.

Janice A. Espinola is a biostatistician/epidemiologist in the Department of Emergency Medicine, Massachusetts General Hospital, in Boston.

Carlos A. Camargo Jr. is an attending physician in the Department of Emergency Medicine, Massachusetts General Hospital.

J. Stephen Bohan is an attending physician in the Department of Emergency Medicine, Brigham and Women's Hospital.

ABSTRACT With US emergency care characterized as “at the breaking point,” we studied how the aging of the US population would affect demand for emergency department (ED) services and hospitalizations in the coming decades. We applied current age-specific ED visit rates to the population structure anticipated by the Census Bureau to exist through 2050. Our results indicate that the aging of the population will not cause the number of ED visits to increase any more than would be expected from population growth. However, the data do predict increases in visit lengths and the likelihood of hospitalization. As a result, the aggregate amount of time patients spend in EDs nationwide will increase 10 percent faster than population growth. This means that ED capacity will have to increase by 10 percent, even without an increase in the number of visits. Hospital admissions from the ED will increase 23 percent faster than population growth, which will require hospitals to expand capacity faster than required by raw population growth alone.

The annual frequency of US emergency department (ED) visits is increasing faster than the rate of population growth.¹ The population grew by 15 percent from 1997 to 2009, while annual ED visits increased by 43 percent—almost three times faster.² The Institute of Medicine described emergency care in the United States as being “at the breaking point.”³

EDs are important for catastrophes, but they also account for a large and increasing part of noncatastrophic outpatient care—now more than 28 percent of all acute care visits.⁴ About 44 percent of all hospitalizations originate in the ED, and this number is increasing.⁵

ED overcrowding is associated with inefficient and unsafe care.⁶ Overcrowding results from more frequent ED visits, but it is also affected by visit duration and delays in movement of admitted patients into the hospital. Patients in this

status are known as “boarders.” Boarding contributes not only to overcrowding but also to poor-quality care.⁷

A threat that looms behind the crisis in emergency care is the fact that the US population is aging. Today 13 percent of US residents are age sixty-five or older; by 2030 approximately 23 percent of the population will be in that age bracket.⁸ Their number will surpass seventy million by 2030.⁹ Visits by older patients are viewed as a driving force in demand for emergency care. The population ages 65–74 is expected to increase from 18.3 million in 2003 to 24.4 million in 2013, and annual ED visits by this group alone would increase from 6.4 million to 11.7 million.^{10–13} The studies producing these data have concluded that population aging could have catastrophic effects on overcrowding.

To date, research has been based on analysis of limited age groups, such as the group ages 65–74

discussed above. However, predicting the total frequency of ED visits and hospitalizations requires analysis of the entire population rather than an isolated age bracket. A ready source of projections of the age structure of the entire US population is provided by the Census Bureau.⁹ For this article, our goal was to use those projections to predict nationwide ED utilization in future decades. We expected to find that the frequency of ED visits would increase faster than expected from numerical population growth alone.

Study Data And Methods

To isolate the effect of aging on demand for ED services, our methodology quantified the number of visits that would occur if the age structure of the US population changed but everything else remained constant.

DATA SOURCES We obtained subgroup-specific visit rates from the National Hospital Ambulatory Medical Care Survey, a representative random sample of all nonfederal ED visits in the United States.¹⁴ We obtained data on the current and expected age and racial makeup of the population from the Census Bureau.⁹ We then categorized people into five-year age intervals and by race. It was necessary to include race in the analysis to account for well-known differences in ED use by race, with blacks more likely to visit the ED than whites.¹³

METHODS We used 2009 as our baseline, to determine ED use for each age and race subgroup. We then applied these visit rates to the population expected to exist in future years. Our main outcome measure was the ratio of the rate of increase in ED visits to the rate of increase in total population, and our hypothesis was that this ratio would be greater than 1, indicating that the demand for ED services by an aging population would cause aggregate visit frequency to increase faster than the size of the population.

Next, we predicted the number of ED-to-hospital admissions by applying hospitalization rates observed during 1993–2009 to the visit counts predicted for future years, by subgroup. We also estimated the total amount of time that patients would spend in EDs, given that the elderly present with more complex problems and typically have longer visits.¹² We refer to the total time spent by patients in EDs throughout the country as “aggregate visit length.” We calculated the length of each visit as the total length-of-stay minus waiting time. We derived subgroup-specific values from the period 2003–09, the years for which these data were available.

