

## National Surveillance of Dialysis-Associated Diseases in the United States, 2001

Jerome I. Tokars, Lyn Finelli, Miriam J. Alter, and Matthew J. Arduino

National Center for Infectious Diseases, Centers for Disease Control and Prevention, Department of Health and Human Services, Atlanta, Georgia

### ABSTRACT

In December 2001, all U.S. chronic hemodialysis (HD) centers were surveyed regarding selected patient care practices and dialysis-associated diseases. The results were compared with similar surveys conducted in previous years. During 1997–2001, the percentage of patients vaccinated against hepatitis B virus (HBV) infection increased from 47% to 60% and the percentage of staff vaccinated increased from 87% to 89%. In 2001, an estimated 65% of patients had been vaccinated for influenza and 26% for pneumococcal pneumonia. In 2001, routine testing for antibody to hepatitis C virus (anti-HCV) was performed on staff at 42% of centers and on patients at 62% of centers; anti-HCV was found in 1.5% of staff and 8.6% of patients. In 2001, the incidence of HBV infection was higher among patients in centers where injectable medications were prepared at the dialysis station, and both HCV prevalence and

incidence were higher among patients in centers where injectable medications were prepared at the dialysis station compared to a dedicated medication room. During 1995–2001, the percentage of patients who received dialysis through central catheters increased from 13% to 25%; this trend is worrisome, as infections and antimicrobial use are higher among patients receiving dialysis through catheters. However, during the same period, the percentage of patients receiving dialysis through fistulas increased from 22% to 30%. In 2001, 25% of catheters were used for new patients awaiting an arteriovenous (AV) access, 28% for established patients with a failed access awaiting new AV access, 40% as an access of last resort, and 6% for other reasons, including patient preference. The percentage of centers reporting one or more patients infected or colonized with vancomycin-resistant enterococcus (VRE) increased from 12% in 1995 to 31% in 2001.

The Centers for Disease Control and Prevention (CDC) has been conducting surveillance of hemodialysis (HD)-associated hepatitis since the early 1970s (1), when the CDC reported that the incidence of hepatitis B virus (HBV) infection among patients and staff during 1972–1974 had increased by more than 100%, to 6.2% and 5.2%, respectively. These early surveys had only a 50–65% response rate for centers listed by the National Dialysis Registry. In an effort to obtain a higher response rate, and thus more complete information, the CDC initiated a cooperative program in 1976 with the Health Care Financing Administration (now the Centers for Medicare and Medicaid Services [CMS]) that provided for a questionnaire from the CDC to be included in CMS's annual facility survey. As a result of this collaboration, the response rate to the CDC questionnaire now exceeds 90%.

Since collaboration with the CMS was begun, the CDC survey has been performed for calendar years 1976, 1980, 1982–1997, and 1999–2001 (2–14). HD-associated diseases and practices not related to hepatitis have been included over the years, and the questionnaire is contin-

ually updated to collect data about HD practices and HD-associated diseases of current interest and importance. The objectives of this yearly survey are to (a) determine the frequency with which certain HD practices are used, including measures designed to prevent disease, (b) determine the frequency of HD-associated complications and diseases, and (c) use this information to suggest further measures to prevent complications and disease in HD patients and staff.

### Methods

In conjunction with the annual facility survey performed by the CMS for calendar year 2001, the CDC distributed a questionnaire by mail to all chronic HD centers licensed by the CMS (available at <http://www.cdc.gov/ncidod/hip/dialysis/dialysis.htm>). Approximately 5% of responding centers provided inaccurate or inconsistent answers and were contacted for clarification. The survey covered

1. HD practices, reuse of disposable dialyzers, type of vascular access, and procedures for cleaning and disinfection of dialysis equipment.
2. Use of hepatitis B, pneumococcal pneumonia, and influenza vaccines in patients.
3. The results of testing patients for hepatitis B surface antigen (HBsAg), antibody to HBsAg (anti-HBs), and antibody to hepatitis C virus (anti-HCV).

*Address correspondence to:* Lyn Finelli, DrPH, MS, Centers for Disease Control and Prevention, 1600 Clifton Rd. NE, Mailstop G-37, Atlanta, GA 30333, or e-mail: LFinelli@cdc.gov.  
*Seminars in Dialysis*—Vol 17, No 4 (July–August) 2004 pp. 310–319

4. Whether patients with vancomycin-resistant enterococcus (VRE) or methicillin-resistant *Staphylococcus aureus* (MRSA) were treated during 2001.
5. The number of patients with human immunodeficiency virus (HIV) infection.
6. In staff members, receipt of hepatitis B vaccine and testing for anti-HCV.

Survey questions on hepatitis B vaccination and the prevalence of HIV infection/acquired immune deficiency syndrome (AIDS) were changed for the 1997 and 1999–2001 surveys, and referred only to patients treated or staff members who worked during a 1-week period in December of the survey year (in 2001, this was December 3–8); in previous years the questions referred to patients and staff present in the unit at any time during the year.

In 2001, the incidence of HBV infection was defined as the number of patients who became positive for HBsAg during 2001 divided by the number of patients treated at the facility during December 3–8, 2001; in effect, the number of patients treated during the 1-week period in December 2001 was used as an estimate of the average census at that dialysis center during 2001. Prior to 1999, the denominator for this incidence rate was the total number of patients treated at the facility at any time during the year.

The prevalence rates of chronic HBV infection and immunity were defined as the percentage of all patients or staff present in the facility during December 3–8, 2001, who were positive for HBsAg or anti-HBs, respectively. All patients or staff (regardless of their susceptibility to HBV infection) were included in calculations of the incidence and prevalence of HBV infection.

Information on dialysis center location and ownership was obtained from the CMS End Stage Renal Disease (ESRD) Facility Survey dataset. The results of the 2001 survey were compared to results from previous surveys.

For administrative purposes, the CMS has designated 18 ESRD networks, each composed of one or more U.S. states, districts, or territories (15); to evaluate differences in practices and diseases among centers in different geographic regions, analyses were performed according to the ESRD network.

Proportions were compared with the chi-square or Fisher's exact test; when adjustment for confounding variables was required, the Mantel-Haenszel test or logistic regression was used. Risk factors for HCV incidence and prevalence were evaluated using Poisson regression, controlling for ESRD network with indicator variables and for individual dialysis center by using generalized estimating equations and clustering on dialysis center. All *p* values were two-tailed; a *p* value of less than 0.05 was considered statistically significant.

