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Alpha-gal Immunoglobulin E Seroprevalence Among Blood Donors — 10 States, 2024–2025

Eleanor F. Saunders, MD[1,2]; Marissa L. Taylor, MPH[2]; Emma S. Jones, MS[2]; Brad J. Biggerstaff, PhD[2]; Julia M. Vorobiov[3]; David W. McCormick, MD[4]; Marion C. Lanteri, PhD[5,6]; Valerie Green, MS[5]; Brian Custer, PhD[6,7]; Laura Tonnetti, PhD[8]; Gilbert J. Kersh, PhD[2]; Scott P. Commins, MD, PhD[3]; Johanna S. Salzer, DVM, PhD[2]

Abstract

Alpha-gal syndrome (AGS) is an emerging, noninfectious tickborne disease characterized by an allergic reaction to galactose-α-1,3-galactose (alpha-gal), an oligosaccharide found in red (mammalian) meat and other mammalian products such as dairy and gelatin. As of 2022, AGS was estimated to affect up to 450,000 persons in the United States (*1*). Anaphylactic AGS reactions can be fatal, and AGS allergic reactions encompass a range of symptoms including urticaria, angioedema, wheezing, and gastrointestinal distress. AGS is primarily managed through an avoidance diet. The U.S. geographic distribution of AGS is closely associated with the range of the lone star tick (*Amblyomma americanum*); bites from this tick introduce alpha-gal through its saliva, which can trigger the allergy. Diagnosis of AGS requires both the presence of clinically compatible symptoms and the detection of serologic immunoglobulin E (IgE) antibodies against alpha-gal. Persons can have alpha-gal–specific IgE antibodies without clinical symptoms. The proportion of persons in the United States who are seropositive for alpha-gal IgE is unknown. To better understand the distribution and seroprevalence of alpha-gal IgE among U.S. adults, 3,000 serum samples collected during November 2024–April 2025 from blood donors living in 10 states were tested for the presence of alpha-gal IgE antibodies. States previously reported to have high numbers of suspected AGS cases were found to have correspondingly high seroprevalences. Among the 10 states, the highest estimated seroprevalences among persons aged ≥16 years were detected in Arkansas (31.2%) and Missouri (26.0%). These findings can guide the development of surveillance systems for AGS and help identify regions at increased risk.

Introduction

Alpha-gal syndrome (AGS) is an emerging, noninfectious tickborne disease. Persons with AGS experience allergic symptoms after exposure to the oligosaccharide galactose-α-1,3-galactose (alpha-gal). Alpha-gal is found in red (mammalian) meat, dairy products, and mammalian-derived byproducts such as gelatin. Alpha-gal is found naturally in the saliva of many tick species (*2*). In the United States, AGS is most commonly understood to develop after the bite of a lone star tick (*Amblyomma americanum*). Lone star and certain other tick bites induce production of alpha-gal–specific immunoglobulin E (IgE) by injecting salivary alpha-gal (the allergen) along with other tick salivary molecules such as prostaglandins that provoke the human immune response. Physical disruption of the skin barrier (e.g., through a tick bite) plays an important role in the development of this allergy (*2*,*3*).

Persons with IgE antibodies against alpha-gal either have AGS (symptomatically seropositive) or are sensitized (asymptomatically seropositive). The Council of State and Territorial Epidemiologists 2022 alpha-gal syndrome confirmed case definition requires clinical criteria and confirmatory laboratory evidence of serum or plasma alpha-gal–specific IgE of ≥0.1 kU/L. A case with no clinical information available but with confirmatory laboratory evidence

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is considered a suspect case. Tick bites increase the risk for both AGS and sensitization to alpha-gal (*4*,*5*). Only a small minority of persons who are seropositive have AGS, although the precise percentage is unknown. A 2019–2020 case-control study identified 63 control participants who were alpha-gal IgE seropositive in North Carolina, none of whom had AGS (*4*). However, as with other allergies, being sensitized to a specific allergen might be a risk factor for future development of the corresponding allergy (*6*).

Studies have examined alpha-gal IgE seroprevalence in certain populations at risk for tick exposure or within specific geographic regions (*3*,*5*). Among adults in the southeastern United States, seroprevalences between 16% in a Virginia study (*3*) and 60% among North Carolina state park and forestry employees (*5*) have been reported. To further understand the geographic distribution of alpha-gal IgE seropositivity, seroprevalence was estimated at a state population level using data from blood donor samples in 10 states.

Methods

Data Source

During November 14, 2024–April 9, 2025, samples of residual donor serum and corresponding demographic variables (age, sex, race and ethnicity, zip code, and county of residence) were obtained from specimens collected from 3,000 unique blood donors* (300 per state from 10 selected states: Arkansas, Kentucky, Maine, Minnesota, Missouri, New Mexico, South Carolina, Tennessee, Virginia, and Washington).† County of residence included U.S. Census Bureau county–equivalent entities, including the city of St. Louis, Missouri, and multiple independent cities in Virginia. Samples were acquired by Creative Testing Solutions via quota sampling of sequential residual donor sera. Consent for the use of specimens for research purposes was obtained by the American Red Cross and Vitalant from blood donors at the time of blood donation, per routine protocol.

Serologic Analysis

Serum was tested at the University of North Carolina at Chapel Hill using ImmunoCAP o215 (Thermo Fisher Scientific; Waltham, Massachusetts), a highly sensitive blood test component that measures alpha-gal–specific IgE antibodies, using the Phadia 250 instrument (Phadia; Uppsala, Sweden). An alpha-gal IgE titer of ≥0.1 kU/L was defined as a positive result.

* Serum samples and demographic variables were collected through Creative Testing Solutions, which provides laboratory testing to the blood collection organizations American Red Cross and Vitalant. Samples from all states except Arkansas were collected during November 14, 2024–January 21, 2025. Samples from Arkansas were collected during November 22, 2024–April 9, 2025.

† During 2017–2022, Arkansas, Kentucky, Missouri, Tennessee, and Virginia had the highest numbers of suspected AGS cases per population. New Mexico and Washington were selected as states without lone star ticks and with low numbers of suspected AGS cases. Maine, Minnesota, and South Carolina were considered to have moderate numbers of suspected AGS cases. Maine was selected because 1) the state is at the leading edge of the northward expansion of lone star ticks and 2) Maine CDC has performed and published AGS surveillance as a reference point. Minnesota was selected as a state with a relatively high number of suspected AGS cases relative to its minimal lone star tick populations. South Carolina was selected as a state with established lone star tick populations but with fewer suspected AGS cases than its neighboring states.

