

The Changing Profile of Patients Who Used Emergency Department Services in the United States: 1996 to 2005

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Study objective: Because of the vital role of emergency departments (EDs) in the US health care system, it is important to monitor the changes in the patient mix over time to identify existing problems and ways to improve the system. The current study aimed to identify raw and population-adjusted time trends for demographic characteristics, socioeconomic characteristics, access to care, utilization of care, and general health of ED users and heavy ED users.

Methods: Ten years' worth of nationally representative data was derived from the Medical Expenditure Panel Survey, 1996 to 2005. Raw time trends of various patient characteristics for ED users, nonusers, and heavy users were estimated to demonstrate changes in ED patient mix. Population-attributable fraction was used to generate population-adjusted trends that elucidate the net changes in subpopulations' propensities to ED use in relation to those of the general population.

Results: Between 1996 and 2005, the total number of noninstitutionalized individuals who used ED services increased from 34.2 to 40.8 million. That is, the proportion of ED users in the US population increased from 12.7% to 13.8%. Increasing proportions of elderly and those who perceived themselves to be in poor or fair physical health among ED users, particularly heavy users, were found in both raw and population-adjusted trends. Several subpopulations demonstrated increasing levels of ED use after population adjustment: blacks, patients within 100% to 199% of the federal poverty line, patients with only Medicare, patients with greater than or equal to 2 types of insurance, and patients with at least 1 inpatient stay. Decreasing population-adjusted trends were found in the proportions of female patients, Hispanics, patients at greater than or equal to 200% of the federal poverty line, the uninsured, and patients with only private insurance, respectively.

Conclusion: EDs play a larger role in the management of geriatric patients over time. The increasing burden of the aging population in the EDs poses challenges in the training of future emergency physicians, care for older patients, public health insurance, and health care system reform. [Ann Emerg Med. 2009;54:805-810.]

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INTRODUCTION

Background

The use of emergency department (ED) services in the United States has been increasing. According to the National Hospital Ambulatory Medical Care Survey, the total number of ED visits increased from 96.5 to 115.3 million between 1995 and 2005.¹ Changes in certain demographic characteristics may have contributed to this trend; for example, the increasing proportion of persons aged 65 years or older in the United States. The aging of the population implies increased prevalence of chronic diseases that leads to a higher utilization rate of all medical services. Indeed, it was shown that ED visits for patients aged 65 to 74 years increased by 34% between 1993 and 2003.² In addition,

evidence suggested that the rate of ED visits increased more rapidly among blacks than whites.^{2,3} Rural residents may have a lower ED utilization than their urban counterparts, probably because of the geographic distribution of EDs.^{1,4}

Patients' access to the medical care system was also found to affect ED utilization. National Hospital Ambulatory Medical Care Survey 2005 data showed that Medicaid/State Children's Health Insurance Program (SCHIP) insurance was associated with a higher ED visit rate than other insurance types.¹ Also, parents of pediatric patients with Medicaid were more likely to view EDs as their usual source of care.⁵ Several studies demonstrated that the presence of, satisfaction with and effectiveness of a usual source of care

Editor's Capsule Summary

What is already known on this topic

It is indisputable that annual emergency department (ED) visits in the United States have steadily increased for many years. We know less about changes in the kinds of patients accounting for these visits.

What question this addressed

The 1996 to 2005 Medical Expenditure Panel Survey was analyzed to describe changes in the characteristics of patients using the ED during this period.

What this study adds to our knowledge

The use of the ED by the elderly, the poor, and those in poor health has increased to a greater extent than the increase in these groups in the overall population.

How this might change clinical practice

This study will not change practice but will help those planning the kinds of ED resources that will be needed in the future.

(other than EDs) significantly decreased the utilization of EDs.⁶⁻¹⁰

Importance

Because of the vital role of EDs in health care delivery, it is important to monitor changes in the patient mix over time to identify problems and ways for improvement. For example, if the proportion of older and more chronically ill patients among ED users is increasing over time, more staff training in geriatric care is warranted. If more indigent patients are treated, improved financial management may be crucial to some EDs' survival. Consequently, raw time trends of ED patients' characteristics are valuable for efficient ED management.

On the other hand, demonstrating a raw trend in a characteristic of ED users, for example, a higher proportion of Hispanics in 2005 than in 1995, does not necessarily indicate that Hispanics had an increased propensity to using ED services in 2005. Instead, it could be that the proportion of Hispanics had increased in the US population; the increase in the proportion of Hispanics observed among ED users simply mirrored the change in the population. This is particularly important from the perspectives of health policy and health care distribution. If a segment of the US population has an altered propensity to using ED services after adjusting for population changes, it may indicate lapses in appropriate care or access barriers to primary care for this segment. Therefore, it is imperative to obtain population-adjusted trends to better understand health care needs of subpopulations, especially the traditionally underserved ones.

Goals of This Investigation

The objectives of the current study were to estimate raw and population-adjusted trends of ED users' demographic characteristics, socioeconomic characteristics, access to care, utilization of care, and general health level and to identify trends of characteristics of heavy users of ED services.

MATERIALS AND METHODS

The Medical Expenditure Panel Survey data from 1996 to 2005 were used.¹¹ The Medical Expenditure Panel Survey is nationally representative of the civilian noninstitutionalized US population and collected by the Agency for Healthcare Research and Quality in each year since 1996. Various underserved and historically underrepresented subpopulations, for example, blacks, Hispanics, and the poor, are targeted for oversampling in different years. The response rates in 1996 through 2005 range from 61.3% to 70.7%; sample sizes, from 21,571 to 37,418. The household component contains detailed information about sociodemographic characteristics, health, access to care, health care utilization and expenditure, health insurance, and satisfaction with care at both the person and the household levels. Children's information is obtained from parents or guardians.

