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List of Terms and Abbreviations

AIHA	American Industrial Hygiene Association
ASSE	American Society of Safety Engineers
ATSDR	Agency for Toxic Substances and Disease Registry
BLLs	Blood Lead Levels
BLS	Bureau of Labor Statistics
BRFSS	Behavioral Risk Factor Surveillance System
CFOI	Census of Fatal Occupational Injuries
CO	Carbon monoxide
COHb	Carboxyhemoglobin
COPD	Chronic Obstructive Pulmonary Disorder
CSTE	Council of State and Territorial Epidemiologists
DWH	Deepwater Horizon
ED	Emergency Department
EPA	Environmental Protection Agency
EPHT	Louisiana's Environmental Public Health Tracking Program
FDA	Food and Drug Administration
HRI	Occupational heat-related illness
IH	Inpatient Hospitalizations
IOM	Institute of Medicine
LAHIDD	Louisiana Hospital Inpatient Discharge Data
LBP	Low Back Pain
LMR	Louisiana Morbidity Report
LOHIS	Occupational Health and Injury Surveillance/Louisiana Program
LPC	Louisiana Poison Center
LSU	Louisiana State University
LWC	Louisiana Workforce Commission
MSDs	Musculoskeletal disorders
MSHA	Mine Safety Health & Administration
NIOSH	National Institute for Occupational Safety and Health
NOMS	National Occupational Mortality Surveillance
OHIP	Occupational Health Internship Program
OSHA	Occupational Safety & Health Administration
OVR	Louisiana's Office of Vital Records
OWC	Office of Workers' Compensation
SOII	Survey of Injuries and Illnesses
SouthON	Southern States Occupational Network
WC	Workers' compensation
WRA	Work-related asthma

Abstract

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While Louisiana is a relatively small state, a significant number of its workforce is employed in high risk industries – oil & gas exploration, chemical manufacturing, agriculture, transportation, and construction – each with unique, geographic and hazard variability. Every year, thousands of these workers are injured on the job or become ill as a result of exposure to health and safety hazards at work. These work-related health conditions have high human and economic costs not only for workers and employers, but also for society at large. Workers' compensation claims alone in Louisiana cost approximately \$870 million in 2012, and there is an annual average of 2,500 work-related hospitalizations and 121 work-related fatalities. Louisiana's occupational fatality rate exceeded the national rate by almost 35%, is the 7th highest rate in the country, and the highest among other southern states.

An accurate count of injuries and illnesses is necessary to identify and address unsafe work conditions, allocate resources, initiate and prioritize interventions, and evaluate work processes and changes. The Occupational Health and Injury Surveillance Program in Louisiana is the primary state program for occupational health surveillance. During the past 5 years, the program has conducted population-based surveillance of occupational illnesses, injuries, and hazards using data from multiple in-state and federal data sources. New data sources were also developed: Emergency Department, Workers' Compensation, and Louisiana's Behavioral Risk Factor Surveillance System (BRFSS). There are approximately 16,000 work-related ED visits per year, and about 75% of were due to an injury. In partnership with the Louisiana Workforce Commission, we initiated the first inter-agency effort to analyze workers' compensation claims data to identify trends and high risk industries. We successfully added employment data to Louisiana's BRFSS survey allowing for characterization of Louisiana's working population by health status, risk factors, and other variables. Using multiple data sources, indicators of occupational health were annually calculated in addition to in-depth analysis of conditions relevant to Louisiana's diversified workforce: falls in the construction industry, asbestosis, asthma, heavy metal exposure and heat-related illness. Responding to emergent events is a core public health function and the program participated in numerous emergency response activities impacting Louisiana workers ranging from indoor air quality investigations to establishing a sentinel surveillance system with hospitals and emergency departments during the 2010 Deepwater Horizon disaster to track acute exposures impacting response workers. Through collaborative partnerships with a diverse network of stakeholders, findings were disseminated in multiple formats and venues in order to advance occupational health surveillance research and practice at the state and national level. We have contributed to increased occupational health surveillance capacity at the regional level through the Southern States Occupational Network (SouthON) which has successfully held

annual conferences and conducted several regional projects including heat-related illness and fatal occupational injuries.

The work of the Occupational Health and Injury Surveillance Program during the past 5 years has resulted in numerous positive impacts: increased occupational safety and health outreach and education, expanded collaborations and partnerships, enhanced use of surveillance data, and increased awareness of priority occupational health issues.

Section 1

Significant findings

We have developed a robust occupational health surveillance system that routinely processes, evaluates, and analyzes data from state and federal data sources. Multiple data analysis projects were conducted:

- Twelve years of asbestosis hospitalizations were reviewed and analyzed. Results indicate that Louisiana's asbestosis hospitalization rate is significantly greater than the US rate, and Louisiana has more facilities that produce, process, or use asbestos than any other state in the US. Historically, asbestosis in Louisiana has been associated with the large shipbuilding industry.
- Review of data from the Census of Fatal Occupational Injuries (CFOI) indicates that Louisiana continues to have fatal occupational injury rate greater than the US rate, and most states. Construction represents about 10% of Louisiana's workforce, and has one of highest number of fatal injuries. On average 26 construction works die every year, and one-quarter of the fatalities are due to falls, and many of the falls occur from low levels, such as a fall from a ladder.
- Occupational heat-related illness data for 9 southeastern states indicate out-of-state residents made up about 10% of all visits, and that rates were elevated in males and blacks. Louisiana had significantly elevated rates compared with other states, and the region. We conducted an in-depth review of Louisiana cases hospitalized > 3 days and fatalities. Cases represented 9 different industries, although almost half of the cases were involved in either construction or oil and gas work, and both fatalities occurred in workers who had been on the job for less than 1 week.
- Data from Louisiana's Behavioral Risk Factor Surveillance System (BRFSS) indicate that 42% of individuals with asthma reported their asthma was exacerbated or related to work. An in-depth analysis of asthma hospitalizations found that 22% had more than one asthma-related hospitalization, Black women had the highest rate, followed by white women, and overall rural counties had a higher rate than urban counties. Although industry information is not collected in hospitalization records, there are a high number of Louisiana industries where asthmagens are prevalent: chemical and petrochemical, construction, and agriculture.
- Through the approximately 100 blood leads ≥ 25 mcg/dL that are received, processed, and evaluated annually, worksites at high risk of lead exposure have been targeted and investigated including bridge renovation projects and indoor shooting ranges.

The program has assisted the state health department in numerous emergency response activities and investigations. Most notably, following the Deepwater Horizon (DWH) Disaster in the Gulf of Mexico in 2010, a sentinel surveillance system was established with healthcare providers to track acute exposures impacting response workers. Evaluation of more than 300 worker reports and medical records revealed high levels of heat-related illness, minimal pre-employment screening, and the critical role of occupational medicine during large-scale emergency operations.

