Background: Recent studies have documented increases in infectious disease mortality and in the proportion of hospitalizations attributable to infectious diseases. To further evaluate trends in the burden of infectious diseases in the United States, we analyzed data from the National Ambulatory Medical Care Survey from 1980 through 1996.

Objective: To examine the epidemiology of and recent trends in outpatient visits for infectious diseases.

Methods: Data were from a national probability sample of patient visits to office-based physicians. Diagnoses reported by the surveyed physicians were coded to indicate whether they were infectious or noninfectious. Infectious diseases were placed into 11 mutually exclusive categories.

Results: During the course of the survey, infectious diseases accounted for 19.0% of visits to physicians, or an average of 129 million visits per year. The infectious disease visit rate was higher in females than in males (587 vs 461 per 1000 persons per year) and higher in non-Hispanic whites than in non-Hispanic blacks or Hispanics (538 vs 407 vs 485 per 1000 persons per year). The visit rate for infectious diseases was greatest in 0- to 4-year-olds. Upper respiratory tract infections accounted for the largest proportion of visits (38.0% of infectious disease visits), followed by otitis (15.1%) and lower respiratory tract infections (14.1%). The age-adjusted visit rate for infectious diseases increased from 462 visits per 1000 persons (17.5% of all visits) in 1980 to 575 (20.2%) in 1990. From 1990 to 1996, this rate declined to 483 per 1000 (18.1%).

Conclusions: Infectious diseases are responsible for a substantial proportion of outpatient visits to physicians in the United States. Upper respiratory tract infections account for the largest proportion of these visits.

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METHODS

DATA SOURCES

We analyzed data from the NAMCS from 1980 through 1996. The NAMCS is a national probability sample survey that has been conducted by the NCHS in each year between 1980 and 1996 except from 1982 to 1984 and 1986 to 1988. The sampling frame of the survey includes physicians in the American Medical Association and American Osteopathic Association master files who are (1) office based, (2) principally engaged in patient-care activities, (3) not federally employed, and (4) not in the specialties of anesthesiology, pathology, or radiology. Within this frame, physicians are chosen according to a multistage probability sampling design. Chosen physicians are then asked to collect information on a random sample of patient visits during the course of a randomly selected week.

For each visit, the physician or office assistant fills out a 1-page form that includes questions about the patient’s demographic characteristics, the principal diagnosis made at the visit, other diagnoses, tests ordered, and medications prescribed. Information on the forms is then entered into the database by staff at the NCHS, and diagnoses are coded according to the International Classification of Diseases, Ninth Revision (ICD-9). Each visit is assigned a weight equal to the reciprocal of its probability of selection to obtain national estimates.

From 1980 through 1996, between 1354 and 2879 physicians participated in the survey (participation rate, 70% to 74%). Approximately 33 000 to 46 000 visits were sampled in each of the years except 1985, in which 71 954 visits were sampled.

Population data were obtained from the US Bureau of Census. Intercensal or postcensal estimates of the civilian noninstitutionalized population were used in all calculations of rates. The populations of Hawaii and Alaska were removed from the 1980, 1981, and 1985 data, since these states were not included in the surveys performed in those years.

DATA ANALYSIS

Data were analyzed with SAS software (SAS Institute Inc, Cary, NC). Standard errors of point estimates of the number of visits were calculated according to algorithms published in the documentation for the public use data tapes.

Only principal diagnoses were considered in the analyses. All visit records were weighted by using weights supplied on the public use data tapes. Analyses used either (1) the visit rate, expressed as the number of visits per 1000 persons per year, or (2) the visit proportion, expressed as a percentage of all visits that year attributed to the particular diagnosis. Visit rates and visit proportions were compared by means of t test or 1-way analysis of variance, assuming no covariance between the groups. When data from several years were combined to give a single estimate, the SE of this estimate was calculated according to algorithms recommended by the NCHS (Iris M. Shimizu, PhD [ims1@cdc.gov], e-mail, September 26, 1997).