ED utilization was extracted as the reported total number of ED visits in a year for each subject. Subjects were then grouped into ED users (at least 1 ED visit) and nonusers. Heavy users of ED services were also identified. There has not been a consensus in regard to the definition of heavy ED users. Previous studies used cutoffs of 3,^{12,13} 4,¹⁴⁻¹⁶ and even 12 visits.^{17,18} In the current study, heavy users were those who had 3 or more ED visits in a year, representing the top 5th percentile of ED users in terms of the number of ED visits. In the preliminary analyses, it was found that higher cutoffs resulted in sample sizes of heavy users in some years too small to provide reliable nationally representative estimates.

Demographic characteristics included were whether a subject lived in a Metropolitan Statistical Area as a proxy of rural/urban residency, age, sex, and race/ethnicity. The race/ethnicity variable was constructed as non-Hispanic white, black, Hispanic, and other races. Because there were too few nonwhite Hispanics, a categorization based on the interaction of race and ethnicity was not explored. Hispanics of all races were combined into the Hispanic category, with the majority being white. Socioeconomic characteristics included a subject's poverty level, highest educational achievement, and employment status. In the Medical Expenditure Panel Survey, poverty level was defined according to the percentage of federal poverty level. Three categories of poverty were created in the current study: poor (<100% federal poverty level), near poor or low income (100% to 199% federal poverty level), and middle or high income ($\geq 200\%$ federal poverty level). A subject's highest educational achievement was dichotomized into whether he or she was a high school graduate. Employment status was dichotomized according to whether a subject had a job (or jobs).

Two groups of indicators of access to care were used, health insurance and usual source of care. Health insurance variables were no health insurance, private insurance only, Medicare

only, Medicaid only, other public insurance only, and more than one type of insurance. Whether a subject had a usual source of care was dichotomized. Subjects reporting EDs as their usual source of care were classified as having no usual source of care. In addition, whether a subject reported that their usual source of care had off-hour services was included. The Medical Expenditure Panel Survey 1997 and 1998 did not have information about usual source of care. In addition, although other characteristics of usual source of care were included in the Medical Expenditure Panel Survey, those characteristics were not consistently included in all years, making it impossible to analyze their trends. Consequently, these characteristics were not included in the current study.

A subject's utilization of ambulatory care and inpatient services was included to indicate the intensity of overall health care utilization. As in any care utilization data, the total number of ambulatory visits to office-based or outpatient clinics during a year was highly skewed to the right. Consequently, it was categorized into 3 groups: zero, 1 to 5, and 6 or more visits. The cutoff point at 6 visits represented the 67th percentile of the distribution. Whether a subject had any inpatient stay was included as a dichotomized variable. Health was measured by self-reported overall physical and mental health and injury/accident. The 5-category overall physical health was dichotomized into fair/poor versus excellent/very good/good. The same dichotomization was applied to overall mental health.

PRIMARY DATA ANALYSIS

The annual numbers and percentages of the US population who used EDs were estimated for 1996 through 2005. Among ED users, the proportion of heavy users (≥ 3 ED visits) and the mean number of visits were estimated. For each patient characteristic, a raw time trend was first identified. For example, in each year, the proportion of female users among ED users was estimated. The linear trend of the proportion of female users among ED users between 1996 and 2005 would be the raw trend. An ordinary least squares method was used for the regression of a variable of interest; for example, the proportion of female users, over years. If the slope obtained from the ordinary least squares was significant at $P < .05$, the trend would be deemed statistically significant.

As discussed earlier, the raw trend may simply mirror a change in the population, rather than a change in propensity for ED use. Consequently, population-attributable fraction was used to obtain population-adjusted trends.¹⁹ It was calculated as the ratio of the proportion among ED users to that among nonusers for each year; for example, the proportion of female users among ED users divided by that among nonusers. The linear trend of population-attributable fraction would approximate the changes in the propensity for ED use in the subpopulation of interest. Similarly, raw and population-adjusted trends for heavy users of EDs were obtained.

Statistical software STATA (StataCorp, College Station, TX) was used for all analyses. To provide nationally representative

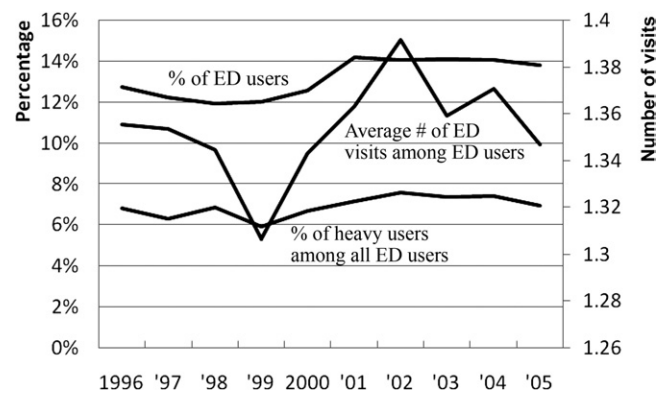


Figure 1. ED service utilization pattern.

estimates, strata, primary sampling units, and person weights were accounted for in all analyses. More detailed information in regard to the statistical analyses performed can be viewed in [Appendix E1](http://www.annemergmed.com) (available online at <http://www.annemergmed.com>).

RESULTS

Between 1996 and 2005, the total number of noninstitutionalized individuals who used ED services increased from 34.2 to 40.8 million. That is, the proportion of ED users in the US population increased from 12.7% to 13.8%. As [Figure 1](#) shows, the largest increase occurred between 1999 and 2001. The continual increase in the proportion of heavy users (number of visits ≥ 3) among ED users occurred between 1999 (5.9%) and 2002 (7.6%).

[Figure 2](#) shows selected raw and population-adjusted trends for patient characteristics of interest among ED users. Interested readers can find the trends for all variables in [Appendix E1](#) (available online at <http://www.annemergmed.com>). Variables that demonstrated significant increasing raw trends were observed in the proportions of older patients; racial and ethnic minorities; patients with only Medicare, only Medicaid, or greater than or equal to 2 types of insurance; patients with at least 1 inpatient stay; and patients with poor/fair physical and mental health, respectively. Significant decreasing raw trends were shown in the proportions of female users, whites, patients with a lower education level, patients who were employed, patients with only private insurance, patients whose usual source of care had off-hour services, and patients with 1 to 5 ambulatory visits, respectively.