## Results and Discussion

Questionnaires were returned by 3831 of 4058 centers. These 3831 centers represented 252,739 patients and 58,460 staff members. During 1987–2001, the median number of patients per center increased from 40 to 58 and the median number of staff members per center increased from 12 to 13 (Tables 1 and 2).

During 1985–2001, the percentage of freestanding (i.e., located outside the hospital) centers increased from 56% to 83%, and the percentage of centers operating for profit increased from 46% to 78% (Table 3).

### Dialyzer Reuse

The percentage of centers that reported reuse of disposable dialyzers increased from 18% to 82% during 1976–1997, but declined slightly over the past 4 years to

TABLE 1. Summary: National Surveillance of Dialysis-Associated Diseases, 1995–2001, United States

Category	Unit of measurement	1995	1999	2000	2001
Centers responding to survey	Number of centers	2647	3483	3683	3831
Reuse dialyzers	Percent of centers	77	80	80	76
Total staff, all centers (end of year)	Number of staff	43,465	52,368	55,585	58,460
Hepatitis B vaccination, staff	Percent of staff	82 <sup>a</sup>	88 <sup>a</sup>	88 <sup>a</sup>	89 <sup>a</sup>
Test staff for anti-HCV	Percent of centers	16	36	40	42
Anti-HCV prevalence, staff	Percent of staff	2.0	1.9	1.7	1.5
Total patients, all centers (end of year)	Number of patients	162,970	225,226	241,113	252,739
Vascular access					
Arteriovenous graft	Percent of patients	65	52	48	44
Arteriovenous fistula	Percent of patients	22	26	28	30
Central catheter	Percent of patients	13	22	24	25
Hepatitis B vaccination, patients	Percent of patients	35 <sup>a</sup>	55 <sup>a</sup>	58 <sup>a</sup>	60 <sup>a</sup>
Influenza vaccination, patients	Estimated percentage of patients	—	67	64	65
Pneumococcal pneumonia vaccination, patients	Estimated percentage of patients	—	29	27	26
Test patients for anti-HCV	Percent of centers	39	56	58	62
Anti-HCV prevalence, patients	Percent of patients	10.4	8.9	8.4	8.6
HIV infection	Percent of patients	1.4	1.4	1.5	1.5
AIDS	Percent of patients	0.7	0.5	0.4	0.4
VRE	Percent of centers $\geq$ 1 patient	11.5	34.1	32.7	30.8
MRSA	Percent of centers $\geq$ 1 patient	40	67	71	72

AIDS, acquired immunodeficiency syndrome; anti-HCV, antibody to hepatitis C virus; HIV, human immunodeficiency virus; MRSA, methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant enterococcus.

<sup>a</sup> For 1999–2001, included patients treated or staff members working at the end of the year. For 1995, included patients and staff from throughout the year.

**TABLE 2. Numbers of HD centers, patients, and staff members surveyed, 1985–2001, United States**

Year	No. of centers	Total patients	Median patients per center	Total staff	Median staff per center
1985	1250	62,172	— <sup>a</sup>	20,346	— <sup>a</sup>
1986	1350	67,387	— <sup>a</sup>	21,094	— <sup>a</sup>
1987	1486	74,249	40	22,334	12
1988	1586	80,651	41	23,778	12
1989	1726	90,596	42	26,112	12
1990	1882	101,763	43	29,252	13
1991	2046	116,651	46	33,079	13
1992	2170	128,264	49	36,000	14
1993	2304	135,798	49	37,992	14
1994	2449	149,743	51	40,951	14
1995	2647	162,970	51	43,465	14
1996	2808	177,324	53	47,215	14
1997	3077	195,935	54	50,321	14
1999	3483	225,226	56	52,368	13
2000	3683	241,113	57	55,585	13
2001	3831	252,739	58	58,460	13

The numbers of patients and staff members reflect the numbers present during a 1-week period in December of the year.

<sup>a</sup> Data not available.

76% in 2001 (Fig. 1). Although dialyzer reuse has been implicated in numerous outbreaks of bacteremia and pyrogenic reactions, this practice is safe if performed according to recognized protocols (16,17).

### Methods Used for Reprocessing Dialyzers

During 1983–2001, the percentage of centers using formaldehyde for reprocessing dialyzers decreased from 94% to 29%, while the percentage using a peracetic acid product increased from 5% to 62% (Fig. 2). In 2001, 4% of centers used heat to disinfect dialyzers between reuses.

### Vascular Access Types

During December 3–8, 2001, 44.4% of patients received dialysis through an arteriovenous (AV) graft, 30.4% through an AV fistula, and 24.6% through a temporary or permanent central catheter (Table 4). Since

**TABLE 3. Location and ownership of HD centers, 1985–2001, United States**

Year	Location hospital	Ownership			
		freestanding	Profit	Nonprofit	Government
1985	44	56	46	44	11
1986	42	58	49	41	10
1987	39	61	51	40	9
1988	37	63	53	39	8
1989	35	65	55	38	7
1990	34	66	56	37	7
1991	35	65	56	35	9
1992	33	67	57	34	9
1993	31	69	62	32	6
1994	29	71	62	31	6
1995	27	73	63	30	7
1996	26	74	66	28	6
1997	23	77	70	25	5
1999	20	80	75	21	4
2000	18	82	78	18	4
2001	17	83	78	18	4

Values are the percentage of HD centers in each category.

1995, the percentage of patients receiving dialysis through catheters increased from 12.7% to 24.6%.

Of patients with catheters in 2001, 24.6% were used for new patients awaiting an AV access, 28.3% for established patients with a failed access awaiting a new AV access, 40.5% as an access of last resort, and 6.5% for other reasons, including patient preference.

Among the 18 ESRD networks designated by the CMS, use of fistulas (the most desirable access type) ranged from 23.3% to 43.4% (Table 5). Use of port access devices ranged from 0.0% to 1.5%.