We co-founded the SouthON: a network of occupational health colleagues focused on expanding occupational health surveillance and research capacity among the 12 Southeastern states. Through 2-day annual meetings, webinars, and joint projects, this collegial network

has been instrumental in building regional occupational partners and identifying common labor issues and practices relevant to the workers in the southeast.

An evaluation of workers' compensation data revealed significant under-reporting of claims data by insurance companies. After legislative changes improved reporting requirements and data quality, we partnered with the Louisiana Workforce Commission (LWC) to maximize the use of Louisiana's workers' compensation data for use in occupational health surveillance. This project represented the first inter-agency effort to analyze claims data to identify trends and high risk industries. Other data source improvements: adding employment data to the Behavioral Risk Factor Surveillance System for multiple years; purchasing ED data, and establishing a process for incorporating industry and occupation information in mortality data.

Translation of Findings

Research findings have been widely disseminated via professional journals, newsletters, presentations, factsheets, and webinars. Communication of research methodologies (e.g., identification of work-related cases) and findings (e.g., high risk industries and populations) in multiple formats and venues improves occupational health surveillance research and practice. Research findings can be used to target outreach and education activities. Examples include: lead surveillance investigations revealed three bridge renovation worksites with multiple workers with elevated lead levels; construction represents about 10% of the workforce and is experiencing significant growth throughout the state. On average, 26 construction workers die every year in Louisiana and the most common cause is falls to a lower level; Louisiana has significantly elevated rates of occupational heat-related illness in comparison with other Southeastern states which is likely due to large number of outdoor workers (e.g., oil and gas, construction, and agriculture). Findings from our DWH surveillance activities identified several critical issues relevant to the large-scale emergency operations such as the importance of pre-placement evaluations to identify individuals with specific susceptibilities whose activities may need to be restricted or modified and provision of continuing medical education courses to local physicians about the occupational exposure history, pre-placement evaluations, and factors that should be considered before making a determination of work-relatedness.

Outcomes/ Impact

Potential: Our research activities provide insight into occupational safety and health issues impacting Louisiana workers. These findings have been shared with our stakeholders and represent opportunities to improve worker safety and health, including education and policy changes.

Intermediate: Our network of occupational health stakeholders in Louisiana provides a strong and stable framework for ongoing occupational safety and health activities. Engagement with local universities increases capacity through new research opportunities and student internships; close collaboration with the Occupational Safety & Health Administration (OSHA) and the LWC fosters regulatory and policy changes; and partnerships with other Southeastern states through SouthON promotes capacity-building at both the state and the regional level.

Section 2

Background:

While Louisiana is a relatively small state, many of its workers are engaged in industries that have a high risk of injury or disease: construction, oil and gas extraction, chemical production, commercial fishing, agriculture and transportation. The seafood industry is second largest in the US, and Louisiana is among the 10 largest producers of cotton, sugar cane, yams, rice, and pecans. Louisiana is a leading supplier of both basic organic and petrochemicals with over 90 major chemical plants and approximately 300 petrochemical manufacturers. The port of South Louisiana, which spans 54 miles along the banks of the Mississippi, is the single largest port in the United States, and 4 other Louisiana ports are ranked in the top 15. In addition to water transport, Louisiana also has a major land transportation infrastructure. New Orleans is one of two sites in the United States where all six of North America's Class One railroads converge. Every year, thousands of these workers are injured on the job or become ill as a result of exposure to health and safety hazards at work. These work-related health conditions have high human and economic costs not only for workers and employers, but also for society at large. Workers' compensation claims alone in Louisiana cost approximately \$870 million in 2011, and from 2008 to 2012, there was an annual average of 1,900 work-related hospitalizations and 121 work-related fatalities. Louisiana's fatality rate is greater than the US rate, and most other states.

An accurate count of injuries and illnesses is necessary to identify and address unsafe work conditions, allocate resources, initiate and prioritize interventions, and evaluate work processes and changes. Although OSHA and the Mine Safety Health & Administration (MSHA) enforce workplace safety and health standards, State health departments, which are vested with the legal authority to require disease reporting and collect health data, play a critical and complementary role in the prevention of occupational illnesses and injuries by applying public health surveillance tools to identify problems, target interventions, and evaluate programs to reduce occupational illness and injury morbidity and mortality. The overall goal of the Occupational Health and Injury Surveillance/Louisiana (LOHIS) Program was to reduce injuries, illnesses and deaths among Louisiana workers through collection, interpretation, and dissemination of surveillance data that can be used to target outreach and prevention activities and inform policy recommendations. This was achieved by compiling, analyzing, and interpreting occupational health surveillance data from multiple data sources in order to identify trends, high risk occupations and industries; collaborating with a diverse network of partners to develop and implement prevention strategies; improving data sources; disseminating findings in a variety of formats using various communication modalities; and responding to emergent and emerging events. Accomplishments for each aim are described in the following section.

Analysis of Surveillance data

The program created established protocols for obtaining, evaluating, and analyzing the primary population-based data sources needed for occupational health surveillance: inpatient hospitalizations, mortality, cancer incidence, emergency department visits, Census of Fatal

Occupational Injuries (CFOI), Survey of Injuries and Illnesses (SOII), and Louisiana Poison Center (LPC) call. In addition to annual calculation of grant-funded occupational health indicators, competency in data analysis allowed for multi-year data analysis projects using established methodologies to extract relevant cases based on diagnosis, histology, and other variables. These analyses provide descriptive details on characteristics of Louisiana's workforce, employment patterns, and health outcomes.

Demographics

Louisiana's average annual workforce includes 1,917,000 individuals. About 53% of the workforce is male. While the percent of Louisiana workers age 16-17 and 18-64 decreased by 10% and 1% respectively from 2003 to 2013, the percent of workers age 65 years and older increased by 25%. On average, 70% percent of Louisiana's workforce is white, and 27% is black; the average percentage in the United States workforce from 2010-2011 was 82% white and 11% black. About 4% of the Louisiana workforce is of Hispanic ethnicity, compared to 14% of the United States workforce. Twenty-three percent of Louisianans work more than 40 hours per week. Education and Health Services is the largest industry sector (24%), and the largest occupational group is Professional and Related Occupations (20%).

High-risk industries and occupations

Twenty-five industries listed by the Bureau of Labor Statistics (BLS) had occupational injury and illness rates more than double the national rate. Workers in these industries made up 6% of the national private sector workforce, but 17% of the OSHA-reportable injuries and illnesses. The average annual percentage of persons employed in high risk morbidity industries from 2010-2012 was 7.6 for Louisiana and 7.2 for the U.S. Primarily, the high-risk industries in Louisiana are manufacturing; agriculture, forestry & fishing; mining, oil and gas; construction and transportation.