Several subpopulations demonstrated significant increasing population-adjusted trends (or population-attributable fractions), that is, increased propensity to ED use over time: older patients, blacks, patients within 100% to 199% federal poverty level, patients with only Medicare, patients with greater than or equal to 2 types of insurance, patients with at least 1 inpatient stay, and patients with poor/fair physical health. Subpopulations with decreasing population-adjusted trends included female users, Hispanics, patients with greater than or equal to 200% federal poverty level, the employed, the uninsured, patients with only private insurance, and patients with 1 to 5 ambulatory visits.

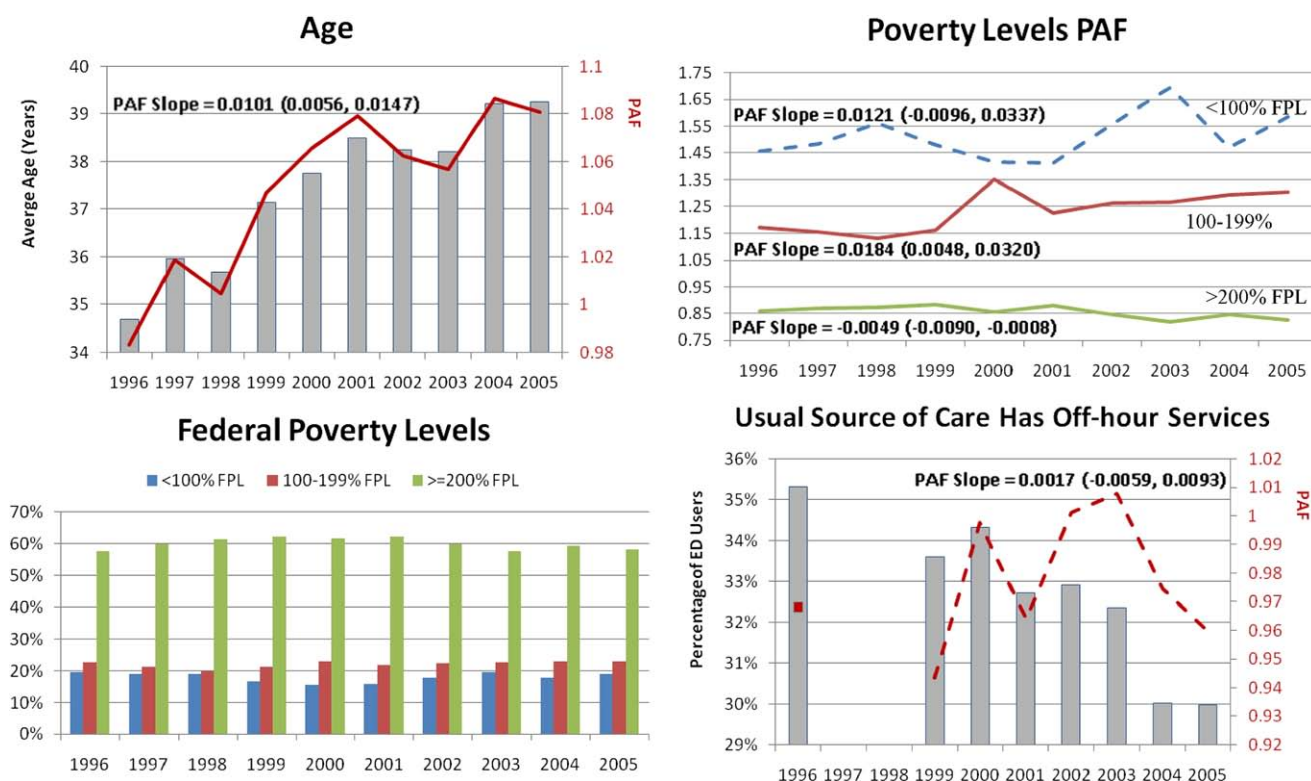


Figure 2. Raw and population-adjusted trends of characteristics of ED users, 1996-2005. Bars show raw trends whereas lines indicate population-adjusted trends. The slopes for population-adjusted trends are shown with their respective 95% CIs. Solid lines for population-adjusted trends indicate statistically significant linear time trends ($P < 0.05$). PAF, Population-adjusted trends; FPL, federal poverty levels.

Graphs of statistically significant raw and population-adjusted trends of characteristics of heavy users of ED services can be found in [Appendix E1](#) (available online at <http://www.annemergmed.com>). Patient characteristics that indicated increasing raw trends were age, other race/ethnicity, having greater than or equal to 2 insurance types, and having at least 1 inpatient stay. Characteristics with decreasing raw trends included being employed, having only private insurance, and usual source of care with off-hour services. With population-attributable fraction adjustment, increasing population-adjusted trends were observed in age, whites, having only Medicare, having greater than or equal to 2 insurance types, and having at least 1 inpatient stay. Decreasing population-adjusted trends were indicated in Hispanics, being employed, and having only private insurance.

LIMITATIONS

The majority of the Medical Expenditure Panel Survey household data are self-reported. Consequently, readers are cautioned to take into consideration all biases inherent in self-report and recall when interpreting the results. As compared with NHAMC, both the Medical Expenditure Panel Survey and the National Health Interview Survey produce only about half of the total number of ED visits estimated by the NHAMC (90.3 million in 1996). Possible explanations included recall error on ED visits followed by hospitalization, a wider scope of

NHAMC (eg, homeless and institutionalized persons), and misclassification of visits when ED was considered a usual source of care.²⁰ Also, no information of differential coding over time was available in the Medical Expenditure Panel Survey. Furthermore, some indicators may have nonlinear trends. This possibility was not pursued in the current study because 10 points of observation may be too small to establish accurate nonlinearity. Lastly, the linear regression method used to establish trends assumes normality of the underlying distribution. Nonlinear and step trends cannot be captured.