In a secondary analysis, we predicted the demand for ED services in the event that the visit

rate by people of given ages continued to increase over the coming years, as it has done during the past two decades. To achieve this, we applied the subgroup-specific rate of increase in ED visits seen during 1993–2009 to our projections for 2015–50. This yielded an estimate that accounted for both demographic change and continued increases in people’s likelihood of visiting the ED.

Our Institutional Review Board exempted this study from review. We used Stata 11.2 and Microsoft Excel for all analyses.

LIMITATIONS The principal limitation of our investigation was its scope. We sought only to estimate the number of visits attributable to aging, all other things being equal. As an example, our analysis suggests that inpatient hospital capacity will have to grow 23 percent faster than the rate of population growth. This observation is limited in its scope to hospitalizations that originate from the ED, and it does not consider changes in hospitalizations that do not begin in the ED. For example, hospitalizations from sources other than the ED could increase if joint replacement surgery became more common, but they could decrease if hospitalizations for childbirth became less common.

Another important limitation is the possibility that the projections of the Census Bureau are incorrect. For example, if fertility declines faster than expected, there will be fewer visits, but if immigration restrictions are loosened, there will be more visits.

A minor limitation is that we classified race as white, black, or other, because no finer stratification was possible as a result of discrepancies in race and ethnicity classification in the two data sources. More precise estimates could be obtained if we could also stratify by Hispanic ethnicity.

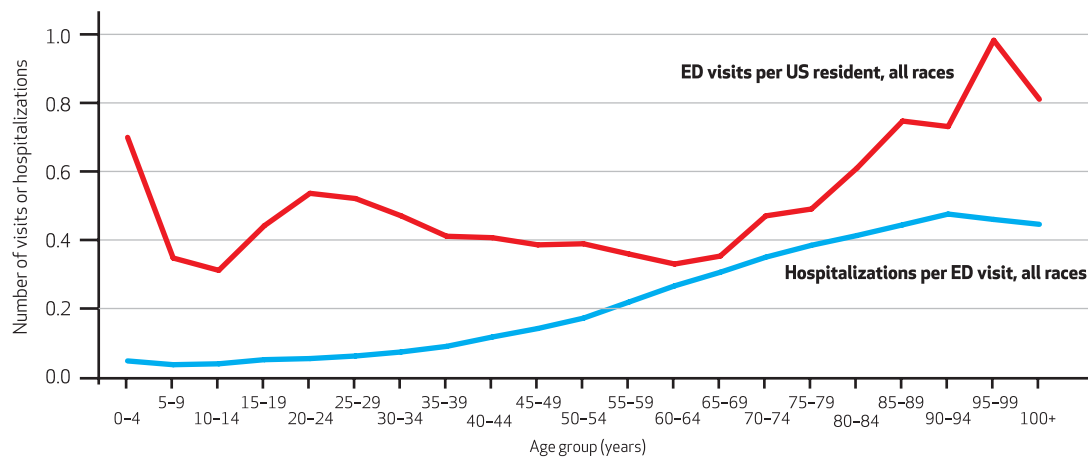
Study Results

AGE-SPECIFIC USE RATES The relationship of age to visit rate is not linear but rather has three peaks: infancy, young adulthood, and advanced old age (Exhibit 1). Each year there are 7 ED visits for every 10 children ages 0–4, 5.4 visits for every 10 adults ages 20–24, and 10 visits for every 10 adults ages 95–99.

Most notable is the fact that adults ages 60–80, who are the most numerous older Americans, are not heavy users of the ED. For example, there are only 3.5 visits per year for every 10 adults ages 65–69. Those older than 80 make up only 3.7 percent of the population; thus, although the very old are more likely than other older adults to visit the ED, they do not account for a large number of visits.⁹

EXHIBIT 1

Current Emergency Department (ED) Use And ED-To-Hospital Admissions, By Age Group, 2009



SOURCES National Center for Health Statistics, National Hospital Ambulatory Medical Care Survey (NHAMCS, Note 2 in text); and Bureau of the Census (Note 9 in text). **NOTES** Numerators for each visit rate were derived from the 2009 NHAMCS. Denominators were derived from the Census Bureau's intercensal estimates for 2009. Hospitalization rates were calculated from NHAMCS 1993-2009.

