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Impact of Requiring Influenza Vaccination for Children in Licensed Child Care or Preschool Programs — Connecticut, 2012–13 Influenza Season

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Preschool-aged children are at increased risk for severe influenza-related illness and complications. Congregate child care settings facilitate influenza transmission among susceptible children. To protect against influenza transmission in these settings, in September 2010, Connecticut became the second U.S. state (after New Jersey) to implement regulations requiring that all children aged 6–59 months receive at least 1 dose of influenza vaccine each year to attend a licensed child care program. To evaluate the impact of this regulation on vaccination levels and influenza-associated hospitalizations during the 2012–13 influenza season, vaccination data from U.S. and Connecticut surveys and the Emerging Infections Program (EIP) were analyzed. After the regulation took effect, vaccination rates among Connecticut children aged 6–59 months increased from 67.8% during the 2009–10 influenza season to 84.1% during the 2012–13 season. During the 2012–13 influenza season, among all 11 EIP surveillance sites, Connecticut had the greatest percentage decrease (12%) in the influenza-associated hospitalization rate from 2007–08 among children aged ≤4 years. Additionally, the ratio of the influenza-associated hospitalization rates among children aged ≤4 years to the overall population rate (0.53) was lower than for any other EIP site. Requiring vaccination for child care admission might have helped to increase vaccination rates in Connecticut and reduced serious morbidity from influenza.

The Advisory Committee on Immunization Practices first recommended annual influenza vaccination for children aged 6–23 months in 2004 (*1*) and for children aged 24–59 months in 2006 (*2*). In 2012–13, the national vaccination level among children aged 6–59 months was 69.8%, the lowest among vaccines routinely recommended for this age group except for rotavirus and hepatitis A vaccines (*3,4*). In the United States, 60% of preschool-aged children receive nonparental care each week, and among these children, 60% receive center-based care, which includes child care centers, preschools, and pre-kindergarten programs (*5*). To protect against outbreaks of disease, all 50 states have legal requirements for specific immunizations for children attending these centers (*6*). However, only two states, Connecticut and New Jersey, require immunization against influenza. In January 2014, New York City became the first reported municipality to pass a similar requirement.

Connecticut first required that all children aged 6–59 months in licensed child care receive at least 1 dose of influenza vaccine by January 1 of each year, beginning September 2010. One year later, the same requirement was made for all children aged 24–59 months who were enrolled in a preschool program.

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Data from multiple surveys were used to estimate vaccination rates among children aged 6–59 months in Connecticut. Estimates of influenza vaccination coverage from the National 2009 H1N1 Flu Survey and Behavioral Risk Factor Surveillance System (BRFSS) for the 2009–10 influenza season (*7*) and from the National Immunization Survey and BRFSS for the 2012–13 influenza season (*3*) were used to compare Connecticut's and national influenza vaccination rates before and after implementation of the Connecticut requirement. Data from a survey of all licensed child care facilities in Connecticut conducted in March 2013 were used to determine vaccination levels among child care attendees (but not among preschoolers).

Surveillance data from EIP were used to examine changes in influenza-associated hospitalization rates in Connecticut,* compared with other EIP sites before and after implementation of the Connecticut influenza vaccination requirements. Because different influenza strains tend to affect different age distributions, data from 2007–08 were chosen *a priori* as the comparison with the post-requirement data (2012–13) to compare the two most recent influenza seasons during which the same influenza subtype (influenza A [H3N2]) was the predominant circulating strain. Eleven EIP sites, including two in New York, have been conducting active population-based surveillance for laboratory-confirmed influenza-associated hospitalizations for all ages since the 2005–06 season.

During 2009–10, the season before the state's influenza vaccination requirement took effect, 67.8% (95% confidence interval [CI] = 61.1%–74.5%) of Connecticut children aged 6–59 months received a vaccination for seasonal influenza (Figure).† During the 2012–13 season, the seasonal influenza vaccination rate increased to 84.1% (CI = 78.2%–90.0%). The increase of 16.3 percentage points in Connecticut was greater than the national increase of 11.9 percentage points (from 57.9% to 69.8%), comparing the same age group for the same two seasons, but the difference is not statistically significant (Figure).

Among 11 EIP sites during the 2007–08 influenza season, Connecticut ranked third-highest in incidence of influenza-associated hospitalizations among children aged ≤4 years (58.6 per 100,000). During the 2012–13 season, Connecticut dropped to seventh (51.5 per 100,000) and was one of only two sites to record a decrease in incidence (12%) among children aged ≤4 years (Table 1).

During the 2007–08 influenza season in Connecticut, the ratio of the rate of influenza-associated hospitalization among children aged ≤4 years to the rate overall (i.e., for all ages) was 1.18 (Table 2). For the 2012–13 influenza season, the Connecticut ratio was 0.53, lower than any other EIP site.

Results from the Connecticut child care survey indicated that, as of December 31, 2012, licensed child care enrollment

*Additional information available at http://gis.cdc.gov/grasp/fluview/fluhosprates.html.

†Vaccination coverage for influenza A (H1N1)pdm09 was not included.

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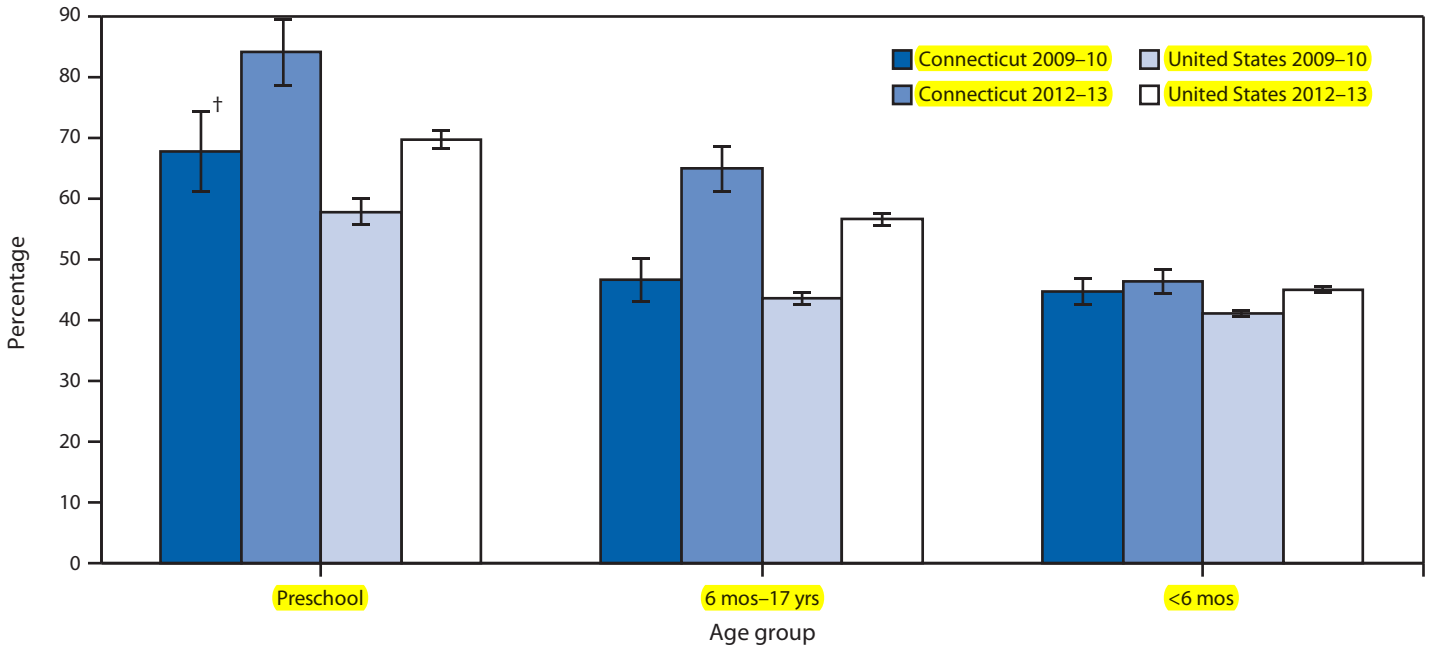
FIGURE. Seasonal influenza vaccination coverage, by age group — Connecticut and United States overall, 2009–10* and 2012–13



* Vaccination coverage for influenza A (H1N1)pdm09 was not included.
† 95% confidence interval.

TABLE 1. Percentage change in the influenza-associated hospitalization incidence rate per 100,000 children aged ≤4 years — 11 Emerging Infections Program (EIP) sites, 2007–08 and 2012–13 influenza seasons

EIP site	2007–08 season		2012–13 season		(%) change from 2007–08 to 2012–13
	No. of cases	Rate per 100,000	No. of cases	Rate per 100,000	
California	72	36.2	82	40.8	(13)
Colorado	134	76.9	151	85.9	(12)
Connecticut	29	58.6	24	51.5*	(-12)
Georgia	52	18.9	145	53.6	(184)
Maryland	143	87.0	136	81.9	(-6)
Minnesota	91	46.9	148	76.0	(62)
New Mexico	35	45.4	73	82.0	(81)
New York – Albany	4	7.2	26	47.8	(564)
New York – Rochester	26	40.4	45	70.1	(74)
Oregon	19	18.4	21	19.7	(7)
Tennessee	34	33.8	42	40.3	(19)
EIP sites overall	**639**	**43.8**	**898**	**60.6**	**(38)**

* This incidence rate is different from the rate for Connecticut displayed in CDC's FluView at http://gis.cdc.gov/grasp/fluview/fluhosprates.html. The rate in this table is based on New Haven County only, whereas the FluView catchment area for Connecticut expanded from one county in 2007–08 to three counties in 2012–13. During the 2012–13 influenza season, New Haven County had 24 cases and 46,626 children aged ≤4 years, based on the annual county population estimate used in FluView.

included 55,640 children who were aged 6–59 months. Of these, 87.1% had received ≥1 dose of influenza vaccine for the 2012–13 season. In total, 5.1% of children enrolled in the survey were listed as exempt from influenza vaccination for either religious or medical reasons, compared with 1.7% for all other vaccinations.

Editorial Note

Requirements for vaccination against communicable diseases in licensed child care have long been important as a component of disease control in congregate care settings. Children aged ≤4 years are at greater risk for severe complications from influenza than older children (*1,2*). Those in congregate settings such as licensed child care or preschool also are at greater risk for influenza exposure and have the potential to expose many more persons than those outside of such settings. Similar to other vaccine-preventable diseases that are spread by respiratory droplets and that affect children, achieving high vaccination rates against influenza in child care settings not only protects those who are vaccinated, but also reduces transmission of influenza within the setting and to the associated outside community (*8,9*).

Although almost every state has adopted licensed child care requirements for other routinely recommended childhood vaccinations, only two have adopted a requirement for influenza vaccination (*6*). The reasons behind this discrepancy have not been studied. However, it might be, in part, because influenza vaccine is not widely available until well after licensed child care begins in August or September, when requirements

What is already known on this topic?

Preschool-aged children are at increased risk for severe influenza-related illness and are a major source of influenza transmission within communities. Only two states and recently, New York City, require influenza vaccination for child care attendance. In September 2010, Connecticut became the second U.S. state to implement regulations requiring that all children aged 6–59 months attending a licensed child care program receive at least 1 dose of influenza vaccine each year.

What is added by this report?