Many of Louisiana's approximately 2 million workers are engaged in occupations that have a high risk of injury: construction, oil and gas extraction, chemical production, commercial fishing, agriculture and transportation. Twenty-three occupations in the U.S. had injury and illness rates greater than 5 per 100 full-time workers - more than two-and-a-half times the overall rate. While workers in these occupations made up only 6% of the national private sector workforce, they accounted for 27% of cases with one or more days away from work. The average annual percentage of persons employed in high risk morbidity occupations from 2010-2012 was 16.5 for Louisiana and 15.4 for the U.S.

Occupational Safety and Health Professionals

Occupational safety and health professionals share the common goal of identifying workplace hazards and preventing or reducing workers' risks to these hazardous conditions or processes. According to the Institute of Medicine (IOM), an estimated 75,000 to 125,000 occupational safety and health professionals actively participate or are eligible to participate in professional societies, e.g., industrial hygiene, occupational safety, occupational health nursing, occupational medicine. Rates for members of the American Society of Safety Engineers (ASSE) in Louisiana (44.3) were nearly twice the U.S. rate (22.6). Average annual rates of Safety and Health professionals in Louisiana (12.6) are also consistently higher than the national rate (7.8). Although membership in the American Industrial Hygiene Association

(AIHA) is higher in Louisiana (7.2) than the U.S. (6.8), the rate of industrial hygienists in Louisiana is lower (3.4) than the U.S. rate (4.8).

Louisiana has relatively limited occupational safety and health regulatory and enforcement resources. The state is under federal OSHA jurisdiction, with an Area Office located in Baton Rouge that has 12 compliance officers whose jurisdiction covers private sector organizations in Louisiana. The small staff size limits the ability to conduct routine safety and health inspections, as well as increases the workload of inspectors available to respond to occupational fatality investigations. The average annual percentage of OSHA-covered establishments eligible for inspection that were inspected by Federal/State OSHA from 2004-2013 was 0.49% (602) out of an average of 123,494 eligible establishments for Louisiana and 1.1% (92,952) out of an average of 8,711,780 eligible establishments in the United States.

Hospitalizations

There was an average annual count of 1,815 work-related hospitalizations for persons age 16 and older in Louisiana from 2010-2012 with workers' compensation as the primary payer. The number of work-related hospitalizations in Louisiana ranged from 1,598 to 1,961 during the time period. On average, there were 34 work-related burn hospitalizations per year in Louisiana from 2010-2012.

Low Back Pain (LBP) disorders are one of the leading occupationally related conditions and are the most frequent reason for filing a workers' compensation claim. LOHIS analyzed 12 years (1998-2009) of hospitalization data for Louisiana residents at least 16 years old who had a hospitalization paid for by workers' compensation and had a relevant LBP diagnosis and LBP surgery code. There were a total of 5,267 workers hospitalized with LBP disorder. There were approximately 365 surgical cases in Louisiana each year. The surgical rate showed a significant decrease over the study period with a mean annual rate of 19.05 per 100,000 employed persons ranging from a high of 30.0 in 2002 to a low of 15.3 in 2006 ($p=0.036$). The most common LBP disorder was herniated discs (65% of all diagnosis). The mean age of surgical cases was 43 (SD=10.1 range 19-79), with 65% of procedures occurring among individuals aged 35-54. Men had a higher rate of LBP surgical hospitalizations than women (27.6 per 100,000 employed men vs. 9.10 per 100,000 employed women). From 2010 to 2012, there was an annual average of 273 hospitalizations in Louisiana for LBP, with an annual average of 178 surgical cases (65% of all LBP cases). There were 9.3 surgical cases per 100,000 employed Louisiana residents.

Pneumoconiosis is a term for lung diseases caused by the inhalation of mineral dust, primarily in work-related settings. Most hospitalizations in Louisiana for pneumoconiosis involve individuals at least 45 years old. On average, 90% of pneumoconiosis hospitalizations in Louisiana from 2010 to 2012 were for asbestosis-related complications. The number of asbestosis-related hospitalizations in Louisiana ranged from 373 to 396, and the average annual age-standardized rates increased from 107.2 in 2010 to 109.0 in 2012.

Asbestosis is a debilitating, chronic, lung disease with no known treatment and most commonly occurs among workers in certain occupational settings. As a condition highly associated with occupational exposure, its incidence has been affected by changes in industry

standards. In particular, the bans on both production and new uses of asbestos fibers put in place during the past 20 to 30 years have significantly reduced occupational exposures. Despite these restrictions, asbestos can still be found in many products. Louisiana has more facilities that produce, process, or use asbestos than any other state in the US. Health outcomes associated with asbestos exposure include asbestosis, mesothelioma, and lung cancer. To evaluate the impact of asbestos exposure on Louisiana residents, retrospective review of asbestosis hospitalizations using Louisiana Hospital Inpatient Discharge Data (LAHIDD) from 1999-2009 was conducted. Results indicate that asbestosis hospitalizations have remained steady over the 11-year period with approximately 295 cases per year. White males have the highest rates, and cases are clustered geographically. The elevated rate among whites reflects differences in employment patterns. Historically, due to racial inequality, Caucasians were more likely than African-Americans to obtain employment in high paying labor occupations, such as shipbuilding and textile manufacturing. Several studies have shown that blacks faced rigid racial employment patterns in the south, and these discriminatory practices prevented blacks from obtaining employment in many southern industries. The parishes that had incidence rates two to three times greater than the state average are parishes located in regions where shipyards, power plants, oil refineries, and railroad industries are most abundant. Shipyards along the southern coast (including southeast Louisiana) extensively used asbestos as insulator for pipes and within the walls in the construction of ships and oil rigs. Exposure to asbestos occurs during the construction and demolition of ships and oil rigs. Power plants in east and south Louisiana contain pipes and boilers that are covered with asbestos fibers for thermal insulation purposes. Lastly, hospitalizations resulting from asbestosis are an important economic and social burden for workers, their families, and the health care system. Many of the 3,240 patients were hospitalized multiple times as asbestosis is a chronic, debilitating condition that requires ongoing medical treatment and is frequently complicated by chronic co-morbidities including Chronic Obstructive Pulmonary Disorder (COPD), asthma, and cardiovascular disease.

