Short report

Legionnaires' disease in transportation, construction and other occupations in 39 US jurisdictions, 2014–2016

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ABSTRACT

Background Certain workers are at increased risk for acquiring Legionnaires' disease compared with other workers. This study aims to identify occupations at increased risk for acquiring Legionnaires' disease.

Methods Using data from the US Centers for Disease Control and Prevention's Supplemental Legionnaires' Disease Surveillance System, this study identified Legionnaires' disease confirmed patients ≥16 years of age in 39 states with reported symptom onset during 2014–2016. Age-adjusted and sex-adjusted incidence rate ratios (IRR) stratified by occupation group were calculated by comparing Legionnaires' disease patients in an occupation group (eg, transportation) to those in all other occupation groups (eg, non-transportation).

Results A total of 2553 patients had a known occupation group. The two occupations with the highest burden were transportation (N=287; IRR=2.11) and construction (N=269; IRR=1.82). Truck drivers comprised the majority (69.7%) of the transportation occupation group and construction labourers comprised almost half (49%) of the construction occupation group. The healthcare support occupation had the highest IRR (N=75; IRR=2.16).

Conclusion Transportation and construction workers, who are generally not covered by guidance related to building water systems, have increased risk of Legionnaires' disease compared with other workers. One hypothesised risk factor for truck drivers is the use of non-genuine windshield cleaner in their vehicles. A simple intervention is to use genuine windshield cleaner with bactericidal properties (ie, includes isopropanol/methanol) which can reduce the risk of *Legionella* growth and transmission. To improve surveillance of Legionnaires' disease and identification of similar exposures, the authors encourage the collection of occupation and industry information for all patients with Legionnaires' disease.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The work environment can be a risk factor for acquiring Legionnaires' disease.

WHAT THIS STUDY ADDS

⇒ This is the first study examining Legionnaires' disease burden by occupation group. Compared with all other occupations, the highest burden was among transportation workers, mainly drivers, followed by construction workers.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Although more studies are needed, for transportation workers, a simple preventative intervention is the use of genuine windshield cleaner, which includes isopropanol/methanol in their vehicles. For improved surveillance of Legionnaires' disease, industry and occupation information should be collected from each patient.

INTRODUCTION

International research has found that among workers professional drivers are at increased risk for acquiring Legionnaires' disease (LD).[1 2] Previously investigated exposures for this population include travel-related exposures associated with the work environment (eg, truck stop showers), vehicle cabin air filters or air conditioners and windshield wiper fluid.[1 3–5] Epidemiologists conducting LD surveillance in several states have observed that truck driver was a frequently reported occupation among individuals with LD. Other occupations with exposure to water may also be a risk. To explore this, we used nationwide surveillance data to determine the risk of LD among transportation and other occupations.

METHODS

Confirmed LD cases in the USA are reported to Centers for Disease Control and Prevention's (CDC's) National Notifiable Diseases Surveillance System (NNDSS). A confirmed LD case occurred in a person with a clinically compatible illness with at least one of the confirmatory laboratory criteria as defined by the 2005 Council of State and Territorial Epidemiologists legionellosis position statement.[6] Briefly, laboratory criteria include isolation of any *Legionella* organism from respiratory culture, detection of *Legionella* antigen in urine or seroconversion (more than fourfold rise in antibody titre between acute and convalescent sera) to *Legionella pneumophila* serogroup 1. Some states submit supplemental LD patient information (eg, exposure history, occupation, hospitalisation, outcome,

known outbreak (yes/no/unknown)) to CDC's Supplemental Legionnaires' Disease Surveillance System (SLDSS).[7] SLDSS captures the following exposure history information for the 10 days prior to symptom onset: if the patient (1) spent one or more days away from home; (2) visited, worked in or stayed in a healthcare setting; (3) visited, worked in or stayed in an assisted/senior living facility; (4) used respiratory therapy equipment or (5) got in or spent time near a whirlpool spa. Using SLDSS data from 39 jurisdictions that reported ≥90% of confirmed NNDSS LD cases to SLDSS for ≥1 year, we identified cases among patients ≥16 years of age with reported symptom onset during 2014–2016 (The following 25 jurisdictions contributed data for all 3 years: AL, CO, CT, FL, GA, IA, KS, KY, ME, MI, MN, MO, MS, NH, NY, NYC, OH, PA, RI, SC, VA, VT, WA, WI, WV, WY. The following 5 jurisdictions contributed 2 years of data: AK, HI, ND, TX, UT. The following jurisdictions contributed 1 year of data: AR, AZ, DE, IL, MD, MT, NJ, NM.). We coded reported occupation into groups based on the 2010 US Census occupation codes. Coding was completed using a combination of manual coding and the National Institute for Occupational Safety and Health (NIOSH) Industry and Occupation Computerized Coding System: https://www.cdc.gov/niosh/topics/coding. Population denominators for each stratification level were obtained from US Census Bureau American Community Survey 1-year estimates, Public Use Microdata Sample. We calculated age-adjusted and sex-adjusted incidence rate ratios and 95% confidence intervals (CIs) comparing patients with LD in a given occupation group (eg, transportation) to those in all other occupation groups (eg, non-transportation). This analysis was completed as part of routine public health surveillance activities using secondary data, as such it was not possible to involve patients or the public in the design of this study.