After implementation in September 2010 of required influenza vaccination for children in licensed child care programs, vaccination coverage among children aged 6–59 months in Connecticut increased from 67.8% during the 2009–10 influenza season to 84.1% in 2012–13, and the influenza-associated hospitalization rate in 2012–13 among children aged ≤4 years, compared with the 2007–08 season, decreased by 12%, the largest percentage decrease among the 11 Emerging Infections Program sites. In addition, the ratio of the influenza hospitalization rate among children aged ≤4 years to the overall (i.e., all ages) influenza hospitalization rate was lower in Connecticut (0.53) than in any of the other 10 sites.

What are the implications for public health practice?

Requiring vaccination against influenza for licensed child care attendance appears feasible and might help reduce the number of cases of serious illness from influenza among children aged ≤4 years.

TABLE 2. Ratio of influenza-associated hospitalization incidence rate per 100,000 in children aged ≤4 years to the incidence rate for the population overall — 11 Emerging Infections Program (EIP) sites, 2007–08 and 2012–13 influenza seasons

EIP Site	2007–08 season		Rate ratio ≤4 yrs/ overall	2012–13 season		Rate ratio ≤4 yrs/ overall
	≤4 yrs rate	Overall rate		≤4 yrs rate	Overall rate	
California	36.2	10.3	3.30	40.8	34.5	1.18
Colorado	76.9	26.4	2.91	86.5	37.3	2.32
Connecticut	58.6	49.6	1.18	51.5*	96.5*	0.53
Georgia	18.9	9.5	1.99	53.6	31.1	1.72
Maryland	87.0	26.9	3.23	81.9	50.1	1.63
Minnesota	46.9	19.3	2.43	76.0	51.8	1.47
New Mexico	45.4	10.0	4.54	82.0	29.0	2.83
New York - Albany	7.2	8.8	0.82	47.8	43.8	1.09
New York – Rochester	40.4	37.3	1.08	70.1	95.7	0.73
Oregon	18.4	9.3	1.98	19.7	29.7	0.66
Tennessee	33.8	16.2	2.09	40.3	28.6	1.41
EIP sites overall	**43.8**	**18.3**	**2.39**	**60.6**	**43.2**	**1.40**

* These incidence rates are different from the rates for Connecticut displayed in CDC's FluView at http://gis.cdc.gov/grasp/fluview/fluhosprates.html. The rates in this table are based on New Haven County only, whereas the FluView catchment area for Connecticut expanded from one county in 2007–08 to three counties in 2012–13. During the 2012–13 influenza season, New Haven County had 24 cases and 46,626 children aged ≤4 years, and overall had 833 cases and a total population of 862,813, based on the annual county population estimates used in FluView.

are enforced. In addition, surveying of licensed child care centers and preschools for compliance usually takes place in October, when influenza vaccination often is just beginning. Thus, additional efforts are required to monitor and enforce compliance of entry requirements. In addition, because influenza vaccination has been available for decades but never required, it might be more difficult to convince parents and guardians of its necessity.

Several of these concerns were encountered in conducting this study in Connecticut. Conducting an influenza-specific survey in the winter or spring after the requirement went into effect required more resources and took 2 years to arrange. The actual statewide compliance during the first two influenza seasons (2010–11 and 2011–12) after the requirement went into effect is unknown. Without timely surveys, compliance might be less with influenza than with other vaccines, and also might wane over time. In addition, religious and medical exemptions from influenza vaccination were observed to be higher than for any other required vaccine. Nonetheless, following implementation of the requirement in Connecticut in September 2010, vaccination rates among all children aged ≤4 years by 2012–13 appeared to have increased more than expected compared with national rates, and the incidence of hospitalization with influenza among children aged ≤4 years decreased more than in other states that conducted similar surveillance.

The findings in this report are subject to at least four limitations. First, this was an ecologic analysis comparing trends in influenza hospitalizations and vaccination coverage and must be interpreted as such. Other factors might have contributed to the relative decrease in hospitalizations of young children in Connecticut. Second, the results of the child care survey of vaccination coverage for the 2012–13 influenza season do not include family day care homes, which also are covered by the influenza vaccination requirement and account for approximately 22% of all children in licensed child care in Connecticut, nor do they include preschools, which also are covered by the requirement. Third, the rates and dynamics of influenza circulation in each EIP site are different, and changes over time in one site compared with others must be interpreted with caution. Finally, EIP hospitalization rates include those for children aged <6 months although these children are not yet eligible for influenza vaccination.

Vaccination against influenza has gradually evolved from an elective annual event for

selected groups at high risk for influenza complications to a recommended annual event for all persons aged ≥6 months (*10*). In congregate settings in which persons are at greater risk for both exposure and complications, such as child care programs and health-care settings, the current recommendations call for most persons to be vaccinated. The Connecticut study might be helpful to public health agencies elsewhere considering requiring influenza vaccination of children in licensed child care programs and preschools.

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Trends in Incidence of End-Stage Renal Disease Among Persons With Diagnosed Diabetes — Puerto Rico, 1996–2010

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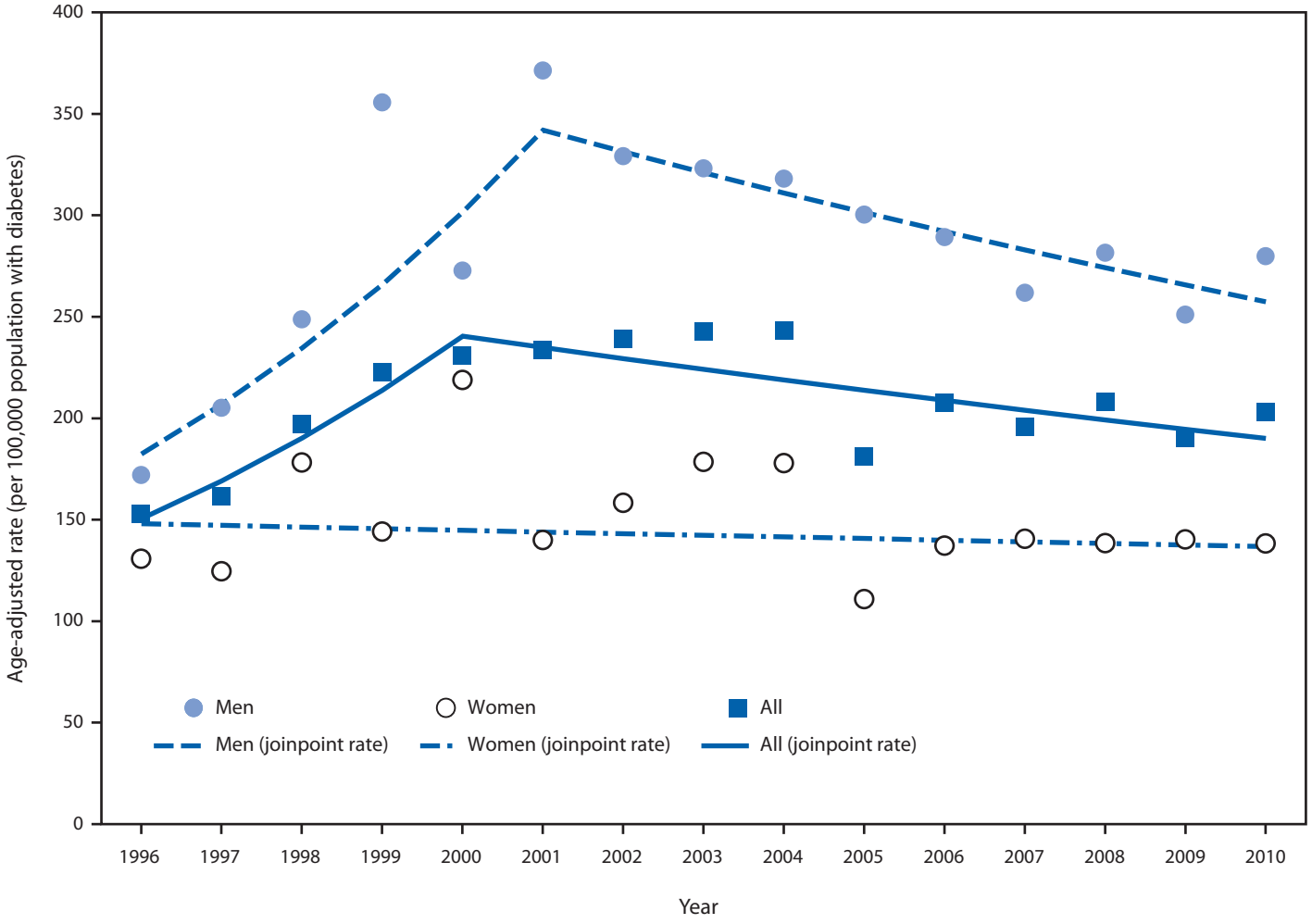
During 2010, approximately 6,091 persons aged ≥18 years in Puerto Rico were living with end-stage renal disease (ESRD) (i.e., kidney failure that requires regular dialysis or kidney transplantation for survival). This included 1,462 persons who began treatment for ESRD in 2010 (*1*). Diabetes is the leading cause of ESRD in Puerto Rico, accounting for 66% of new cases in adults, followed by hypertension, which accounts for 15% of the cases (*1*). Although the number of adults initiating ESRD treatment (i.e., dialysis or kidney transplantation) in Puerto Rico each year who have diabetes listed as a primary cause (ESRD-D) has increased since 1996 (*1,2*), ESRD-D incidence among adults with diagnosed diabetes has not shown a consistent trend (*2*). To assess recent trends in ESRD-D incidence among adults aged ≥18 years in Puerto Rico with diagnosed diabetes and to further examine trends by age group and sex, CDC analyzed 1996–2010 data from the U.S. Renal Data System (USRDS) and the Behavioral Risk Factor Surveillance System (BRFSS). After increasing in the late 1990s, ESRD-D incidence decreased during the 2000s among adult men and among persons aged 18–44 years with diagnosed diabetes in Puerto Rico. Throughout the period, ESRD-D incidence among adult women and among persons aged 45–64 and ≥75 years with diagnosed diabetes did not show a consistent trend, and ESRD-D incidence among persons aged 65–74 years with diagnosed diabetes increased. Increased awareness of the risk factors for kidney disease and implementation of effective interventions to prevent or delay kidney disease among persons with diagnosed diabetes might decrease ESRD incidence in Puerto Rico, particularly among women and older persons.

USRDS collects, analyzes, and distributes ESRD clinical and claims data to the Centers for Medicare and Medicaid Services (CMS) (*3*). Health-care providers are required by law to complete the CMS Medical Evidence Report for each new patient with ESRD. USRDS collects demographic and ESRD-related information (e.g., date patient was first treated and diagnosed primary cause of kidney failure). Throughout the period, in Puerto Rico, the proportion of new ESRD cases that were ESRD-D ranged from 58% to 67% (*1*). ESRD-D incidence per 100,000 persons with diagnosed diabetes was calculated by dividing the number of adults aged ≥18 years with a new diagnosis of ESRD-D (determined by their initiation of treatment) by the estimated number of adults aged ≥18 years with diagnosed diabetes. The USRDS Renal Data Extraction and Referencing System, an online data querying application (*1*), was used to determine the number of adults aged ≥18 years in Puerto Rico initiating ESRD treatment with diabetes listed as a primary cause for each year during 1996–2010. The number of adults aged ≥18 years in Puerto Rico with diagnosed diabetes was estimated from the BRFSS, which conducts state-based, random-digit—dialed telephone surveys in the 50 states, the District of Columbia, Puerto Rico, and other U.S. territories. During 1996–2010, BRFSS response rates for Puerto Rico ranged from 65% to 89%. BRFSS respondents were classified as having diagnosed diabetes if they answered "yes" to the question, "Has a doctor ever told you that you have diabetes?" Women who were told that they had diabetes only during pregnancy were classified as not having diabetes. BRFSS data were weighted to represent the noninstitutionalized population in Puerto Rico.