### Use of Pneumococcal Vaccine

In 2001, pneumococcal vaccine was offered to patients at 58.5% of centers, which included 18.3% of centers with less than 25% of patients vaccinated, 8.8% with 25–49% vaccinated, 10.0% with 50–74% vaccinated, 16.3% with ≥75% vaccinated, and 5.1% with the percentage vaccinated unknown. The percentage of patients vaccinated was estimated by assuming that 0% of patients were vaccinated at centers not offering the vaccine, 12.5% were vaccinated at centers with less than 25%

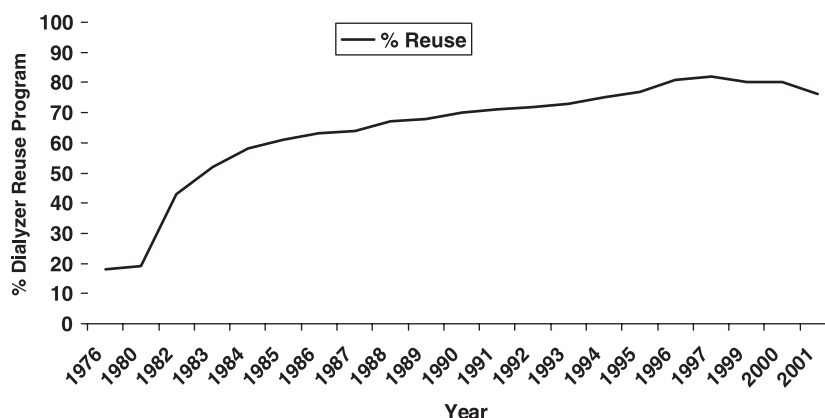


Fig. 1 Hemodialysis centers having dialyzer reuse programs, 1976–2001, United States.

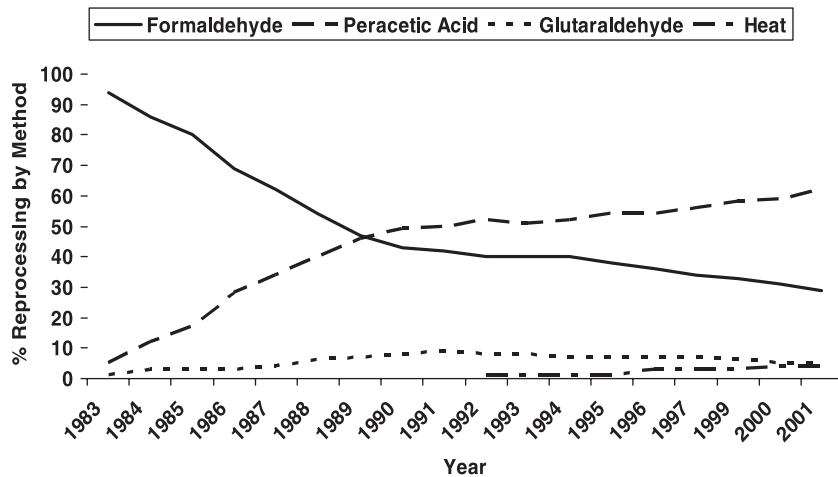


Fig. 2 Methods for reprocessing dialyzers in hemodialysis centers, 1983–2001, United States.

TABLE 4. Types of vascular access used for HD, 1995–2001, United States

Year	Number of patients	Percent of patients receiving dialysis through					Port
		Fistula	Graft	All catheters	Tunneled catheters	Nontunneled catheters	
1995	153,320	22.2	65.1	12.7	— <sup>a</sup>	— <sup>a</sup>	— <sup>a</sup>
1996	176,609	22.1	62.9	14.9	— <sup>a</sup>	— <sup>a</sup>	— <sup>a</sup>
1997	195,588	22.8	59.7	17.5	— <sup>a</sup>	— <sup>a</sup>	— <sup>a</sup>
1999	225,226	26.0	51.9	22.2	19.0	3.2	— <sup>a</sup>
2000	241,113	28.0	48.0	24.0	20.8	3.3	— <sup>a</sup>
2001	252,265	30.4	44.4	24.6	21.7	2.8	0.6

<sup>a</sup> Data not collected.

TABLE 5. Vascular access types by ESRD network, December 2001, United States

ESRD network	States, districts, or territories	No. of patients	Percent of patients receiving dialysis through				Port access device
			Fistula	Graft	Nontunneled catheter	Tunneled catheter	
14	TX	21,414	23.3	57.7	2.7	15.8	0.5
17	AS, GU, HI, CA (northern)	13,055	31.5	49.1	3.4	15.6	0.4
18	CA (southern)	18,854	32.2	47.7	3.1	16.6	0.4
16	AK, ID, MT, OR, WA	6337	43.4	35.9	2.0	18.3	0.4
8	AL, MS, TN	13,246	24.3	55.3	2.9	16.9	0.7
15	AZ, CO, NM, NV, UT, WY	10,827	36.6	39.7	2.2	21.4	0
2	NY	18,974	37.9	38.3	2.2	21.0	0.5
6	GA, NC, SC	23,455	27.4	46.5	2.5	22.2	0.9
5	DC, MD, VA, WV	15,638	24.8	49.3	3.6	21.6	0.7
1	CT, MA, ME, NH, RI, VT	8881	42.2	31.0	1.5	24.8	0.6
10	IL	10,423	30.7	41.5	4.0	23.5	0.3
13	AR, LA, OK	11,058	24.4	48.9	3.4	21.8	1.5
11	MI, MN, ND, SD, WI	15,515	29	42.5	2.5	25.0	0.7
12	IA, KS, MO, NE	8502	30.3	41.5	1.9	24.9	1.3
7	FL	15,029	32.4	38.0	2.7	26.0	0.5
3	NJ, PR	11,225	32.3	37.8	6.2	23.7	0.1
4	DE, PA	12,186	30.9	38.8	2.4	27.3	0.6
9	IN, KY, OH	18,161	28.4	40.3	2.3	28.5	0.4
20	All	252,780	30.4	44.4	2.9	21.7	0.6

AS, American Samoa; GU, Guam.

Rows are sorted by total catheters (= nontunneled + tunneled + port access device).

vaccinated, 37.5% at centers with 25–49% vaccinated, 67.5% at centers with 50–74% vaccinated, and 87.5% at centers with ≥75% vaccinated. Overall the estimated percentage vaccinated was 26.2% (range 9.9–38.7% among the ESRD networks) (Table 6).