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Statistical Analysis

For population inference, poststratification based on 2020 U.S. Census Bureau data was used to account for differences between the sampled blood donors and each donor's state population, aligning the sample data with the age group (16–34, 35–44, 45–54, 55–64, 65–74, and ≥75 years) and sex distributions of each donor's state population. Univariate logistic regression was used to calculate the estimated odds of seropositivity by age, sex, race, ethnicity, and urban-rural county designation adapted from the 2023 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme. The six NCHS categories were subgrouped into three categories: urban (large central metropolitan), suburban (large fringe metropolitan, medium metropolitan, and small metropolitan), and rural (micropolitan and noncore). Bonferroni adjustments for multiple comparisons were applied to comparisons of interest. A logistic quasibinomial regression model was used to quantify the relationship between seropositivity and county population density from the 2020 U.S. Census Bureau. Statistical analyses were performed using R (version 4.5.0; R Foundation). Statistical significance was defined as a 95% CI that excluded the null value. This activity was reviewed by CDC, deemed research not involving human subjects, and conducted consistent with applicable federal law and CDC policy.[§]

Results

Demographics of Blood Donors

The median age of blood donors included in the study was 62 years (range = 16–95 years). A total of 56.2% were male, 92.9% were White, and 93.4% were not Hispanic or Latino (non-Hispanic) (Table 1).

Estimated Alpha-gal IgE Seroprevalence, by State

Estimated (poststratified) alpha-gal IgE seroprevalence ranged from 1.1% in Washington to 31.2% in Arkansas (Table 2). Among positive test results in each state, estimated geometric mean alpha-gal IgE titers were highest in Kentucky and lowest in Washington (Supplementary Figure 1). Seroprevalence was not uniform within states, as evidenced by substantial variations by county (Figure). The combined estimated seroprevalence in the five states with the highest seroprevalence was 24.0%.

Population Characteristics by Alpha-gal IgE Serostatus

The estimated alpha-gal IgE seroprevalence among persons aged 16–34 years was lower than that among persons aged 55–64 years (odds ratio [OR] = 0.40). Estimated seroprevalence was higher among males than among females (OR = 1.61). The estimated seroprevalence among Hispanic persons (who accounted for 4.8% of blood donor samples) was lower than that of non-Hispanic persons (OR = 0.43). For every tenfold increase in county population density, the probability that a county resident aged ≥16 years was alpha-gal IgE seropositive decreased by 29.5%. Counties with at least one seropositive donor were predominantly suburban or rural. However, in states with high seroprevalences, urban counties also had seropositive donors (Supplementary Figure 2). Blood donors with positive alpha-gal IgE antibody titers were identified in urban counties in Kentucky, Missouri, Tennessee, and Virginia. Among all counties in Arkansas, none of them are classified as urban.

Discussion

The U.S. geographic distribution of alpha-gal IgE seroprevalence identified in this serosurvey is similar to the distribution of suspected cases of AGS (*1*). In this analysis, estimated alpha-gal IgE seroprevalence was higher in states with established populations of lone star ticks (Arkansas, Kentucky, Missouri, South Carolina, Tennessee, and Virginia) than in the four analyzed states outside the lone star tick range. New Mexico and Washington are outside the established range of this tick species, whereas southernmost Minnesota and southeastern coastal Maine are within the estimated range but do not have documented established populations of lone star ticks. Despite the documented presence of lone star ticks in South Carolina, estimated seroprevalence in this state was low. The reason South Carolina has fewer reported cases of both AGS and ehrlichiosis, a serious bacterial infection primarily transmitted by the lone star tick, compared with reported cases from neighboring states, is unknown (*1*). Although coastal Maine is on the northern edge of the lone star tick range, recent evidence indicates that bites from blacklegged ticks (*Ixodes scapularis*), a species found in Maine, can also cause AGS. This finding might account for the relatively high seroprevalence observed in Maine (*2*,*7*). Understanding the geographic distribution of seroprevalence in selected U.S. states can strengthen public health surveillance and guide clinicians about local risk.

County population density was found to be inversely associated with seroprevalence. Although residents of less populated areas are at higher risk for tick bites, and bites of the lone star tick are the primary known risk factor for alpha-gal IgE seropositivity (*4*), seroprevalence was not statistically different in rural, suburban, and urban areas. This might be attributable in part to the details of rural, suburban, and urban definitions; the narrow definition of urban in this study (comprising large central metropolitan counties only, accounting for 8.0% of

[§] 45 C.F.R. part 46; 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d), 5 U.S.C. Sect. 552a, 44 U.S.C. Sect. 3501 et seq.

TABLE 1. Number and percentage of blood donors positive for alpha-gal immunoglobulin E, estimated population seroprevalence of alpha-gal immunoglobulin E, and odds ratios, by age group, sex, race, and ethnicity — 10 states,* November 2024–April 2025

