

An assessment of data related to inspections of risk factors for public swimming poolsShanita Shack, MPH¹, Maurice Redmond, MS, REHS², and R. Christopher Rustin, DrPH, MT, REHS³¹Rollins School of Public Health, Emory University, Atlanta, GA, ²Georgia Department of Public Health Environmental Health Section, Atlanta, GA, ³Jiann-Ping Hsu College of Public Health, Georgia Southern University, Statesboro, GA**Corresponding Author:** R. Christopher Rustin • P.O. Box 8015, Statesboro, GA 30460 • 912-478-2414 • rrustin@georgiasouthern.edu**ABSTRACT****Background:** The Georgia Department of Public Health (DPH) is mandated to ensure that public swimming pools are safe for those who use them. This mandate is carried out by the DPH and local environmental health professionals through regulations and inspections. In 2015, legislation was introduced proposing to reduce the authority of the DPH to inspect certain pool types (apartments, subdivision, condominiums) and thus reduce regulatory protections in place for swimmers. To ensure that the DPH had current information on the risks associated with pools, the EH team, with assistance from a graduate student, analyzed inspection data to evaluate risk factors associated with these pool types and summarized drownings and waterborne disease outbreaks (WBDOs).**Methods:** Pool inspection data (n=4,441 pools) for 2014 were retrieved from the Environmental Health Information System (EHIS) of the DPH. Data from the 2010 Census and epidemiological data on drownings and water-borne disease outbreaks (WBDOs) were also evaluated. Data were stratified by public health district and type/number of pools and analyzed for selected violations of health risk factors (pH, barriers, disinfectant residual). Drownings and WBDOs were described and summarized.**Results:** Approximately 55% of inspected pools were for apartments, condominiums, and subdivisions. These pool types were consistently cited by inspectors for the selected risk factors and ranked in the top five for these violations. In 2013, children aged 1-17 had the highest percentage (30%) of deaths from drowning. In 2001-2014, there were 28 WBDOs, with 39% occurring at public pool venues.**Conclusions:** Data from this research provided information on risks associated with pools and supported the importance of inspection programs for public swimming pools. The data were used to inform policy makers on the risks associated with the pool venues under legislative review. These data, combined with other risk factor information, were utilized by the DPH to inform training needs and to reinforce public health messaging on protecting swimmer health.**Key Words:** public swimming pool, risk factor violations, inspection**Statement of Student-Mentor Relationship:** The research described in this report is derived from a master of public health capstone project completed by lead author, Shanita Shack. She was mentored by co-authors, Mr. Maurice Redmond and Dr. Chris Rustin.<https://doi.org/10.21633/jgpha.6.2s05>**INTRODUCTION**According to the U.S. Census Bureau, swimming, with over 301 million visits to pools annually, is the 4th most popular recreational activity overall and the most popular for children of ages 7-17 (Census, 2016). Swimming, which

offers enjoyment and fun, is a popular way to exercise, providing whole-body health benefits (Uyan et al., 2009). As a form of exercise, swimming improves capacity of the heart and lungs, reduces cholesterol levels, and is a low stress environment on the body's joints (Berkley, 2016). For children with asthma, swimming is a

recommended form of exercise, providing benefits of improved lung function and decreased asthma symptoms (Font-Ribera et al., 2011; Huang et al., 2009). In addition to these health benefits, the social and psychological benefits of swimming include improved social learning and reduced stress, which drives the popularity of this recreational activity (University of North Carolina, 2016; Berger & Owen, 1992).

Although there are benefits of swimming, pool sites must be monitored for safety and cleanliness to ensure the enjoyment and health of everyone. For swimmers, pools pose a risk of injury or illness from water that may contain pathogenic germs; from chemical, physical, or entrapment hazards; and from damaged fence barriers that allow children unmonitored access to pools. According to a study in 2008 by the Centers for Disease Control and Prevention (CDC), 1 in 8 public pool inspections found issues (12.1% or 13,532 of 111,487) that placed the public's health at risk and forced regulatory closures (CDC, 2010). In the same study, 1 in 10 (10.7% or 12,917 of 120,975) pool inspections cited disinfectant levels (chlorine, bromine) as too low, leaving the water quality at risk (CDC, 2010).

Unsafe pools can lead to WBDOs or drownings, which are a leading cause of unintentional injury-related deaths. For example, outbreaks of cryptosporidiosis, caused by a parasite resistant to chlorine, usually occurs when pool water is contaminated with feces of an infected swimmer, and the disinfectant residual is inadequate or there is not enough contact time for the disinfectant to inactivate the parasites before swimmers come in contact with them (McAnulty et al., 1994; Shields et al., 2008). Cryptosporidiosis leads to a prolonged gastrointestinal illness that is spread through the fecal-oral route. The CDC reports that, during 2009-2010, 49 WBDOs were reported, with 55% caused by *Cryptosporidium* (CDC(a), 2014). Lastly, pools with inadequate fence barriers or gates that improperly latch create an opportunity for unsupervised children to gain access to a pool and potentially drown. Other than birth defects, drowning is the leading cause of death in children 1-4 years of age and is the second leading cause of unintentional deaths in children 1-14 years of age (CDC, 2016; CDC, 2011).