Exhibit 1 also displays the relationship of age to the likelihood of hospital admission after an ED visit, revealing a steady increase. The older an ED patient is, the more likely he or she is to be hospitalized. About 10 percent of ED visits by small children end in hospitalization, compared with almost 50 percent for the oldest patients.

LENGTH OF VISITS Exhibit 2 details the relationship of age to the length of ED visits and reveals a steady increase in visit length with in-

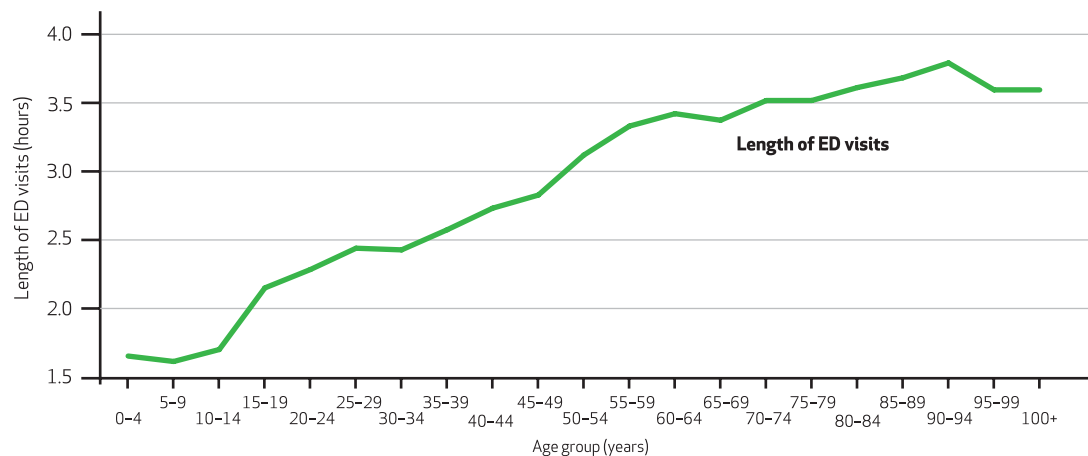
creasing age. The mean visit length for small children is about 1.6 hours, versus more than 3.5 hours for the oldest patients.

EFFECTS OF RACE The online Appendix provides ED visit rates stratified by race (white, black, and other).¹⁵ It confirms that blacks visit the ED more than whites do, per capita.

FUTURE PROJECTIONS Our main results are displayed in Exhibit 3. The Census Bureau projects that the population will grow from 307 mil-

EXHIBIT 2

Emergency Department (ED) Visit Lengths, By Age Group, 2009



SOURCES National Center for Health Statistics, National Hospital Ambulatory Medical Care Survey (NHAMCS, Note 2 in text); and Bureau of the Census (Note 9 in text). **NOTE** Subgroup-specific lengths of ED visits were derived from NHAMCS 2003-2009, calculated as total ED visit length minus waiting time.

lion in 2009 to 439 million in 2050—a growth factor of 1.4. Our projections suggest that ED visits will increase from 136 million to 197 million—also a factor of 1.4. Thus, the annual number of visits will increase at exactly the same rate as the population, at a ratio of 1.0, refuting our initial hypothesis.

Exhibit 3 projects that hospital admissions from the ED will increase from 19 million to 33 million per year—a factor of 1.8. This is 1.23 times faster than population growth, reflecting the strong linear association of age and likelihood of hospitalization, discussed above. This implies that more hospital beds will be needed, as a result of the increase in hospitalizations from the ED alone and not considering hospitalizations from other sources.

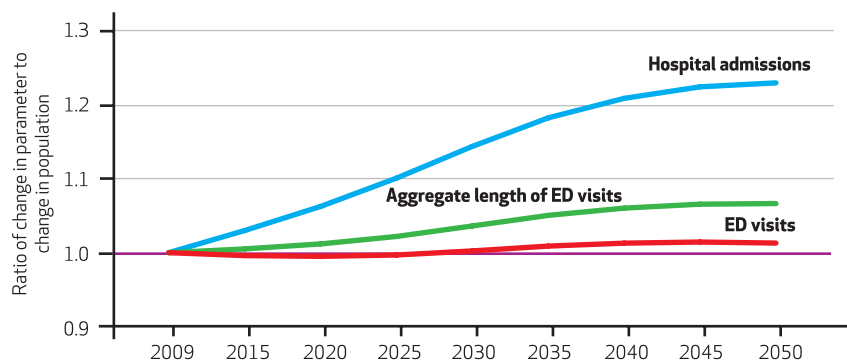
Finally, our data suggest that aggregate visit length (that is, the total number of hours people spend in EDs nationwide) will increase from 337 million to 515 million patient hours—a factor of 1.5 (Exhibit 3), or 1.1 times greater than the increase in population.