Characteristic	No. (column %)			Estimated population seroprevalence,¶ % (95% CI)	Unadjusted OR (95% CI)**
	Blood donor samples	Alpha-gal IgE serostatus			
	Total N = 3,000†	Positive§ n = 592	Negative n = 2,408		
Age group, yrs					
16–34	**287 (9.6)**	22 (3.7)	265 (11.0)	8.7 (4.2–13.2)	0.40 (0.18–0.86)
35–44	**280 (9.3)**	36 (6.1)	244 (10.1)	13.6 (9.1–18.2)	0.66 (0.38–1.15)
45–54	**419 (14.0)**	55 (9.3)	364 (15.1)	13.7 (10.2–17.2)	0.66 (0.42–1.04)
55–64	**769 (25.6)**	157 (26.5)	612 (25.4)	19.3 (16.6–22.0)	Referent
65–74	**915 (30.5)**	227 (38.3)	688 (28.6)	24.3 (21.6–27.0)	1.34 (0.99–1.81)
≥75	**330 (11.0)**	95 (16.0)	235 (9.8)	25.8 (21.2–30.4)	1.45 (0.98–2.14)
Sex					
Female	**1,313 (43.8)**	188 (31.8)	1,125 (46.7)	12.4 (9.9–14.8)	Referent
Male	**1,687 (56.2)**	404 (68.2)	1,283 (53.3)	18.5 (15.8–21.2)	1.61 (1.20–2.15)
Race††					
American Indian or Alaska Native	**16 (0.5)**	1 (0.2)	15 (0.6)	2.6 (0.0–7.7)	0.14 (0.01–1.97)
Asian or Native Hawaiian or Pacific Islander	**27 (0.9)**	2 (0.3)	25 (1.0)	3.0 (0.0–7.1)	0.16 (0.02–1.06)
Black or African American	**72 (2.4)**	7 (1.2)	65 (2.7)	5.3 (0.8–9.8)	0.29 (0.09–0.96)
White	**2,788 (92.9)**	578 (97.6)	2,210 (91.8)	16.3 (14.3–18.3)	Referent
Multiple races or other	**79 (2.6)**	3 (0.5)	76 (3.2)	4.7 (0.0–10.8)	0.25 (0.04–1.51)
Preferred not to answer	**18 (0.6)**	1 (0.2)	17 (0.7)	12.0 (0.0–32.7)	0.70 (0.05–9.40)
Ethnicity					
Hispanic or Latino	**145 (4.8)**	12 (2.0)	133 (5.5)	7.4 (2.5–12.4)	0.43 (0.19–0.99)
Not Hispanic or Latino	**2,802 (93.4)**	573 (96.8)	2,229 (92.6)	15.8 (13.9–17.7)	Referent
Preferred not to answer	**53 (1.8)**	7 (1.2)	46 (1.9)	9.4 (1.5–17.3)	0.55 (0.19–1.63)

Abbreviations: IgE = immunoglobulin E; OR = odds ratio.

* Arkansas, Kentucky, Maine, Minnesota, Missouri, New Mexico, South Carolina, Tennessee, Virginia, and Washington.

† The number and percentage of each category refer to the blood donor samples (i.e., the raw data).

§ The alpha-gal IgE threshold for positivity is 0.1 kU/L.

¶ Estimated seroprevalence refers to poststratification weighted seroprevalence, representing the general population aged ≥16 years within the 10 states. Data were weighted by age and sex on a state population level to account for differences between the blood donor population and each donor's state population. The lower CI bounds were truncated at 0.

** Unadjusted ORs are based on poststratified data. Bonferroni adjustments for multiple comparisons were made when computing 95% CIs. 95% CIs that excluded the null value (i.e., 1 for OR) were considered statistically significant.

†† Race and ethnicity categories for data provided by the American Red Cross and Vitalant differ from those in the Office of Management and Budget's Statistical Policy Directive No. 15.

blood donors); travel and relocation; and opportunities for tick encounters in all county types.

Alpha-gal IgE testing has low specificity for AGS; results from this study indicate that nearly one fourth (24%) of the population aged ≥16 years in states with the highest numbers of suspected AGS cases per population would receive a positive alpha-gal IgE test result. In one 10-year chart review of patients seeking care at an allergy clinic in Suffolk County, New York, 7.5% of referred patients were determined by the allergist to be seropositive only (i.e., sensitized), without clinically compatible AGS symptoms (*8*). Reliance on positive alpha-gal IgE test results without considering whether patients also have clinical signs and symptoms of AGS might result in overdiagnosis and unnecessary dietary restrictions. In addition, although cardiovascular implications of sensitization have been studied (*9*), the evidence is insufficient to recommend dietary modifications for sensitized but nonallergic persons. Overdiagnosis poses challenges for public health surveillance, the goal of which is to identify clinical disease. Indiscriminate clinical testing might increase the time and effort needed by public health officials to verify that clinical criteria are met for case identification.

Limitations

The findings in this report are subject to at least three limitations. First, the voluntary blood donor population differs from the general population because it typically comprises persons who have higher socioeconomic and health statuses, are predominantly White, and were born in the United States (*10*). Poststratification by age and sex was used to reduce potential biases in inference that might have resulted from using blood donor samples; however, these characteristics are not expected to be completely aligned with relevant donor and population differences. The number of donors in this study who were not White was too low to enable making reliable inferences by race. Second, opportunistic sampling methods and the location of blood donation centers resulted in uneven geographic coverage

TABLE 2. Number and percentage of blood donors positive for alpha-gal immunoglobulin E, estimated population seroprevalence of alpha-gal immunoglobulin E, and odds ratios, by state and urban-rural classification — 10 states,* November 2024–April 2025

State and urban-rural classification	Blood donor samples	Alpha-gal IgE serostatus		Estimated population seroprevalence,§ % (95% CI)	Unadjusted OR¶ (95% CI)
	Total N = 3,000	Positive† n = 592	Negative n = 2,408		
State**					
Arkansas, Missouri, Virginia, Kentucky, and Tennessee combined	**1,500**	485	1,015	24.0 (20.9–27.1)	—
Arkansas	**300**	105	195	31.2 (25.7–36.6)	—
Missouri	**300**	121	179	26.0 (22.0–30.0)	—
Virginia	**300**	86	214	22.8 (15.0–30.6)	—
Kentucky	**300**	91	209	22.7 (15.5–29.8)	—
Tennessee	**300**	82	218	21.5 (15.4–27.6)	—
Maine	**300**	49	251	10.6 (6.1–15.0)	—
South Carolina	**300**	28	272	5.5 (3.0–7.9)	—
Minnesota	**300**	23	277	5.4 (3.0–7.7)	—
New Mexico	**300**	4	296	1.9 (0.0–3.9)	—
Washington	**300**	3	297	1.1 (0.0–2.4)	—
Urban-rural classification,†† no. (column %)					
Rural	**964 (32.1)**	221 (37.3)	743 (30.9)	18.8 (15.4–22.2)	1.31 (0.92–1.87)
Suburban	**1,795 (59.8)**	331 (55.9)	1,464 (60.8)	15.0 (12.5–17.5)	Referent
Urban	**241 (8.0)**	40 (6.8)	201 (8.3)	9.4 (5.2–13.6)	0.59 (0.32–1.08)

Abbreviations: AGS = alpha-gal syndrome; IgE = immunoglobulin E; OR = odds ratio.

* Arkansas, Kentucky, Maine, Minnesota, Missouri, New Mexico, South Carolina, Tennessee, Virginia, and Washington.

† The alpha-gal IgE threshold for positivity is 0.1 kU/L.