Where indicated, rates were age adjusted to the 1990 census with 1-year age groups by means of the direct method.

Trends were analyzed by using weighted linear regression with a segmented model. The model included the year as the independent variable and the age-adjusted number of visits in each year as the dependent variable. For each year, the point estimate of number of visits was weighted with the inverse of its variance. The model was segmented, allowing the slope before a designated pivot point to be different from that afterward. To decide where to place this pivot point, the point was varied from 1981 to 1995 and the model was fit to the data. The model that produced the lowest residual sum of squares was chosen.

RESULTS

VISITS TO PHYSICIANS

FOR INFECTIOUS DISEASES

During the 11 survey years included in the study, there were an estimated 677 million visits to physicians annually, or 2774 visits per 1000 persons per year. Infectious diseases accounted for 19.0% of these visits, with an average rate of 526 visits per 1000 persons per year. When routine visits (visits for physical examinations or for administrative purposes only) were removed from the database, infectious diseases accounted for 21.2% of all visits.

The overall rate of outpatient visits varied by age group (Figure 1). This rate was lowest in the 5- to 24-year age group and highest in the oldest 2 age groups. In contrast, the infectious diseases visit rate was highest in the youngest age group and decreased with age until the 65- to 84-year age group, after which the visit rate leveled off. In general, the proportion of all visits attributable to infectious diseases decreased with age. Infectious diseases accounted for 45% of all visits in 0- to 4-year-olds but only 15.9% of visits in all other age groups combined.

Visit rates for all diagnoses and visit rates for infectious diseases were higher for females than for males (Table 2, and Figure 2). Compared with the visit rate for males, that for females was 41% higher overall and 27% higher for infectious diseases. For infectious diseases, this difference resulted from disparities in visit rates in the age groups between 5 and 84 years. There was no significant difference in infectious disease visit rates between boys and girls aged 0 to 4 years or between men and women 85 years old and older.

CLASSIFICATION OF ICD-9 CODES

We used a previously described protocol to classify ICD-9 codes according to whether they were infectious or non-infectious. We restricted our analysis to those diagnoses that are always or almost always caused by infectious agents. Infectious diseases were grouped into 10 categories of related conditions (Table 1) that accounted for 94% of all infectious disease visits. A category of “other infectious diseases” was created for the remaining 6% of visits.

DATA ANALYSIS

Data were analyzed with SAS software (SAS Institute Inc, Cary, NC). Standard errors of point estimates of the number of visits were calculated according to algorithms published in the documentation for the public use data tapes.

Only principal diagnoses were considered in the analyses. All visit records were weighted by using weights supplied on the public use data tapes. Analyses used either (1) the visit rate, expressed as the number of visits per 1000 persons per year, or (2) the visit proportion, expressed as a percentage of all visits that year attributed to the particular diagnosis. Visit rates and visit proportions were compared by means of t test or 1-way analysis of variance, assuming no covariance between the groups. When data from several years were combined to give a single estimate, the SE of this estimate was calculated according to algorithms recommended by the NCHS (Iris M. Shimizu, PhD [ims1@cdc.gov], e-mail, September 26, 1997).

Where indicated, rates were age adjusted to the 1990 census with 1-year age groups by means of the direct method.

Trends were analyzed by using weighted linear regression with a segmented model. The model included the year as the independent variable and the age-adjusted number of visits in each year as the dependent variable. For each year, the point estimate of number of visits was weighted with the inverse of its variance. The model was segmented, allowing the slope before a designated pivot point to be different from that afterward. To decide where to place this pivot point, the point was varied from 1981 to 1995 and the model was fit to the data. The model that produced the lowest residual sum of squares was chosen.
Visit rates for all diagnoses and visit rates for infectious diseases were higher in non-Hispanic whites than in non-Hispanic blacks or Hispanics (Table 2, Figure 3). The visit rates for non-Hispanic whites were 41% higher overall and 32% higher for infectious diseases than rates for non-Hispanic blacks. The visit rates among non-Hispanic whites were 43% higher overall and 11% higher for infectious diseases than rates for Hispanics.