Exhibit 4 shows the results of our secondary analysis, in which we predicted total visits under the assumption that subgroup-specific visit rates would continue to increase as they did during 1993–2009. In reality, we do not know if the increase in visits seen in recent years will continue, be attenuated, or even reverse. Thus, this secondary analysis should be viewed as speculative. During 1993–2009 the number of visits increased from 90 million to 136 million per year—a factor of 1.5. Meanwhile, the population increased from 258 million to 307 million—a factor of 1.2. The ratio of change in visit frequency to change in population during 1993–2009 was thus 1.3. Under the assumption that subgroup-specific visit rates will continue to increase at this rate, aggregate visit frequency would increase from 136 million per year in 2009 to 260 million per year in 2050—a factor of 1.9. This is 1.3 times the predicted rate of population growth. This means that we would need to have 30 percent more ED beds per capita by 2050. Under this same scenario, we predict that aggregate visit length would increase by a factor of 2.1—that is, 1.4 times faster than the population’s increase. Taking both effects together produces a combined estimate of 1.82; this means that per capita ED services would need to increase by 82 percent under these assumptions.

For all of the exhibits presented in this article, the detailed data underlying the figures are available in the Appendix.¹⁵

EXHIBIT 3

Changes In Emergency Department (ED) Visit Frequency, Aggregate Length Of ED Visits, And ED-To-Hospital Admissions, 2009-50, As A Ratio To Change In Population



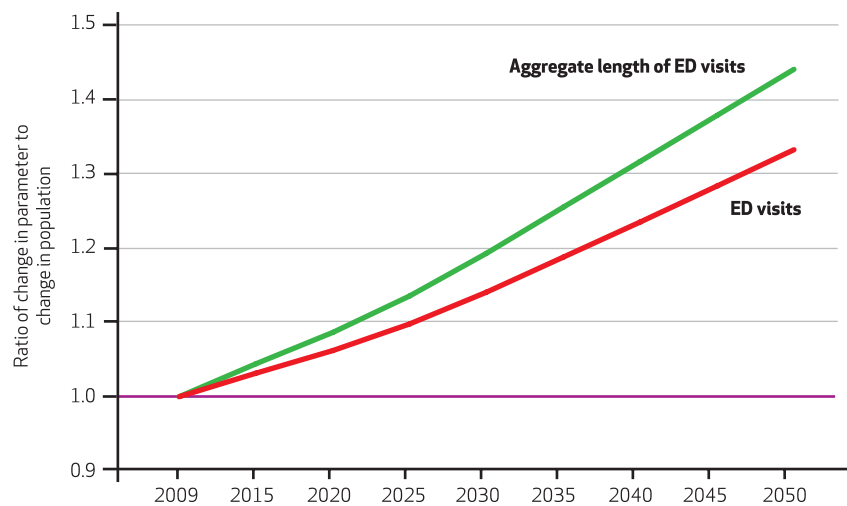
SOURCES National Center for Health Statistics, National Hospital Ambulatory Medical Care Survey (NHAMCS, Note 2 in text); and Bureau of the Census (Note 9 in text). **NOTES** At each future time point, the change in each parameter relative to 2009 is compared to the change in population. As discussed in the text, the increase in hospital admissions is not due to shifting of admissions from other sources to ED-to-hospital admissions but rather constitutes new hospital admissions, as a result of the aging of the population.

