DROWNING-RELATED HOSPITALIZATION IN ARIZONA AND MARICOPA COUNTY, 2016-2018

Annual Report for the Drowning Prevention Coalition of Arizona

ARIZONA DEPARTMENT
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Bureau of Public Health Statistics

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DROWNING-RELATED HOSPITALIZATIONS IN ARIZONA AND MARICOPA COUNTY, 2016-2018

SUMMARY

This annual report provides statistical information about drownings and nonfatal drownings occurring in Arizona, with a focus on incidents occurring in Maricopa county. Starting with data for 2016 we analyze Arizona hospitalization data, called the Hospital Discharge Database (HDD). The national switch in late 2015 to ICD-10-CM diagnostic coding allows a robust analyses of admissions to emergency departments and to the in-patient setting.

In 2016, 2017, and 2018 the HDD recorded 419, 438, and 429 statewide admissions (incidents) of persons of all ages. Young children (0-4 years of age) comprised 751 of these admissions statewide. For the 3-year period, admissions to hospitals in Maricopa county totaled 871, of which 558 were young children. Swimming pools and bathtubs were the water types most commonly identified in Maricopa county for incidents involving young children. Hospitalizations from incidents during the 3 years in so-called “natural water” (such as rivers and lakes) totaled 136, mostly among persons 15 years of age and older. Hospital charges for the 3 years in Maricopa county exceeded $17.8 million, and for the state $25 million. In a separate analysis using death certificates, the Maricopa drowning death rate of young children increased from 3.3 deaths per 100,000 children in 2015 to 6.4 deaths per 100,000 children in 2018.

While use of HDD data for the monitoring of incident cases now extends statewide there are shortcomings, such as a lack of inclusion of persons who are not hospitalized (e.g., deaths on-scene) and loss of detail about the circumstances that first responders provided in the previous monitoring system. Nevertheless, the HDD when accompanied by data from death certificates provides data useful for studying the risk factors and monitoring progress in reducing the incidence of drowning and nonfatal drowning.

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INTRODUCTION

In the mid-1980's the drowning death rate of Arizona's preschoolers ranked first in the nation.[1] In the latest 6 years, data for the 50 states show that Arizona ranks 4th highest for drowning of children age 1-4 years.[2] And in recent years, among children 1-4 years of age in Arizona, drowning is the leading cause of death in that age group.[3] Furthermore, in about 9% of nonfatal drowning incidents the child may be left with some degree of neurological impairment.[4] Warm weather, long summers, and the presence of more than 300,000 residential swimming pools make Arizonans of all ages at risk for water-related incidents.

To address the problem of water-related incidents in the Phoenix metropolitan area (called "Maricopa County" in this report), the Drowning Prevention Coalition of Arizona was formed in 1988. This Coalition is comprised of municipal fire departments, hospitals, the state and county health departments, community organizations, pool builders, suppliers of pool safety equipment, parents of drowned children, concerned business leaders, and others.

The Coalition's website www.preventdrownings.org and a community partner's website http://childrensafetyzone.com provide stories about individual incidents. These stories convey the often tragic impact to a child and family. At a community level, the following report aggregates the individual events and uses data from hospital admissions to describe the larger patterns and trends. The information can be used in understanding the risk factors and in designing community approaches to reduce these incidents.

ADHS annual drowning reports prior to 2016 relied mainly upon incident reports from fire departments. However, since 2016 we use a new data source, namely hospitalization data, which produces findings not directly comparable to those in previous years. But, as in previous years, much of the new reporting system focuses on children under five years of age, and specifically on incidents occurring in swimming pools. The current report looks at incidents in the combined period 2016-2018.

[1] Arizona Department of Health Services. Unintentional Drowning Deaths, Arizona, 1980-1989. Office of Planning & Health Status Monitoring, October 1990.
[2] CDC WONDER query for AZ deaths, 2010-2016, unintentional drowning, age 1-4 years, AZ crude rate of 4.6 deaths per 100,000 toddlers. Accessed June 14, 2018.
[3] Link to AZ data, 2010-2015, generated from CDC WISQARS.
[4] Beyda, D. and Masuello, J. Phoenix Children's Hospital. Oral communication, July 1999.

METHODS AND DATA SOURCE

Data Source: Hospitalization records

Effective on October 1, 2015 the U.S. Department of Health and Human Services required hospitals to implement the coding of injuries and diseases using the International Classification of Diseases, 10th edition, Clinical Modification (ICD-10-CM). The ADHS also requires Arizona hospitals to use this system in reporting patient admissions and discharges, the conditions diagnosed and treated, and the hospital's financial charges to the patient. This classification system allows for more detailed epidemiologic analysis of hospital data from 2016 forward.