The responsibility to ensure public health and safety of public pools rests with the Georgia

Department of Public Health (DPH) and the local county health departments (LHDs). The mission of the public pool program of the DPH is to minimize illnesses and injuries associated with contaminated water or hazardous conditions in or around swimming pools (DPH, 2012).

Michelle's Law, found in the Official Code of Georgia Annotated (O.C.G.A. 31-45), was passed in 1999 by the state legislature and gave legal authority to the DPH and the LHDs to "protect the public health and safety through proper design, operation, and maintenance of public swimming pools." Prior to this law, there was no mandate that the DPH or local health departments ensure the safety of public swimming pools, although 24 LHDs had an existing local ordinance on public swimming pool safety. This law was passed after two events brought state and national attention to Georgia: the unfortunate drowning death of a little girl named Michelle in an unregulated pool and a major waterborne disease outbreak (WBDO) of *E. coli* at a recreational swimming park that caused illness in 26 children, with 7 hospitalized and one death. Although the law gave the DPH authority to promulgate rules and regulations and to inspect public swimming pools in the state, the provisions applied only in "those counties where local rules and regulations governing public swimming pools [were] not in effect on December 31, 2000" (OCGA, 2016). The public health system in Georgia is divided into 18 public health districts comprising all 159 counties. Currently, 67 of the 159 counties enforce local public swimming pool rules and regulations, leaving the remaining counties under DPH rules and regulations. However, all public pools in Georgia are under an inspection program with oversight from the DPH.

The purpose of the present assessment was two-fold: 1) It provided a learning opportunity in program evaluation and assessment for a graduate student obtaining a Masters of Public Health degree, and 2) Evaluation of inspection records provided information on the risks associated with public swimming pools to inform policy and training needs. In 2015, state legislation was introduced to reduce the inspection and rule-making authority of the DPH and the LHDs for specific pool types (condominiums, apartments, subdivisions, townhomes and timeshares). Although versions of the bill changed over the ensuing two-year time frame, the premise was to remove governmental oversight of pools viewed as

“private” or “semi-public.” The current assessment provided data that were presented to policy makers to ensure that public health protections were kept in place and highlighted the importance of inspection programs for public swimming pools.

METHODS

The assessment of public pools provided a look at data on the public swimming pool environment in Georgia. Information was collected from various sources, including the DPH Environmental Health Information System (EHIS), the U.S. Census Bureau, and the DPH Online Analytical Statistical Information System (OASIS). Selected data representing pool inspection health risk factor indicators, hazards, pool counts, and population were summarized. Data were stratified by health district, pool setting, risk factors cited, and population affected. Descriptive statistics, such as counts and percentages, were used to describe and summarize the data. Due to only 132 counties reporting data electronically in the DPH EHIS

system, a subset of the total number of pools was analyzed by type and selected risk factors.

Drowning rates, with a focus on the most vulnerable ages, 1-14, were calculated using OASIS data and compared to national rates. In addition, numbers and incidence of WBDOs in Georgia were described.

RESULTS

Public Pool Environment

According to Environmental Health Section reports by the DPH, there are 9,188 public pools in the state (range: 21-1,772/Public Health District). As summarized (Table 1), the urban health districts have the most public pools, with the Fulton Health District making up 19.3% of the total, followed by Cobb (14.9%), East Metro (13.2%), Coastal (9.9%), and DeKalb (9.1%). These five districts represent a large percentage of the state’s population. This is in contrast with rural health districts, such as the Waycross and Albany Health Districts (0.9%) and the Dublin Health District, having the fewest pools, only 0.2% of the total.