Discussion And Implications

The Institute of Medicine’s report stating that US emergency care is “at the breaking point” cited recent increases in visit rates; however, it did not consider the possibility of a surge in visits resulting from the aging of the population.³ Several prior studies observed that the elderly use the ED frequently and that visit rates among the elderly have been increasing over time.^{10–13} This led to concern that population aging in and of itself

EXHIBIT 4

Changes In Emergency Department (ED) Visit Frequency And Aggregate Length Of ED Visits, 2009-50, As A Ratio To Change In Population, Assuming That Subgroup-Specific ED Visit Rates Continue To Increase As They Did During 1993-2009



SOURCES National Center for Health Statistics, National Hospital Ambulatory Medical Care Survey (NHAMCS, Note 2 in text); and Bureau of the Census (Note 9 in text). **NOTE** The slope of increase was derived from NHAMCS, and the remaining calculations were as described in Exhibits 2 and 3.

could cause ED visit frequency to increase faster than population growth, requiring more per capita emergency care capacity.

Our analysis, which incorporates the age structure and visit rates of the entire population, belies this concern. We observe that it is actually infants and young adults, not the elderly, who account for the largest number of ED visits (Exhibit 1). Although it is true that people older than 80 are most likely to visit the ED, they make up only 3.7 percent of the population and thus contribute little to the total national number of visits.⁹

Yet there is still some cause for concern regarding the impact of the aging population on emergency care. Our analysis predicts that the total amount of time spent by patients in EDs across the country will increase 1.1 times faster than population growth as the population ages. This means that the United States will need 10 percent more ED resources per capita than available today, even without an increase in the number of visits.

For the health care system at large, our most worrisome projection is the increase in ED visits resulting in hospitalization. We found that all other things being equal, demographic change will cause hospitalizations originating in the ED to increase 1.23 times faster than population growth. This means that US hospitals will have to grow faster than population to accommodate this surge. We cannot quantify how much faster, because we did not project hospitalizations from other sources. Moreover, these patients will continue to use ED resources while waiting to move to their hospital rooms. This scenario, known as “boarding,” is a major cause of ED crowding and a threat to patient safety.^{6,7}

Our analysis suggests a large number of new inpatient hospital admissions among ED patients. However, it does not consider admissions that originate from other sources, such as scheduled admissions for joint replacement surgery, heart surgery, cancer treatment, or childbirth. Additionally, aside from the question of new hospitalizations, recent studies have found that hospital admissions that once originated elsewhere are increasingly originating in the ED. In 1993, 33.5 percent of US hospitalizations originated in the ED, but by 2006 this number had risen to 43.8 percent.⁵ This increase provides an additional source of “boarding” patients.

Thus, although we were reassured to find that demographic change would not drive a surge in the number of ED visits, increased visit lengths and numbers of hospitalizations will nevertheless increase future demand for ED services. Our EDs must expand to keep pace, and they must do all they can to increase efficiency and

The United States will need 10 percent more ED resources per capita than available today.

minimize boarding.^{6,16}

In a secondary analysis, we predicted how ED use would increase if subgroup-specific visit rates continued to increase as they did during 1993–2009.² That analysis suggests that ED visits would increase 1.3 times faster than population growth by 2050, necessitating 30 percent more staffed ED beds per capita. Given population growth, a 90 percent increase would be required. This secondary analysis did not consider increased hospitalizations, which would further burden EDs because of boarding.

Our primary investigation, however, was designed to isolate the effect of aging under the assumption that people of a given age would not continue to increase their likelihood of visiting the ED. As discussed, during 1993–2009 ED visits increased 30 percent faster than population growth. We cannot predict whether this trend will continue, but it does seem germane to reflect on possible reasons for this increase. Potential explanations include insurance coverage and access to care, patient preferences, clinician preferences, and legal factors.

Some studies have suggested that poor insurance coverage and access to care might cause people to visit the ED instead of a physician’s office.^{17,18} However, other data indicate that people with a regular source of care were actually more likely to use the ED frequently than those without a primary care physician.¹⁹ Moreover, the proportion of ED visits by the uninsured between 1996 and 2003 remained relatively stable despite a 26 percent overall increase in all visits during that period.²⁰ Enactment of universal insurance coverage in Massachusetts did not decrease ED visit rates.²¹ And although Ontario, Canada, provides universal health insurance, ED visit rates there are nearly identical to those in the United States.²² These data suggest that insurance and access do not explain increasing ED visit rates.²³ Much of the attention surrounding the Affordable Care Act has related to insurance. Regarding ED use, the more important question might be whether office-based providers can im-

1.23

Times faster

Demographic change will cause hospitalizations originating in the emergency department to increase 1.23 times faster than population growth.