ESRD-D incidence rates were calculated for the adult population with diabetes overall, by age group, and by sex, and rates were age-adjusted by the direct method to the 2000 U.S. standard population. Trends were analyzed using joinpoint regression, which uses permutation tests to identify points (i.e., joinpoints) where linear trends change significantly in direction or magnitude (e.g., zero joinpoints indicate a straight line). The rate of change for each trend is tested to determine whether it is significantly different from zero, and each trend in the final model is described by an annual percentage change (APC) with a 95% confidence interval. Results were considered significant if $p<0.05$.

During 1996–2010, the total number of adults aged ≥18 years in Puerto Rico who began ESRD-D treatment each year increased from 536 to 970. During the study period, the age-adjusted ESRD-D incidence rates in Puerto Rico increased significantly, from 152.8 per 100,000 population with diabetes in 1996 to 230.8 in 2000 (APC = 12.4%; p=0.01), and then declined to 203.1 in 2010 (APC = -2.3%; p=0.02) (Figure 1, Table). Among men, the age-adjusted ESRD-D rates increased from 171.9 per 100,000 population with diabetes in 1996 to 371.3 in 2001 (APC = 13.4%; p<0.001), and then declined to 279.8 in 2010 (APC = -3.1%; p=0.03). Among women, however, age-adjusted rates showed no consistent trend. Rates were lower for women than men throughout the period. Among persons aged 18–44 years, ESRD-D rates increased from 96.4 per 100,000 population with diabetes in 1996 to 201.6 in 2002

FIGURE 1. Age-adjusted* rates† (per 100,000 population with diabetes) of adults aged ≥18 years initiating treatment for end-stage renal disease attributed to diabetes, by sex — Puerto Rico, 1996–2010



* Based on the 2000 U.S. standard population.
† Observed rates and modeled rates using joinpoint regression.

TABLE. Rate (per 100,000 population with diabetes) of adults aged ≥18 years initiating treatment for end-stage renal disease attributed to diabetes, by age group and sex, and trend analysis, by period — Puerto Rico, 1996–2010

	Rate*		Trend analysis							
	1996	2010	Period 1	APC	(95% CI)	p-value	Period 2/3	APC	(95% CI)	p-value
Total										
Crude	193.5	267.9	1996–2000	11.5	(7.2–15.9)	<0.001	2000–2005	-3.9	(-7.0– -0.7)	0.02
							2005–2010	1.9	(0.1–3.7)	0.05
Age-adjusted†	152.8	203.1	1996–2000	12.4	(3.3–22.4)	0.01	2000–2010	-2.3	(-4.1– -0.5)	0.02
Age group (yrs)										
18–44	96.4	132.0	1996–2002	13.1	(5.1–21.8)	0.004	2002–2010	-6.3	(-10.5– -1.9)	0.01
45–64	205.9	261.9	1996–2010	-0.4	(-1.8–1.0)	0.55				
65–74	234.0	382.0	1996–2010	2.9	(1.4–4.4)	0.001				
≥75	236.8	254.5	1996–2010	-0.5	(-3.7–2.8)	0.73				
Sex†										
Men	171.9	279.8	1996–2001	13.4	(6.9–20.3)	<0.001	2001–2010	-3.1	(-5.7– -0.5)	0.03
Women	130.7	138.3	1996–2010	-0.6	(-2.6–1.5)	0.56				

Abbreviations: APC = annual percentage change; CI = confidence interval.
* Per 100,000 population with diabetes.
† Based on the 2000 U.S. standard population.

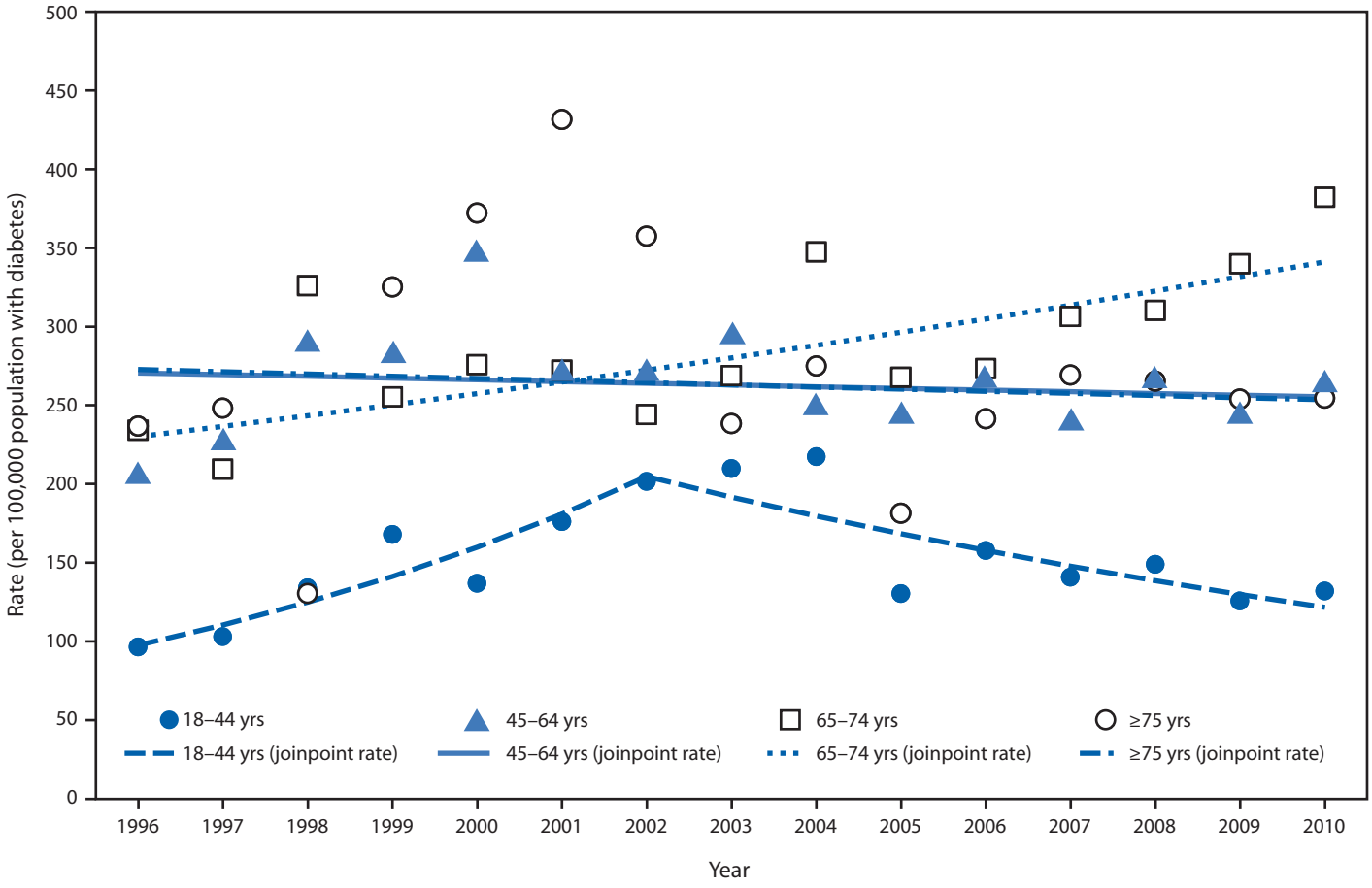
(APC = 13.1%; p=0.004), and then declined to 132.0 in 2010 (APC = -6.3%; p=0.01) (Figure 2, Table). Throughout the period, rates for those aged 45–64 years and ≥75 years showed no consistent trend, and among those aged 65–74 years, rates increased, from 234.0 per 100,000 population with diabetes in 1996 to 382.0 in 2010) (APC = 2.9%; p=0.001).

Editorial Note

ESRD is a costly and disabling condition that can result in premature death (*3*). Diabetes is a major risk factor for ESRD, accounting for about two thirds of new cases in Puerto Rico. During 1996–2010, the number of ESRD-D cases in Puerto Rico increased, as did the number of persons with diagnosed diabetes (*2,4*). After increasing in the late 1990s in Puerto Rico, ESRD-D rates decreased in the 2000s among those aged 18–44 years and among men with diagnosed diabetes. However, these encouraging trends were not found for women or for persons aged ≥45 years with diagnosed diabetes, who showed little change, except for persons aged 65–74 years, whose rates increased throughout the period.

In contrast with the ESRD-D trends in Puerto Rico, ESRD-D incidence in the U.S. population with diabetes declined during the 2000s in all age groups, in men, in women, and in Hispanics (*2,5*). Reasons for this decline in ESRD-D incidence cannot be determined from surveillance data but might include reductions in ESRD risk factors (e.g., hyperglycemia and hypertension) or better treatment of kidney disease among persons with diagnosed diabetes. Why trends were not as encouraging in the population with diabetes in Puerto Rico is unknown; a particular concern is the increasing trend in incidence among those aged 65–74 years. Additional strategies might be needed to reduce ESRD risk factors among persons with diabetes aged ≥45 years and among women. However, reducing ESRD-D incidence among persons aged 65–74 years likely will be challenging because persons with diabetes are surviving longer and ESRD typically occurs 10–20 years after diabetes onset (*6*). Furthermore, the number of new ESRD-D

FIGURE 2. Rate (per 100,000 population with diabetes)* of adults aged ≥18 years initiating treatment for end-stage renal disease attributed to diabetes, by age group — Puerto Rico, 1996–2010



* Observed rates and modeled rates using joinpoint regression.

What is already known on this topic?

Diabetes is the leading cause of end-stage renal disease (ESRD) in the United States. In the 2000s, the incidence of ESRD attributed to diabetes (ESRD-D) in the U.S. total and U.S. Hispanic populations with diagnosed diabetes declined.

What is added by this report?

After increasing in the late 1990s, ESRD-D incidence among adults in Puerto Rico with diagnosed diabetes decreased in the 2000s in men and in persons aged 18–44 years. From 1996 to 2010, ESRD-D incidence among adults in Puerto Rico with diagnosed diabetes did not show a consistent trend among women and among persons aged 45–64 years and ≥75 years, and it increased among persons aged 65–74 years.

What are the implications for public health practice?

Further research might be considered to learn why ESRD-D incidence trends in the population with diabetes were not as encouraging in Puerto Rico as in the United States, and especially why ESRD-D incidence is increasing among persons aged 65–74 years. Additional strategies might be needed to reduce ESRD risk factors among persons aged ≥45 years and among women with diagnosed diabetes.

cases is likely to continue to increase as the population ages and the number of persons with diabetes increases (*2,4*).