### Use of Influenza Vaccine

In 2001, influenza vaccine was offered to patients at 90.6% of centers, which included 5.5% of centers with less than 25% of patients vaccinated, 11.1% with 25–49%

TABLE 6. Use of pneumococcal vaccine in patients by ESRD network, 2001, United States

ESRD network	States, districts, or territories	No. of centers	Offer vaccine to patients (% of centers)	Estimated percentage of patients vaccinated
17	AS, GU, HI, CA (northern)	140	30.0	9.9
18	CA (southern)	193	32.6	11.5
6	GA, NC, SC	371	52.6	22.3
7	FL	264	57.6	22.3
3	NJ, PR	115	55.7	23.4
5	DC, MD, VA, WV	278	54.7	24.2
8	AL, MS, TN	249	58.2	25.3
14	TX	322	65.5	26.7
10	IL	121	61.2	26.8
1	CT, MA, ME, NH, RI, VT	126	62.7	27.2
15	AZ, CO, NM, NV, UT, WY	177	49.2	27.2
2	NY	221	64.3	29.8
4	DE, PA	201	61.7	29.8
16	AK, ID, MT, OR, WA	120	59.2	30.2
9	IN, KY, OH	242	69.0	35.3
13	AR, LA, OK	232	63.8	35.4
12	IA, KS, MO, NE	186	64.5	36.9
11	MI, MN, ND, SD, WI	269	75.8	38.7
	All	3827	58.5	26.2

AS, American Samoa; GU, Guam.

Rows are sorted by the estimated percentage of patients vaccinated.

vaccinated, 24.5% with 50–74% vaccinated, 57.8% with  $\geq 75\%$  vaccinated, and 1.0% with the percentage vaccinated unknown (Table 7). The percentage of patients vaccinated was estimated using the method outlined under “Use of Pneumococcal Vaccine.” Overall the estimated percentage vaccinated was 64.6% (range 49.0–72.5% among the ESRD networks) (Table 7).

### Use of Hepatitis B Vaccine

In 2001, 96.0% of centers reported that they offered hepatitis B vaccine to patients, 1.7% reported that vaccine was offered to patients at individual physician’s offices, 1.6% reported that they did not offer vaccine to patients,

and less than 1.0% reported other policies. During 1983–2001, the percentage who had ever received at least three doses of hepatitis B vaccine increased from 5.4% to 59.8% among patients and from 26.1% to 88.7% among staff (Fig. 3). Note that the survey questions on vaccination of patients and staff were changed for the 1997–2001 surveys. In 1997–2001, the percentage of patients vaccinated was calculated as the number of vaccinated patients who were present during a 1-week period in December divided by the total number of patients present during the same 1-week period.

Among the ESRD networks, the percentage of patients who received hepatitis B vaccination in 2001 ranged from 42.8% to 69.5% (Table 8). The largest absolute

TABLE 7. Use of influenza vaccine in patients by ESRD network, 2001, United States

ESRD network	States, districts, or territories	No. of centers	Offer vaccine to patients (% of centers)	Estimated percentage of patients vaccinated
7	FL	264	79.2	49.0
16	AK, ID, MT, OR, WA	120	78.3	58.1
18	CA (southern)	193	82.4	58.2
8	AL, MS, TN	249	85.5	58.7
10	IL	121	93.4	59.2
17	AS, GU, HI, CA (northern)	140	85.0	61.4
12	IA, KS, MO, NE	186	87.6	64.9
1	CT, MA, ME, NH, RI, VT	126	91.3	65.0
5	DC, MD, VA, WV	278	90.3	65.5
15	AZ, CO, NM, NV, UT, WY	177	93.2	65.6
14	TX	322	94.4	66.7
13	AR, LA, OK	232	90.1	67.5
3	NJ, PR	115	97.4	67.6
9	IN, KY, OH	242	94.2	67.9
6	GA, NC, SC	373	94.4	68.2
2	NY	221	95.0	69.5
11	MI, MN, ND, SD, WI	269	96.7	72.3
4	DE, PA	201	96.0	72.5
	All	3829	90.6	64.6

AS, American Samoa; GU, Guam.

Rows are sorted by the estimated percentage of patients vaccinated.

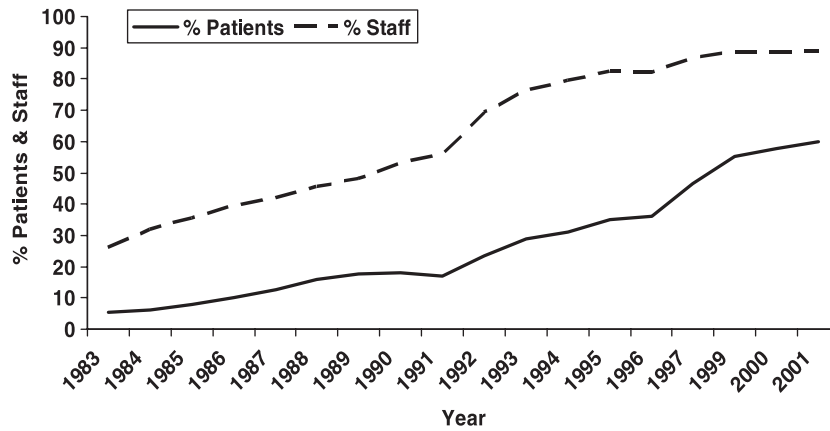


FIG. 3 Use of hepatitis B vaccine in hemodialysis centers, 1983–2001, United States.

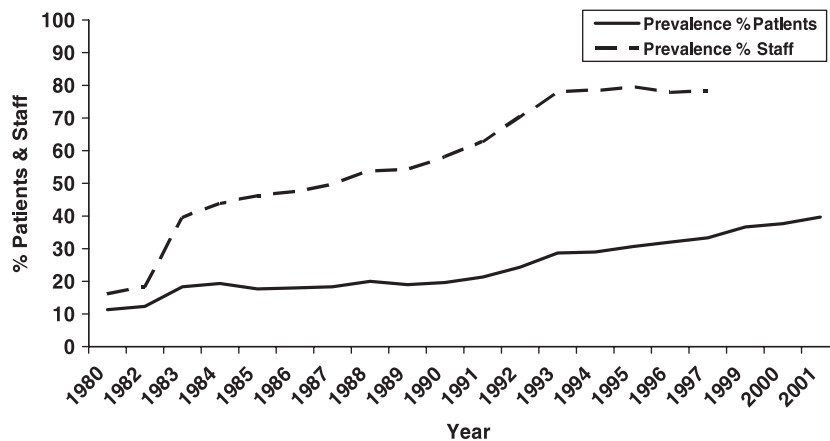


FIG. 4 Prevalence of antibody to hepatitis B surface antigen in hemodialysis patients and staff, 1980–2001, United States. \*Note collected for staff 1999–2001.