TRENDS IN VISITS FOR INFECTIOUS DISEASES

The segmented linear regression model fit the data best when the pivot point was placed at 1990. This model fit the data better than the nonsegmented model (residual sum of squares, 15.8 vs 38.5, \( P = .006 \) for the difference).

Between 1980 and 1990, the visit rate for infectious diseases increased by 2.14% per year (\( P = .006 \), Table 3 and Figure 4). This trend was seen in all age groups and was statistically significant in all but 0- to 4-year-olds. Overall, the proportion of visits attributable to infectious diseases increased from 17.5% to 20.2% (\( P = .003 \) for trend). This increase in proportion of visits attributable to infectious diseases was statistically significant in all but the 2 oldest age groups, in which increases in infectious disease visits were matched by increases in visits for all reasons.

There was a significant decrease in visits for infectious diseases from 1990 to 1996 (2.9% per year; \( P = .03 \); Figure 4), and the proportion of all visits resulting from infectious diseases decreased from 20.2% to 18.1% (\( P = .02 \)). This decrease was significant only in 25- to 44-year-olds and 45- to 64-year-olds.

### Table 1. Classification System for Infectious Diseases

<table>
<thead>
<tr>
<th>Disease Category</th>
<th>ICD-9 Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper respiratory tract</td>
<td>032.0-032.9, 034.0, 101.0, 460.0-465.9</td>
</tr>
<tr>
<td>infections</td>
<td>473.0-473.9, 474.0, 475.0</td>
</tr>
<tr>
<td>Otitis media and externa</td>
<td>380.1, 382.0-382.9, 383.0-383.2, 384.0</td>
</tr>
<tr>
<td>Lower respiratory tract</td>
<td>022.1, 031.0, 033.0-033.9, 466.0-466.1</td>
</tr>
<tr>
<td>infections and influenza</td>
<td>480.0-487.9, 490.0, 510.0-510.9, 511.1, 513.0-513.1, 517.1</td>
</tr>
<tr>
<td>Skin infections</td>
<td>035.0, 053.0-053.9, 078.0-078.1, 079.4, 110.0-111.9, 112.3, 680.0-680.9</td>
</tr>
<tr>
<td></td>
<td>681.0-682.9, 684.0-684.9, 685.0, 686.0-686.9</td>
</tr>
<tr>
<td>Urinary tract infections</td>
<td>590.0-590.9, 595.0, 597.0-597.9, 598.0, 599.0, 646.6</td>
</tr>
<tr>
<td>Other viral infections</td>
<td>045.0-052.9, 054.0, 054.2-066.9, 071.0-076.9, 078.8-079.3, 079.8-790.8</td>
</tr>
<tr>
<td>Eye and eyelid infections</td>
<td>054.4, 077.0-077.9, 380.0, 370.0, 372.2, 372.3, 373.0-373.2, 373.4-373.6</td>
</tr>
<tr>
<td>Vaginitis and cervicitis</td>
<td>112.1, 616.0-616.1</td>
</tr>
<tr>
<td>Sexually transmitted</td>
<td>054.1, 090.0-099.9, 131.0-131.9, 614.0-614.5, 647.0-647.2</td>
</tr>
<tr>
<td>diseases</td>
<td>001.0-009.9, 022.2, 127.0-127.9, 129.0</td>
</tr>
</tbody>
</table>

* ICD-9 indicates International Classification of Diseases, Ninth Revision. Infectious diseases not belonging to any of the above categories were placed in an 11th category, “other infectious diseases.”