The findings in this report are subject to at least three limitations. First, data were collected for patients whose ESRD treatment was reported to CMS and do not include patients who died before receiving treatment or persons who refused treatment. Second, changes in ESRD-D incidence might have been caused by factors other than a true change in disease incidence. These factors might include access to or acceptance of ESRD treatment, changes in treatment and care practices, or changes in physician reporting of the primary cause of kidney failure. Furthermore, revised diagnostic criteria for diabetes in 1997 might have led to a greater number of persons being detected with diabetes earlier in the disease process (*7*) who have not had diabetes long enough to develop ESRD, thus possibly lowering ESRD-D rates. Finally, BRFSS data during the study period were limited to adults living in noninstitutional households who had landline telephones. These sample restrictions and lower response rates (65% in 2000) might have biased the estimated population with diagnosed diabetes.*

Continued interventions, such as blood glucose and blood pressure control (*8,9*), to improve diabetes care and to increase awareness of risk factors for kidney disease in persons with diabetes might be considered to reduce ESRD incidence in Puerto Rico, particularly among women and among older persons. Diabetes prevalence estimates by Puerto Rico municipio (equivalent to a county or township) might assist public health officials in targeting interventions for promoting kidney health (*4*). To assess progress, CDC's National Diabetes Surveillance System monitors ESRD-D incidence trends in Puerto Rico (*2*). Ultimately, prevention of type 2 diabetes and improved diabetes management are likely to contribute in part to the prevention of kidney disease and ESRD (*8,9*). CDC works with state and territorial health departments diabetes prevention and control programs and other public and private partners to reduce the incidence of type 2 diabetes and to improve outcomes for persons with diabetes. CDC's National Diabetes Prevention Program† supports the implementation of community-based lifestyle programs throughout the United States and Puerto Rico for persons at high risk for type 2 diabetes. The National Diabetes Education Program,§ sponsored by CDC and the National Institutes of Health (NIH), develops and disseminates materials and resources in Spanish to educate persons about diabetes prevention and control. Likewise, NIH's National Kidney Disease Education Program¶ promotes kidney disease awareness in the Hispanic population.

*Additional information available at http://www.cdc.gov/brfss/data_documentation/index.htm.

†Additional information available at http://www.cdc.gov/diabetes/prevention.
§Additional information available at http://ndep.nih.gov.
¶Additional information available at http://nkdep.nih.gov/inicio.shtml.

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CDC Grand Rounds: Preventing Hospital-Associated Venous Thromboembolism

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Deep venous thrombosis (DVT) is a blood clot in a large vein, usually in the leg or pelvis. Sometimes a DVT detaches from the site of formation and becomes mobile in the blood stream. If the circulating clot moves through the heart to the lungs it can block an artery supplying blood to the lungs. This condition is called pulmonary embolism. The disease process that includes DVT and/or pulmonary embolism is called venous thromboembolism (VTE). Each year in the United States, an estimated 350,000–900,000 persons develop incident VTE, of whom approximately 100,000 die, mostly as sudden deaths, the cause of which often goes unrecognized (*1*). In addition, 30%–50% of persons with lower-extremity DVT develop postthrombotic syndrome (a long-term complication that causes swelling, pain, discoloration, and, in severe cases, ulcers in the affected limb) (*2,3*). Finally, 10%–30% of persons who survive the first occurrence of VTE develop another VTE within 5 years (*4*).

VTE can result from three pathogenic mechanisms: hypercoagulability (increased tendency of blood to clot), stasis or slow blood flow, and vascular injury to blood vessel walls. Individual characteristics include congenital and acquired factors, such as advanced age or cancer, and interact with external factors, such as hospitalization or surgery (Table). Hospitalization is an important risk factor in the latter two mechanisms; injury and surgery are causes of vascular injury, and prolonged bed rest can cause stasis. Approximately half of new VTE cases occur during a hospital stay or within 90 days of an inpatient admission or surgical procedure, and many are not diagnosed until after discharge (*5,6*).

As a health-care–associated condition, VTE is receiving increased attention from patient safety experts, the Agency for Healthcare Research and Quality (AHRQ), and the Centers for Medicare & Medicaid Services (CMS). Despite that recognition, the number of secondary diagnoses of VTE in hospital patients has increased (*7*), and during 2007–2009, an average of nearly 550,000 adult hospital stays each year had a discharge diagnosis of VTE (*8*). Nonetheless, VTE often is not recognized as an issue of public health importance. No ongoing surveillance system monitors the occurrence of VTE at the population level, and public education and awareness is limited.

This is another in a series of occasional MMWR *reports titled CDC Grand Rounds. These reports are based on grand rounds presentations at CDC on high-profile issues in public health science, practice, and policy. Information about CDC Grand Rounds is available at http://www.cdc.gov/about/grand-rounds.*

Successful Implementation of a VTE Prophylaxis Program in the Inpatient Setting

Both pharmacologic and mechanical prophylaxis can be used to prevent VTE (*9*). Pharmacologic approaches, such as unfractionated and low molecular weight heparin and other anticoagulants (i.e., blood thinners), reduce the potential of blood to clot. Mechanical approaches such as intermittent pneumatic compression devices and graduated compression stockings can reduce blood clot formation by increasing blood flow. Patient adherence is essential for success with both approaches (*10*). Pharmacologic and mechanical methods of prophylaxis have different risks and benefits.

Prevention of VTE can be complicated because physicians must balance the risk for thrombosis with the risk for bleeding from anticoagulants by considering each patient's risk for VTE and bleeding relative to the risks and benefits of prophylaxis. The 2012 American College of Chest Physicians VTE-prevention guidelines endorsed three quantitative risk-stratification models and suggested that VTE prophylaxis might not be beneficial for low-risk hospitalized patients (*11–13*). Assessment models for bleeding risk can be used to identify patients at high risk for bleeding (*14*). Because many cases of VTE are health-care associated, clinicians and health-care organizations can play an important role in preventing hospital-associated VTE (HA-VTE) events as part of patient-safety quality-improvement initiatives.

In 2004, the Johns Hopkins Medical Institutions Center for Innovations in Quality Patient Care assembled a multidisciplinary VTE-prevention team to develop a VTE education program for health-care providers, design evidence-based risk-appropriate prophylaxis strategies, establish a mechanism to assess performance, and review data with staff to improve performance (*15,16*). Paper-based order sets or forms were developed to guide clinicians through the risk-stratification process and recommend appropriate VTE prophylaxis. Among

TABLE. Risk factors for venous thromboembolism (VTE)

Strong risk factors	Moderate risk factors	Weak risk factors
Fracture (hip or leg)	Arthroscopic knee surgery	Prolonged bed rest
Hip or knee replacement	Central venous lines	Immobility
Major general surgery	Chemotherapy/Cancer	Age >40 yrs
Major trauma	Congestive heart or respiratory failure	Laparoscopic surgery
Spinal cord injury	Estrogen	Obesity
	Age >65 yrs	Pregnancy
	Paralytic stroke	Varicose veins
	Postpartum period	
	Previous VTE	
	Thrombophilia	

Source: Anderson FA Jr, Spencer FA. Risk factors for venous thromboembolism. Circulation 2003;107 (23 Suppl 1):I9–16.

surgical patients, use of risk-appropriate VTE prophylaxis increased from 26% (42 of 161) at baseline to 68% (178 of 262) within 12 months. However, paper order sets were difficult for providers to use and made performance assessment labor-intensive. Therefore, computer-based "smart order sets" were designed and inserted as mandatory fields in all admission and transfer order sets for all surgical and medical patients. After this change, prescription of risk-appropriate VTE prophylaxis increased to approximately 85%, and all surgical and medical patients were risk-stratified for VTE (Figure) (*15*). A before/after study of outcomes for medical patients noted a 67% decrease in the frequency of confirmed symptomatic VTE within 90 days of hospital discharge, from 2.5% to 0.7%, and a 100% reduction in potentially preventable episodes of VTE (e.g., VTE that occurred with suboptimal VTE prophylaxis), from 1.1% to zero; no increase was observed in major bleeding events during hospitalization (*16*).

The Johns Hopkins experience emphasizes the key elements of an optimal VTE-prevention strategy: 1) VTE-prevention risk assessments must be a mandatory part of patient care; 2) clinicians must identify VTE risk factors and contraindications to prophylaxis; 3) clinicians must order risk-appropriate VTE prophylaxis; 4) patient risk factors must be reassessed during their hospital stay; 5) the system must collect patient and provider data to monitor performance; 6) adverse outcomes (e.g., hospital-acquired VTE and bleeding) must be monitored; and 7) performance must be measured regularly to promote continuous improvement (*15*).

Prevention of VTE as an Overall Component of Patient Safety

VTE is the subject of numerous patient-safety quality or performance measures developed and promoted by federal agencies, such as AHRQ and CMS, and professional organizations, such as the Joint Commission and the National Quality Forum. Such measures are typically based on administrative data that are routinely collected and reported, but accurately ascertaining HA-VTE can be difficult without reviewing medical charts. In two studies conducted by the Institute for Healthcare Improvement using hospital patient chart reviews to identify adverse events, VTE was a fairly frequent cause of harm (eight events per 1,000 stays) and accounted for one out of 17 preventable deaths (*17,18*).

VTE is one of nine hospital-acquired conditions (HACs) targeted for an overall 40% reduction in preventable harms by the Partnership for Patients, a collaborative national health-care quality initiative led by CMS.* Hospital Engagement Networks are providing technical assistance to hospitals across the country to achieve the Partnership for Patients goals, including a reduction in 30-day readmissions.