To create the dataset for the present analysis, ADHS generated a list of records of persons admitted and discharged using the following criteria.

Data item	Criteria or Code Description	Comment
Year of admission	2016, 2017, 2018	
Residence	Any state or country	
Age	Any age at time of admission	
Record type	Emergency record or In-patient record	If a case had both types of records, only the single incident record was analyzed
ICD-10-CM code group		Search of all diagnostic and e-code fields
T75.1	Unspecified effects of drowning and nonfatal drowning	
V90	Drowning and submersion due to accident to watercraft	e.g., watercraft overturns
V92	Drowning and submersion due to accident on board watercraft, without accident to watercraft	e.g., falling off the watercraft
W16	Fall, jump or diving into water	Only if the detailed code describes an associated drowning
W22.041	Strike wall of swimming pool causing drowning and submersion	
W65-W74	Accidental non-transport drowning and submersion	Includes bathtub, swimming pool, natural water, other, and unspecified water
X37-X38	Cataclysmic storm or flood	Only if another code implies an associated drowning
Y21	Drowning and submersion, undetermined intent	

Because the ICD-10-CM codes distinguish between an initial hospital encounter for an injury and subsequent admissions for continuing care we limited our analysis to admissions for the initial event.[5] This report calls them the "incident" event or "case".

Information sources and records not included: Starting with the 2016 data year, our approach no longer includes information supplied by fire departments or gleaned from news clipping or TV coverage. Drowning-related cases not admitted to a hospital emergency department ('ED') or not admitted for in-patient care are not counted either;

[5] These records generally contain an "A" in the seventh position of the diagnostic and E codes.

so, cases pronounced dead on-scene are not counted as hospitalizations.[6] Similarly, minor incidents that are not sent to a hospital are not a part of the dataset. Although the diagnostic code text description contains the word 'drowning', there were 45 hospitalized cases during 2016-2018 that we excluded from analysis where the manner of drowning or nonfatal drowning event was coded as "assault" or "self harm".

Data assumption: Because the hospital dataset is unable to provide the physical location of drownings and nonfatal drownings, for analysis purposes we assume that the county of the admitting hospital is the same as the county in which the incident occurred. For example, a case admitted to Phoenix Children's Hospital or Banner Desert/Cardon's Children's Hospital is assumed to have occurred in Maricopa county. Thus, any case with an incident scene in one county who is transported directly to another county for admission would be misclassified as to the county of incidence.

Analysis: For incidents occurring since 2016, analysis of data is performed using SAS and Microsoft Excel.

[6] A later section of this report (see Figure 4) presents the counts derived from death certificates.

FINDINGS

Analysis of the 2016, 2017, and 2018 Hospital Discharge Database (HDD) for persons of all ages revealed 419, 438, and 429 recorded admissions statewide for incidents of drowning or nonfatal drowning. Admissions to Maricopa county facilities totaled 275, 313, and 283 respectively (see **Table 1**).

The distribution of the 1286 incidents statewide in 2016-2018 according to the facility county and age of the victim is shown in **Table 1** also. Maricopa county facilities admitted 871 persons in 2016-2018, and Pima county facilities admitted 143 persons. Again, this report assumes that county of the facility of the admission reflects an occurrence of the incident in that same county. For the three combined years, admissions in Maricopa County only to EDs totaled 708, and admissions as in-patients totaled 163 (data not shown). If a person had multiple admissions, only the "incident" admission was considered. If a person was seen in the ED and then was admitted as an in-patient at the same facility, there is only one record (an inpatient record) which also includes the details of the ED admission (e.g., time of ED admission).

Table 1. Water-related incidents admitted in 2016, 2017, and 2018 according to age group and the county in which the hospital facility was located.