Non-fatal Injuries and Illnesses

The average annual work-related injury and illness incidence rate per 100,000 full-time workers from 2010 to 2013 was estimated at 1,850 for Louisiana and 3,425 for the U.S. The average annual incidence rate for cases involving days away from work per 100,000 full-time workers was estimated at 800 for Louisiana and 1,044 for the U.S. Amputations may reduce a worker's quality of life or prohibit the worker from adequately performing some previous job duties. The average number of amputations each year from 2010 to 2012 was 107 in Louisiana and 5,120 in the United States, respectively. The number of non-fatal work-related amputations with days away from work in Louisiana ranged from 70 to 170.

Musculoskeletal disorders (MSDs) are among the most common and expensive work-related health issue. The number of MSDs with days away from work in Louisiana averaged 2,847 from 2010 to 2012. The average annual rate in Louisiana was 216 per 100,000 full-time equivalent workers, and the average annual rate in the U.S. was 302,917 per 100,000 full-time equivalent workers. The highest incidence rate of MSDs in Louisiana with days away from work involved the back, with an average annual rate of 112 per 100,000 full-time equivalent workers.

Fatalities

There was an average annual count of 114 fatal work-related injuries in Louisiana and 4,655 in the U.S. from 2010 through 2014. The number of work-related fatalities in Louisiana ranged from 111 to 140 during the 5-year period. The number of asbestosis-related deaths in Louisiana from 2010 to 2012 decreased from 33 to 24, and the average annual age-standardized death rate due to asbestosis was 7.1 deaths per million residents. Malignant mesothelioma is a rare but highly fatal cancer that usually occurs in the thin membranes surrounding the chest cavity or abdominal cavity. The only well-established risk factor for mesothelioma is exposure to asbestos fibers; 62 to 85% of all malignant mesothelioma cases reported having prior exposure to asbestos. The number of newly diagnosed malignant mesothelioma cases in persons age 15 and older in Louisiana decreased from 66 in 2010 to 62 in 2012; the age-standardized rates decreased from 18.4 to 15.6 during the time period.

Data were reviewed for the construction industry, a rapidly expanding industry that currently represents about 10% of Louisiana's workforce and has one of the highest fatal injury rates. On average 26 construction workers die every year in Louisiana, and one-quarter of the fatalities are due to falls. This finding was supported by an analysis of Louisiana's Emergency Department data: about 75% of ED visits were due to an injury, 19% of which were due to falls.

According to the BLS, workers in twenty-seven industries comprised 14% of the private sector workforce, but sustained 58% of the fatal work-related injuries. Twenty-four occupations had fatality rates greater than 20 per 100,000. Workers in these occupations made up 6% of the private sector workforce, but sustained 45% of the fatalities. These 27 industries and 24 occupations comprised the "high-risk" groups for this occupational health indicator. The average annual percentage of persons employed in high risk mortality industries from 2010-2012 was 21.0 for Louisiana and 15.5 for the U.S; the average annual percentage of persons employed in high risk mortality occupations was 15.7 for Louisiana and 12.4 for the U.S.

Asthma

Data from Louisiana's BRFSS survey indicate that 42% of individuals with asthma reported their asthma was exacerbated or related to work. More than 18 million U.S. adults have asthma, and one in ten adults in Louisiana suffers from asthma in his or her lifetime. Work-related asthma (WRA) is diagnosed when asthma symptoms may be aggravated or caused by the work environment and temporal association is probable. If detected early and further exposures are reduced, work-related asthma may be reversible. Approximately 36-58% of adult asthma cases in the U.S. may be work-related; however, work-related asthma continues to be underdiagnosed. Common asthma triggers are: mold, cockroach parts, animal dander, pollen, grass, dust mites, environmental tobacco smoke, fires, cleaning products, exercise, respiratory infections and occupational exposures (e.g., isocyanates).

To better characterize the demographic and geographic distribution of asthma cases in Louisiana, we conducted an in-depth analysis of approximately 22,000 asthma hospitalizations during a 6-year period (2006-2011), with 14,401 unique cases. Twenty-two percent of the hospitalized individuals had more than one asthma-related hospitalization

during the study period. Black women had the highest age-adjusted rate (10.2 per 10,000), followed by white women (7.8 per 10,000); overall rural counties had a higher hospitalization rate (8.38) than urban counties (6.16, $p=0.006$). The average annual rate for Louisiana was 7.3 cases per 10,000 residents; while parish rates ranged from 1.31 (Claiborne) to 22.93 (LaSalle). Three parishes had rates that were greater than twice the mean rate: Caldwell (15.29), Jefferson Davis (17.08), and LaSalle (22.93). The mean US rate was significantly higher than Louisiana's mean rate (15.3 vs 10.2; $p = 0.002$). From 2006 to 2009, Louisiana's overall adult hospitalization rate for asthma did not significantly change ($p = 0.94$). Medicare was the largest payor source for asthma hospitalizations (40%) followed by Medicaid (22%). Although industry information is not collected in hospitalization records, there are a high number of Louisiana industries where asthmagens are prevalent: chemical and petrochemical, construction, and agriculture.

Heat-related Illness

Occupational heat-related illness (HRI) has become an increasingly important occupational health hazard as climate projections predict longer and hotter periods of extreme heat. For subtropical Louisiana where some parishes have 15-20% of their workforce involved in outdoor activities (e.g., construction, oil & gas production, agriculture, and manufacturing), these extreme temperatures pose a dangerous health risk. In response to this issue, we collaborated with 9 southeastern states to analyze occupational HRI data and co-author an article that was recently published in the *Journal of Industrial Hygiene*. There were 8,315 occupational HRI ED visits (6.5/100,000 workers) and 1,051 inpatient hospitalizations (IHs) (0.61/100,000) among the 9 southeastern over the 5-year study period. Out-of-state residents comprised 8% of ED visits and 12% of IHs. Rates for both ED visits and IHs were significantly elevated in males and blacks. Younger workers had elevated rates for ED visits, while older workers had higher IH rates. Rates of ED (17.3 per 100,000) and IHs (1.3 per 100,000) for occupational HRI in Louisiana were significantly greater than the aggregated SE rate (6.5 (ED) and 0.6 (IH)). Louisiana's elevated rates are likely a reflection of the large number of at-risk outdoor workers. To further characterize Louisiana's cases, we conducted a case review of hospitalizations > 3 days and fatalities over a 2-year period. Cases represented 9 different industries, although almost half of the cases were involved in either construction or oil and gas work, and both fatalities occurred in workers who had been on the job for less than 1 week. Despite data documenting HRI in select working populations, there is scant data on occupational HRI among workers in the southeastern United States. This research provides an important contribution to the current assessment and ongoing evaluation of occupational HRI, and represents an occupational health surveillance framework for state health departments and occupational health partners in other regions.