Table 1. Public pool counts and Georgia population by District

| District (n=18) | # of Pools | % of State Total Pool Count | 2010 Census | % of State Pop. Total |
|-----------------|--------------|-----------------------------|------------------|-----------------------|
| Albany | 79 | 0.9 | 356,433 | 3.7 |
| Augusta | 269 | 2.9 | 461,476 | 4.8 |
| Clayton | 229 | 2.5 | 259,424 | 2.7 |
| Coastal | 907 | 9.9 | 570,000 | 5.9 |
| Cobb-Douglas | 1,373 | 14.9 | 820,481 | 8.5 |
| Columbus | 109 | 1.2 | 370,887 | 3.8 |
| Dalton | 347 | 3.8 | 437,978 | 4.5 |
| DeKalb | 836 | 9.1 | 691,893 | 7.1 |
| Dublin | 21 | 0.2 | 154,467 | 1.6 |
| East Metro | 1,215 | 13.2 | 990,494 | 10.2 |
| Fulton | 1,772 | 19.3 | 920,581 | 9.5 |
| LaGrange | 557 | 6.1 | 800,270 | 8.3 |
| Macon | 398 | 4.3 | 520,905 | 5.4 |
| North | 372 | 4.0 | 617,646 | 6.4 |
| Northeast | 335 | 3.6 | 460,189 | 4.8 |
| Rome | 198 | 2.2 | 639,585 | 6.6 |
| Valdosta | 89 | 1.0 | 252,306 | 2.6 |
| Waycross | 82 | 0.9 | 362,638 | 3.7 |
| Total | 9,188 | 100 | 9,687,653 | 100 |

Source: U.S. Census Bureau; EH Activity Reports

The following data, derived from the DPH EHIS system, represents the total operational count of 4,441 pools, representing 132 counties and 14 health districts (Table 2; Figure 1). This subset

of pools represents permitted pools in the 2014 calendar year. Regulatory authority is either state, local, or a combination of state and local rules and regulations. Each district is denoted by

its lead county health department, with pools aggregated by setting to represent the typical pool types in Georgia. In this analysis, subdivision pools represent 27% (n=1,179), with

hotels at 26% (n=1,133), apartments at 20% (n=910), community club pools at 9% (n=399), and condominiums 8% (n=378) for the top five pool venues.

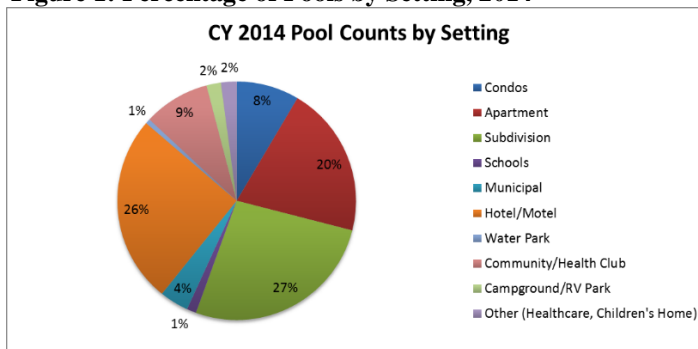
Table 2. Public Pools by Regulatory Authority, District, & Setting, CY 2014 (n=4,441)

| District (n=14) | Con dos ¹ | Apt ² | Sub Divis ion ³ | Scho ols ⁴ | Muni cipal ⁵ | Hotel ⁶ | Water Park ⁷ | Comm unity Club ⁸ | Camp Ground ⁹ | Other ¹⁰ | Total |
|-------------------------|----------------------|------------------|----------------------------|-----------------------|-------------------------|--------------------|-------------------------|------------------------------|--------------------------|---------------------|--------------|
| Albany ^a | 4 | 1 | 0 | 2 | 8 | 38 | 1 | 16 | 2 | 2 | 74 |
| Augusta ^b | 9 | 61 | 49 | 1 | 12 | 63 | 0 | 28 | 3 | 5 | 231 |
| Clayton ^c | 2 | 95 | 35 | 2 | 9 | 43 | 0 | 8 | 1 | 4 | 199 |
| Coastal ^d | 116 | 138 | 186 | 10 | 24 | 297 | 4 | 72 | 11 | 4 | 862 |
| Columbus ^a | 0 | 0 | 3 | 3 | 11 | 66 | 2 | 7 | 6 | 2 | 100 |
| Dalton ^b | 13 | 31 | 199 | 1 | 13 | 37 | 0 | 35 | 11 | 2 | 342 |
| Dublin ^a | 0 | 0 | 0 | 2 | 2 | 16 | 0 | 1 | 0 | 2 | 23 |
| East Metro ^d | 2 | 30 | 47 | 1 | 1 | 22 | 0 | 9 | 4 | 4 | 120 |
| Fulton ^c | 204 | 367 | 383 | 6 | 30 | 170 | 0 | 134 | 5 | 12 | 1311 |
| LaGrange ^b | 13 | 64 | 183 | 1 | 20 | 100 | 2 | 39 | 10 | 33 | 465 |
| Macon ^d | 14 | 106 | 47 | 13 | 17 | 118 | 0 | 24 | 13 | 15 | 367 |
| Rome ^b | 1 | 17 | 46 | 5 | 15 | 58 | 3 | 14 | 17 | 5 | 181 |
| Valdosta ^b | 0 | 0 | 0 | 1 | 3 | 58 | 9 | 11 | 3 | 1 | 86 |
| Waycross ^a | 0 | 0 | 1 | 9 | 10 | 47 | 8 | 1 | 1 | 3 | 80 |
| Total | 378 | 910 | 1,179 | 57 | 175 | 1,133 | 29 | 399 | 87 | 94 | 4,441 |