§ Estimated seroprevalence refers to poststratification weighted seroprevalence representing the general population aged ≥16 years within the 10 states. Data were weighted by age and sex by state to account for differences between the blood donor population and each donor's state population. The lower CI bounds were truncated at 0.

¶ Unadjusted ORs are based on poststratified data. ORs comparing states are not displayed. Bonferroni adjustments for multiple comparisons were made when computing 95% CIs. 95% CIs that excluded the null value (i.e., 1 for OR) were considered statistically significant.

** During 2017–2022, Arkansas, Kentucky, Missouri, Tennessee, and Virginia had the highest numbers of suspected AGS cases per population. New Mexico and Washington were selected as states without lone star ticks and with low numbers of suspected AGS cases. Maine, Minnesota, and South Carolina were considered to have moderate numbers of suspected AGS cases. Maine was selected because 1) the state is at the leading edge of the northward expansion of lone star ticks and 2) Maine CDC has performed and published AGS surveillance as a reference point. Minnesota was selected as a state with a relatively high number of suspected AGS cases relative to its minimal lone star tick populations. South Carolina was selected as a state with established lone star tick populations but with fewer suspected AGS cases than its neighboring states.

†† Rural, suburban, and urban designations are adapted from the National Center for Health Statistics 2023 Urban-Rural Classification Scheme. Rural incorporates noncore and micropolitan counties, suburban incorporates small metropolitan, medium metropolitan, and large fringe metropolitan, and urban refers to large central metropolitan.

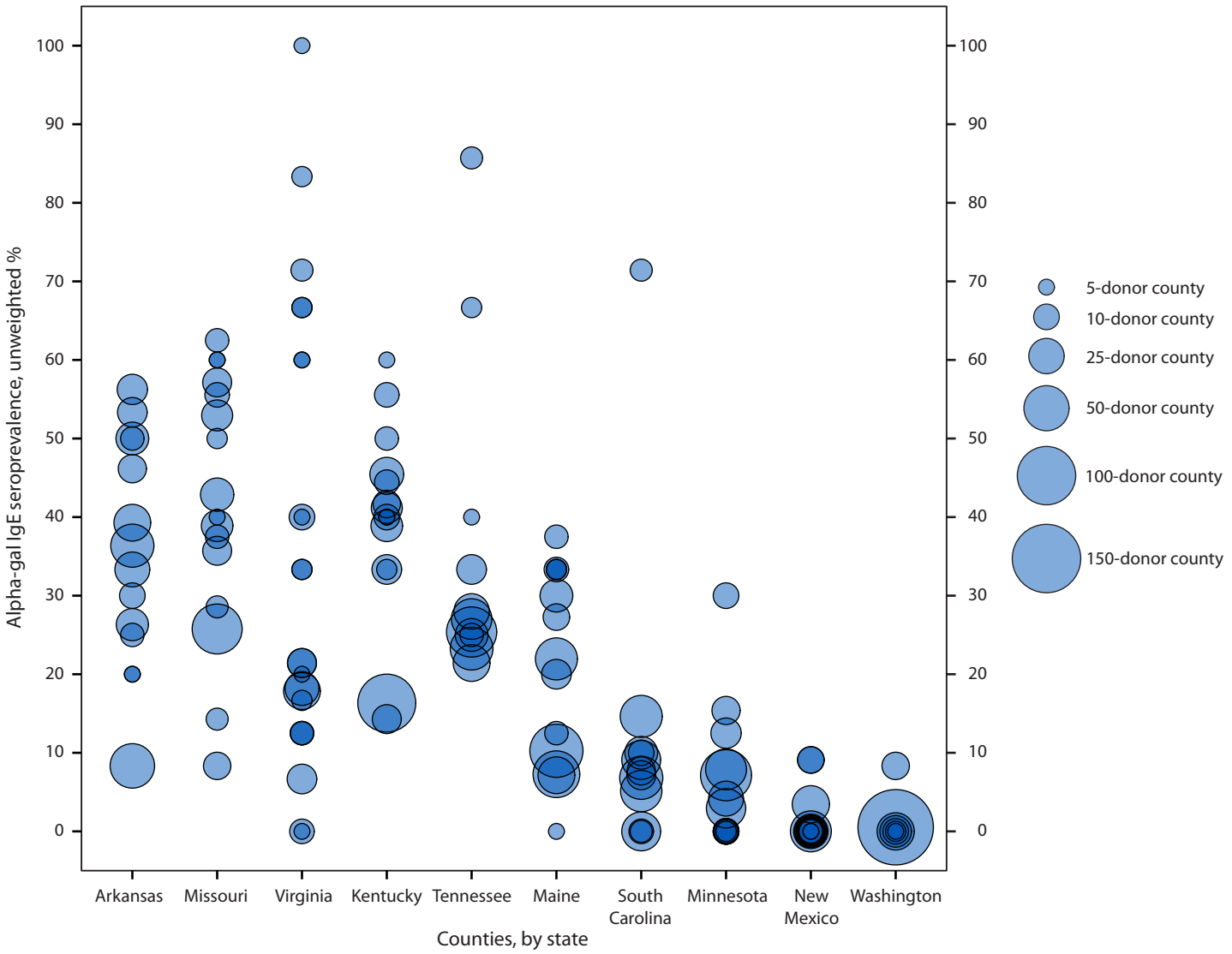
within states, decreasing statewide representativeness. Finally, blood donors disproportionately have type O blood, which might have affected the findings; increasing evidence indicates that alpha-gal IgE seroprevalence might be lower in persons with type B blood (*3*). Type B blood has been found to be protective against both alpha-gal seropositivity and AGS. This might have resulted in seroprevalence overestimates in this report because the general U.S. population includes more persons with type B blood than does the blood donor sample population.

Implications for Public Health Practice

The estimated state-level alpha-gal IgE seroprevalences in this study far exceed the 2022 estimate of up to 450,000 persons nationwide affected by AGS (0.14% of the U.S. population, based on the 2022 U.S. Census Bureau estimated population). As AGS becomes a reportable condition in an increasing number of states and disease surveillance efforts increase, more data will become available to ascertain the proportion of seropositive persons who also are allergic (i.e., have AGS).