Adult Blood Lead data

Over 90% of adults with elevated blood lead levels are exposed in the workplace and the majority of these through the inhalation of lead-containing dust and fumes. Occupations at greatest risk of exposure include battery manufacturing, soldering (electrical components and automobile radiators), refinery workers, lead smelters, sandblasters, and bridge and construction workers. Lead dust can be taken home on the worker's clothing, shoes and personal protective equipment, which may pose significant health risks to young children and pregnant or nursing women in the home.

Louisiana cases with blood lead levels (BLLs) ≥ 25 $\mu\text{g}/\text{dL}$ for males or ≥ 10 $\mu\text{g}/\text{dL}$ for females are investigated to determine the source of exposure. More than 80% of all elevated adult BLLs are males and more than 85% of the BLLs ≥ 25 $\mu\text{g}/\text{dL}$ or greater are work-related exposures. In 2010, at least 2 battery manufacturers/recyclers which significantly contributed to the number of reported lead tests closed; this resulted in a sharp decline in the number of elevated lead tests between 2009 and 2010. However, an increase in the number of construction projects and subsequent blood lead testing may account for the uptick in lead reports from 2011 and beyond. The number of reported adult residents in Louisiana with elevated BLLs (≥ 10 $\mu\text{g}/\text{dL}$) ranged from 287 to 382 from 2010 to 2012. The prevalence rates of elevated BLLs (≥ 25 $\mu\text{g}/\text{dL}$) increased from 2.4 in 2010 to 3.5 in 2012.

There were 92 cases with elevated BLLs ≥ 25 $\mu\text{g}/\text{dL}$ in 2013 (range = 25 to 62 $\mu\text{g}/\text{dL}$) which included nine workers who met or exceeded OSHA's medical surveillance retesting requirement of ≥ 40 $\mu\text{g}/\text{dL}$. Twenty-two workers (29%) were bridge painters and lead abatement workers who were renovating the U.S. 190 Old Mississippi River Bridge during a major restoration project. Of those 22 bridge workers, 10 (46 %) had two or more BLL tests ≥ 25 $\mu\text{g}/\text{dL}$. As a result of the observed elevated blood lead levels for the bridge repair workers, a health referral was made to OSHA to investigate potential lead violations. Upon conclusion of the investigation, the company was cited for serious violations, including failure to provide break areas away from the worksite and allowing workers to leave the premises without showering (increasing take-home exposures); the company ultimately reached an informal settlement of a \$14,000 fine. Additional health referrals for two Louisiana bridge restoration projects were made to OSHA upon receiving elevated blood lead levels ≥ 25 $\mu\text{g}/\text{dL}$ for 23 workers. Four workers had BLLs ≥ 50 $\mu\text{g}/\text{dL}$, OSHA's Permissible Exposure Limit for medical removal; however, no lead violations were identified during the OSHA investigations.

Arsenic data

Exposure to arsenic may occur in several industries: refining or smelting of metal ores, microelectronics, wood preservation, wood joinery shops, battery manufacturing, and working in power plants that burn arsenic-rich coal. Occupational exposure occurs primarily through inhalation of dust or fumes containing inorganic arsenic. Arsine gas is one of the most toxic forms and is readily absorbed into the body by inhalation. Inorganic forms of arsenic are more toxic than organic forms. Workers can transport arsenic on shoes and work clothes into their homes or automobiles, which puts children and spouses at risk for arsenic exposure.

Louisiana investigates blood arsenic levels ≥ 70 $\mu\text{g}/\text{L}$ and speciated urine arsenic levels ≥ 35 $\mu\text{g}/\text{L}$ for inorganic and methylated metabolites and ≥ 50 $\mu\text{g}/\text{g}$ creatinine-adjusted organic arsenic to determine the source of exposure in adults age 16 years and older. From 2010 to 2014, there were average annuals of 771 individual blood tests and 653 urine tests for arsenic exposure, with four elevated urine tests. Predominantly more males than females received arsenic testing, accounting for 65% of patients with blood tests and 60% of patients with urine tests.

In a multi-program effort involving Louisiana's Environmental Public Health Tracking (EPHT) Program, Louisiana State University School of Public Health, and Louisiana's Private Water

Well Initiative, we evaluated and applied GIS geo-spatial analysis to 6 inter-related datasets: environmental sampling (water and soil), private well locations and use, and arsenic biomonitoring results. Evaluation of 9613 arsenic urine samples (2007-2012), indicate significantly greater testing rate among males (59% vs 41% for women), particularly for ages 20-39 where men make up almost two-thirds of all tests. There was an annual average of 1602 tests and 1105 tested individuals. Four cases had urine levels above the biological exposure index ($35\mu\text{g/L}$) for inorganic plus methylated arsenic metabolites in urine. The mean value of urinary arsenic for these cases was $48\mu\text{g/L}$ (range, $35\text{-}59\mu\text{g/L}$). For specimens with an elevated total arsenic ($\geq 35\mu\text{g/L}$), which includes inorganic and organic species, speciation may have been performed to determine the proportion of arsenic forms. The increased rate among men and geographical variation in testing may be reflective of occupational monitoring: the industry-dense parishes of Calcasieu and West Baton Rouge had testing rates that were almost 6 times the mean parish rate. Despite minimum arsenic exposure in the sampled population, the project presented a novel method to evaluate existing environmental and bio-monitoring data sources to prioritize outreach and monitoring activities.

Mercury data

Most occupational exposures to mercury occur through inhalation of elemental mercury vapors in the workplace. This is of particular concern in some chemical manufacturing plants and facilities that manufacture and/or use instruments that contain elemental mercury. Workers can transport metallic or inorganic mercury on shoes, work clothes, skin, hair, and tools into their homes or automobiles with subsequent exposure to their families. According to the Agency for Toxic Substances and Disease Registry (ATSDR), exposure to mercury has been reported in children of workers who bring mercury into the home; increased levels of mercury were measured in places where work clothes were stored and in some washing machines. Mercury exposure may also occur through the consumption of seafood. The Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) recommend that pregnant women, women who might become pregnant and nursing women reduce their exposure to mercury by not eating fish containing high levels of mercury (shark, swordfish, king mackerel, and tilefish).

Louisiana investigates blood mercury levels $> 10\mu\text{g/L}$ for all tests regardless of age and urine mercury levels $\geq 20\mu\text{g/g}$ creatinine-adjusted for adults age 16 years and older and $> 10\mu\text{g/L}$ for children 15 years and younger to determine the source of exposure. From 2010 to 2014, there were average annuals of 1,127 individual blood tests (80 elevated) and 623 urine tests (10 elevated) for adult mercury exposure. Predominantly more males than females received mercury testing, accounting for 63% of patients with blood or urine tests.