Note Regulatory Authority: ^aState (all counties), ^bState and Local, ^cLocal, ^dLocal (all counties)

1: Condo; 2: Apartment, Retirement Home; 3: Subdivision/Neighborhood pool, Townhome, Mobile Home; 4: Schools, Colleges, Universities; 5: Municipal, City Park/Pool; 6: Hotel, Motel; 7: Water Park; 8: Community/Health Club, Rec. Center, Spa, Church; 9: Campground, RV park, Retreat, Nature Center; 10: Other: Daycare/Childcare, Children’s Home, Hospital/Healthcare Facility, Corporation; Districts not included: (2) North, (3-1) Cobb/Douglas, (3-5) DeKalb, (10) Northeast, Gwinnett County. *Source: DPH EHIS*

Figure 1: Percentage of Pools by Setting, 2014



*n=4,441. *Source: DPH EHIS*

Public Pool Health Risk Factor Indicators

From the subset of data, there were 7,551 violations related to public pool risk factors cited during inspections for the 2014 calendar year. The data in Table 3 show, by settings, a subset of the violations (n=1,456) for disinfection residual concentration, proper barrier around pool, and

pH (7.2-7.8). These three risk factors make up 19.2% of the overall violations cited for the pools evaluated in this assessment. Of these risk factors, disinfection residual was the top violation, cited by inspectors as 9.1% (n=689) of the total, followed by pH at 5.9% (n=443), and proper barrier around the pool at 4.3% (n=324).

Table 3. Number of violations cited by setting for disinfection residual, pH, and barrier

| Violations by Setting | Disinfection Residual | pH (7.2-7.8) | Proper Barrier | Total |
|-------------------------------------|-----------------------|--------------|----------------|--------------|
| Condos | 18 | 15 | 8 | 41 |
| Apartment | 168 | 88 | 79 | 335 |
| Subdivision | 113 | 64 | 99 | 276 |
| Schools | 7 | 3 | 4 | 14 |
| Municipal | 21 | 15 | 8 | 44 |
| Hotel/Motel | 287 | 205 | 85 | 577 |
| Water Park | 3 | 0 | 0 | 3 |
| Community/Health Club | 33 | 23 | 17 | 73 |
| Campground/RV Park | 13 | 15 | 12 | 40 |
| Other (Healthcare, Children's Home) | 26 | 15 | 12 | 53 |
| Total | 689 | 443 | 324 | 1,456 |

Source: DPH Environmental Health Information System

Figure 2.A shows the top 3 settings with violations of disinfection residual concentration as hotels, apartments, and subdivisions (42%, 24%, and 16%, respectively). Hotels, apartments, and subdivisions were also the top 3 settings for

pH violations (46%, 20%, and 15%, respectively) in Figure 2.B. For violations of proper barrier around pool (Figure 2.C), the top 3 settings were subdivisions, hotels, and apartments (31%, 26%, and 24%) respectively.

Figure 2A: Disinfection violations by setting

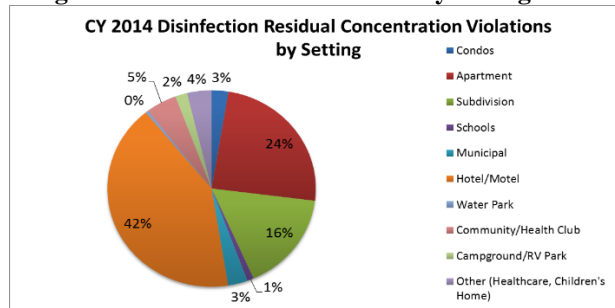
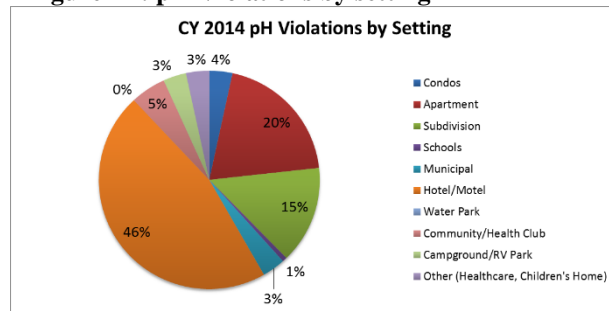
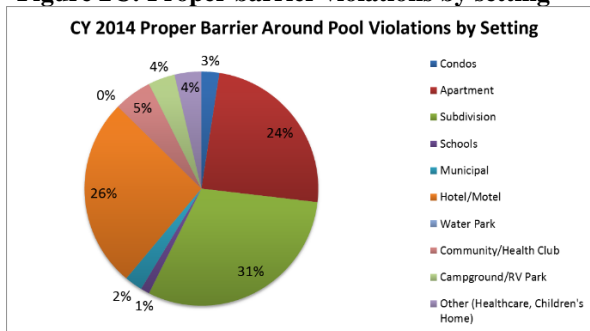