### Table 2. Comparison of Visit Rates by Sex and Race

<table>
<thead>
<tr>
<th>Disease Category</th>
<th>Women vs Men</th>
<th>Non-Hispanic Whites vs Non-Hispanic Blacks</th>
<th>Non-Hispanic Whites vs Hispanics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper respiratory tract infections</td>
<td>1.28*</td>
<td>1.35*</td>
<td>1.11†</td>
</tr>
<tr>
<td>Otitis media and externa</td>
<td>0.91†</td>
<td>1.85*</td>
<td>1.05</td>
</tr>
<tr>
<td>Lower respiratory tract infections</td>
<td>1.20*</td>
<td>1.53*</td>
<td>1.08</td>
</tr>
<tr>
<td>and influenza</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin infections</td>
<td>1.04</td>
<td>1.50*</td>
<td>1.48*</td>
</tr>
<tr>
<td>Other infectious diseases</td>
<td>0.94</td>
<td>0.98</td>
<td>1.00</td>
</tr>
<tr>
<td>Urinary tract infections</td>
<td>3.67*</td>
<td>1.09</td>
<td>1.22</td>
</tr>
<tr>
<td>Eye and eyelid infections</td>
<td>1.10</td>
<td>1.41*</td>
<td>1.02</td>
</tr>
<tr>
<td>Vaginitis and cervicitis</td>
<td>Not applicable</td>
<td>0.63*</td>
<td>1.07</td>
</tr>
<tr>
<td>Sexually transmitted diseases</td>
<td>2.05*</td>
<td>0.37*</td>
<td>1.15</td>
</tr>
<tr>
<td>Enteric infections</td>
<td>1.50†</td>
<td>0.99</td>
<td>0.93</td>
</tr>
<tr>
<td>All infectious diseases</td>
<td>1.27*</td>
<td>1.32*</td>
<td>1.11†</td>
</tr>
<tr>
<td>All visits to physicians</td>
<td>1.41*</td>
<td>1.43*</td>
<td></td>
</tr>
</tbody>
</table>

* \( P < .005 \).
† \( P < .05 \).
During the 1990s, visit rates for 6 infectious disease categories decreased: otitis media and externa (P = .02), skin infections (P = .02), urinary tract infections (P = .04), vaginitis and cervicitis (P = .001), sexually transmitted diseases (P = .001), and enteric infections (P = .008). Visits for diagnoses in these categories also decreased as a proportion of all visits (P = .009, .03, .06, <.001, <.001, and .01, respectively).

Of the disease categories, only sexually transmitted diseases declined during this period. The decline in visit rate was not statistically significant, but, because overall visits were increasing during this time, there was a significant decline in the proportion of visits attributable to this category (P = .04).

During the 1980s, significant increases in visit rates were seen in the 3 largest categories of infectious diseases (upper respiratory tract infections [P = .02], otitis media and otitis externa [P = .001], and lower respiratory tract infections [P = .001]) as well as in enteric infections (P = .02; Table 3). Because visits for all 4 of these categories were increasing faster than all visits, the proportion of visits attributable to diseases in these categories also increased significantly.

Of the disease categories, only sexually transmitted diseases declined during this period. The decline in visit rate was not statistically significant, but, because overall visits were increasing during this time, there was a significant decline in the proportion of visits attributable to this category (P = .04).

During the 1990s, visit rates for 6 infectious disease categories decreased: otitis media and externa (P = .02), skin infections (P = .02), urinary tract infections (P = .04), vaginitis and cervicitis (P = .001), sexually transmitted diseases (P = .001), and enteric infections (P = .008). Visits for diagnoses in these categories also decreased as a proportion of all visits (P = .009, .03, .06, <.001, <.001, and .01, respectively).

**COMMENT**

During the years included in this study, infectious diseases accounted for 19.0% of ambulatory visits to office-
Based physicians in the United States, or approximately 129 million visits each year. These measures provide conservative estimates of the impact of infectious diseases on outpatient medicine, because they include only conditions that are always or almost always caused by infectious agents. Numerous conditions that are often a direct result of infectious diseases, especially chronic and neoplastic diseases such as hepatic cirrhosis and cervical cancer, were not examined.