In areas of the United States where lone star tick populations are established, 5.5%–31.2% of the human population aged ≥16 years might receive a positive alpha-gal IgE test result and therefore possibly be at increased risk for future development of AGS. Because of this level of population seroprevalence using the current diagnostic test and threshold for positivity, IgE testing should only be performed for patients with a clinical history and symptoms consistent with AGS. A more specific diagnostic method, and possibly an increase in the threshold for alpha-gal IgE positivity, are needed to improve AGS surveillance (*4*). Public health case investigations will be required to evaluate clinical symptoms in addition to IgE testing data, which could strain the resources in the most affected states. Blood donor seroprevalence data align well geographically with areas where persons are impacted by AGS. This adds further support for a geographic focus for AGS surveillance, tick bite prevention, and health care provider education. Elevated alpha-gal IgE seroprevalence might also serve as sentinel surveillance for areas and populations where cases might be underdiagnosed and underreported to improve estimates of AGS incidence.

FIGURE. Seroprevalence* of alpha-gal immunoglobulin E among blood donors, by county and state, with number of donors per county† — 10 states,§ November 2024–April 2025



Abbreviations: AGS = alpha-gal syndrome; IgE = immunoglobulin E.

* Within each state, included counties are those in which at least five blood donors contributed to the current investigation. Seroprevalences are based on raw, unweighted blood donor seropositivity data. Alpha-gal IgE seroprevalence was weighted by age and sex on a state level. Weighting was not performed at the county level.

† For counties with at least five blood donors, these data represent 146 (41.1%) of 355 counties in the full dataset and 2,591 (86.4%) of 3,000 total blood donors.

§ During 2017–2022, Arkansas, Kentucky, Missouri, Tennessee, and Virginia had the highest numbers of suspected AGS cases per population. New Mexico and Washington were selected as states without lone star ticks and with low numbers of suspected AGS cases. Maine, Minnesota, and South Carolina were considered to have moderate numbers of suspected AGS cases. Maine was selected because 1) the state is at the leading edge of the northward expansion of lone star ticks and 2) Maine CDC has performed and published AGS surveillance as a reference point. Minnesota was selected as a state with a relatively high number of suspected AGS cases relative to its minimal lone star tick populations. South Carolina was selected as a state with established lone star tick populations but with fewer suspected AGS cases than its neighboring states.

Summary

What is already known about this topic?

Alpha-gal syndrome (AGS) is an allergy to mammalian meat (e.g., pork, beef, and lamb), dairy, and by-products; most cases result from lone star tick bites. In 2022, up to 450,000 persons in the United States were estimated to be affected. AGS is diagnosed by alpha-gal immunoglobulin E (IgE) testing and a clinical evaluation. Persons can have alpha-gal IgE antibodies but not have AGS.

What is added by this report?

Based on 3,000 residual blood donor samples collected during 2024–2025 from 10 states, the estimated alpha-gal IgE seroprevalence was 24.0% in the five states with the highest seroprevalence (Arkansas, Kentucky, Missouri, Tennessee, and Virginia).

What are the implications for public health practice?

Because only a small minority of persons who are IgE seropositive have AGS, health care providers should only test patients with clinically compatible symptoms, and public health surveillance should include clinical criteria.

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Corresponding author: Johanna S. Salzer, hio7@cdc.gov.

[1]Division of Infectious Diseases, Department of Medicine, School of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina; [2]Division of Vector-Borne Diseases, National Center for Emerging and Zoonotic Infectious Diseases, CDC; [3]Division of Rheumatology, Allergy, and Immunology, Department of Medicine, School of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina; [4]Division of Healthcare Quality Promotion, National Center for Emerging and Zoonotic Infectious Diseases, CDC; [5]Creative Testing Solutions, Tempe, Arizona; [6]Department of Laboratory Medicine, University of California San Francisco, San Francisco, California; [7]Vitalant Research Institute, San Francisco, California; [8]American Red Cross, Rockville, Maryland.

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Legionellosis Outbreaks Associated with Two Hotels — U.S. Virgin Islands, October 2024–April 2025

Sarah Gallalee, PhD[1,2]; Hannah M. Cranford, PhD[2], Aubrey Drummond[2]; Lisa LaPlace Ekpo, DrPH[2]; Brett R. Ellis, PhD[2]; Esther M. Ellis, PhD[2]

Abstract

Legionellosis is a bacterial disease caused by inhalation or aspiration of *Legionella* bacteria; Legionnaires disease is a type of legionellosis characterized by illness with pneumonia. During November 2024, the U.S. Virgin Islands (USVI) Department of Health (VIDOH) was notified of two confirmed Legionnaires disease cases among travelers to two different hotels on St. Croix Island. VIDOH investigated to determine exposure sources and prevent additional cases. Two additional legionellosis cases were identified. The four patients with cases were aged 53–73 years; two patients were hospitalized and none died. At hotel A, *L. pneumophila* was detected in three of 21 (14%) environmental samples. VIDOH required hotel A to close one guest room, remediate, and retest. At hotel B, *L. pneumophila* was detected in 22 of 40 (55%) samples. VIDOH required hotel B to cease hotel operations until remediation and retesting were completed. *L. pneumophila* was isolated from shower samples at both hotels, in the cistern and cold water system at hotel A, and in cold and hot water systems at hotel B. The two USVI outbreaks underscore the importance of reporting legionellosis among returned travelers to facilitate local public health investigations and prevent additional cases. In addition, in tropical climates, cold water systems operate at temperatures favorable for *Legionella* growth (77°F–113°F [25°C–45°C]), highlighting the importance of effective water management programs and water system disinfection to prevent disease spread.

Investigation and Results

Hotel A

On November 6, 2024, CDC notified VIDOH of a case of Legionnaires disease confirmed by a urinary antigen test (UAT) in a man aged 73 years (patient 1); Council of State and Territorial Epidemiologists case definitions for legionellosis were used. On October 30, the patient developed fever, shortness of breath, body aches, joint pain, neck pain, loss of appetite, and diarrhea. He was hospitalized in his U.S. state of residence after returning from travel to St. Croix Island and recovered. He reported staying in two guest rooms at hotel A during October 21–29.

During the investigation of patient 1, a case of probable legionellosis was identified in a woman aged 71 years (patient 2). Patient 2 was a travel companion of patient 1, shared the same travel history, stayed in the same guest rooms, and experienced symptoms including fever and body aches, beginning November 4. She received treatment with antibiotics but was not tested for legionellosis. Both patients reported using showers and sinks in the guest rooms and reported no other water exposures.