Figure 2B: pH Violations by setting



Source: DPH EHIS

Figure 2C: Proper barrier violations by setting



Source: DPH EHIS

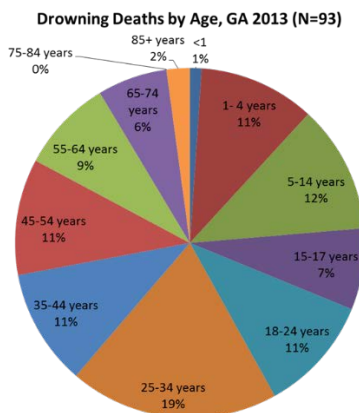
Public Pool Hazards

Georgia Drowning Deaths Summary for 2013

In 2013, there were 93 drowning deaths in the state of Georgia (Figure 3). Among children ages 1-4 years, there were 10 deaths (11%), 11 deaths for children ages 5-14 (12%), and 7 deaths

among children ages 15-17 years (7%). Overall, children of ages 1-17 accounted for the highest percentage of deaths (30%). The highest percentage of deaths that occurred over age 17 was among the 25-34 years age group, accounting for 19% of deaths (OASIS, 2015).

Figure 3: Drowning deaths by age, GA 2013 (N=93)



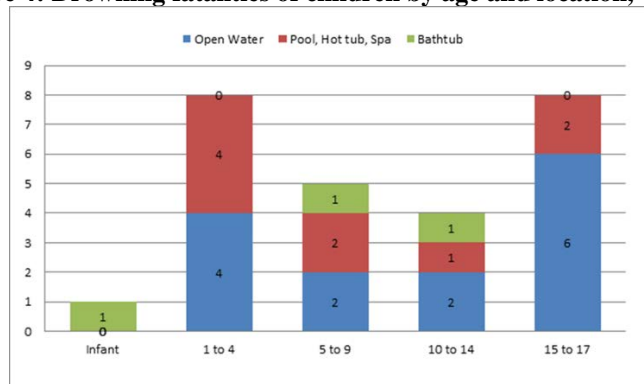
Source: Georgia DPH, OASIS

Age & Location

The Annual Report of the Georgia Child Fatality Review (CFR) Panel 2013 reported drowning fatalities by age and location (Randle et al., 2015). The data in this report were slightly different from the death certificate data in the GDPH OASIS database because the CFR data were based on “all reviewed” deaths (CFR, page 11). In 2013, there were 26 drowning deaths among children in Georgia (Figure 4). In the

‘open water’ category, there were 4 deaths among children ages 1-4, 2 deaths each among ages 5-9 and ages 10-14, and 6 deaths among ages 15-17. Within the ‘pool, hot tub, and spa’ category, there were 4 deaths in the 1-4 age group, 2 deaths in the 5-9 age group, 1 death in the 10-14 age group, and 2 deaths in the 15-17 age group. The remaining deaths (n=3) occurred in bathtubs.

Figure 4: Drowning fatalities of children by age and location, GA 2013 (n=26)



Note: Zeros on the bar graph indicate no drowning fatalities for the remaining categories
 Source: Randle et al., 2015

Rural vs. Non-Rural

Rural counties were defined as those with less than 35,000 total population per year for the 2000 Census; non-rural counties were defined as those with 35,000 or more total population per year. In 2013, rural counties had 4 drowning deaths each among children ages 1-4 years and ages 5-14 years. The death rate for ages 1-14 years was 2.5/100,000. In non-rural counties, there were 6 deaths among children of ages 1-4 years, and the death rate was 1.3/100,000. For ages 5-14 years, there were 7 deaths, and the death rate was 0.6/100,000. The overall death rate for ages 1-14 years was 0.8/100,000 (OASIS, 2015).

Drowning Deaths, All Ages Georgia and National, 2013

In Georgia (Table 4), the highest rates for drowning deaths occurred among ages 1-4 years, with a rate of 1.9/100,000. The overall death rate for all ages was 0.9/100,000 (OASIS, 2015). Nationally, there were 393 drowning deaths among children ages 1-4 years, with a crude rate of 2.5/100,000. The death rates for all ages was 1.1/100,000 (CDC(b), 2015). The rate of drowning for Georgia exceeded the national rate among children of age 5-14 (0.8/100,000 vs 0.5/100,000), age 15-24 (1.2/100,000 vs 1.1/100,000), and age 25-34 (1.3/100,000 vs 1.0/100,000).