Additionally, certain outpatient visits fall outside the scope of NAMCS. Visits to emergency departments and to hospital-based outpatient clinics are captured in a separate survey, the National Hospital Ambulatory Medical Care Survey, which began in 1992. Examination of the data in the 1995 survey with the use of criteria from this study shows that infectious diseases accounted for 21.5% of the estimated 96.5 million visits to emergency departments and 14.7% of the estimated 67.2 million visits to hospital-based clinics. Government-sponsored health clinics, such as sexually transmitted disease clinics, military clinics, and prison clinics, fall outside the scope of both surveys.

Trends in visits for infectious diseases were not uniform during the course of our study. It is clear that visits for infectious diseases increased slightly from 1980 until the early 1990s and that infectious diseases constituted an increasing proportion of illness seen by outpatient practitioners. But the magnitude of this increase was small compared with that seen for the infectious disease mortality rate or the proportion of hospitalizations for infectious disease.

Infectious disease visits have declined slightly since 1990. The reason for this decline and the increase that preceded it is unclear. Infectious disease visit rates depend not only on the incidence of disease but also on factors such as access to care, current diagnostic practices, and the availability of over-the-counter medications.

Visits for certain categories of infectious diseases declined during the study, most prominently for vaginitis and cervicitis and for sexually transmitted diseases. The decrease in vaginitis and cervicitis mostly reflects a decline in unspecified vaginitis and candidal vaginitis, which accounted for 82.8% of the visits in this category. The decline in outpatient visits for this disorder may be a result of the availability since 1992 of over-the-counter treatments for fungal vaginitis.

The trends in visits for sexually transmitted diseases are more complex and are similar to those documented by the National Notifiable Disease Surveillance System. Visits for gonorrhea declined steadily during the 16 years, a trend that has been attributed to improvements in screening and treatment initiated in the 1970s. Visits for syphilis increased during the late 1980s and declined in the 1990s, a trend that has been attributed by some to the rise and fall in crack cocaine abuse and that, according to national surveillance data, was most prominent in minorities in Eastern cities and in the South.

The NAMCS is a useful component in determining the overall burden of infectious diseases in the United States and in monitoring trends in broad categories of infectious diseases.
infectious diseases. However, 3 factors limit its usefulness in the surveillance of individual diseases. First, the survey is not large enough to provide precise estimates of visits for most specific diseases. Second, the diagnoses used are clinical diagnoses given by the physician at the time of the patient visit and often have not been confirmed by laboratory tests. It is possible that many of the visits attributed to infectious diseases in the survey are actually the result of noninfectious conditions such as allergies that are sometimes clinically indistinguishable from certain infectious diseases. Third, diagnoses in the survey are not assigned according to uniform case definitions.

Three indicators of overall burden of infectious diseases increased during the 1980s: the mortality rate attributable to infectious diseases, the proportion of hospitalizations attributable to infectious diseases, and the rate of ambulatory visits for infectious diseases. Many factors, such as the emergence of acquired immunodeficiency syndrome, the reemergence of tuberculosis, and the increase in antibiotic resistance, probably contributed to this increase. The trends in the 1990s have been different. Ambulatory visits for infectious diseases have declined, while infectious disease mortality may have leveled off (G.L.A. and R.W.P., unpublished data, 1998). Interpretation of these trends is complex, given the diverse, sometimes offsetting factors that influence them—eg, the impact of protease inhibitors on improved survival in persons with acquired immunodeficiency syndrome, increased public health efforts to control tuberculosis, and structural changes in health care delivery that have resulted in trends toward fewer hospitalizations and outpatient visits. It is clear, however, that many dynamic factors continue to promote the emergence of infectious diseases and that trends in the infectious disease burden will probably continue to fluctuate.

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Reprints: Gregory L. Armstrong, MD, Mailstop G-37, 1600 Clifton Rd NE, Atlanta, GA 30333 (e-mail: gca3@cdc.gov).

REFERENCES