In response to these cases, VIDOH conducted on-site environmental sampling at hotel A.* Sampling consisted of 21 swab and bulk water samples from the two guest rooms (showers and sinks), the water heater supplying those guest rooms, a cistern (container that collects and stores rainwater), and the water supply pipe separate from the cistern (Table). In the guest rooms, the bulk water samples were drawn immediately when the faucet or showerhead was turned on to capture a cold (unheated) water system sample and after running the water until hot to capture a hot (heated) water system sample. The cistern and water supply pipe were part of the cold water system. Samples were submitted to an external laboratory for *Legionella* species testing using Legiolert.† *L. pneumophila* was detected in one showerhead, the cistern, and the water supply pipe. Serogroup 1 was detected in one sample and serogroups 2–14 in two samples. The most probable number (MPN) per 10 mL ranged from 1.1 to 213.3, indicating uncontrolled *Legionella* bacterial growth§ (*1*). All three positive samples were collected from cold (unheated) water system sources with water temperatures of 80°F–87°F (26.7°C–30.6°C). Free chlorine levels ranged from undetectable (<0.02 mg/L) to 0.04 mg/L in guest rooms, 0.03 in the cistern, and 0.02 in the water heater.

Hotel B

On November 22, 2024, a member of the public notified VIDOH of a woman aged 53 years (patient 3) who was

* Hotel A's water supply system used both chlorinated municipal water and rainwater cisterns; water was filtered using sedimentation and filtration. Water from the cistern, although seldom used, was treated with chlorine and dispersed to hot water heaters before reaching guest rooms. On occasion, the cistern was filled by a water truck delivery.

† Positive results were considered presumptive until isolates were plated on buffered charcoal yeast extract, and their serogroups were identified to differentiate *L. pneumophila* serogroup 1 from other serogroups.

§ Legiolert reports in MPNs. The MPN of *L. pneumophila* colonies is based on reaction of *L pneumophila* with the enzyme substrate in the Legiolert test; after the number of positive wells is counted, an MPN table is used to determine the concentration in the original sample. The MPN method is considered scientifically equivalent to, or better than, the colony-forming unit plate method for determining concentration.

hospitalized in an intensive care unit in her U.S. state of residence after returning from travel to St. Croix Island, where she had stayed at hotel B. Patient 3 had Legionnaires disease with laboratory confirmation by UAT. She had stayed in three guest rooms at hotel B during October 31–November 9. On November 7, she experienced chest tightness and trouble breathing. After returning to her state of residence, she was hospitalized and received a diagnosis of severe sepsis, bilateral pneumonia, and acute respiratory failure. During the investigation of patient 3, a probable case of Legionnaires disease was identified in another woman aged 55 years (patient 4), who was a family member of patient 3 and had traveled with her, had stayed in the same guest rooms, had symptoms consistent with Legionnaires disease (shortness of breath, cough, fever, headache, and muscle aches), and had received a positive serologic test result detecting antibodies to *L. pneumophila*. She had been treated with antibiotics for her illness, and completely recovered. Three additional family members who traveled with patient 3 also felt ill and received testing by UAT; all results were negative.

VIDOH collected 40 swab and water samples from showers, sinks, and faucets in the three guest rooms, cistern, and water heater (Table) at hotel B.[¶] In the guest rooms, the bulk water samples were drawn immediately when each water source was turned on to obtain a sample from the cold water system and after running the water until hot to obtain a sample of the hot water system. The cistern was part of the cold water system only. Samples were sent for *Legionella* species testing at the same laboratory that had tested hotel A samples. *L. pneumophila* was detected in 22 (55%) samples, including samples from six sinks and four showers. The positive samples consisted of 19 from serogroup 1 (86%) and three from serogroups 2–14 (14%). MPNs per 10 mL ranged from 1.1 to 149, indicating uncontrolled *Legionella* bacterial growth. Positive water samples were taken from a mixture of cold (unheated) and hot (heated) water sources, with temperatures ranging from 82°F to 118°F (27.8°C to 47.8°C). Free chlorine levels ranged from 0.04 to 0.87 mg/L among samples from cold and hot water sources from sinks and showers. The free chlorine level was below the detectable limit in the cistern and was not measured in the water heater because of limited accessibility. This activity was reviewed by CDC, deemed not research, and conducted consistent with applicable federal law and CDC policy.[**]

Public Health Response

VIDOH launched an investigation to determine possible sources of infection, mitigate exposures, and educate hotel staff members and guests, health care providers, and the public.

[¶] Hotel B's water supply system used chlorinated municipal water and stored the water in a cistern. No additional information was available.

[**] 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

TABLE. *Legionella pneumophila* environmental sampling and culture results from an investigation of two unrelated legionellosis outbreaks at two hotels — U.S. Virgin Islands, November 2024

Sampling site	Sample type*	Water temperature, °F (°C)	Free chlorine, mg/L	*Legionella pneumophila* culture result	Serogroup	MPN per 10 mL
Hotel A						
Guest room 1						
Kitchen sink	Swab	—	—	NG	—	—
	Bulk, cold	71 (21.7)	0	NG	—	—
	Bulk, hot	142 (61.1)	0	NG	—	—
Bathroom sink	Swab	—	—	NG	—	—
	Bulk, cold	75 (23.9)	0.04	NG	—	—
	Bulk, hot	149 (65.0)	0.04	NG	—	—
Bathroom shower	Swab	—	—	NG	—	—
	Bulk, cold	80 (26.7)	0	*L. pneumophila*	2–14	14.6
	Bulk, hot	150 (65.6)	0	NG	—	—
Guest room 2						
Bathroom sink	Swab	—	—	NG	—	—
	Bulk, cold	79 (26.1)	0	NG	—	—
	Bulk, hot	149 (65.0)	0	NG	—	—
Bathroom shower	Swab	—	—	NG	—	—
	Bulk, cold	79 (26.1)	0	NG	—	—
	Bulk, hot	148 (64.4)	0	NG	—	—
Hot water heater	Swab	—	—	NG	—	—
	Bulk, hot	—	0.02	NG	—	—
Cistern	Swab	—	—	NG	—	—
	Bulk, cold	85 (29.4)	0.03	*L. pneumophila*	2–14	1.1
Pipe	Swab	—	—	NG	—	—
	Bulk, cold	87 (30.6)	0.14	*L. pneumophila*	1	213.3

See table footnotes on the next page.