RESULTS

Of 11 122 LD cases meeting study criteria, 2552 (23.0%) received an occupation code, 84 (0.8%) were coded as unpaid occupations (ie, homemakers, students, volunteers), 655 (5.9%) were non-work (eg, disabled, inmate, not working), 2823 (25.4%) were coded as retired and occupation was reported unknown for 5008 (45.0%). The majority of patients with LD who received an occupation code were male (1849/2553=72.4%) with less than 1% (18/2553) missing information on sex. For the same group by age, a plurality of patients with LD were 50–59 years (923/2553=36.2%), followed by those 60–69 years (612/2553=24.0%) and 40–49 years (492/2553=19.3%). Age was available for all patients.

Table 1 lists the frequency of LD cases by occupation group; 287 (11.2%) were in the transportation occupation group with a crude LD incidence rate of 1.72 per 100 000 workers versus the overall crude LD rate among those with an occupation code of 0.56 per 100 000 workers. Professional drivers comprised the majority (258, 89.9%) of transportation occupations (driver/sales workers and truck drivers=200; bus drivers=33; taxi drivers and chauffeurs=25). There were 29 LD cases in other transportation occupations (these included jobs related to planes (eg, flight attendants, pilots), boats (eg, sailors), trains (eg, locomotive engineers, yardmasters), street cars, parking lot and watercraft attendants, and transportation inspectors). The adjusted LD incidence rate for transportation occupations was 2.1 times the rate of non-transportation occupations (95% CI 1.8 to 2.4) (table 1). Among the 8537 LD cases with data available on outbreak status as reported by the state to CDC's SLDSS, 3.4% (8/235) of cases among patients reporting transportation occupations were outbreak-associated vs 6.4% (120/1883) of cases among patients reporting non-transportation occupations and 8.0% (514/6419) of cases among patients reporting unpaid/not-working/retired/unknown occupations (χ^2=11.5, df=2, p=0.003). Among the 4767 cases with a reported possible

Table 1 Stratified by occupation group, frequency, crude IR and age-adjusted and sex-adjusted IRR* for confirmed patients with LD ≥16 years of age whose symptom onset occurred during 2014–2016 from the 39 jurisdictions that reported ≥90% of their cases—Supplemental Legionnaires' Disease Surveillance System, USA

US Census 2010 occupation group	Total no of patients with LD	Total no of workers†	Crude IR per 100 000 workers	Adjusted IRR* (95% CI)
Transportation	287	16 659 691	1.72	2.11 (1.83 to 2.45)
Construction	269	22 195 238	1.21	1.82 (1.58 to 2.10)
Office and administrative support	242	58 368 001	0.41	0.93 (0.80 to 1.08)
Sales	235	47 749 046	0.49	0.91 (0.78 to 1.07)
Production	178	26 627 910	0.67	1.02 (0.86 to 1.21)
Building and grounds cleaning and maintenance	163	17 809 077	0.92	1.46 (1.23 to 1.74)
Management	160	46 076 681	0.35	0.46 (0.38 to 0.55)
Installation, maintenance and repair	119	14 077 977	0.85	1.10 (0.89 to 1.36)
Food preparation and serving	115	26 452 274	0.43	1.46 (1.17 to 1.83)
Healthcare practitioners and technical	106	26 541 374	0.40	0.84 (0.67 to 1.06)
Personal care and service	88	16 850 560	0.52	1.33 (1.04 to 1.70)
Material moving	87	12 018 492	0.72	1.37 (1.09 to 1.72)
Protective service	75	9 655 797	0.78	1.26 (0.98 to 1.62)
Healthcare support	75	10 699 396	0.70	2.16 (1.67 to 2.80)
Education, training and library	59	26 965 583	0.22	0.47 (0.35 to 0.63)
Architecture and engineering	53	8 166 546	0.65	0.76 (0.56 to 1.03)
Arts, design, entertainment, sports and media	43	8 954 457	0.48	---‡
Business operations	38	11 737 203	0.32	---‡
Community and social services	36	7 739 875	0.47	---‡
Financial	33	10 017 264	0.33	---‡
Legal	26	5 091 320	0.51	---‡
Life, physical and social science	21	3 944 611	0.53	---‡
Computer and mathematical	20	12 897 027	0.16	---‡
Extraction	9	618 413	1.46	---‡
Farming, fishing and forestry	9	3 248 462	0.28	---‡
Military specific	6	1 550 111	0.39	---‡

*The comparison group is all other occupations. For instance, transportation occupations versus non-transportation occupations or construction occupations versus non-construction occupations.
†Sum of workers by occupation group for the 39 jurisdictions that reported ≥90% of their cases.
‡Age-adjusted and sex-adjusted IRR only calculated for occupational groups with 50 or more LD cases.
CI, confidence interval; IR, incidence rate; IRR, incidence rate ratio; LD, Legionnaires' disease.

exposure source, a larger proportion of patients reporting transportation occupations (83/114=72.8%) travelled during the exposure period versus non-transportation occupations (450/936=48.1%) or unpaid/not-working/retired/unknown occupations (1052/3717=28.3%) (χ^2=214.1, df=2, p<0.0001).