Demographic change will not cause ED visits to increase in frequency.

prove their ability to meet patients' needs.²³

Another potential explanation for increasing visit rates may be patients' preferences.^{5,23} If patients are choosing the ED simply because they prefer it to the physician's office, reversing the trend may require incorporation of ED characteristics into physicians' offices. For instance, the "patient-centered medical home" is one primary care paradigm that incorporates some of the features that are natural in emergency medicine, such as same-day access. In one study, same-day clinic access successfully decreased ED utilization.²⁴ Other evidence shows that patients are less likely to use the ED when primary care providers are available outside normal business hours. US primary care doctors, however, are only a third as likely to offer after-hours access as doctors elsewhere, such as in the United Kingdom and the Netherlands.²⁵

Clinicians' preferences may also contribute to recent increases in ED visits.²⁶ It has been noted that office-based physicians view acute care visits as disruptive to their business.²⁷ This surprising observation bears repeating: Doctors find visits by the sick to be inconvenient. This is an understandable result of modern medicine's increasing emphasis on preventive care and chronic disease management, combined with the shortening of the office visit.²³ Changing office-based physicians' preferences may require a broader recognition that an acute care visit is more demanding than a focused chronic care visit and should be reimbursed adequately by third-party

payers. Otherwise, providers may continue to direct acutely ill patients toward the ED.

Office-based providers might also benefit from the support provided by reforms to the health care system, such as accountable care organizations and health information technology. For example, an accountable care organization could provide office providers with video consultation by emergency physicians or other specialists. In parallel, EDs should continue to strive to maximize the efficiency of care—for example, by implementing protocols that can safely reduce the use of expensive diagnostic tests.²⁸

Legal issues are rarely discussed in this context, but they may also explain increasing per capita ED visit rates. In particular, the Emergency Medical Treatment and Active Labor Act of 1986 (the "patient dumping law") made it illegal for an ED to turn away a patient without evaluating him or her and stabilizing any identified conditions.²⁹ Logically, this must favor EDs over offices, which can turn patients away. This discrepancy should be considered in efforts to provide incentives for office-based care. There is also evidence that primary care providers may transfer patients with acute issues to the local ED out of fear of litigation.²³

Conclusion

Demographic change will not cause ED visits to increase in frequency. However, we project that the aggregate duration of ED visits will increase 10 percent by 2050. To keep pace, EDs must expand 10 percent faster than population growth, or emergency care and the process of hospital admission will have to become more efficient.

Our projections also suggest that hospitalizations from the ED will increase 23 percent faster than the anticipated rate of population growth. To keep pace, hospitals would have to grow faster than the population, and they must optimize the movement of admitted ED patients to inpatient units. ■

A version of this article was presented at the Society of Academic Emergency Medicine, Atlanta, Georgia, May 16, 2013. This study received support from a seed grant from the Brigham and Women's Hospital Department of Emergency Medicine.