TABLE 8. Use of hepatitis B vaccine in HD patients by ESRD network, 2000–2001, United States

ESRD network	States, districts, or territories	Percent vaccinated		Absolute change
		2000	2001	
10	IL	42.4	42.8	0.4
2	NY	46.3	45.8	-0.5
3	NJ, PR	47.5	51.4	3.9
9	IN, KY, OH	57.6	57.0	-0.6
17	AS, GU, HI, CA (northern)	59.7	58.0	-1.7
5	DC, MD, VA, WV	56.6	58.3	1.7
1	CT, MA, ME, NH, RI, VT	53.8	59.4	5.6
7	FL	60.7	60.2	-0.5
15	AZ, CO, NM, NV, UT, WY	56.7	60.9	4.2
13	AR, LA, OK	61.0	61.4	0.4
4	DE, PA	60.6	61.8	1.2
18	CA (southern)	55.3	61.9	6.6
11	MI, MN, ND, SD, WI	58.2	63.1	4.9
6	GA, NC, SC	57.8	64.5	6.7
16	AK, ID, MT, OR, WA	63.6	65.5	1.9
14	TX	69.4	65.8	-3.6
8	AL, MS, TN	63.6	66.9	3.3
12	IA, KS, MO, NE	66.4	69.5	3.1
	All	57.7	59.8	2.1

AS, American Samoa; GU, Guam.  
Rows are sorted by the estimated percentage of patients vaccinated.

increase in the percentage vaccinated during 2000–2001 occurred in ESRD network 6.

### Prevalence of Antibody to Hepatitis B Surface Antigen

During 1980–2001, the prevalence of antibody to hepatitis B surface antigen (anti-HBs) among patients increased from 11.3% to 39.6% (Fig. 4). The presence of anti-HBs indicates immunity to HBV infection, either from vaccination or as a result of recovery from natural infection (18).

### Incidence and Prevalence of HBV Infection

In 2001, 78.8% of centers reported screening susceptible patients monthly for HBsAg, 0.7% bimonthly, 11.0% quarterly, 4.3% semiannually, and 5.2% other or none. During 1976–2001, the incidence of HBV infection in patients decreased from 3.0% to 0.05%, with the largest decline occurring during 1976–1980 (Fig. 5). During 1976–2001, the prevalence of HBsAg positivity among patients declined from 7.8% to 0.9% (Fig. 5).

In 2001, 2.9% of centers reported one or more patients with newly acquired (incident) HBV infection, 26.5%

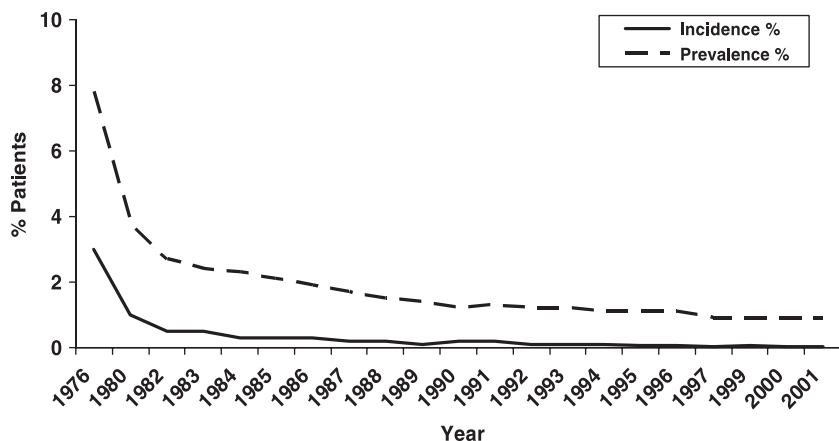


FIG. 5 Incidence and prevalence of hepatitis B virus infection in hemodialysis patients, 1976–2001, United States.

of centers reported one or more patients with chronic (prevalent) HBV infection, and 26.5% (i.e., all centers with acute infection also had chronic infection) of centers reported one or more patients with either acute or chronic HBV. Although the incidence and prevalence of HBV infection among HD patients has declined dramatically, patients still acquire HBV infection from community sources or from transmission in HD centers due to inadequate infection control precautions (19–21) or accidental breaks in technique (22). Factors contributing to

the decline in HBV infection since the 1970s, as well as ongoing transmission, have been reviewed elsewhere (10).

### HCV Infection

In 2001, 62% of centers tested patients for anti-HCV and the prevalence of anti-HCV among patients at these centers was 8.6%; 42% of centers tested staff for anti-HCV and the prevalence of anti-HCV among staff at these centers was 1.5% (Fig. 6). Among the ESRD networks,