Table 4. Rates for drowning deaths, all ages, GA and national 2013

| Age | Georgia | | National | |
|-------------------|-----------|-------------|--------------|-------------|
| | Deaths | Death Rates | Deaths | Death Rates |
| <1 | 1 | * | 23 | 0.6 |
| 1- 4 years | 10 | 1.9 | 393 | 2.5 |
| 5-14 years | 11 | 0.8 | 209 | 0.5 |
| 15-24 years | 17 | 1.2 | 501 | 1.1 |
| 25-34 years | 18 | 1.3 | 424 | 1.0 |
| 35-44 years | 10 | 0.7 | 367 | 0.9 |
| 45-54 years | 10 | 0.7 | 464 | 1.1 |
| 55-64 years | 8 | 0.7 | 452 | 1.1 |
| 65-74 years | 6 | 0.8 | 283 | 1.1 |
| 75-84 years | 0 | 0 | 175 | 1.3 |
| 85 + years | 2 | * | 96 | 1.6 |
| Total | 93 | 0.9 | 3,387 | 1.1 |

Rates based on 1-4 events are not shown and are indicated by an *
 Source: Georgia DPH, OASIS; CDC WONDER Online Database

Sex, Race, and Ethnicity

As determined by data from OASIS, males accounted for most (75%) of the drowning deaths. For all age groups represented, 37 of the drowning deaths were White males

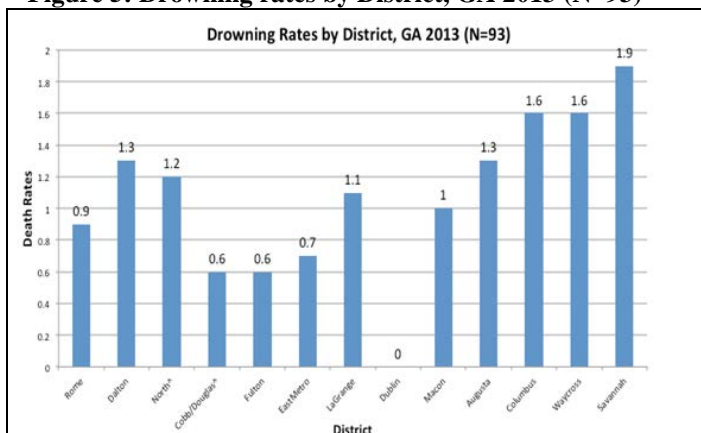
(rate=1.2/100,000). Among White females, there were 14 deaths (rate=0.4/100,000). African-American males and African-American females combined had the second highest number of drowning deaths (38 total) and the highest rate of

drowning deaths at 1.2/100,000. Among African-American males, there were 31 drowning deaths (rate=2.1/100,000), and among African-American females there were 7 deaths (rate=0.4/100,000). There were 7 deaths among Hispanic or Latinos (rate=0.8/100,000), and Asian males and females accounted for 4 deaths, adding to the total of 93 drowning deaths (OASIS, 2015).

Public Health District Drowning Rates

In 2013, overall drowning rates varied by public health district, ranging from a rate of 0.6/100,000 deaths in Cobb-Douglas and Fulton Health Districts to 1.9/100,000 deaths in the Savannah Health District. The Dublin Health District, a rural region of the state, had 0 drowning deaths during this year of analysis.

Figure 5: Drowning rates by District, GA 2013 (N=93)



^ Districts not included in the violations report and the CY2014 data.

Source: Georgia DPH, OASIS

Rates based on 1-4 events are not shown (includes Clayton, DeKalb^, Valdosta, Albany, and Athens^)

Recreational Water Illness

In treated water, Cryptosporidium, Legionella, and E. coli are among the top ten causes of recreational outbreaks (CDC, 2014). Diarrheal illness is caused by microbes such as Cryptosporidium and E. coli 0157:H7 (CDC(c),

2015). In 2001-2014, there were 28 WBDOs, with 39% (n=11) occurring at pools under Georgia DPH inspection and 14.2% (n=4) occurring in unknown venues that were most likely under DPH inspection based on their description (Table 5).