DISCUSSION

We found that ED users had become older and those who perceived themselves to be in poor or fair physical health from 1996 to 2005, with and without population adjustment of the trends. A similar observation was made in the raw and adjusted trends of increasing proportion of patients with Medicare. This is consistent with the findings from a previous study using a nationally representative cross-sectional data set.¹⁵ These trends suggest that EDs may play a larger role in geriatric disease management over time. Because we used population-adjusted trends in the analyses, increases in the prevalence rates of various chronic diseases do not seem to be the reasons for these changes. Instead, failure of control at the primary care level, including treatment adherence,

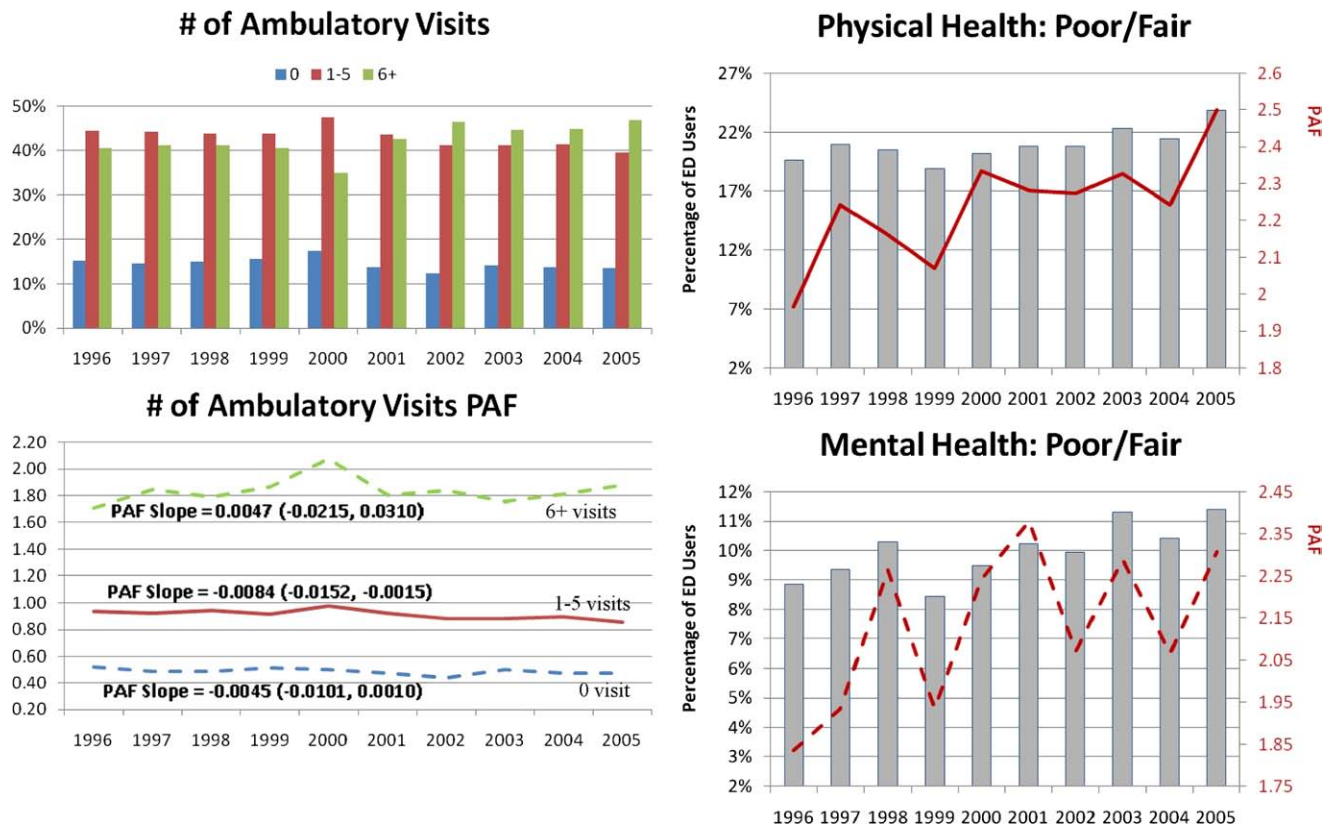


Figure 2. (Cont'd)

increased propensity to care-seeking, and easier access to EDs, may be plausible reasons for these observations.

Weber et al²¹ found no raw trends in various insurance statuses and that individuals of greater than 400% federal poverty level accounted for an increasing portion of ED visits. In contrast, we showed that there were increasing raw trends in Medicare and Medicaid and a decreasing raw trend in private insurance. There are several possible explanations for the differences in the findings. First, the current study included children, whereas Weber et al²¹ did not. Second, the current study used a different classification scheme of insurance. About 20% of the US population has more than 1 type of insurance. The current study consequently created a separate category for more than 1 insurance type, a large proportion of which was individuals with Medicare plus a supplemental insurance plan. The most comparable category between the 2 studies is probably the uninsured group. As did Weber et al,²¹ we found no significant raw trend. The current study further demonstrated that, after adjusting for population changes, however, a decreasing population-attributable fraction trend was observed. It is possible that the observed decreasing population-attributable fractions of the uninsured and the subpopulation with only private insurance, respectively, reflect the age effect. The majority of the uninsured and those with only private insurance are working-age adults (<65 years of age). In contrast, an increasing population-attributable fraction was observed in individuals with Medicare. These findings coincide

with the increasing population-attributable fraction of the age variable. Further studies of these individual subpopulations are needed to investigate whether age or other factors were at play to have generated the observed trends.

No significant population-adjusted trends were observed for the proportion of the poor and that of individuals with only Medicaid between 1996 and 2005, which may reflect the consistent health insurance coverage by Medicaid for this subpopulation during the 10-year period. The results from the current study also confirmed a previous finding that ED users were more likely to be publicly insured¹³ and expanded the finding to show that this pattern has become more apparent recently than 10 years ago.