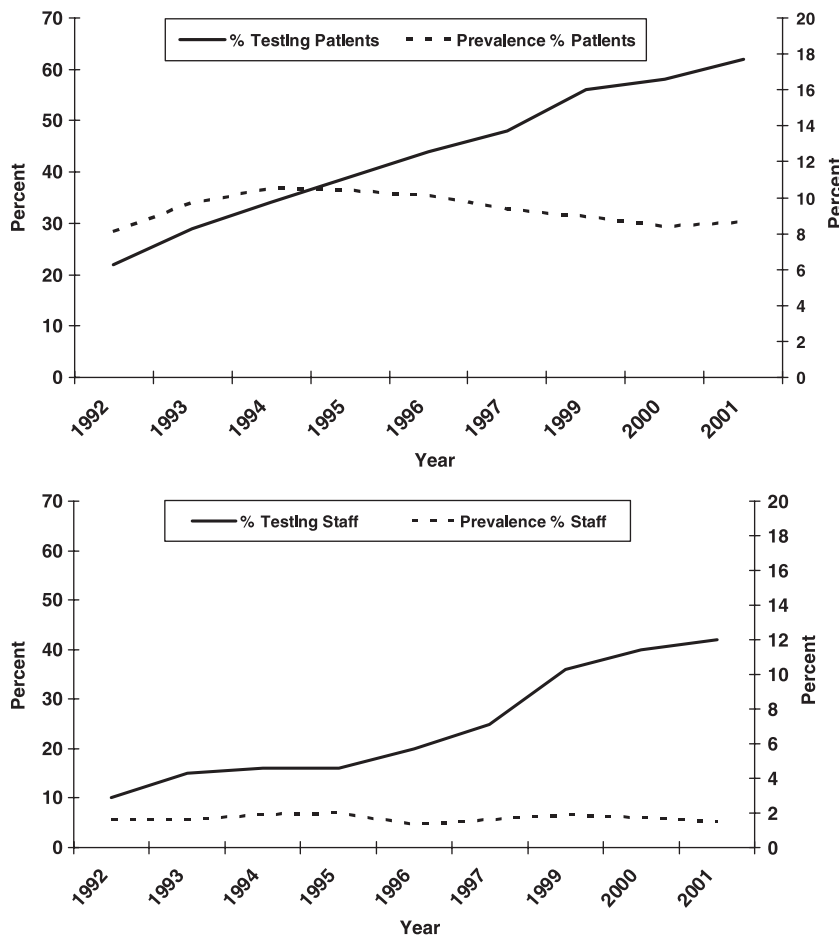


FIG. 6 Antibody to hepatitis C virus testing and prevalence among hemodialysis patients and staff, 1992–2001, United States.

**TABLE 9. Prevalence of anti-HCV among HD patients by ESRD network, 2001, United States**

ESRD network	States, districts, or territories	Total tested	Anti-HCV positive (%)
5	DC, MD, VA, WV	10,660	11.7
2	NY	13,587	11.1
14	TX	15,320	9.9
3	NJ, PR	8051	9.5
13	AR, LA, OK	7269	9.4
17	AS, GU, HI, CA (northern)	7427	8.7
4	DE, PA	7074	8.7
8	AL, MS, TN	7928	8.4
18	CA (southern)	10,855	8.4
12	IA, KS, MO, NE	3921	8.4
11	MI, MN, ND, SD, WI	8211	8.1
6	GA, NC, SC	14,974	7.4
10	IL	5380	7.3
7	FL	9954	7.2
15	AZ, CO, NM, NV, UT, WY	5359	6.4
1	CT, MA, ME, NH, RI, VT	6874	6.2
9	IN, KY, OH	7295	6.2
16	AK, ID, MT, OR, WA	3563	5.7
	All	153,702	8.6

AS, American Samoa; GU, Guam.

**TABLE 10. Incidence and prevalence of anti-HCV among HD patients by reuse practice, United States, 2001**

Anti-HCV prevalence			Anti-HCV incidence		
Centers	No. of patients (%)	<i>p</i> <sup>a</sup>	Centers	No. of patients (%)	<i>p</i> <sup>a</sup>
Reuse dialyzers					
No	657	3018 (9.1)	626	75 (0.24)	
Yes	1718	10,138 (8.4)	0.3	1662	353 (0.30)
Reuse dialyzers on anti-HCV-positive patients					
No	318	1698 (8.1)	313	78 (0.38)	
Yes	1323	8311 (8.6)	0.14	1279	274 (0.29)

<sup>a</sup> *p* values determined by Poisson regression, controlling for ESRD network and dialysis unit.

anti-HCV prevalence among patients ranged from 5.7% to 11.7% (Table 9).

Among centers that tested for anti-HCV, 12.2% reported having at least one patient who became anti-HCV positive in 2001 (i.e., tested positive for anti-HCV in 2001 and had previously tested negative); the incidence rate in 2001 was 0.29%. In 2000, the first time HCV incidence (i.e., the number of patients testing positive for anti-HCV who had tested negative in the past) was on the survey form, the rate was similar, 0.27%.

Anti-HCV prevalence among staff was not higher at centers that reused dialyzers (1.4%) than those that did not reuse dialyzers (1.9%). Similar results were also observed for patients (Table 10). Among the 2637 centers that reused dialyzers, 2192 (83.1%) reused them on patients who were anti-HCV positive. The prevalence of anti-HCV among patients at centers that reused dialyzers on anti-HCV-positive patients (8.6%) was no different than the prevalence at centers that reused dialyzers but not on anti-HCV patients (8.1%) or in centers that never reused dialyzers (9.1%) (Table 10).

HCV incidence among patients also was not different among centers that reused and did not reuse dialyzers (Table 10). In addition, among centers that reused dialyzers, HCV incidence was not higher at centers that reused dialyzers on anti-HCV-positive patients compared with those that did not (0.29% versus 0.38%, respectively).

### Place of Preparation of Injectable Medications

In 2001, 49.5% of centers reported that medications from multidose vials were drawn into syringes in preparation for patient administration in a dedicated medication room or area separate from the treatment area, 28% on a medication cart or medication area within the treatment area, 5.6% at the dialysis station, and 16.9% in other areas. Compared with the incidence of HBV infection in centers that used a dedicated medication room or area separate from the treatment area, the incidence of HBV infection was higher among patients in centers where injectable medications were prepared at the dialysis station, and both HCV prevalence and incidence were higher among patients in centers where injectable medications were prepared at the dialysis station or on a medication cart or medication area within the treatment area (Table 11). These results are consistent with those of previous studies demonstrating the potential for viral hepatitis transmission from cross-contamination of injectable medications prepared from multidose vials in treatment areas.

### Antimicrobial Use Policies

In 2001, 95% of centers reported using at least one measure to encourage judicious antimicrobial use. Antimicrobial use policies included the following: the reason for the antimicrobial must be recorded in the patient's chart or on an order form, 73.2% of centers; a written policy on antimicrobial use, 41.2% of centers;

**TABLE 11. Place where injectable medications were prepared and association with hepatitis B virus and hepatitis C virus infection in patients, United States, 2001**

Place where medication drawn up into syringe	HBsAg incidence, % of patients	Anti-HCV prevalence, % of patients <sup>a</sup>	Anti-HCV incidence, % of patients <sup>a</sup>
Dedicated medication room or medication preparation area separate from treatment area	0.05	8.0	0.24
Dialysis station	0.07	9.1 <sup>b</sup>	0.31
Medication cart or medication area located within the treatment area	0.05	9.3 <sup>b</sup>	0.37 <sup>b</sup>

HBsAg, hepatitis B surface antigen; anti-HCV, antibody to hepatitis C virus.