Table 5. WBDOs associated with treated water & unknown venues, GA, 2001-2014 (n=15)

| Treated Water (DPH Inspection) | | | | |
|--------------------------------|------------------------|-----------|-------------|------------------------|
| Month/Year | Etiology | No. Cases | Venue | Setting |
| July 2002 | <i>Cryptosporidium</i> | 3 | Public pool | School |
| April 2003 | <i>S. aureus</i> | 5 | Hot tub | Hotel |
| January 2004 | Chemical toxin | 17 | Public pool | Hotel |
| August 2004 | <i>Cryptosporidium</i> | 12 | Public pool | Multiple neighborhoods |
| March 2006 | <i>Pseudomonas</i> | 8 | Hot tub | Park cabin |
| August 2006 | <i>Cryptosporidium</i> | 19 | Public pool | Subdivision |
| April 2007 | Unknown | 2 | Hot tub | Hotel |
| September 2007 | <i>Cryptosporidium</i> | 10 | Public pool | Neighborhood |
| November 2007 | <i>S. aureus</i> | 8 | Hot tub | Park cabin |
| May 2008 | Unknown | 7 | Public pool | Neighborhood |
| August 2014 | <i>Cryptosporidium</i> | 63 | Public pool | Swim club |

| Unknown Venue | | | | |
|---------------|------------------------|----|---------|------------------|
| June 2011 | <i>Shigella</i> | 5 | Unknown | Water park |
| October 2012 | <i>Legionella</i> | 2 | Unknown | Aquatic facility |
| August 2013 | <i>Cryptosporidium</i> | 5 | Unknown | Water park |
| August 2014 | <i>Cryptosporidium</i> | 18 | Unknown | Water park |

Source: SendSS

Of the 15 WBDOs under DPH inspection (confirmed and unknown), most human exposures occurred from *Cryptosporidium* (46.6%), with *S. aureus* and unknown exposures occurring (13.3% each, respectively). The remaining WBDOs not listed in this report were related to exposures from private pools, footbaths, water systems, wastewater, and lakes/streams.

DISCUSSION

The goal of this assessment was to evaluate pool inspection data, drowning hazards, and WBDOs to gain a picture of risks associated with pool settings. This assessment was a result of inquiries on legislation introduced that, if signed into law as initially written, would have removed current public health protections provided by DPH and local health departments. This legislation targeted regulated settings in counties with local rules and regulations in place. As the data demonstrated, most districts with local rules are large and in urban areas that have the highest number of pools and a higher percentage of the population potentially served. The impact of the proposed legislation would have resulted in a large number of pools no longer requiring inspections.

Evaluation of inspection data focused on specific risk factors (disinfectant residual, pH, barriers) that, if not controlled, can cause disease or injury, is a way to evaluate risks associated with public pools. As the data demonstrated, the settings with the highest percentage of risk factor violations were apartments, condos, subdivisions, hotels, and community club pools. With the exception of hotels, these pools could have been exempt from inspections if the proposed legislation had been enacted.

Drowning deaths, which can be preventable, are a focus of the DPH pool regulations. Although these regulations are designed to protect all swimmers, in regulated facilities, it is necessary to have rules in place to protect children, for the highest rates of drowning are for children (0-4 years) and at sites in the state where the greatest exposure occurs. The data indicate that more

children are exposed to drowning risk factors in districts with at least one large urban county, underscoring the importance of ensuring that rules are in place for pools under local rules. To protect swimmers, DPH and local rules ensure that barriers are in place and in working order, emergency life-saving equipment is available, and suction hazards are abated.

According to the CDC, there has been an increase in WBDOs over the last twenty years. Data for Georgia demonstrate that the risk for exposure to microorganisms continues to burden the swimming population, even in inspected public pools. This underscores the importance of pool inspection programs that have enforcement capability to stop outbreaks by issuing a regulatory closure order for a pool suspected of being contaminated. Ensuring water quality, such as proper disinfection and pH, is necessary for preventing WBDOs, and identifying the pools of highest risk allows the DPH and LHDs to target prevention efforts.

The strengths of this analysis included linking inspection risk factor data with pool settings to demonstrate which types of pools are at higher risk. Modeled after a similar study conducted by the CDC, derived data were used in real time to make policy recommendations. There are limitations relating to the data. Only 132 of 159 counties report inspection data in real time to DPH, which limited the overall number of pools analyzed, and the current structure of the database limits the stratification of risk factors by pool setting. However, the data were stratified manually, and 14 of 18 districts were represented, with the pools geographically dispersed between rural and urban public health districts.

This assessment provided a picture of the “state of public health” in the DPH pool program and identified key risk factor violations by pool setting. Linking risk factor data by pool setting allows public health agencies to target education and enforcement for the pools at highest risk and assures that policy makers are presented with accurate data to drive policy decisions. Risk-

based approaches in protecting public health can be shared across programs.

CONCLUSIONS

The DPH has invested considerable time and money into building a robust inspection system that allows accurate collection and analysis of data on risk factors. The results of this labor are now being realized, as thousands of inspection reports are entered into the EHS system daily, allowing timely analysis and programmatic decisions. Consequently, data from this assessment was used to drive policy recommendations at the legislative and executive branches of government and resulted in a positive outcome ensuring that public health protections remained in place for public pools in Georgia.