Moderate use of ambulatory care seemed to be associated with lowered utilization of EDs, and the magnitude of this effect increased from 1996 to 2005. Individuals who were hospitalized were more likely to be ED users and heavy users. As a previous study reported, heavy users of EDs tended to be heavy users of other health services.²² Our study further demonstrated that the disease burden in the EDs associated with aging and the complementation of ED to inpatient service use significantly increased in the last decade. Geriatrics has been a major part of emergency medicine training, with the first suggested curriculum published in 1986,²³ and this focus is accelerating.

There is a methodological merit of using population-adjusted trends in conjunction with raw trends. By examining only raw trends, one would have concluded that there were no significant trends in certain subpopulations; for example, the

uninsured. In certain cases, for example, the proportion of Hispanics, the raw and population-adjusted trends were in opposite directions. These cases highlight the importance of choosing appropriate trend indicators for different purposes. Raw trends are appropriate for the management of EDs. In contrast, population-adjusted trends help to elucidate changes in certain population segments, providing valuable information about barriers to care and inappropriate use of care.

Our study confirmed that the poor and the uninsured are not the main contributing factors for ED crowding in recent years, as found in many previous studies. Future health policies that target improvement of access of the poor and the uninsured through the route of easier ED access will probably have limited effects. In contrast, better management of geriatric patients, who are likely to have a constellation of chronic diseases, may produce better results. In terms of cost containment and disease management of patients, the relationship between primary and ED care perhaps is more similar to that between primary and specialist care than we previously thought, especially as the proportion of the elderly population in the US increases. Ways to achieve efficient chronic disease management, disease prevention, and health promotion at the primary care level are critical in the pursuit of the solution for ED crowding and overutilization.

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Appendix E1. Technical notes.

The trend estimation of the current study was based on point estimates of means or proportions, using 10 years of the Medical Expenditure Panel Survey data. To provide nationally representative means and proportions for each year, special statistical considerations were taken to account for the multiple-stage complex sampling design of the Medical Expenditure Panel Survey. In a simple random sampling design, the sample mean is an unbiased estimator of the population mean. Because of the extreme small probability for any simple random sample to sufficiently represent subpopulations in a large population, for example, the United States, stratification is used in most large surveys. Each stratum represents a subpopulation, for example, women. Probability sampling is then conducted within each stratum. The population mean is calculated as a weighted average.

$$mean = \frac{\sum_{s=1}^S \sum_{i=1}^{n_s} w_{is} x_{is}}{\sum_{s=1}^S \sum_{i=1}^{n_s} w_{is}}$$

s and i stand for strata and subjects, respectively. The 2 main disadvantages of using a stratified sampling method to obtain population mean are that the population frame for each stratum must be known beforehand, and data collection is costly because the selected subjects may be very scattered.

Most large population surveys use multistage sampling to overcome the high cost associated with (stratified) simple random sampling. The entire population is divided into clusters, or the primary sampling units (PSUs); for example, the census districts. The sampling unit in the first stage is the PSU. Within each PSU, a second-stage sampling can be conducted with a smaller sampling unit; for example, a street. The population mean is calculated as a weighted average, with the weight being the inverse of the probability of inclusion. Oversampling of a particular subpopulation can be accommodated by weighting. Because of the complexity of the study design, variances calculated using the formula for stratified simple random samples are underestimated. On the other hand, there are no mathematical formulas for the calculation of the true variances in a multistage complex sampling design. Specialized software empirically produces estimation of variances

with the Taylor Series approach. Examples of the software include SAS, SUDAAN, Stata, and SPSS.

The Medical Expenditure Panel Survey sample is a subsample of previous year's National Health Interview Survey (NHIS). NHIS uses a stratified multistage sampling design for the noninstitutionalized civilian US population. There are 1,995 PSUs (counties or groups of adjacent counties) and 237 strata. The second-stage units are clusters of housing units. The Medical Expenditure Panel Survey Web site provides guidelines in regard to estimation using various statistical software (http://www.meps.ahrq.gov/mepsweb/survey_comp/standard_errors.jsp). The current study followed the statistical guidelines using Stata.

The estimation and the construction of the charts in Figures 1 to 3 are detailed as the following. The variable Female is used as an example. First, the Medical Expenditure Panel Survey 1996 data set was declared as a data set with a multistage sampling design in Stata. This was accomplished by using the "svyset" command to let Stata recognize the variables indicating the PSUs, strata, and weights, as suggested by the Medical Expenditure Panel Survey Web site. Next, the proportions of the female population among the user and nonuser subpopulations were calculated. Then the population-attributable fraction was calculated as the proportion for users divided by that for nonusers. At this point, 3 numbers, the proportion for users, the proportion for nonusers, and the population-attributable fraction, were obtained for 1996. The same procedure was repeated for 1997, 1998, and so on.

To obtain the trend among ED users, we plotted the proportion (of females) against year in Excel 2007 (Microsoft, Redmond, WA), as seen in the chart in Figure 2. We then used ordinary least squares to regress the 10 proportions from 1996 to 2005 throughout their respective years to obtain the slope of the line in the chart. The same regression was then conducted for the 10 proportions among nonusers and the population-attributable fractions. The statistical significance of a trend was indicated by the significance of the regression slope. This was repeated for all variables of interest. For Figure 3, the same procedures were used. The only difference was that heavy users, instead of all ED users, were the subpopulation.