TABLE. (*Continued*) *Legionella pneumophila* environmental sampling and culture results from an investigation of two unrelated legionellosis outbreaks at two hotels — U.S. Virgin Islands, November 2024

Sampling site	Sample type*	Water temperature, °F (°C)	Free chlorine, mg/L	*Legionella pneumophila* culture result	Serogroup	MPN per 10 mL
Hotel B						
Guest room 1						
Kitchen sink	Swab	—	—	*L. pneumophila*	1	3.9
	Bulk, cold	73 (22.8)	0.45	NG	—	—
	Bulk, hot	105 (40.6)	0.45	*L. pneumophila*	1	22.3
Bathroom sink	Swab	—	—	NG	—	—
	Bulk, cold	70 (21.1)	0.25	NG	—	—
	Bulk, hot	103 (39.4)	0.25	*L. pneumophila*	1	47.4
Shower	Swab	—	—	*L. pneumophila*	1	149.0
	Bulk, cold	90 (32.2)	0.28	NG	—	—
	Bulk, hot	110 (43.3)	0.28	NG	—	—
Guest room 2						
Kitchen sink	Swab	—	—	*L. pneumophila*	1	1.1
	Bulk, cold	86 (30.0)	0.28	*L. pneumophila*	1	26.4
	Bulk, hot	114 (45.6)	0.28	*L. pneumophila*	1	3.9
Bathroom 1 sink	Swab	—	—	NG	—	—
	Bulk, cold	84 (28.9)	0.18	NG	—	—
	Bulk, hot	109 (42.8)	0.18	*L. pneumophila*	1	72.3
Bathroom 1 showerhead	Swab	—	—	*L. pneumophila*	1	18.7
	Bulk, cold	88 (31.1)	0.25	NG	—	—
	Bulk, hot	105 (40.6)	0.25	*L. pneumophila*	1	21.9
Bathroom 1 bath faucet	Swab	—	—	NG	—	—
	Bulk, cold	88 (31.1)	0.87	*L. pneumophila*	1	41.6
	Bulk, hot	107 (41.7)	0.87	*L. pneumophila*	1	72.3
Bathroom 2 sink	Swab	—	—	*L. pneumophila*	1	1.1
	Bulk, cold	83 (28.3)	0.79	NG	—	—
	Bulk, hot	112 (44.4)	0.79	*L. pneumophila*	1	78.8
Bathroom 2 showerhead	Swab	—	—	*L. pneumophila*	1	126.9
	Bulk, cold	83 (28.3)	0.04	*L. pneumophila*	2–14	1.1
	Bulk, hot	102 (38.9)	0.04	*L. pneumophila*	2–14	2.2
Guest room 3						
Kitchen sink	Swab	—	—	*L. pneumophila*	1	105.7
	Bulk, cold	82 (27.8)	0.47	*L. pneumophila*	1	92.1
	Bulk, hot	110 (43.3)	0.47	*L. pneumophila*	2–14	47.4
Bathroom sink	Swab	—	—	NG	—	—
	Bulk, cold	80 (26.7)	0.05	NG	—	—
	Bulk, hot	82 (27.8)	0.05	NG	—	—
Shower	Swab	—	—	*L. pneumophila*	1	22.3
	Bulk, cold	83 (28.3)	0.08	NG	—	—
	Bulk, hot	118 (47.8)	0.08	*L. pneumophila*	1	65.9
Air conditioning unit	Swab	—	—	NG	—	—
Cistern	Bulk, cold	—	0	NG	—	—
Hot water heater	Bulk, hot	130 (54.4)	—	NG	—	—
	Bulk, hot	130 (54.4)	—	NG	—	—

Abbreviations: MPN = most probable number; NG = no growth.
* Bulk samples were either drawn immediately when the faucet or showerhead was turned on (bulk, cold) to capture the cold (unheated) water system or after running the water until hot (bulk, hot) to capture the hot (heated) water system.

Both hotels temporarily closed implicated water systems and undertook remediation and response activities to control the growth of *Legionella*. The hotels worked with VIDOH to identify and contact guests who had stayed in the identified guest rooms at the properties within approximately 4 weeks before identification of each outbreak. Guests were notified of potential *Legionella* bacteria exposure and advised to monitor themselves for cough, fever, and shortness of breath; to seek medical attention if symptoms developed; and to inform their health care provider about the exposure to aid in timely testing, diagnosis, and treatment.

VIDOH established a dedicated outbreak telephone hotline to address public concerns, provide information, and offer guidance to persons who might have been exposed. An official VIDOH press release was issued to announce the hotel B outbreak and inform the public of the ongoing investigation and public health actions (*2*). The press release emphasized the importance of recognizing symptoms early and encouraged potentially exposed persons to consult their health care providers.

VIDOH required hotel A to close the guest room where patients 1 and 2 had stayed. VIDOH provided recommendations to remediate the hotel's water system and conducted follow-up

Summary

What is already known about this topic?

Legionellosis is a bacterial disease caused by inhalation or aspiration of *Legionella* bacteria. *Legionella* bacteria can pose a health risk when they contaminate building water systems.

What is added by this report?

In November 2024, two outbreaks of legionellosis occurred at two hotels in the U.S. Virgin Islands. Two of four total patients with legionellosis were hospitalized; none died. Although legionellosis outbreaks are commonly associated with warm water sources, probable sources of exposure included both cold (unheated) and hot (heated) water from showerheads and sinks in guest rooms.

What are the implications for public health practice?

Implementing effective water management programs and ensuring adequate water system disinfection to prevent the growth of *Legionella* bacteria is important for hotel operators.

testing to confirm the absence of *Legionella* bacteria in the system, in accordance with CDC guidance (*1*). The property owner conducted remediation during November 2024–February 2025, including replacing the showerhead and plumbing, hyperchlorinating the system, evaluating filtration, permanently closing the cistern with *Legionella* bacteria growth, and creating an access point for adding disinfectant to water piping. Postremediation sampling was conducted during January–February; hotel A was then cleared to fully reopen after test results indicated that the water system was well controlled.

VIDOH required hotel B to close the entire hotel until remediation and retesting for *Legionella* bacteria were completed. VIDOH guided the hotel in remediating the plumbing system and guest rooms. The property owner completed remediation during November 2024–April 2025, including replacing plumbing and fixtures, hyperchlorinating the system, and evaluating filtration. Sampling was conducted in January and April; after testing no longer detected *Legionella* bacteria, hotel B was cleared to fully reopen.