The source of mercury exposure for cases from 2010-2014 is typically either related to seafood consumption or is unknown (82%), with 18% of the remaining cases potentially associated with work-related exposures. LOHIS investigated mercury exposures to workers at an alumina manufacturing facility situated along the Mississippi River. A Mine Safety and Health Administration (MSHA) investigation found that nine contract workers were exposed to mercury while replacing rods in heat exchangers. Eight of the workers had elevated blood

mercury levels (based on MSHA's standard of 20 µg/L), and three workers also had elevated inorganic urine levels.

Cadmium data

The workplace is the most common source of cadmium exposure, occurring mainly through inhalation of dust and fumes. The highest risks for exposure occur in occupations involving heating cadmium-containing products, such as ore smelting operations, drying of cadmium pigments, soldering or welding of cadmium-containing ores, petroleum refining, and manufacturing of batteries or plastics. Metal fume fever can occur from inhalation of cadmium oxide fumes that are produced when cadmium metal and cadmium compounds are heated to high temperatures. Workers may transport cadmium on shoes, tools, and work clothes into their homes or automobiles with subsequent exposure to their families.

Louisiana investigates blood cadmium levels ≥ 5 µg/L and ≥ 3 µg/g creatinine-adjusted cadmium urine to determine the source of exposure in adults age 16 years and older. From 2010 to 2014, there were average annuals of 613 individual blood tests and 411 urine tests for cadmium exposure, with 7 elevated tests. The sources of cadmium exposure for the patients with elevated tests are primarily unknown (86%), with 1 potentially work-related exposure. More males than females received cadmium testing, accounting for 71% of patients with blood tests and 85% of patients with urine tests.

During OSHA's investigation of the U.S. 190 Old Mississippi River Bridge renovations, elevated cadmium levels were detected in the air and dust. One company was issued citations due to cadmium standard violations and ultimately reached an informal settlement of a \$4,200 fine.

Carbon monoxide data

Carbon monoxide (CO) is made when carbon in fuel is not burned completely, and exposure can occur due to both human-created and natural sources. A common work-related source of exposure comes from using generators or other gas-powered equipment in enclosed spaces. Carboxyhemoglobin levels (carbon monoxide attached to hemoglobin in the blood reported as COHb) are routinely tested in patients when blood samples are drawn. Therefore, a patient may have multiple COHb test results during a single hospital or clinic visit, regardless of the initial COHb level or reason for the hospital visit.

The CO action threshold for Louisiana's investigations is determined by a laboratory report of a venous blood specimen with a COHb level $> 12\%$ for smokers or $> 9\%$ for non-smokers. Smoking status is determined for adult (age 16 years and older) cases with test results $> 9\%$. From 2010 to 2014, there were 5,221 adult patients with carbon monoxide blood tests, with 82 elevated tests. The number of patients tested more than doubled from 2012 (787) to 2013 (1616), as more laboratories began reporting COHb test results to LOHIS. More than 2,500 COHb tests were received in 2014. Slightly more males than females received carbon monoxide testing, accounting for 51% of patients with blood tests. Most of the adult CO exposures were due to smoking (38%), followed by using gas-powered equipment indoors (22%). Potentially work-related exposures accounted for 12% of the cases.

Some of the CO exposure cases in 2012 were due to indoor generator use during Hurricane Issac, which caused power outages in some Louisiana parishes from late August to early September. LOHIS also responded to CO exposures at 2 different schools. Both involved an unintentional gas release in the cafeteria due to malfunctioning equipment, resulting in elevated COHb for 5 workers. COHb levels ranged from 26% to 37%, and several workers experienced weakness, dizziness and headaches.

Improved surveillance data

LOHIS compiled and computed data from multiple data sources including: inpatient hospitalizations, tumor registry, census of fatal occupational injuries, survey of injuries and illnesses, LPC calls, and laboratory reports. No one data source provides a complete and accurate accounting of work-related conditions, and each data source has its unique strengths and limitations and provides different information on occupational health conditions. There were several notable data improvements, both acquisition of new data sources, and enhancements to current data.

BRFSS is an annual telephone survey that collects uniform, state-specific data on preventive health practices & risk behaviors; BRFSS can be used to address data gaps such as lack of work-related information in health data like inpatient hospitalizations. By successfully adding employment questions to the BRFSS survey (industry and occupation) over a multi-year period, we can better characterize Louisiana's working population by education, health status, risk factors, and other variables. Evaluation of the 2356 worked-related call data for 2013 revealed robust numbers for analysis of data by all of the 16 major occupational categories, except Farming/Forestry and Fishing. Small cell size, however, will not be an issue with multi-year analysis.

WC insurance, in various forms, covers more than 90% of wage and salary workers. Although the primary purpose of the record is to ensure proper payment to the worker and medical provider, records also contain useful information on the nature of the injury/disorder, part-of-body, event or exposure, industry, and occupation. In addition, narrative contents provide details about the event or activity causing the injury and medical data provide further information about the extent, severity of the injury, treatments and costs. The implementation of an electronic reporting process in 2014 presented an opportunity to begin using WC data for longitudinal tracking of occupational injuries and illnesses. In collaboration with the LWC, we developed a funding proposal and data analysis plan that represents the first inter-agency effort to analyze WC claims data.

ED data are another key data source for occupational health surveillance: in Louisiana approximately 17,000 workers per year are treated in the ED, and approximately 71% of these visits involve an injury or exposure. Most commonly reported diagnoses among workers with an injury include wounds (24%), sprains/strains (23%), and fractures (11%). Rates were highest among younger workers (less than 35 years).

Improvements to mortality records include ascertainment of occupational fatalities, and coding of occupation and industry. Following a change in the death certificate process from a paper-based system to an electronic system, we implemented a process for timely review of

cases that appear work-related based on cause and location of death, but were not coded as work-related on the death certificate. Some cases also have media reports confirming occupational mortality. Flagged cases are shared with Louisiana's Office of Vital Records (OVR) for further investigation and changes to death certificate data, if warranted. Occupation and industry are captured and recorded in mortality data, but have had limited use by researchers due to non-standardized text. To address this limitation, we initiated a data sharing agreement between the National Institute for Occupational Safety and Health (NIOSH)/National Occupational Mortality Surveillance (NOMS) staff and Louisiana's OVR Staff that ultimately resulted in coding industry and occupation literals collected on the death certificate to census occupation and industry codes. These codes facilitate analysis as they can be easily grouped into larger and more meaningful census industry and occupation categories, and denominator employment data can be used to calculate rates by occupation.