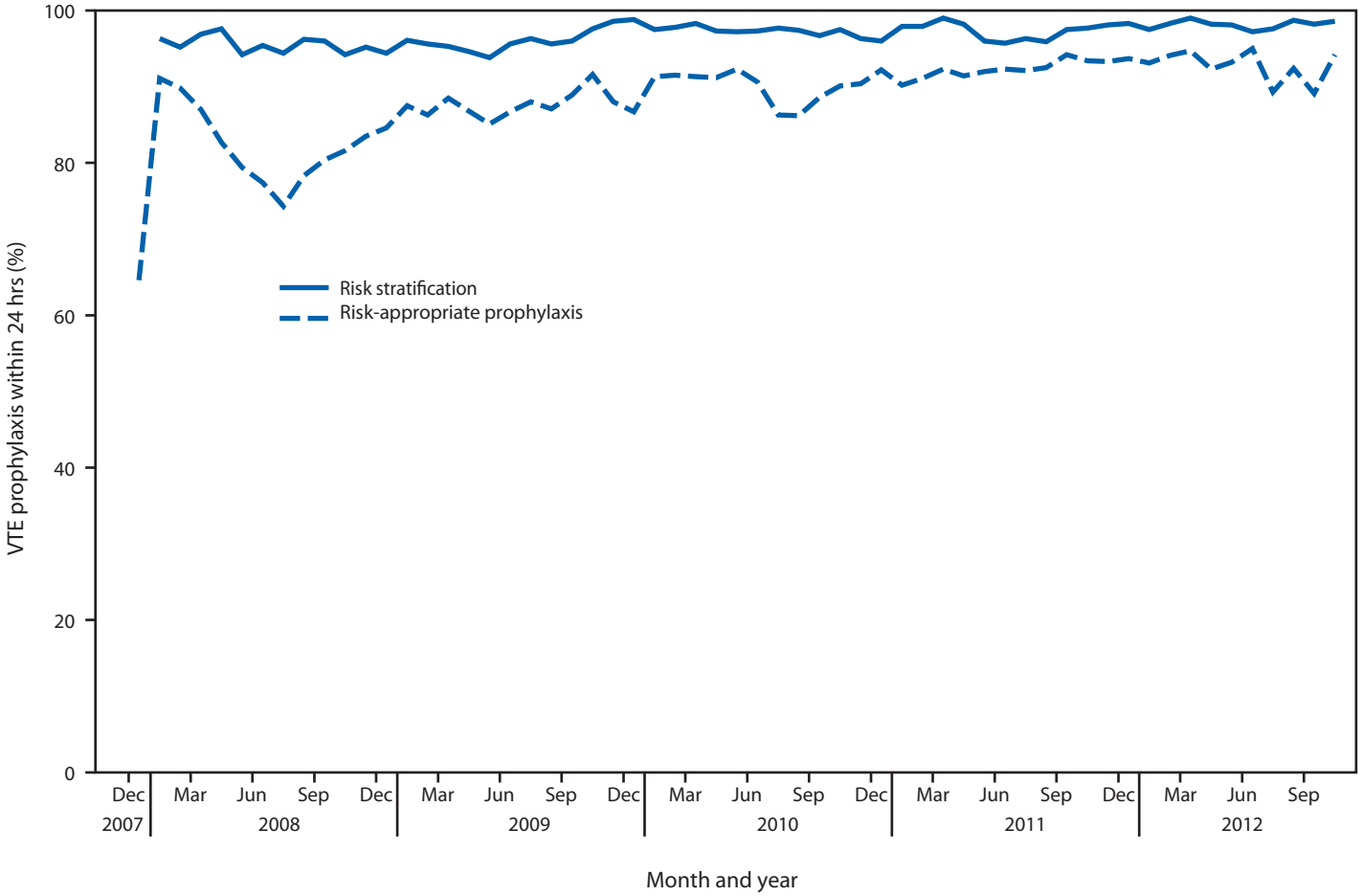
AHRQ developed a VTE-prevention guide containing sample forms and protocols for clinicians to help implement processes to prevent VTE (*19*). It provides helpful resources and guides clinicians through key elements for change that need to be combined. Themes such as simplicity and ease of use are common to many successful quality-improvement efforts; clinicians are more likely to provide better care if it is easy to do so. AHRQ is in the process of revising the VTE-prevention guide to incorporate new information. AHRQ also has produced information guides for patients and consumers on how to prevent blood clots and dangers to be aware of when taking blood thinners.†

Patient safety improvements can help achieve the "triple aim" as defined by the Institute for Healthcare Improvement: 1) to provide better patient experience of health care, 2) to improve population health, and 3) to decrease health-care costs (*20*). A positive patient safety culture fosters mutual trust, openness, and shared institutional goals (*21*). Efforts to prevent VTE share many of the same opportunities observed in patient safety in general. Like all patient safety initiatives, VTE prevention relies on a culture that is conducive to patient safety. There are compelling examples of institutions, in addition to Johns Hopkins, that have driven rates of VTE down to low levels, and some of them are helping others to achieve similar success (*22*). A collaborative, team-based approach to care is not only required for significant and sustained improvement, it also offers efficiency and capacity to tackle other patient safety problems (*23*).

* Additional information available at http://www.ahrq.gov/research/findings/nhqrdr/nhqr10/chap3.html#support.

† Available at http://www.ahrq.gov/patients-consumers/diagnosis-treatment/treatments/btpills/index.html.

FIGURE. Venous thromboembolism (VTE) risk stratification and percentage of patients for whom risk-appropriate VTE prophylaxis was prescribed within 24 hours of hospital admission — Johns Hopkins Medical Institutions, 2008–2012



Public Health Strategies to Prevent HA-VTE

In 2011, CDC convened an expert panel to discuss prevention of HA-VTE. The experts identified the need for strategies to address the use of VTE prophylaxis among hospital patients and better ways to track HA-VTE.[§] A recent publication summarized current HA-VTE prevention guidelines and evaluated risk assessment models (*13*). Multiple tools and approaches to assessing patient risk for HA-VTE have been proposed and implemented, but there is a lack of research to validate these tools and to identify which ones can best identify patients who should receive VTE prophylaxis (and if so, what type of prophylaxis). Comparative effectiveness research to quantify the relative performance of risk assessment models for VTE and bleeding is urgently needed.

Surveillance will be critical for assessing the impact of interventions to reduce HA-VTE. A comprehensive surveillance approach would collect information not only on the incidence of VTE but also information on the prevention practices implemented to assess the relationship between them. However, there are multiple major challenges for conducting surveillance for VTE. First, for various reasons, diagnosis codes for VTE in administrative databases often do not accurately identify patients with acute VTE. One strategy to minimize false positives for VTE in outpatient records is to require confirmation of a diagnosis code through the appearance of the same code in subsequent encounters and a filled prescription of an anticoagulant. However, because of false positives, only review of medical records in which the results of imaging tests document VTE can validate a diagnosis. Second, distinguishing new from recurrent VTE is challenging because an accurate medical history is needed but often is not available from administrative data sources. Third, mortality attributable to pulmonary embolism can lead to missed cases because of sudden death; thus, collecting additional information from autopsies and death records is critical for capturing cases and

[§] Additional information available at http://www.cdc.gov/ncbddd/dvt/documents/12_232434-a_sayers_ha-vte_workshop_report_508.pdf.

outcomes. Fourth, because VTE can be asymptomatic as well as symptomatic, temporal trends in VTE incidence might reflect institutional variations in screening and diagnosis practices instead of actual changes in overall incidence. Information on why screening was done is important for distinguishing these situations. Finally, because many cases of HA-VTE occur after discharge, data must be collected from multiple settings in which VTE is diagnosed and treated. Therefore, in 2012, CDC funded two pilot surveillance programs for a 2-year project to develop methods that combine use of administrative data with review of electronic medical records to yield more complete population-based estimates of VTE incidence and to inform the development of surveillance methods to overcome the challenges described. Data and methods from these pilot surveillance programs will lay the foundation for more accurate ongoing monitoring of VTE nationally.

Conclusion

VTE is a problem of major public health importance, with hundreds of thousands of persons affected each year. Because nearly half of VTE cases occur during or soon after a hospital stay, there is overlap between VTE as a public health problem and a preventable patient safety problem. Public health programs and patient safety stakeholders, such as hospital networks and health-care payers, are encouraged to collaborate to promote effective risk-stratification and VTE prevention in inpatient settings and to assess trends in the use of risk-appropriate VTE prophylaxis for HA-VTE events and complications.

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Vital Signs: Improving Antibiotic Use Among Hospitalized Patients

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Background: Antibiotics are essential to effectively treat many hospitalized patients. However, when antibiotics are prescribed incorrectly, they offer little benefit to patients and potentially expose them to risks for complications, including *Clostridium difficile* infection (CDI) and antibiotic-resistant infections. Information is needed on the frequency of incorrect prescribing in hospitals and how improved prescribing will benefit patients.

Methods: A national administrative database (MarketScan Hospital Drug Database) and CDC's Emerging Infections Program (EIP) data were analyzed to assess the potential for improvement of inpatient antibiotic prescribing. Variability in days of therapy for selected antibiotics reported to the National Healthcare Safety Network (NHSN) antimicrobial use option was computed. The impact of reducing inpatient antibiotic exposure on incidence of CDI was modeled using data from two U.S. hospitals.

Results: In 2010, 55.7% of patients discharged from 323 hospitals received antibiotics during their hospitalization. EIP reviewed patients' records from 183 hospitals to describe inpatient antibiotic use; antibiotic prescribing potentially could be improved in 37.2% of the most common prescription scenarios reviewed. There were threefold differences in usage rates among 26 medical/surgical wards reporting to NHSN. Models estimate that the total direct and indirect effects from a 30% reduction in use of broad-spectrum antibiotics will result in a 26% reduction in CDI.

Conclusions: Antibiotic prescribing for inpatients is common, and there is ample opportunity to improve use and patient safety by reducing incorrect antibiotic prescribing.

Implications for Public Health: Hospital administrators and health-care providers can reduce potential harm and risk for antibiotic resistance by implementing formal programs to improve antibiotic prescribing in hospitals.

Introduction

Antibiotics offer tremendous benefit to patients with infectious diseases and are commonly administered to patients cared for in U.S. hospitals. However, studies have demonstrated that treatment indication, choice of agent, or duration of therapy can be incorrect in up to 50% of the instances in which antibiotics are prescribed (*1*). One study reported that 30% of antibiotics received by hospitalized adult patients, outside of critical care, were unnecessary; antibiotics often were used for longer than recommended durations or for treatment of colonizing or contaminating microorganisms (*2*).

Incorrect prescribing of antibiotics exposes individual patients to potential complications of antibiotic therapy, without any therapeutic benefit. One such complication is infection with *Clostridium difficile*, an anaerobic, spore-forming bacillus that causes pseudomembranous colitis, manifesting as diarrhea that often recurs and can progress to sepsis and death; CDC has estimated that there are about 250,000 *C. difficile* infections (CDI) in hospitalized patients each year (*3*). Other complications related to unnecessary use of antibiotics include infection with antibiotic-resistant bacteria (*4*) and complications from adverse events (*5*).

Evidence is accumulating that interventions to optimize inpatient antibiotic prescribing can improve patient outcomes (*6*). To assist health-care providers to reduce incorrect inpatient prescribing, information is needed regarding how frequently incorrect prescribing occurs in hospitals and how improving prescribing will benefit patients. In this report, current assessments of the scope of inpatient antibiotic prescribing, the potential for optimizing prescribing, and the potential benefits to patients are described.

Methods

The objectives of this evaluation were to 1) describe the extent and rationale for antibiotic prescribing in U.S. acute care hospitals, 2) present data illustrating the potential for improving prescribing in selected clinical scenarios, and 3) estimate the potential reductions in CDI among patients when antibiotic

use is improved. For this report, antibiotics include parenteral, enteral, and inhaled antibacterial agents.

The first objective was accomplished using proprietary administrative data from the Truven Health MarketScan Hospital Drug Database (HDD) and data from CDC's Emerging Infections Program (EIP). EIP is a network of state health departments, academic institutions, and local collaborators funded by CDC to assess the effect of emerging infections and evaluate methods for their prevention and control.* Antibiotic prescribing data and patient demographics were obtained from HDD, which contains individual billing records for all patients from a large sample of U.S. hospitals.† Antibiotic agents and doses provided were identified for all patients discharged during 2010. Age group-specific proportions of hospitalizations during which antibiotics were prescribed were calculated by antibiotic group. In 2011, EIP performed an antibiotic use prevalence survey in acute care hospitals within the 10 EIP sites. Each hospital selected a single day on which to conduct the survey on a random sample of inpatients. EIP data collectors gathered information on antibiotics given to patients and determined the rationale for antibiotic use.

For the second objective, additional data from the EIP were used to determine the frequency of opportunities to improve prescribing for selected urinary tract infections (UTIs) and prescribing of intravenous vancomycin. In addition, data reported during October 2012–June2013 to the National Healthcare Safety Network (NHSN) Antimicrobial Use Option were analyzed; key percentile distributions of usage rates and differences in usage (between usage at 90th percentile and at 10th percentile) were calculated. This difference should be small when comparing usage rates among patient care locations caring for similar types of patients.