Discussion

VIDOH's investigation of two unrelated legionellosis outbreaks at two hotels highlighted *Legionella* environmental challenges, transmission patterns, and case detection limitations in tropical climates. At hotel B, both cold and hot water systems were implicated; at hotel A, only the cold water system had detectable bacteria. Although hot water systems typically have temperatures that favor *Legionella* growth (77°F–113°F [25°C–45°C]), elevated cold water system temperatures can also increase the risk for colonization (*3*,*4*). In tropical climates such as those in USVI, consistently warmer temperatures can create ideal conditions for bacterial proliferation in cold water systems. These findings highlight the need for tailored *Legionella* bacteria control guidance for warmer environments.

At hotel B, multiple water samples tested positive for *Legionella* bacteria at temperatures above the optimal range for growth (>113°F [>45°C]), indicating the bacteria's persistence under a wide range of temperatures. Hotel B's hot water system might not have reached temperatures sufficiently high to suppress growth of *Legionella* bacteria. Water management programs should include protocols to maintain hot water storage >140°F (>60°C) and circulation >120°F (>49°C) to reduce the risk for *Legionella* growth (*1*). These findings highlight the observation that within a water system lacking thermal control, the system relies entirely on disinfectant to control *Legionella* bacterial growth. Both hotels had water samples with free chlorine levels that were below the detectable limit (eight samples at hotel A and one at hotel B).

Both hotels used mixed water supply systems, with combinations of cisterns, municipal water, and private bulk sources (e.g., water trucks). Cisterns in USVI are large volume storage containers typically built into the foundations of buildings to collect and store untreated rainwater captured on the roof. If not properly maintained, cisterns can harbor pathogens (*5*). Cisterns pose challenges for cleaning, monitoring, and disinfectant dosing and risk recontamination from open connections. Ongoing improvements in maintenance and disinfection recommendations for these systems are needed (*1*).

Legionnaires disease has a low attack rate (1%–6%) (*6*), and potable water outbreaks typically involve persons who were exposed to the same facility at different times. In these two outbreaks, additional legionellosis cases were detected among family members who traveled together, demonstrating clustering associated with shared exposures in guest rooms or specific showers. Lower respiratory specimens were not available for any patients; therefore, molecular comparisons with environmental results were not possible. These examples demonstrate the importance of thorough investigations of Legionnaires disease, even a single reported case, and the importance of notifying guests so that additional legionellosis cases can be identified during hotel outbreaks.

The investigation of these outbreaks also highlighted surveillance gaps, including delays in case identification and underreporting. Although Legionnaires disease is a nationally notifiable disease, hotel B's outbreak was identified solely through a report from a member of the public. Legionnaires disease associated with a private vacation rental in USVI has been described previously (*7*); however, many travel-associated cases are likely missed among travelers who return home before becoming symptomatic. Including destinations in reports of travel-associated Legionnaires disease cases when notifying CDC is essential to improving multijurisdiction coordination that can help identify outbreaks and their sources (*8*).

This public health response underscores the importance of rapid reporting, environmental assessments, laboratory testing, and facility engagement in remediation to prevent additional illnesses. When investigating possible sources of *Legionella* outbreaks in tropical climates, public health officials should consider water systems without temperature regulation and alternative water storage systems, including cisterns.

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Florida Department of Health, Public Health Laboratory.

Corresponding author: Sarah Gallalee, sgallalee@cdc.gov.

[1]Epidemic Intelligence Service, CDC; [2]U.S. Virgin Islands Department of Health.

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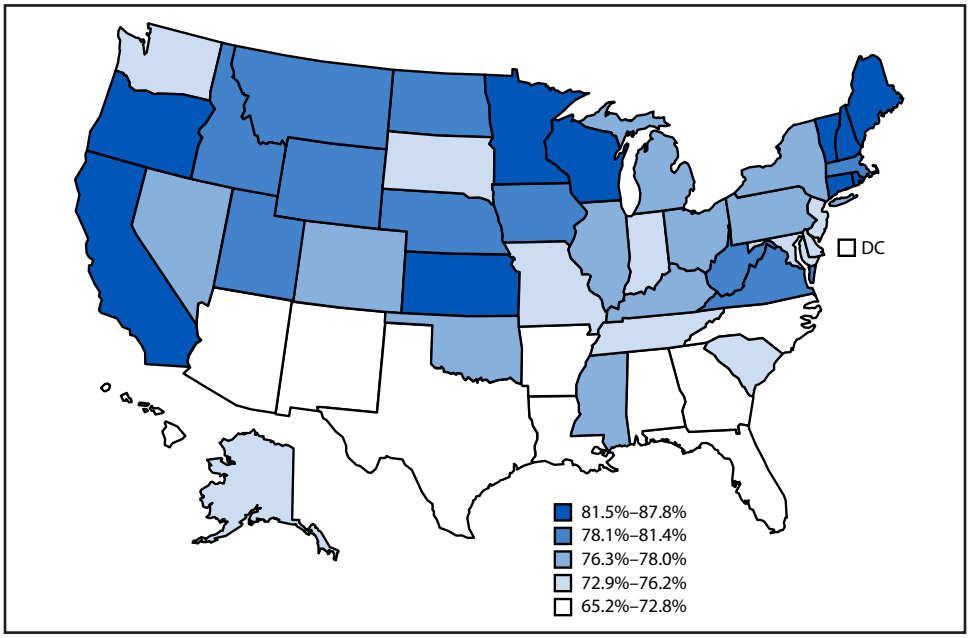
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage of Births in Which Women Received Prenatal Care in the First Trimester of Pregnancy, by State — United States, 2024



Abbreviation: DC = District of Columbia.

For births in the United States in 2024, a total of 75.5% were among women who received prenatal care beginning in the first trimester of the pregnancy. Rates ranged from 65.2% in Florida to 87.8% in Vermont.

Supplementary Table: https://stacks.cdc.gov/view/cdc/257025?preview=1#tabs-3

Source: National Center for Health Statistics, National Vital Statistics System, Natality Data 2024. NVSS - Birth Data

Reported by: Michelle J.K. Osterman, MHS, ibx6@cdc.gov.

For more information on this topic, CDC recommends the following link: Pregnancy | Office on Women's Health.

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