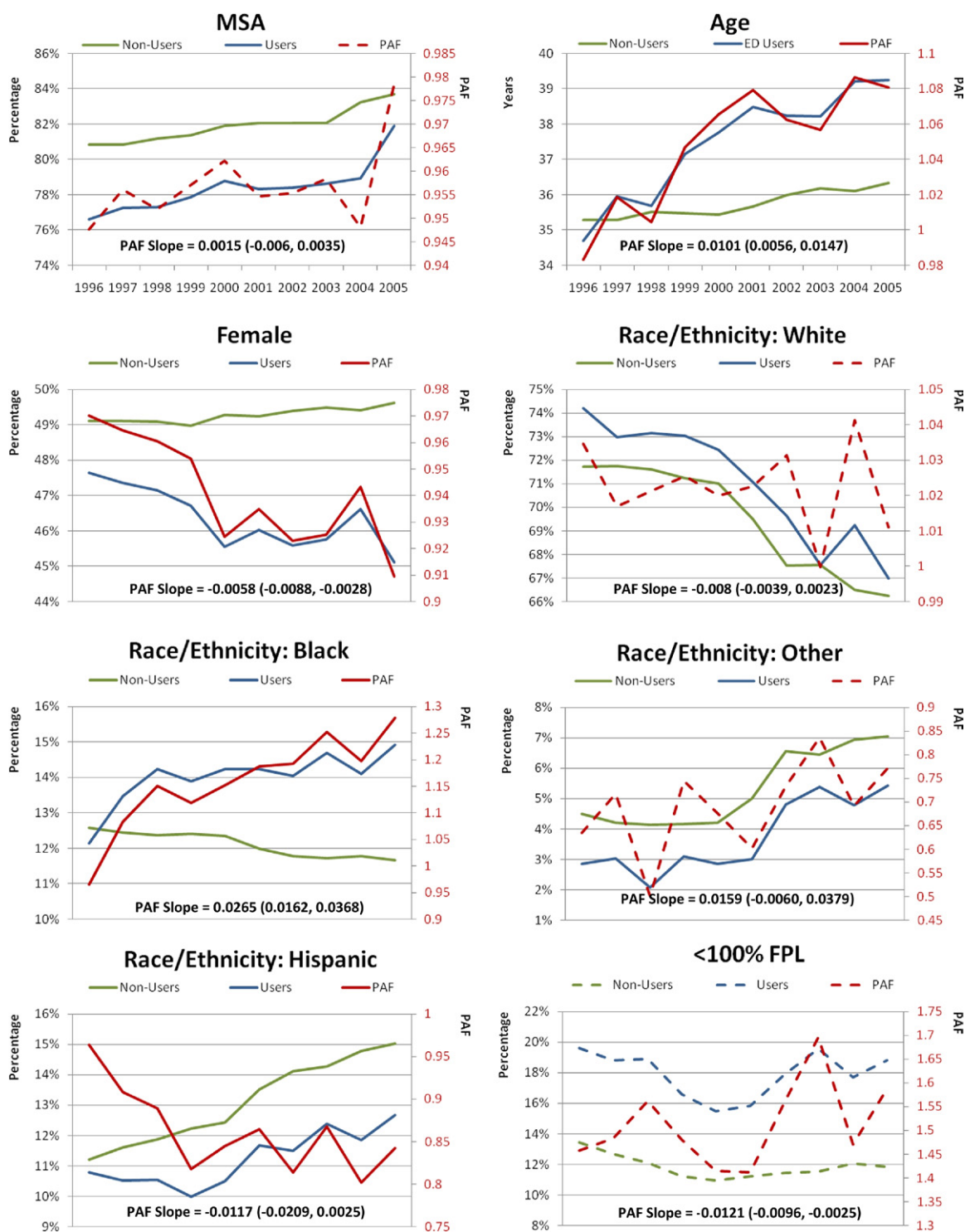


Figure E1. Raw and population-adjusted trends of ED patient characteristics, 1996-2005. Solid lines indicate statistically significant linear time trends ($P < 0.05$). The lines labeled “Users” show raw trends whereas the lines labeled “PAF” indicate population-adjusted trends. The slopes for population-adjusted trends were shown with their respective 95% CIs. The horizontal axis represents time.