NOTES

- 1 Tang N, Stein J, Hsia RY, Maselli JH, Gonzales R. Trends and characteristics of US emergency department visits, 1997–2007. *JAMA*. 2010; 304(6):664–70.
- 2 National Center for Health Statistics, Ambulatory and Hospital Care Statistics Branch. Ambulatory health care data [Internet]. Hyattsville (MD): NCHS; 2009 [cited 2013 Jun 5]. Available from: <http://www.cdc.gov/nchs/ahcd.htm>
- 3 Institute of Medicine. Hospital-based emergency care: at the breaking point. Washington (DC): National Academies Press; 2006.
- 4 National Center for Health Statistics. Health, United States, 2011: with special feature on socioeconomic status and health. Hyattsville (MD): NCHS; 2012.
- 5 Schuur JD, Venkatesh AK. The growing role of emergency departments in hospital admissions. *N Engl J Med*. 2012;367(5):391–3.
- 6 Bernstein SL, Aronsky D, Duseja R, Epstein S, Handel D, Hwang U, et al. The effect of emergency department crowding on clinically oriented outcomes. *Acad Emerg Med*. 2009; 16(1):1–10.
- 7 Singer AJ, Thode HC Jr., Viccellio P, Pines JM. The association between length of emergency department boarding and mortality. *Acad Emerg Med*. 2011;18(12):1324–9.
- 8 Vincent GK, Velkoff VA. The next four decades—the older population in the United States: 2010 to 2050. Washington (DC): Bureau of the Census; 2010 May. (Current Population Reports No. P25-1138).
- 9 Bureau of the Census. Population projections by age, sex, race, and Hispanic origin: July 1, 2000–2050. Washington (DC): The Bureau; 2008.
- 10 Strange GR, Chen EH, Sanders AB. Use of emergency departments by elderly patients: projections from a multicenter data base. *Ann Emerg Med*. 1992;21(7):819–24.
- 11 Lowthian JA, Curtis AJ, Jolley DJ, Stoelwinder JU, McNeil JJ, Cameron PA. Demand at the emergency department front door: 10-year trends in presentations. *Med J Aust*. 2012;196:128–32.
- 12 Reeder T, Locascio E, Tucker J, Czaplinski T, Benson N, Meggs W. ED utilization: the effect of changing demographics from 1992 to 2000. *Am J Emerg Med*. 2002;20(7): 583–7.
- 13 Roberts DC, McKay MP, Shaffer A. Increasing rates of emergency department visits for elderly patients in the United States, 1993 to 2003. *Ann Emerg Med*. 2008;51(6):769–74.
- 14 McCaig LF, McLemore T. Plan and operation of the National Hospital Ambulatory Medical Survey. Series 1: programs and collection procedures. *Vital Health Stat 1*. 1994;(34):1–78.
- 15 To access the Appendix, click on the Appendix link in the box to the right of the article online.
- 16 Pitts SR, Pines JM, Handrigan MT, Kellermann AL. National trends in emergency department occupancy, 2001 to 2008: effect of inpatient admissions versus emergency department practice intensity. *Ann Emerg Med*. 2012;60(6):679–86.
- 17 Grumbach K, Keane D, Bindman A. Primary care and public emergency department overcrowding. *Am J Public Health*. 1993;83(3):372–8.
- 18 Afilalo J, Marinovich A, Afilalo M, Colacone A, Leger R, Unger B, et al. Nonurgent emergency department patient characteristics and barriers to primary care. *Acad Emerg Med*. 2004;11(12):1302–10.
- 19 Hunt KA, Weber EJ, Showstack JA, Colby DC, Callahan ML. Characteristics of frequent users of emergency departments. *Ann Emerg Med*. 2006;48(1):1–8.
- 20 Weber EJ, Showstack JA, Hunt KA, Colby DC, Grimes B, Bacchetti P, et al. Are the uninsured responsible for the increase in emergency department visits in the United States? *Ann Emerg Med*. 2008;52(2): 108–15.
- 21 Smulowitz PB, Lipton R, Wharam JF, Adelman L, Weiner SG, Burke L, et al. Emergency department utilization after the implementation of Massachusetts health reform. *Ann Emerg Med*. 2011;58(3):225–34.
- 22 Li G, Lau JT, McCarthy ML, Schull MJ, Vermeulen M, Kelen GD. Emergency department utilization in the United States and Ontario, Canada. *Acad Emerg Med*. 2007; 14(6):582–4.
- 23 Pitts SR, Carrier ER, Rich EC, Kellermann AL. Where Americans get acute care: increasingly, it's not at their doctor's office. *Health Aff (Millwood)*. 2010;29(9):1620–9.
- 24 Reid RJ, Coleman K, Johnson EA, Fishman PA, Hsu C, Soman MP, et al. The Group Health medical home at year two: cost savings, higher patient satisfaction, and less burnout for providers. *Health Aff (Millwood)*. 2010;29(5):835–43.
- 25 O'Malley AS. After-hours access to primary care practices linked with lower emergency department use and less unmet medical need. *Health Aff (Millwood)*. 2013;32(1):175–83.
- 26 Casalino LP. A Martian's prescription for primary care: overhaul the physician's workday. *Health Aff (Millwood)*. 2010;29(5):785–90.
- 27 Berenson RA, Rich EC. US approaches to physician payment: the deconstruction of primary care. *J Gen Intern Med*. 2010;25(6):613–8.
- 28 Stiell IG, Clement CM, McKnight RD, Brison R, Schull MJ, Rowe BH, et al. The Canadian C-spine rule versus the NEXUS low-risk criteria in patients with trauma. *N Engl J Med*. 2003;349(26):2510–8.
- 29 Cross LA. Pressure on the emergency department: the expanding right to medical care. *Ann Emerg Med*. 1992;21(10):1266–72.