Although the impetus for this analysis was LD among transportation workers, other occupations were also identified as having statistically significantly higher rates of LD (table 1). Among occupations that may not be protected by guidance for complex building water systems, construction occupations had the second highest frequency of LD (269 patients (10.5%)) after transportation occupations and had 1.8 times the rate of LD compared with non-construction occupations (95% CI 1.6 to 2.1). Construction labourers comprised 49% (133/269) of the construction occupation, followed by pipelayers, plumbers, pipefitters and steamfitters (7.4%; 20/269). However, the free-text information used to code the US Census occupation for construction labourers was vague with 80.5% (107/133) of text listing only construction (n=71), construction worker (n=21) or handyman (n=15). Building and grounds cleaning and maintenance had the third highest frequency with 163 patients (6.4%) and 1.5 times the rate of LD compared with non-building and grounds cleaning and maintenance occupations (95% CI 1.2 to 1.7). The two other occupations with statistically significant rates of LD were healthcare support (75 patients (2.9%)), which had the highest incidence rate ratio of 2.2 (95% CI 1.7 to 2.8) compared with non-healthcare support occupations, and food preparation and serving occupations (115 patients (4.5%)) with an incidence rate ratio of 1.5 (95% CI 1.2 to 1.8) compared with non-food preparation and serving occupations. These latter two occupation groups, healthcare support and food preparation and serving, are likely to be protected by guidance for building water systems.[8]

DISCUSSION

Our results indicate that LD occurs at a higher rate among US workers in transportation and construction occupations who might not be covered by guidance for building water systems. This is the first analysis of LD cases stratified by occupation and highlights potential groups to target for prevention. Current LD prevention guidance for building water systems[7] might not adequately protect workers who typically work outside these building types, such as professional drivers or construction workers. We recommend additional studies to confirm our results and identify potential sources of exposure.[9] For instance, two prior case studies found a molecular link between clinical and environmental isolates from car air conditioners[1] while another two found laboratory evidence consistent with windshield wiper fluid as the exposure source.[4 5] Additionally, a 2008/2009 case–control study in England and Wales found that patients with LD had 47 times the odds of using non-screenwash (eg, water without the addition of genuine windshield cleaner) in the windshield wiper fluid (95% CI 3.70 to 603.63) compared with controls.[10] There is very little information in the literature on exposure sources for construction workers, although construction sites and activities are known risk factors for the growth and spread of *Legionella*.[11] For two construction workers, a molecular link between clinical and environmental isolates was identified in 1997 from a construction site sink[1] and in 2002 from a condensing tower during a hospital roof renovation.[11] Other reported exposure sources among non-outbreak-associated cases include excavation sites/activities, potting/natural soil, shower heads or dental office waterlines.[1 11] Our study is limited by the age of the data and the large proportion of records with unknown occupations, the proportion of which varies by reporting state (online supplemental table 1). The 68% of patients with unknown occupation were of traditional working age (16–65 years). Further, it is likely that the observed relationships may be confounded by other factors that were not available in the SLDSS dataset, such as underlying medical conditions. For instance, it is known that occupation group composition differs by race and ethnicity; however, among the LD cases with an occupation code in our data, race and ethnicity data were missing for 17% and 78%, respectively. However, even if the relationship is confounded, it does not negate the possibility of exposure through the work environment.

Outreach is underway to raise awareness among professional drivers to only use genuine windshield cleaner in their vehicles to reduce the risk of *Legionella* growth and transmission.[12] Concurrently, we encourage state and local health departments to help strengthen the evidence supporting an association between windshield wiper fluid and LD by doing the following, as suggestive evidence indicates this is a potential infection source.[4 5] We urge public health professionals to (1) collect respiratory specimens from patients who are professional drivers and environmental samples from the patient's vehicle's windshield fluid tank, (2) assess source attribution by performing genetic comparisons on the collected isolates and (3) determine if water was used to fill the tank instead of genuine windshield cleaner that contains isopropanol/methanol, as the latter may possess bactericidal properties. Even if specimens are not collected, health departments can contribute to this effort by expanding and improving the routine collection of industry and occupation data for patients with LD. More specific information will help to confirm these results, identify subgroups of workers with increased LD risk and potentially identify additional exposure sources based on job duties within industries.

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Patient consent for publication Not applicable.

Ethics approval This study involves human participants but this activity was reviewed by CDC, deemed not research and was conducted consistent with

applicable federal law and CDC policy (e.g., 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.). The study uses a secondary dataset that was created as part of routine public health surveillance. It does not contain identifiers which would allow the authors to contact individuals to obtain consent.

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Data availability statement Data are available on reasonable request. A deidentified dataset can be made available on request. However, due to confidentiality, a data use agreement may be required depending on requested data elements. Data requests can be made to travellegionella@cdc.gov.

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