The third objective was accomplished through development of a dynamic model that was used to interpret the findings of an observational study and predict changes in CDI with changes in antibiotic use. First, a retrospective cohort study was conducted to quantify the relative risk for CDI using hospital discharge data and pharmacy data from two large academic centers, in New York and Connecticut, linked to active population-based CDI surveillance data from the EIP (*6*). The primary outcome was hospital-associated CDI (CDI >2 days after hospital admission and ≤180 days after discharge). Primary exposure of interest was receipt of inpatient broad-spectrum antibiotics (i.e., 3rd and 4th generation cephalosporins, beta-lactam/beta-lactamase inhibitor combinations, and fluoroquinolones) during hospitalization. A multivariate logistic model was used to estimate an adjusted risk ratio controlling for age, sex, Gagne comorbidity score (*7*), hospital, and hospital CDI rates. A stochastic, compartmental model of hospital CDI that represented distinct states of infection (uncolonized, colonized, and symptomatic) was constructed. Antibiotic use was classified with respect to type (high- and low-risk) and where the patient was in the treatment pathway (untreated, treated, and post-treatment). The model was calibrated based on the results of the epidemiologic analyses described in this report and drew other parameter estimates from stochastic distributions based on a previously published agent-based model (*8*).§

Results

In 2010, based on data obtained from all 323 hospitals by MarketScan HDD, 55.7% of patients received an antibiotic during their hospitalization, and 29.8% received at least 1 dose of broad-spectrum antibiotics (Figure 1). The EIP evaluated 11,282 patients in 183 hospitals in 2011, of whom 4,189 (37.1%) had received one or more antibiotics to treat active infections; half (49.9%) of all treatment antibiotics were prescribed for treatment in one or more of three scenarios: lower respiratory infections, UTIs, or presumed resistant Gram-positive infections (Table 1). Prescribing scenarios at a convenience sample of 36 hospitals across eight EIP sites were reviewed. Reviews of 296 instances of treatment in two specific scenarios (UTIs in patients without indwelling catheters, and treatment with intravenous vancomycin) identified that antibiotic use could potentially have been improved in 37.2% (39.6% of 111 UTI patients, 35.7% of 185 vancomycin patients); improvement opportunities mostly involved better use of diagnostic testing (Table 2).

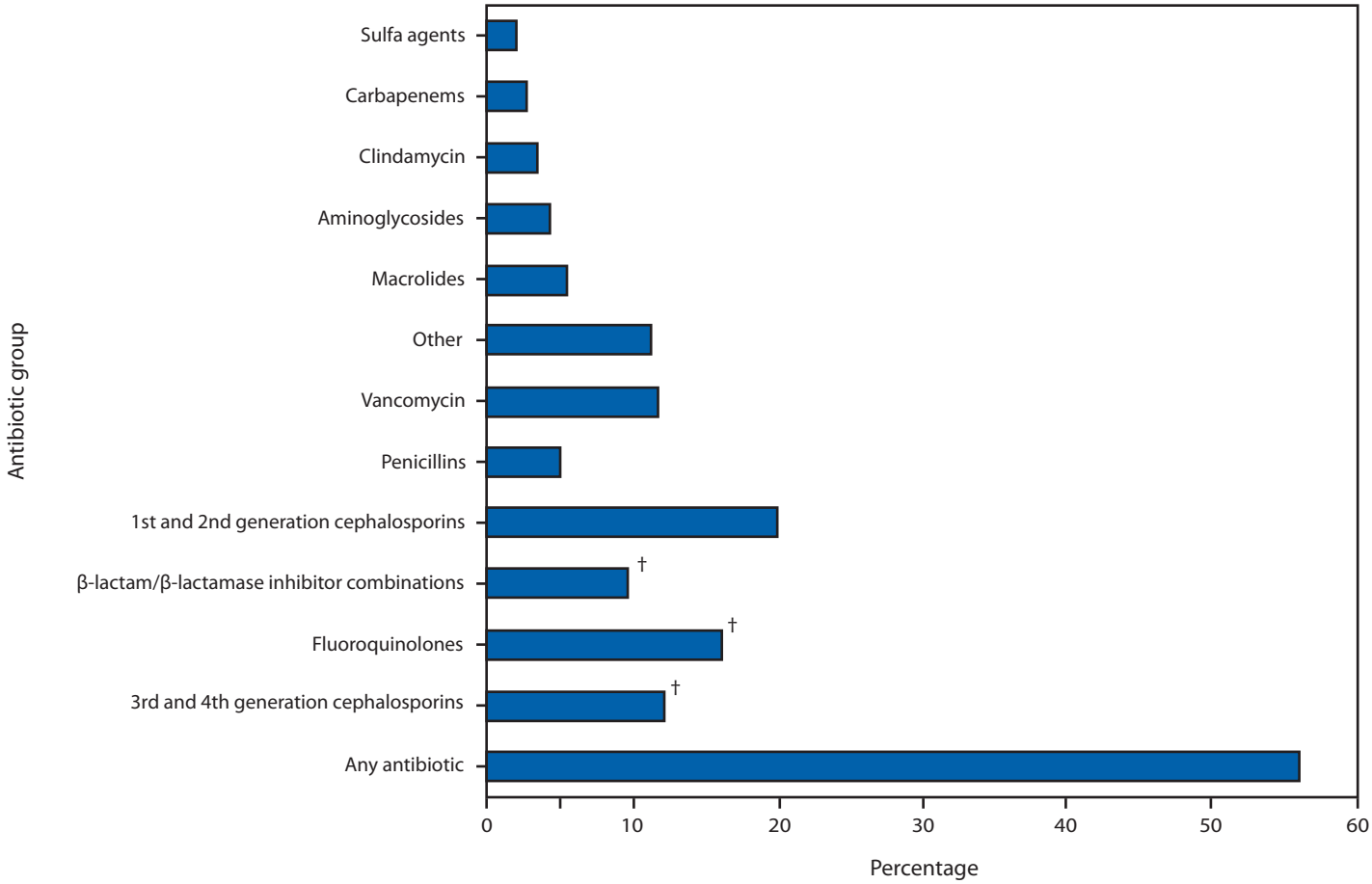
NHSN began receiving antibiotic use data in 2012. Among the 19 hospitals reporting to the NHSN Antimicrobial Use Option that had completed data validation and submitted antibiotic use data from one or more patient care locations, results were reported for 266 patient care locations. Among the six most common types of patient locations, critical care units reported higher rates of antibiotic use (median = 937 days of therapy/1,000 days-present) compared with ward locations (median = 549 days of therapy/1,000 days-present). The variability in usage rates within any one patient location type was highest (threefold difference between 90th and 10th percentile) among combined medical/surgical wards (i.e., 26 wards categorized as caring for a mixture of medical and surgical patients). When limiting the comparisons within combined medical/surgical wards, differences in usage were eightfold for fluoroquinolones, sixfold for antipseudomonal

* Additional information available at http://www.cdc.gov/ncezid/dpei/eip/index.html.

† A proprietary system integrating data systems from claims and hospital-based data systems among a convenience sample of hospitals and providers. Additional information available at http://truvenhealth.com.

§ Additional information available at http://www.cdc.gov/getsmart/healthcare/evidence/cdiff.html.

FIGURE 1. Percentage of hospital discharges with at least one antibiotic day, by antibiotic group — 323 hospitals, United States, 2010*



* Data provided by Truven Health MarketScan Hospital Drug Database.
† Antibiotics from these three groups, which are considered to place patients at high risk for developing *Clostridium difficile* infection, were administered to 29.8% of the patients.

TABLE 1. Prevalence of antibiotic use among randomly selected patients in 183 acute care hospitals — Emerging Infections Program health-care–associated infections and antimicrobial use prevalence survey, United States, 2011

Antibiotic use assessment	No.	(%)
Total no. of patients in the survey	**11,282**	—
Patients on any antibiotic to treat an active infection	4,189	(37.1)
Treatment indication for antibiotic*	7,199	—
For LRI (community onset), with or without BSI	1,596	(22.2)
For UTI (health-care or community onset), with or without BSI	993	(13.8)
For presumptive resistant Gram-positive infection treated with vancomycin (intravenous), linezolid, or daptomycin	1,270	(17.6)
No. of antibiotics with one or more treatment indications above	3,592	(49.9)

Abbreviations: LRI = lower respiratory tract infection; BSI = bloodstream infection; UTI = urinary tract infection.
* Indications are not mutually exclusive.

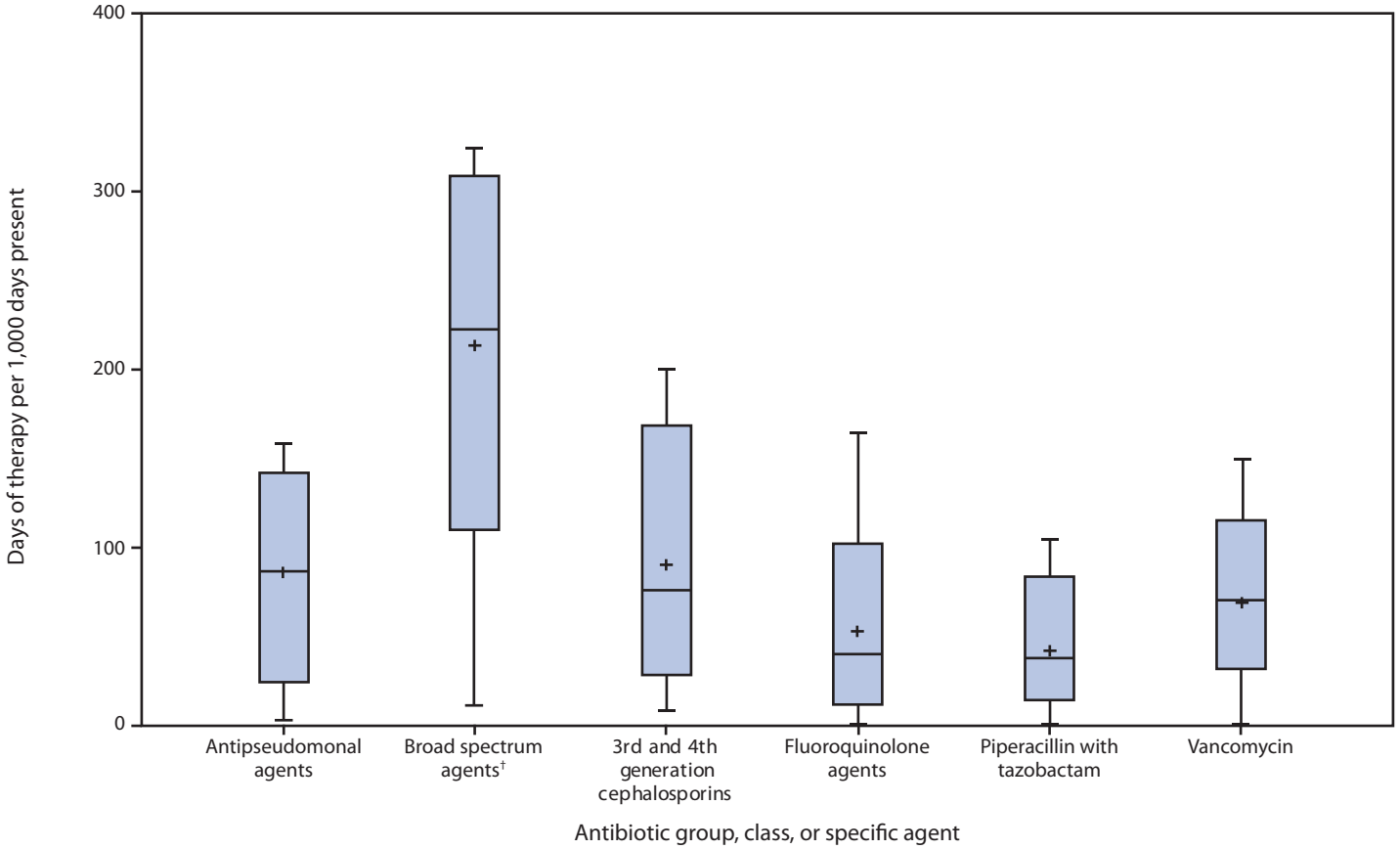
agents, threefold for broad-spectrum agents (antibiotics considered high risk for subsequent CDI), and threefold for vancomycin (Figure 2). Overall, in the cohort study, the risk for CDI among patients unexposed and exposed to antibiotics was 6.8 and 24.9 per 1,000 discharges respectively. Multivariate modelling adjusting for covariates, for all ages combined, estimated the adjusted relative risk for development of CDI within 180 days after inpatient exposure to broad-spectrum antibiotics to be 2.9 (95% confidence interval = 2.3–3.5). The dynamic model, which accounts for both direct and indirect effects, predicted that a 30% decrease in exposure to broad-spectrum antibiotics in hospitalized adults would lead to a 26% decrease in CDI (interquartile range = 15%–38%). Such a reduction in broad-spectrum use equates to an approximately 5% reduction in the proportion of hospitalized patients receiving any antibiotic.