Respond to Emerging/Emergent Events

The program plays a key public health role in identifying, evaluating and responding to emerging and emergent occupational hazards and events. Responses and program activities varied depending on the issue or events including tracking worker injuries or exposures during an extended power outage or emergency response activity; alerting industries of newly identified occupational hazard; or providing medical treatment information for a chemical exposure. These activities were often done in collaboration with other state agencies, including OSHA.

LOHIS's capacity and flexibility to respond to emergency events is highlighted by the Deepwater Horizon Disaster that occurred in the Gulf of Mexico in 2010. Following the explosion, we established a sentinel surveillance system with hospitals and emergency departments, including the LPC. Of the 329 worker reports, about 50% had a heat-related illness; and 70% of the 18 hospitalized workers had pre-existing condition that put them at risk for heat-related illness such as hypertension or cardiovascular disease. Contributory work-related factors included strenuous work, long hours, and use of personal protective equipment. DWH Unified Command logs for daily personnel numbers showed a maximum of 19,608 workers in Louisiana in early July. Thus, the 329 workers with 18 hospitalizations captured by our surveillance system represent a very small fraction of all response workers in Louisiana. Despite the small numbers, several critical issues relevant to the importance of occupational medicine during large-scale emergency operations were noted: implement pre-placement evaluations to identify individuals with specific susceptibilities whose activities may need to be restricted or modified, inform workers about potential effects of work tasks and the work environment on one's personal health, and recommend further medical attention, if needed; and provide continuing medical education courses to local physicians about the occupational exposure history, pre-placement evaluations, and factors that should be considered before making a determination of work-relatedness.

Interact with Partners and Collaborators

Our network of partners have generated new initiatives and projects, leveraged resources, raised awareness of occupational health issues among a wider population, and provided input on priority conditions for Louisiana. Key partnerships include the OSHA-Baton Rouge Office, Workplace Safety Taskforce, Louisiana Department of Agriculture & Forestry, academia (LSU,

Tulane, and Xavier), Louisiana Workforce Commission, local and state health department staff, SouthON, NIOSH, and other state-funded programs.

Our close collaboration with OSHA-Baton Rouge office facilitated communication with regulatory authority that is essential for mobilizing and supporting initiatives that address problems identified through surveillance and case-based investigations. We have collaborated with OSHA on multiple projects: co-presentations at the statewide Worker Safety and Health Conferences on various topics including injuries in the construction industry, heat-related illness, and under-reporting of occupational injuries and illnesses; referral of worksites identified through our laboratory surveillance; and planning memorial day events and worker training sessions.

LOHIS has benefited from close collaboration and proximity with local schools of public health: particularly Tulane, LSU, and Xavier. University-based faculty and researchers provide valuable technical assistance and access to research opportunities and networks that have enriched our program's development. In partnership with these institutions, we have hosted and mentored multiple interns, and co-authored research papers on asbestosis lower back pain, arsenic, and climate change. We have also developed an established forum for presenting occupational health findings at graduate classes. Most recently, we co-hosted 2 students for the Occupational Health Internship Program (OHIP) which is dedicated to helping students learn about the field of occupational health from workers' perspectives. The interns conducted over 50 in-depth interviews of Latino shipyard workers about safety and health hazards and experiences of employer retaliation. Findings highlighted the significant hazards experienced by the shipyard workers: one-third refused work because fear that the job could cause harm; over half of the workers reported symptoms of heat exhaustion such as nausea, lightheadedness, dizziness, muscle cramps and/or generalized weakness; and 40% had experienced a work-related injury.

On a regional level, LOHIS collaborated with several other southeastern states and NIOSH to co-found SouthON: a network of local, state, and federal partners designed to increase occupational health capacity in the Southeast region. Through 2-day annual meetings, webinars, and joint projects, this collegial network has been instrumental in building regional occupational partners and identifying common labor issues and practices relevant to the workers in the southeast. Many southeastern states have limited occupational health capacity coupled with high risk industries, high poverty, an increasing immigrant population and occupational fatality rates significantly greater than the US rate. Through inter-state collaborations, we increased the capacity within our state and improved the overall visibility of occupational health in the region by connecting agencies, organizations, and researchers (such as the NIOSH Education and Research Centers and the Agriculture Safety and Health Centers, and academia) with state health department staff. This successful collaboration has resulted in 4 annual conferences, NIOSH conference grant funding, a CSTE SouthON webpage, and a multi-state review and analysis of heat-related morbidity over a 5-year period.

Dissemination and Outreach

Promoting dissemination and use of surveillance data involved translation of findings and engagement of key stakeholders. This was accomplished by reporting findings in a variety of

formats depending on the intended audience including reports, fact sheets/information briefs, peer-reviewed publications, press releases and presentations. Target audiences included employees and employers, medical and public health community, local, state, and federal government, and community-based organizations and agencies with an interest or role in occupational health. Several reports are prepared annually: Occupational Health Indicator Report summarizes the indicator data sources and calculations and provides trend results for a 5 to 10 year period with US comparison values; Laboratory Surveillance test results (includes arsenic, cadmium, mercury, lead, and carbon monoxide) provides counts by age, sex, and test results; and the Pesticide Surveillance report provides a descriptive review of pesticide surveillance data including information on pesticide product used, reported health effects, and medical treatment. To target Louisiana healthcare providers, public health officials and individuals and organizations with an interest in occupational health, the program published eight articles in the Louisiana Morbidity Report: a bi-monthly Office of Public Health publication. Additional dissemination of program findings occurred through twelve publications in peer-reviewed journals.

Conclusion

In the past 5 years, the Occupational Health & Injury Surveillance Program in Louisiana has increased programmatic capacity to conduct population-based surveillance of occupational illnesses, injuries, and hazards. In addition to annually compiling and calculating the occupational health indicators, the program has gained considerable expertise in conducting in-depth analysis of occupational health conditions relevant to Louisiana's diversified workforce. These projects have had numerous positive impacts: increased occupational safety and health outreach and education, expanded collaborations and partnerships, enhanced use of surveillance data, and increased awareness of priority occupational health issues.

Materials Available for Other Investigators

Program products such as presentations, educational materials, and reports are available on LOHIS's (www.seet.dhh.louisiana.gov), the Council of State and Territorial Epidemiologist's (<http://www.cste.org>) and NIOSH's State-based Occupational Health Surveillance Clearinghouse's websites (<http://wwwn.cdc.gov/niosh-survapps/statedocs>). In addition, annual rates for all of the grant-funded occupational health indicators are available on CSTE's website.