Acknowledgements

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References

- Berger, B.G. & Owen, D.R. (1992). Mood alteration with yoga and swimming: Aerobic exercise may not be necessary. *Perceptual and Motor Skills*, 75(3suppl), 1331-1343.
- Berkley Wellness, University of California. (2016). Why swimming is so good for you. Retrieved from <http://www.berkeleywellness.com/fitness/active-lifestyle/article/why-swimming-so-good-you>
- Centers for Disease Control and Prevention (CDC). (2016). Home and recreational safety. Retrieved from <http://www.cdc.gov/homeandrecreationalafety/water-safety/>
- Centers for Disease Control and Prevention (CDC(a)). (2015). CryptoNet: Molecular-based Tracking to Better Understand U.S. Cryptosporidiosis Transmission. Retrieved from <http://www.cdc.gov/parasites/crypto/cryptonet.html#one>
- Centers for Disease Control and Prevention, National Center for Health Statistics. (CDC(b)) (2015). Underlying Cause of Death 1999-2013 on CDC WONDER Online Database. Retrieved from: <http://wonder.cdc.gov/ucd-icd10.html>
- Centers for Disease Control and Prevention (CDC(c)). (2015). Recreational Water Illnesses. Retrieved from <http://www.cdc.gov/healthywater/swimming/rwi/index.html>
- Centers for Disease Control and Prevention (CDC). (2014). Pools and hot tubs. Retrieved from <http://www.cdc.gov/healthywater/swimming/pools/>

- Centers for Disease Control and Prevention (CDC). (2011). Web-based Injury Statistics Query and Reporting System (WISQARS) [online]. Retrieved from <http://www.cdc.gov/injury/wisqars>
- Centers for Disease Control and Prevention (CDC). (2010). Violations identified from routine swimming pool inspections-selected states and counties, United States, 2008. *Morbidity and Mortality Weekly Reports*, 59(19), 582-587.
- Font-Ribera, L., Villanueva, C.M., Nieuwenhuijsen, M.J., Zock, J.P., Kogevinas, & Henderson, J. (2011). Swimming pool attendance, asthma, allergies, and lung function in the Avon longitudinal study of parents and children cohort. *American Journal of Respiratory and Critical Care Medicine*, 183(5), 582-588.
- Georgia Department of Public Health (DPH). (2015). State Electronic notifiable disease surveillance system (SendSS). Received from the GDPH Epidemiology Department October 2015.
- Georgia Department of Public Health (DPH). (2012). Environmental health report. Key environmental health indicators, 2012. Retrieved from https://dph.georgia.gov/sites/dph.georgia.gov/files/related_files/site_page/EnvHealthReport.pdf
- Georgia Department of Public Health, Online Analytical Statistical Information System (OASIS). (2015). Drowning rates. Retrieved from <https://oasis.state.ga.us/oasis/oasis/qryMorbMort.aspx>
- Huang, S.W., Veiga, R., Sila, U., Reed, E. & Hines, S. (2009). The effect of swimming in asthmatic children—Participants in a swimming program in the City of Baltimore *Journal of Asthma*, (26)2, 1989, 117-121.
- McAnulty, J.M., Fleming, D.W. & Gonzalez, A.H. (1994). A community-wide outbreak of Cryptosporidiosis associated with swimming at a wave pool. *Journal of the American Medical Association*, 272(20), 1597-1600.
- Official Code of Georgia Annotated (OCGA). (2016). Michelle's law, 31-45. Retrieved from <https://www.lexisnexis.com/hottopics/gacode/>
- Randle, T., Gray, A., Shakir, M., & Dixon, C. (2015). Georgia child fatality review panel annual report—calendar year 2013. Retrieved from: https://gbi.georgia.gov/sites/gbi.georgia.gov/files/related_files/site_page/2013%20CFR%20Annual%20Report.pdf
- Shields, J.M., Hill, V.R., Arrowood, M.J. & Beach, M.J. (2008). Inactivation of *Cryptosporidium parvum* under chlorinated recreational water conditions. *Journal of Water Health*, 6(4), 513-520.
- United States Census Bureau. (2016). Georgia: 2010 population and housing unit counts. Retrieved from: <https://www.census.gov/prod/cen2010/cph-2-12.pdf>
- United States Census Bureau (2012). Statistical abstract of the United States. Retrieved from <http://www.census.gov/library/publications/2011/compendia/statab/13led/arts-recreation-travel.html>
- University of North Carolina at Chapel Hill. (2016). Swimming. Retrieved from <http://swimmingbenefits.web.unc.edu/>

Uyan, Z.S., Carraro, S., Piacentini, G. & Baraldi, E.
(2009). Swimming pool, respiratory health, and

childhood asthma. *Pediatric Pulmonology*, 44, 31-37.

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