TABLE 2. Assessment of antibiotic prescribing among inpatients in 36 hospitals treated for urinary tract infection (UTI) without indwelling catheter or treated with intravenous vancomycin — Emerging Infections Program health-care–associated infections and antimicrobial use prevalence survey, United States, 2011

Treatment	No.	(%)
Patients treated for UTI present on admission, without indwelling catheter	**111**	—
Urine culture was not ordered, although standard practice before treatment	18	(16.2)
Urine culture was positive, but no documented symptoms were present	23	(20.7)
Urine culture was negative, and no documented symptoms were present	3	(2.7)
No. of patients with potential for improvement in prescribing	44	(39.6)
Patients treated with intravenous vancomycin	**185**	—
No diagnostic culture obtained around antibiotic initiation, although standard practice with most infections	17	(9.2)
Diagnostic culture showed no Gram-positive bacterial growth, but patient still treated for long duration (>3 days) (excludes presumed SSTI, which often can be culture negative)	40	(21.6)
Diagnostic culture grew only oxacillin-susceptible *Staphylococcus aureus*, but patient still treated for long duration (>3 days) (likely missed opportunity to switch antibiotic based on culture result)	9	(4.9)
No. of patients with potential for improvement in prescribing	66	(35.7)
Combined UTI or vancomycin prescribing	**296**	—
Total no. of patients with potential for improvement in prescribing	110	(37.2)

Abbreviation: SSTI = skin and soft tissue infection.

FIGURE 2. Rate of antibiotic use, by antibiotic group, class, or specific agent, among medical and surgical patients in 26 wards at 19 acute care hospitals — National Healthcare Safety Network Antimicrobial Use Option, October 2012–June 2013*



* Horizontal lines represent median, 10th and 90th percentile values; whisker points are the minimum and maximum values. Plus sign is the mean value.
† Including fluoroquinolones, β-lactam/β-lactamase inhibitor combinations, and 3rd and 4th generation cephalosporins.

Key Points

- Antibiotics are commonly prescribed in hospitals.
- Evidence of incorrect prescribing and observed variability in current usage patterns suggest that improvements are needed and will benefit patients.
- CDC recommends that all hospitals implement antibiotic stewardship programs that include, at a minimum, seven core elements: 1) leadership support; 2) accountability through a single physician lead; 3) drug expertise through a single pharmacy lead; 4) action including at least one intervention, such as an "antibiotic timeout," to improve prescribing; 5) tracking prescribing and resistance patterns; 6) reporting local prescribing and resistance information directly to clinicians, and 7) education for clinicians.
- Urgent action is needed to promote correct antibiotic prescribing to ensure these lifesaving drugs work in the future.
- Additional information is available at http://www.cdc.gov/vitalsigns.

Conclusions and Comment

Antibiotics are prescribed for the majority of patients hospitalized in U.S. acute care hospitals, usually to treat infections. This post prescription review of two common prescribing scenarios for treating suspected infections identified opportunities to improve 37.2% of prescriptions, often by timely use of diagnostic tests or documentation of symptoms. This observation is similar to results of older studies (*1*) and a recent study (*2*) documenting that about 30%–50% of prescribing might be incorrect. Although the aspect of prescribing that could be improved has varied between studies, it usually involves the wrong dose or wrong duration (*2*). The EIP review focused on relatively objective criteria, including established standards around diagnostic testing and documentation of symptoms supporting the presence of infection. A threefold difference in overall antibiotic use in the most common patient care location, where more similar usage rates would be expected, considering similar types of patients are being cared for in these locations, is additional evidence of opportunities for improvement. This difference is a conservative measure made by comparing usage reported at the 90th percentile distribution compared with that at the 10th percentile distribution, among locations caring for similar types of patients. The magnitude of differences seen in some antibiotic groups might be the result of differences in formulary or clinical practice guidelines in place at different institutions. However, within similar location types, twofold differences were consistently measured. Although some of these differences might be attributable to differences in the mix of patients within these similar patient care locations, it is likely some might be explained by differences in prescribing practices. This type of monitoring system, which involves antibiotic use measurement to inform quality improvement activities, has been cited as an urgent need by a recent government report (*10*).

The data in this report confirm the findings of several previous studies demonstrating that antibiotic prescribing in hospitals is common and often incorrect. In particular, patients are often exposed to antibiotics without proper evaluation and follow-up. Misuse of antibiotics puts patients at risk for preventable health problems. These include immediate complications; antibiotics are among the most frequent causes of adverse drug events among hospitalized U.S. patients (*11*), and near-term complications, such as CDI, which can be severe and even deadly (*9*). The analysis of risk for CDI from exposure to broad-spectrum antibiotics during hospitalization found an exposed patient was at three times greater risk than a patient without this exposure. Elevated risks of similar magnitude were observed in previous studies (*12,13*). An estimated 30% reduction in use of these broad-spectrum antibiotics (which would reduce overall antibiotic use by only 5%) would prevent 26% of CDI related to inpatient antibiotic use. Reductions in CDI of this magnitude could also have additional positive effects in reducing transmission of *C. difficile* throughout the community.

An additional near-term complication of the unnecessary and incorrect use of inpatient antibiotics is the growing problem of antibiotic resistance in U.S. hospitals, creating treatment challenges not only for patients who are exposed to the antibiotics, but for other patients to whom these resistant bacteria spread (*3*). Some hospitalized patients now have infections for which there are no available antibiotic treatments (*14*). Urgent action is required to address this growing public health crisis. Improving the prescribing of antibiotics in hospitals is one important part of a broader strategy to counter the increase in antibiotic resistance. The CDC report, Antibiotic Threats in the United States, 2013, addresses other priority needs to reduce antibiotic resistance, including preventing infections and the spread of resistance, tracking resistance patterns, and developing new antibiotics and diagnostic tests (*3*).

Programs dedicated to improving antibiotic prescribing in hospitals are commonly referred to as antibiotic stewardship programs. Such programs serve to ensure optimal treatment for hospitalized patients with infection and reduce unnecessary antibiotic use to minimize harm to patients and prolong the length of time antibiotics are effective (*15*). Variability in the types of patients and available resources and expertise between hospitals calls for flexibility in how these programs

are implemented. However, experience demonstrates that these programs can be successful in a wide variety of hospital types to reduce overall and incorrect antibiotic prescribing, decrease drug costs, prevent adverse events caused by antibiotics, and reduce CDI rates and antibiotic resistance locally (*6,15*). Although cost savings from these programs will vary depending on the size of the facility and the extent to which interventions are implemented, published studies from mostly larger settings have consistently shown significant annual savings ($200,000–$900,000) (*1*).

Correct antibiotic treatment (e.g., prompt treatment of sepsis) is critical to saving lives of hospitalized patients with certain infectious diseases. Given the proven benefit of hospital stewardship programs to patients and the urgent need to address the growing problem of antibiotic resistance, CDC recommends that all hospitals implement an antibiotic stewardship program. CDC has developed guidance that can assist hospitals in either starting or expanding a program to improve antibiotic prescribing (*16*). Central to this guidance are seven core elements that have been critical to the success of hospital antibiotic stewardship programs (Box). In addition to highlighting these key elements for success of stewardship programs, the CDC guidance also provides background information on the proven benefits of improving antibiotic prescribing in hospitals and more details on the structural and functional aspects of successful programs. To accompany the guidance, CDC also has developed a stewardship assessment tool that includes a checklist to help facilities assess the status of their efforts to improve antibiotic prescribing and point out potential areas for further improvement (*16*).

BOX. Seven core elements critical to the success of hospital antibiotic stewardship programs

- Leadership commitment: Dedicating necessary human, financial, and information technology resources.
- Accountability: Appointing a single leader responsible for program outcomes. Experience with successful programs has shown that a physician leader is effective.
- Drug expertise: Appointing a single pharmacist leader responsible for working to improve antibiotic use.
- Action: Implementing at least one recommended action, such as systemic evaluation of ongoing treatment need after a set period of initial treatment (i.e., "antibiotic time out" after 48 hours).
- Tracking: Monitoring antibiotic prescribing and resistance patterns.
- Reporting: Regular reporting information on antibiotic use and resistance to doctors, nurses and relevant staff members.
- Education: Educating clinicians about resistance and optimal prescribing.

Source: CDC. Core elements of hospital antibiotic stewardship programs. Atlanta, GA: US Department of Health and Human Services, CDC; 2014. Available at http://www.cdc.gov/getsmart/healthcare/implementation/core-elements.html.

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Notes from the Field

Rapidly Growing Nontuberculous *Mycobacterium* Wound Infections Among Medical Tourists Undergoing Cosmetic Surgeries in the Dominican Republic — Multiple States, March 2013–February 2014

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(Author affiliations at end of text)

In August 2013, the Maryland Department of Health and Mental Hygiene (MDHMH) was notified of two persons with rapidly growing nontuberculous mycobacterial (RG-NTM) surgical-site infections. Both patients had undergone surgical procedures as medical tourists at the same private surgical clinic (clinic A) in the Dominican Republic the previous month. Within 7 days of returning to the United States, both sought care for symptoms that included surgical wound abscesses, clear fluid drainage, pain, and fever. Initial antibiotic therapy was ineffective. Material collected from both patients' wounds grew *Mycobacterium abscessus* exhibiting a high degree of antibiotic resistance characteristic of this organism (*1*).