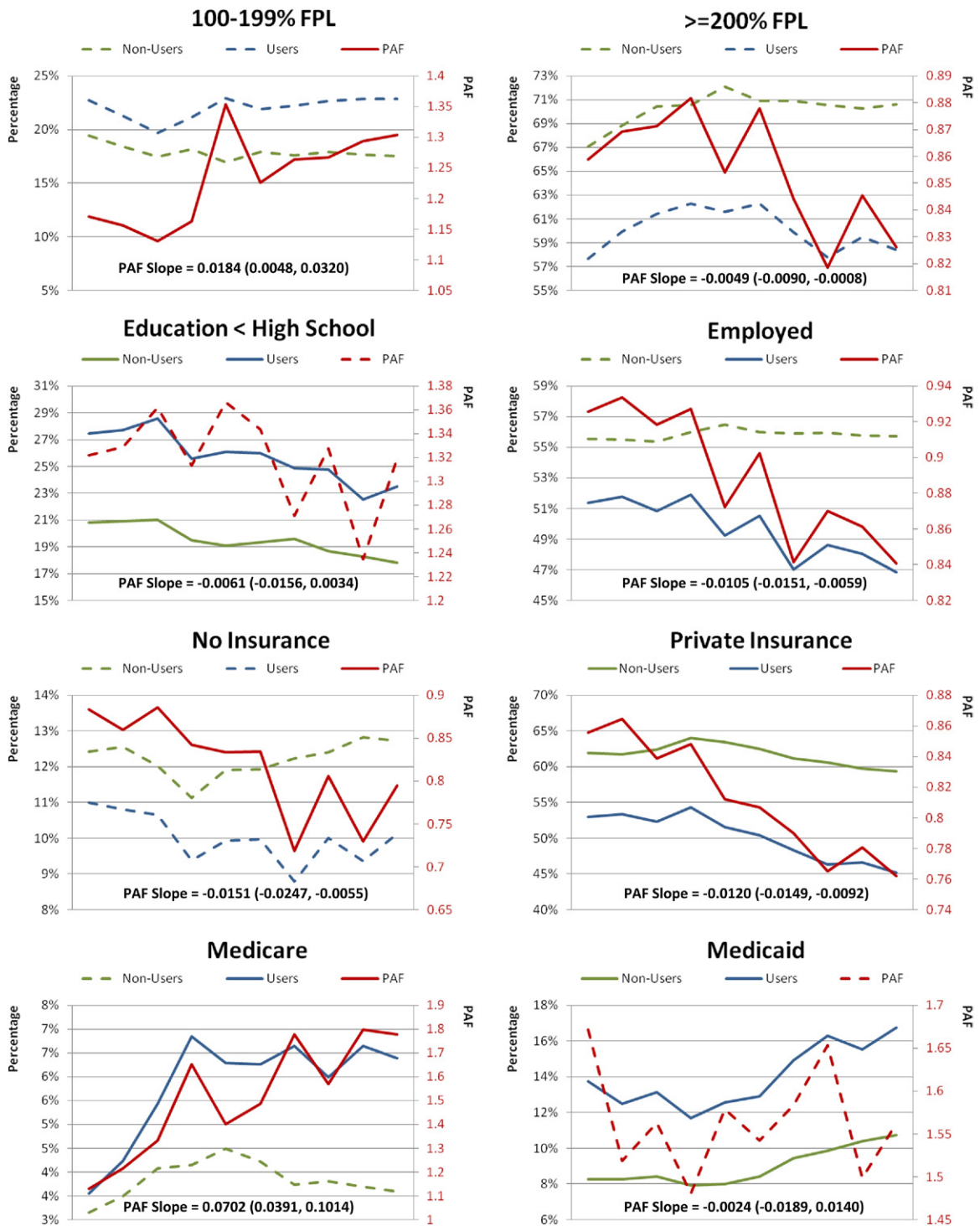


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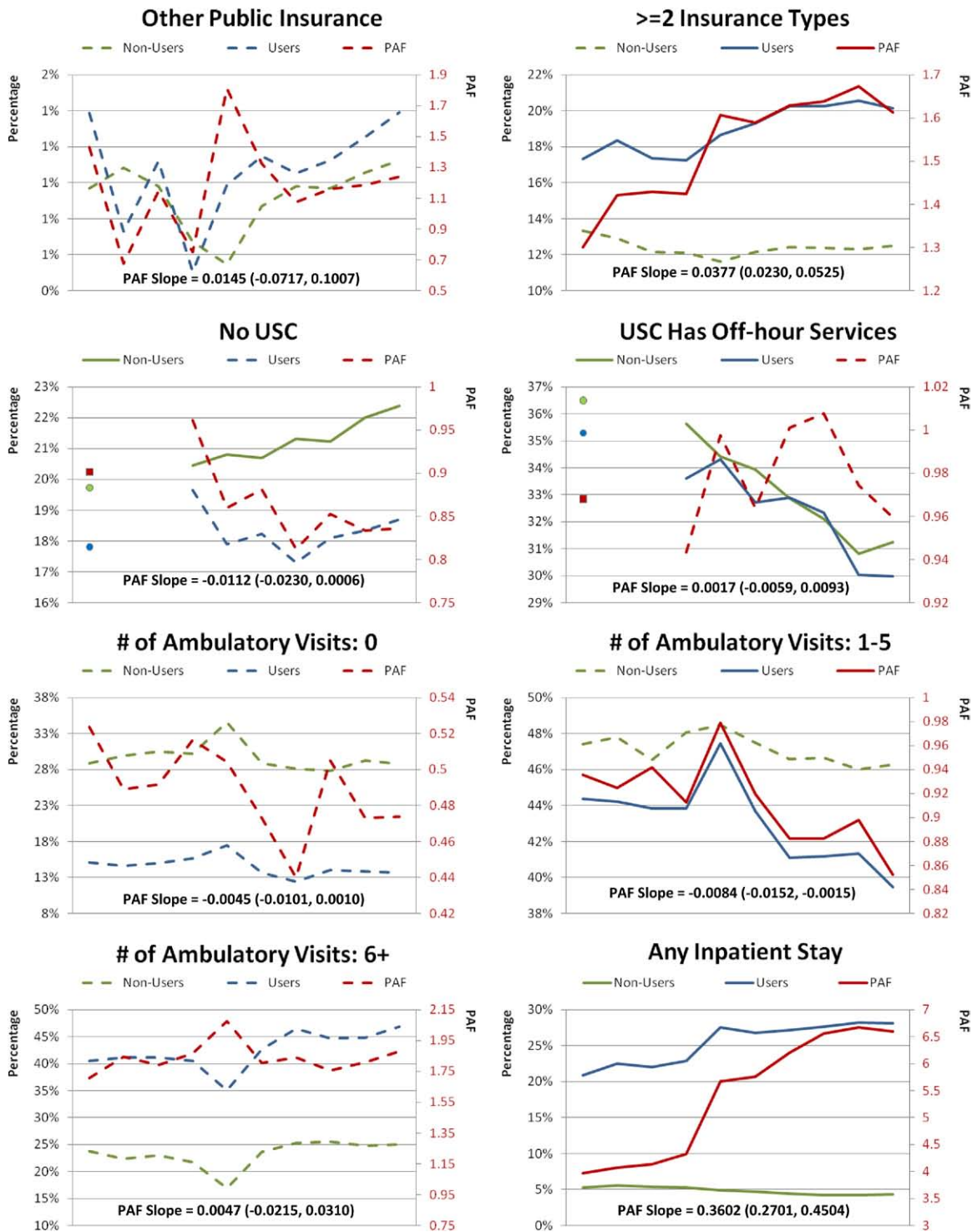


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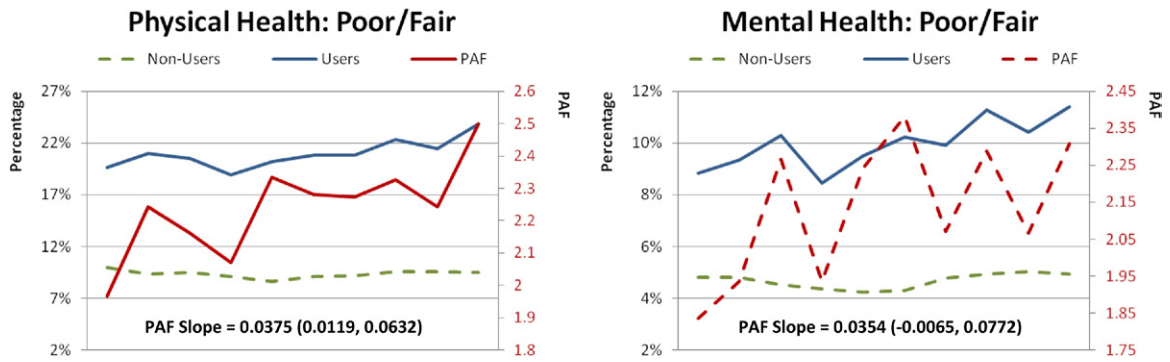