Researchers can request access to data listed in the following table. Research must be approved by the Principal Investigator and the Louisiana Department of Health and Hospitals' Institutional Review Board. Requests for data will be handled according to a pre-established data request protocol developed by Louisiana Environmental Public Health Tracking Program. These data sharing policies recognize that even though the final dataset will be stripped of identifiers prior to release, there remains the possibility of deductive disclosure of subjects with unusual characteristics. To protect disclosure, our data sharing agreement will ensure from researchers: (1) a commitment to using the data only for research purposes and not to identify any individual case; (2) a commitment to not report findings of a cell size less than 5; (3) a commitment to securing the data using appropriate computer technology; and (4) a commitment to destroying or returning the data after analyses are completed.

Name of Database/Summary Description of Data	Format
Adult Blood Lead Epidemiology and Surveillance (ABLES)—Adult blood lead level test results for Louisiana residents	Access or Excel
Arsenic – Blood and urine arsenic test results for Louisiana residents	Access or Excel
Mercury – Blood and urine mercury test results for Louisiana residents	Access or Excel
Cadmium – Blood and urine cadmium test results for Louisiana residents	Access or Excel
Carbon monoxide – Carboxyhemoglobin test results for Louisiana residents	Access or Excel
Emergency Room Visits (work-related)	Access or Excel
Inpatient Hospitalizations (work-related)	Access or Excel
Fatalities (work-related)	Access or Excel
Poison Center Calls (pesticide exposure)	Access or Excel

Publications

Lee SJ, Mulay P, Diebolt-Brown B, Lackovic M, Mehler L, Beckman J, Waltz J, Prado JB, Mitchell Y, Higgins SA, Schwartz A, Calvert GM. Acute Illnesses Associated with Exposure to Fipronil — Surveillance Data from 11 States in the United States, 2001–2007. *Clin Toxicol* 2010; 48:737-44.

Lackovic M., Locklin, C. Work-Related Hospitalizations Louisiana, 1998-2007. Louisiana Morbidity Report Vol 21 No 1, Jan-Feb, 2010.

Gastanaduy, M. Unintentional Falls Among Older Adults – Louisiana, 2007. Louisiana Morbidity Report Vol 21 No 3, May-June, 2010.

Davis C, Vijaykumar J, Lackovic M. Asbestosis: Summary of the Condition and Descriptive Review of Hospitalization Data - Louisiana, 1999-2009. Louisiana Morbidity Report Vol 22 No 2, Mar.- Apr., 2011.

Davis C, Vijaykumar J, Lackovic M, Diaz J. Asbestosis in Louisiana: A descriptive review and demographic analysis of hospitalizations for asbestosis, 1999-2009. *J La State Med Soc* Vol 163, Nov/Dec 2011.

Davis C, Lackovic M, Singleton C. An analysis of low back pain disorders in workers, Louisiana, 1998-2009. Louisiana Morbidity Report, 2011, Vol 22, No 6.

Kasner EJ, Keralis JM, Mehler L, Beckman J, Bonnar-Prado J, Lee SJ, Diebolt-Brown B, Mulay P, Lackovic M, Waltz J, Schwartz A, Mitchell Y, Moraga-McHaley S, Roisman R, Gergely R, Calvert GM. Gender differences in acute pesticide-related illnesses and injuries among farmworkers in the United States, 1998-2007. *Am J Ind Med* 2012; 55:571-583

LOHIS. Fatalities in the Construction Industry – Louisiana, 2007-2011. July 2013
http://new.dhh.louisiana.gov/assets/oph/Center-EH/envepi/occ_health/Documents/Fatalities_Construction_July_2013a.pdf

Lewis J, Lackovic, M. A Review of Adult Asthma Morbidity and Mortality; Louisiana, 2006-2010. Louisiana Morbidity Report, Jan – Feb, 2013.

Lewis, J, Lackovic, M., Soileau, S. Fatalities in the Construction Industry – Louisiana, 2007-2011. LA Morbidity Report. Jul – August 2013, Vol 24, No 4.

Soileau, S. Pesticide Exposure Surveillance – Louisiana, 2013. LA Morbidity Report, Sept-Oct, 2013. Vol 24, No 5.

Hudson NL, Kasner EJ, Beckman J, Mehler L, Schwartz A, Higgins S, Bonnar-Prado J, Lackovic M, Mulay P, Mitchell Y, Larios L, Walker R, Waltz J, Moraga-McHaley S, Roisman R, Calvert GM. Characteristics and magnitude of acute pesticide-related illnesses and injuries associated with pyrethrin and pyrethroid exposures--11 states, 2000-2008. *Am J of Ind Med*. 2014 Jan; 57(1):15-30. doi: 10.1002/ajim.22216

Lewis, J. Lackovic, M. Work-related Lead Exposures and U.S. 190 Old Mississippi Bridge Renovations - Louisiana - 2013-2014. LA Morbidity Report, Mar - Apr, 2014, Vol. 25, No.2.

Lewis J, Lackovic M, Soileau S. A review of adult asthma hospitalizations in Louisiana, 2006-2011. *J La State Med Soc*. Vol 167. March/April 2015.

Katner A, Lackovic M, Strevia K, Soileau S. Evaluation of Available Data Sources to Prioritize Parishes for Arsenic Monitoring and Outreach –*J Public Health Management Practice*, 2015, 21(2 Supp), S93–S101.

Harduar Morano L, Bunn TL, Lackovic M, Lavender A, Dang GTT, Chalmers JJ, Li Y, Zhang L, Flammia DD. Occupational Heat-Related Illness Emergency Department Visits and Inpatient Hospitalizations in the Southeast Region, 2007-2011. *Am J Ind Med*. 2015. Oct 58(10) 1114-25.

Brinker K, Jacobs T, Shire J, Bunn B, Chalmers J, Dang G, Flammia D, Higgins S, Lackovic M, et al. Fatal Work-Related Injuries — Southeastern United States, 2008–2011. Accepted for publication in the AAOHN Workplace Health and Safety.

Gamola F, Beckman J, Schwartz A, Higgins S, Prado J, Lackovic M, et al. Characteristics of Acute Paraquat and Diquat-related Illnesses in the US: 1998-2011. Accepted for publication in *Environmental Health Perspectives*.

Namulanda G, Monti M, Mulay P, Higgins S, Lackovic M, Schwartz A Prado J, Waltz J, Mitchell Y, Calvert G. Acute non-occupational pesticide-related illness and injury — United States, 2007-2011. Accepted for publication in 2016 MMWR Surveillance Report.

Calvert G, Beckman J Prado J Bojes H, Schwartz S Mulay P, Leinenkugel K, Higgins S Lackovic L, Waltz J, Mitchell Y, Stover D, Moraga-McHaley S. Acute occupational pesticide-related illness and injury —United States, 2007-2011 Accepted for publication in 2015 MMWR Surveillance Report