<sup>a</sup> Analysis limited to centers that test for anti-HCV.

<sup>b</sup> *p* < 0.05 compared with dedicated medication room or medication preparation area separate from treatment area.



**TABLE 12. Reporting of one or more patients with VRE or MRSA, United States, 1995–2001**

Year	Number of centers reporting VRE patients/total centers (%)	Number of centers reporting MRSA patients/total centers (%)
1995	303/2634 (12)	1056/2620 (40)
1996	596/2801 (21)	1354/2797 (48)
1997	918/3077 (30)	1720/3077 (56)
1999	1180/3462 (34)	2314/3454 (67)
2000	1195/3659 (33)	2562/3623 (71)
2001	1175/3814 (31)	2724/3792 (72)

MRSA, methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant enterococcus.

automatic stop order (i.e., antimicrobials must be reordered at intervals), 35.5% of centers; formulary restriction (i.e., only selected antimicrobials are available), 35.3% of centers; and approval needed for certain antimicrobials, 23.0% of centers.

### VRE and MRSA

In 2001, the number of patients with known VRE was as follows: no known patients with VRE, 69.2% of centers; 1–4 patients with VRE, 28.6% of centers; 5–9 patients with VRE, 1.7% of centers; and ≥10 patients with VRE, 0.6% of centers. At centers having one or more VRE-positive patients, VRE-positive patients were never treated in a separate room at 69.0% of centers, sometimes in a separate room at 12.0% of centers, and always in a separate room at 19.0% of centers. Rectal swab or stool cultures to check for VRE were done at 4.9% of centers.

The percentage of centers reporting one or more patients with VRE increased from 12% in 1995 to 34.1% in 1999, then decreased slightly to 31% in 2001 (Table 12). Among the ESRD networks, reporting of VRE ranged from 16.2% (network 16) to 64.0% (network 1) (Table 13).

**TABLE 14. Chronic HD centers reporting patients with HIV infection, United States, 1985–2001**

Year	No. (%) of centers treating patients with HIV infection	No. (%) of patients with HIV infection	No. (%) of patients with clinical AIDS
1985	134 (11)	244 (0.3)	—
1986	238 (18)	546 (0.6)	332 (0.4)
1987	351 (24)	924 (0.1)	462 (0.5)
1988	401 (25)	1253 (1.2)	670 (0.6)
1989	456 (26)	1248 (0.1)	663 (0.5)
1990	493 (26)	1533 (1.1)	739 (0.5)
1991	601 (29)	1914 (1.2)	967 (0.6)
1992	737 (34)	2501 (1.5)	1126 (0.7)
1993	792 (34)	2780 (1.5)	1350 (0.7)
1994	914 (37)	3144 (1.5)	1593 (0.8)
1995	1022 (39)	3090 (1.4)	1606 (0.7)
1996	1088 (39)	3112 (1.4)	1512 (0.7)
1997	1214 (39)	3298 (1.3)	1501 (0.6)
1999 <sup>a</sup>	1241 (36)	3223 (1.4)	1077 (0.5)
2000	1352 (37)	3447 (1.5)	893 (0.4)
2001	1434 (37)	3822 (1.5)	968 (0.4)

<sup>a</sup> Denominator changed for 1999–2001 survey. See text.

The data reported here on treatment of VRE patients are limited in that the survey does not distinguish between clinical infection and colonization (i.e., positive culture for the organism without invasive infection). Centers that perform surveillance for VRE with stool or rectal cultures, or that treat patients from hospitals where such culturing is done, would be more likely to report VRE-colonized patients, introducing surveillance bias.

During 1995–2001, the percentage of centers reporting that they had treated one or more patients with MRSA increased from 40% to 72% (Table 12).

### HIV Infection

During 1985–2001, the percentage of centers that reported providing dialysis for patients with HIV infection increased from 11% to 37% (Table 14). Since a

**TABLE 13. Reporting of one or more patients with VRE by ESRD network, United States, 2001**

ESRD network	States, districts, or territories	Percent of centers reporting VRE		
		2000	2001	Absolute change
16	AK, ID, MT, OR, WA	18.6	16.2	-2.4
13	AR, LA, OK	20.4	20.7	0.3
7	FL	23.0	21.2	-1.8
8	AL, MS, TN	18.0	21.8	3.8
17	AS, GU, HI, CA (northern)	26.6	25.2	-1.4
18	CA (southern)	27.3	25.4	-1.9
3	NJ, PR	40.0	26.1	-13.9
6	GA, NC, SC	25.0	26.2	1.2
14	TX	29.2	27.0	-2.2
15	AZ, CO, NM, NV, UT, WY	27.4	30.1	2.7
12	IA, KS, MO, NE	39.5	34.4	-5.1
11	MI, MN, ND, SD, WI	38.2	35.1	-3.1
2	NY	36.6	35.7	-0.9
5	DC, MD, VA, WV	38.5	37.4	-1.1
10	IL	37.2	38.0	0.8
9	IN, KY, OH	46.6	40.9	-5.7
4	DE, PA	47.8	41.0	-6.8
1	CT, MA, ME, NH, RI, VT	60.0	64.0	-2.1
	All	32.7	30.8	-1.9

AS, American Samoa; GU, Guam; VRE, vancomycin-resistant enterococcus.

Rows are sorted by percentage reporting VRE in 2001.