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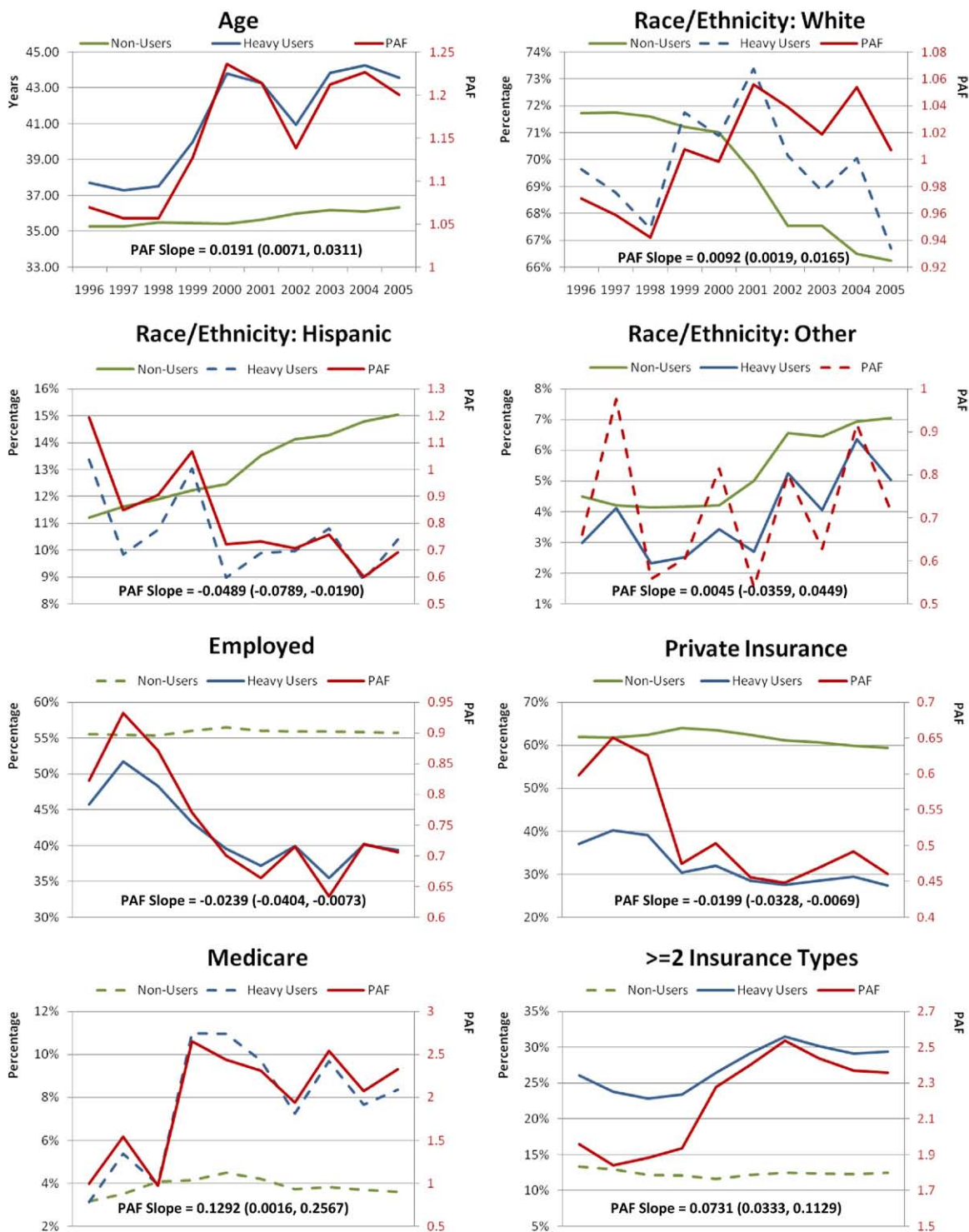


Figure E2. Raw and population-adjusted trends of characteristics of heavy ED service users, 1996-2005. Solid lines indicate statistically significant linear trends ($P < 0.05$). The lines labeled “Heavy Users” show raw trends whereas the lines labeled “PAF” indicate population-adjusted trends. The slopes for population-adjusted trends were shown with their respective 95% CIs. The horizontal axis represents time.

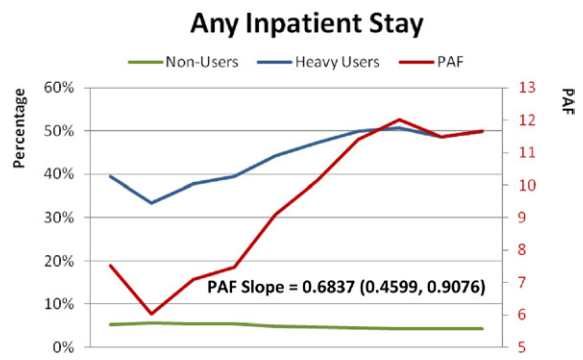
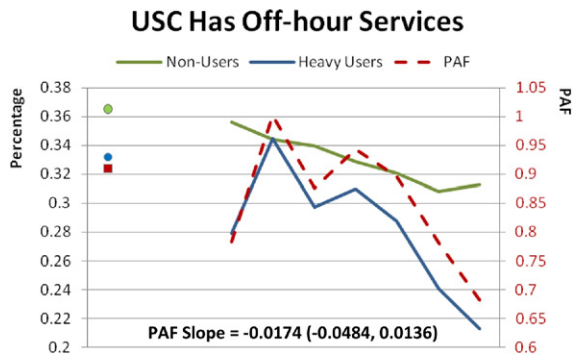


Figure E2. (Cont'd)