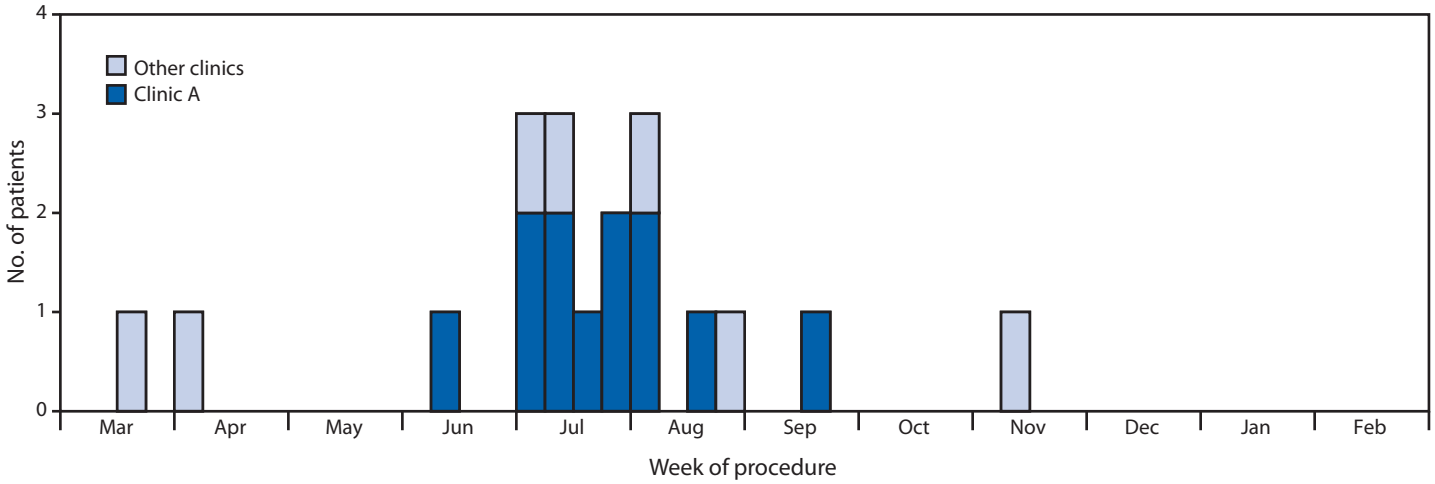
Attempting to identify additional cases, MDHMH posted Epi-X* alerts in August, November, and December 2013. Health department officials in Connecticut, Florida, Massachusetts, New Jersey, New York, Pennsylvania, Boston, and New York City, and CDC officials joined MDHMH to investigate possible cases reported. Official health alerts from state and local health departments and notifications through the Emerging Infections Network and the American Society of Plastic Surgeons requested that health-care providers and the public health community report additional patients. A probable case was defined as a soft-tissue infection unresponsive to standard antibiotic therapy in a patient who had undergone cosmetic surgery in the Dominican Republic after March 1, 2013. A confirmed case was defined as a probable case testing positive for RG-NTM. Patients with probable and confirmed infection were interviewed by using a standardized questionnaire; a systematic abstraction of patients' medical records is ongoing. Pulsed-field gel electrophoresis of available isolates from patients associated with clinic A is being performed at CDC and the New York City Department of Health and Mental Hygiene.

As of February 21, 2014, a total of 19 cases were identified from five states (New York, 11; Massachusetts, three; Connecticut, two; Maryland, two; and Pennsylvania, one). Sixteen (84%) cases were confirmed, and three (16%) were probable. All patients are female (aged 18–59 years). Twelve (63%) reported undergoing surgery at clinic A, and seven (37%) reported surgery at seven other Dominican Republic surgical clinics. The most common cosmetic surgical procedures were liposuction (74%), abdominoplasty (58%), and breast implantation (32%); all procedures occurred during March–November 2013 (Figure), and illness onsets occurred during April–November 2013. Fourteen (74%) were hospitalized in the United States and required multiple therapeutic and corrective surgical procedures and long courses of antibiotics; five were treated as outpatients. No deaths were reported. Of the 16 confirmed cases, 13 (81%) were *Mycobacterium abscessus* infections; two (12%) were *M. fortuitum* infections; and one (6%) is pending final speciation. Of the 18 patients who were interviewed, 13 (72%) were born in the Dominican Republic.

CDC notified Dominican public health authorities of the outbreak investigation and recommended patient follow-up and onsite assessment of infection control practices at the implicated clinics. Clinic A has been closed temporarily by Dominican authorities. This and other outbreaks underscore the risk for infection, including RG-NTM infection, resulting from medical tourism (*2,3*). CDC advises all persons planning to receive surgical care outside the United States to verify that the health-care provider and facility they are considering using are licensed and accredited by an internationally recognized accreditation organization before proceeding (*4,5*). These findings indicate that health-care providers consider RG-NTM among patients with a history of cosmetic surgery in the Dominican Republic who also have a surgical-site infection that fails to respond to standard therapy.

* Epi-X is a CDC-operated, web-based information exchange for public health practitioners. Additional information available at http://www.cdc.gov/epix.

FIGURE. Number of U.S. patients (N = 19) with rapidly growing nontuberculous *Mycobacterium* infections associated with cosmetic surgery in the Dominican Republic, by week of procedure — March 2013–February 2014



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Announcement

Ground Water Awareness Week — March 9–15, 2014

CDC is collaborating with the National Ground Water Association to highlight National Ground Water Awareness Week, March 9–15, 2014. Many persons are not aware that much of the water they use flows from below ground to the surface to public water systems and private wells. The National Ground Water Association uses this week to stress the importance of ground water to the health and well-being of humans and the environment (*1*).

The majority of public water systems in the United States use ground water as their primary source, providing drinking water to almost 90 million persons (*2*). An additional 13 million U.S. homes use private wells, which also rely on ground water (*3*).

Usually, ground water in the United States is safe to use. However, ground water sources can be contaminated naturally or with pesticides, factory waste, and sewage as a result of imperfect agricultural, manufacturing, resource extraction, or sewage disposal practices of businesses or homes. The presence of contaminants at sufficient doses can lead to acute and chronic illness (*4,5*).

The U.S. Environmental Protection Agency has worked with individual states to develop new regulations to provide increased protection against microbial pathogens in public water systems that use ground water sources (*6*). Private ground water wells (i.e., those serving fewer than 25 persons) might not be regulated but nonetheless must be properly maintained by well owners to ensure that the water remains free from harmful chemicals and pathogens.* Resources are available from state and local health departments and nonprofit organizations to help homeowners protect their ground water.†

* Additional information available at http://www.cdc.gov/healthywater/drinking/private/wells/index.html.

† Additional information available at http://www.apha.org/about/public+health+links/linksstateandlocalhealthdepartments.htm and http://www.cdc.gov/healthywater/drinking/training-education.html#webtraining.

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Announcement

National Kidney Month — March 2014

March is designated National Kidney Month to raise awareness about the prevention and early detection of kidney disease. In 2011, kidney diseases were the ninth leading cause of death in the United States (*1*). More than 10% (>20 million) of U.S. adults aged ≥20 years have chronic kidney disease (CKD) (*2*). The chances of having CKD increase with age; the disease is most common among adults aged >70 years.

In collaboration with partner agencies and organizations, CDC released and continues to update the CKD Surveillance System website (http://nccd.cdc.gov/ckd) to document and monitor over time the number of cases of CKD and its risk factors in the United States. The website also provides the means for tracking progress toward achieving *Healthy People 2020* objectives to prevent, detect, and manage CKD (*3*), and for evaluating, monitoring, and implementing quality improvement efforts by federal and nonfederal agencies.

CDC and its partners developed and disseminated the *National Chronic Kidney Disease Fact Sheet, 2014*, a consensus document regarding CKD in the United States that includes data on prevalence by race/ethnicity, risk factors, and health consequences (*2*). Diabetes and high blood pressure are major risk factors for CKD, and controlling these two factors can prevent or delay CKD and improve health outcomes (*2*). Information about kidney disease prevention and control is available at http://www.nkdep.nih.gov. Information about CDC's CKD Initiative is available at http://www.cdc.gov/ckd.

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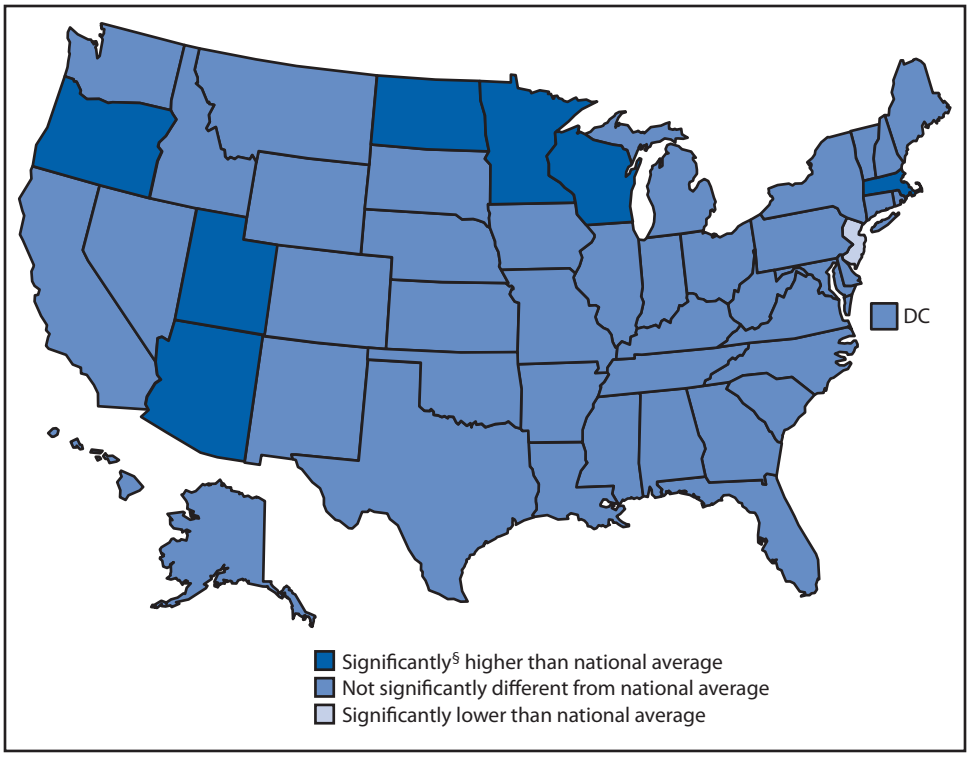
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage of Office-Based Physicians Using an Electronic Health Record (EHR) System,* by State — National Ambulatory Medical Care Survey,† United States, 2013



* An EHR system is a medical or health record system that is entirely or partially electronic.
† A sample survey of office-based physicians.
§ All differences have been tested and determined to be statistically significant, unless otherwise stated.

In 2013, the percentage of physicians using an EHR system was higher than the national average (78%) in seven states (Arizona, Massachusetts, Minnesota, North Dakota, Oregon, Utah, and Wisconsin) (range = 87%–94%) and was lower than the national average in New Jersey (66%).

Source: NCHS Research Data Center: what's new? Winter 2014. National Electronic Health Records Survey (NEHRS). Survey data available through the NCHS Research Data Center at http://www.cdc.gov/rdc/leftbrch/whatnew.htm.

Reported by: Esther Hing, MPH, ehing@cdc.gov, 301-458-4271; Chun-Ju Hsiao, PhD.

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