TABLE 15. Chronic HD centers reporting patients with HIV infection/AIDS by ESRD network, 2001, United States

ESRD network	States, districts, or territories	Percent of patients with			
		No. of centers	No. of patients	HIV infection	AIDS
2	NY	219	16,783	3.2	1.0
5	DC, MD, VA, WV	278	15,979	3.1	0.6
3	NJ, PR	115	10,889	2.9	0.8
7	FL	261	15,180	2.6	0.6
6	GA, NC, SC	373	23,520	2.1	0.5
4	DE, PA	199	11,507	1.7	0.4
1	CT, MA, ME, NH, RI, VT	125	8,809	1.5	0.2
10	IL	121	10,110	1.4	0.4
13	AR, LA, OK	231	10,824	1.2	0.3
14	TX	320	23,002	1.2	0.4
8	AL, MS, TN	246	13,646	1.1	0.4
11	MI, MN, ND, SD, WI	269	15,139	0.7	0.2
17	AS, GU, HI, CA (northern)	126	11,341	0.7	0.1
12	IA, KS, MO, NE	184	8,282	0.6	0.1
18	CA (southern)	190	18,355	0.6	0.2
9	IN, KY, OH	239	16,997	0.5	0.1
16	AK, ID, MT, OR, WA	103	5,342	0.4	0.1
15	AZ, CO, NM, NV, UT, WY	174	10,334	0.3	0.1
	All	3773	248,039	1.5	0.4

AS, American Samoa; GU, Guam.

minority of centers routinely test for HIV, these figures may be underestimates. Note that the survey questions on HIV infection and AIDS were changed for the 1999–2001 survey. In 1985–1997, the percentage of patients with HIV infection was calculated as the number of patients with HIV infection who were treated at any time during the year divided by the total number of patients who were treated at any time during the year. In 1999–2001, the percentage of patients with HIV infection was calculated as the number of patients with HIV infection who were present during a 1-week period in December divided by the total number of patients who were present during that same 1-week period. Similar methods were used to calculate the percentage of patients with AIDS during 1985–1997 versus 1999–2001.

In 2001, 1.5% of patients (range among the networks 0.3–3.2%) were reported to have HIV infection and 0.4% (range among the networks 0.1–1.0%) to have AIDS (Table 15).

### Acknowledgments

We gratefully acknowledge the contributions and assistance of Dr. Harold Margolis, Division of Viral Hepatitis; Drs. Steven Solomon and William Jarvis, Division of Healthcare Quality Promotion, National Center for Infectious Diseases, CDC; Connie Cole, CMS; and the personnel of the End Stage Renal Disease networks and all participating HD centers.

### References

- Snydman DR, Bregman D, Bryan J: Hemodialysis-associated hepatitis in the United States, 1974. *J Infect Dis* 135:687–691, 1977
- Alter MJ, Favero MS, Petersen NJ, Doto IL, Leger RT, Maynard JE: National surveillance of dialysis-associated hepatitis and other diseases, 1976 and 1980. *Dial Transplant* 12:860–865, 1983
- Alter MJ, Favero MS, Miller JK, Moyer LA, Bland LA: National surveillance of dialysis-associated diseases in the United States, 1987. *ASAIO Trans* 35:820–831, 1989
- Alter MJ, Favero MS, Miller JK, Moyer LA, Bland LA: National surveillance of dialysis-associated diseases in the United States, 1988. *ASAIO J* 36:107–118, 1990
- Alter MJ, Favero MS, Miller JK, Moyer LA, Bland LA: National surveillance of dialysis-associated diseases in the United States, 1989. *ASAIO Trans* 37:97–109, 1991
- Tokars JI, Alter MJ, Favero MS, Moyer LA, Bland LA: National surveillance of hemodialysis-associated diseases in the United States, 1990. *ASAIO J* 39:71–80, 1993
- Tokars JI, Alter MJ, Favero MS, Moyer LA, Bland LA: National surveillance of dialysis-associated diseases in the United States, 1991. *ASAIO J* 39:966–975, 1993
- Tokars JI, Alter MJ, Favero MS, Moyer LA, Miller E, Bland LA: National surveillance of dialysis-associated diseases in the United States, 1992. *ASAIO J* 40:1020–1031, 1994
- Tokars JI, Alter MJ, Miller E, Moyer LA, Favero MS: National surveillance of dialysis-associated diseases in the United States, 1994. *ASAIO J* 43:108–119, 1997
- Tokars JI, Alter MJ, Favero MS, Moyer LA, Miller E, Bland LA: National surveillance of dialysis-associated diseases in the United States, 1993. *ASAIO J* 42:219–229, 1996
- Tokars JI, Miller ER, Alter MJ, Arduino MJ: National surveillance of dialysis-associated diseases in the United States, 1995. *ASAIO J* 44:98–107, 1998
- Tokars JI, Miller ER, Alter MJ, Arduino MJ: National surveillance of dialysis-associated diseases in the United States, 1997. *Semin Dial* 13:75–85, 2000
- Tokars JI, Miller ER, Alter MJ, Arduino MJ: National surveillance of dialysis-associated diseases in the United States, 1999. Available at <http://www.cdc.gov/ncidod/hip/dialysis/dialysis.htm>; accessed April 7, 2001
- Tokars JI, Frank M, Alter MJ, Arduino MJ: National surveillance of dialysis-associated diseases in the United States, 2000. *Semin Dial* 15:162–171, 2002
- U.S. Renal Data System: *USRDS 1998 Annual Data Report*. Bethesda, MD: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, 1998:1–188
- Favero MA, Tokars JI, Arduino MJ, Alter MJ: Nosocomial infections associated with hemodialysis. In: Mayhall CG (ed). *Hospital Epidemiology and Infection Control*. Philadelphia: Lippincott Williams & Wilkins, 1999:897–918
- Association for the Advancement of Medical Instrumentation: *American National Standard. Reuse of Hemodialyzers*. ANSI/AAMI RD47-1993. Arlington, VA: Association for the Advancement of Medical Instrumentation, 1993
- Centers for Disease Control and Prevention: Recommendations for preventing transmission of infections among chronic hemodialysis patients. *MMWR Morb Mortal Wkly Rep* 50(RR-5):30–30, 2001
- Kantor RJ, Hadler SC, Schreeder MT, Berquist KR, Favero MS: Outbreak of hepatitis B in a dialysis unit, complicated by false-positive HBsAg test results. *Dial Transplant* 8:232–235, 1979
- Carl M, Francis DP, Maynard JE: A common-source outbreak of hepatitis B in a hemodialysis unit. *Dial Transplant* 12:222–229, 1983
- Niu MT, Penberthy LT, Alter MJ, Armstrong CW, Miller GB, Hadler SC: Hemodialysis-associated hepatitis B: report of an outbreak. *Dial Transplant* 18:542–555, 1989
- Alter MJ, Ahtone J, Maynard JE: Hepatitis B virus transmission associated with a multiple-dose vial in a hemodialysis unit. *Ann Intern Med* 99:330–333, 1983