County of the Facility	Admit Year																	
	2016						2017						2018					
	Age Group						Age Group						Age Group					
	0-4	5-14	15-34	35-64	65+	Yr Total	0-4	5-14	15-34	35-64	65+	Yr Total	0-4	5-14	15-34	35-64	65+	Yr Total
Apache	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	1	1
Cochise	4	.	.	.	.	4	3	.	.	.	.	3	.	.	.	1	.	1
Coconino	4	2	3	3	1	13	.	4	4	3	.	11	2	1	2	3	.	8
Gila	.	.	.	.	.	.	.	2	1	3	.	6	1	.	1	1	1	4
Graham	.	.	.	.	.	.	3	.	.	.	.	3	.	.	1	.	.	1
La Paz	.	.	5	1	.	6	.	.	1	.	.	1	.	.	.	1	1	2
Maricopa	174	27	34	32	8	275	203	40	28	34	8	313	181	36	34	25	7	283
Mohave	10	7	8	11	1	37	6	.	7	8	3	24	10	.	17	13	3	43
Navajo	1	1	.	.	.	2	1	1	1	.	.	3	.	.	1	2	1	4
Pima	29	7	1	5	2	44	28	7	3	4	4	46	39	7	3	4	.	53
Pinal	7	2	3	3	1	16	9	.	1	1	.	11	3	1	1	.	.	5
Santa Cruz	.	.	.	.	.	.	2	.	1	.	.	3	.	.	1	.	1	2
Yavapai	2	1	1	.	1	5	2	.	2	.	1	5	2	2	.	2	2	8
Yuma	9	1	2	3	1	16	7	.	.	2	.	9	9	2	.	2	1	14
Total	240	48	57	59	15	419	264	54	49	55	16	438	247	49	61	54	18	429

Among the 871 cases admitted to a hospital facility in Maricopa county, 803 cases were Arizona residents (see **Table 2**) The most common city of residence was Phoenix (245 cases), followed by Mesa (117 cases), Chandler (55 cases), and Glendale (54 cases). Sixty-eight of the incidents in Maricopa county occurred to out of state residents.

Table 2. Sum of incident cases presumed to have occurred in Maricopa County, 2016-2018 combined data, shown by the Residence City and age group.

	Age Group					
Residence City	0-4	5-14	15-34	35-64	65+	Total
PHOENIX	148	33	30	27	7	245
MESA	74	19	15	5	4	117
CHANDLER	40	7	5	3	0	55
GLENDALE	31	7	5	11	0	54
GILBERT	40	3	4	2	0	49
PEORIA	28	2	3	4	0	37
SCOTTSDALE	22	4	3	6	2	37
GOODYEAR	18	1	3	0	2	24
TEMPE	14	2	3	4	0	23
SURPRISE	13	1	2	2	1	19
QUEEN CREEK	7	2	1	3	0	13
AVONDALE	10	1	0	1	0	12
BUCKEYE	8	2	0	1	0	11
EL MIRAGE	8	0	0	2	0	10
LAVEEN	5	0	1	1	0	7
CASA GRANDE	4	1	1	0	0	6
LITCHFIELD PARK	5	1	0	0	0	6
MARICOPA	4	2	0	0	0	6
SUN CITY	0	0	1	3	2	6
TOLLESON	5	1	0	0	0	6
ANTHEM	3	0	2	0	0	5
FLORENCE	4	0	1	0	0	5
APACHE JUNCTION	3	1	0	0	0	4
FOUNTAIN HILLS	1	0	2	0	1	4
Remainder of cities	21	7	7	6	1	42
Total for AZ Residents	516	97	89	81	20	803
Out of State Residents	42	6	7	10	3	68
TOTAL	558	103	96	91	23	871

In Maricopa county, the four most frequent facilities to which cases were initially[7] admitted were Banner Desert Medical Center, Phoenix Children's Hospital, Banner Thunderbird Medical Center, and Honor Health Deer Valley (**Table 3**). The cases among young children (age 0-4) predominate among the age groups.

Table 3. Count of cases by facility in Maricopa county to which cases were initially admitted, 2016-2018. Hospitals with fewer than 12 admissions during the 3-year period are combined in the Table.

Name of Facility in Maricopa County	Age Group					
	0-4	5-14	15-34	35-64	65+	Total
BANNER DESERT MED CTR	157	33	9	4	1	204
PHOENIX CHILDRENS HOSPITAL	131	27	4	.	.	162
BANNER THUNDERBIRD MED CTR	86	9	2	3	1	101
HONORHEALTH DEER VALLEY MED CTR	30	5	12	5	1	53
HONORHEALTH SCOTTSDALE SHEA MED CTR	26	3	6	3	1	39
BANNER ESTRELLA MED CTR	14	3	6	5	1	29
DIGNITY HEALTH - MERCY GILBERT MED CTR	12	4	5	5	1	27
DIGNITY HEALTH - CHANDLER REGIONAL MED CTR	6	3	6	4	1	20
BANNER BAYWOOD MED CTR	2	.	8	6	3	19
ABRAZO WEST CAMPUS	10	1	1	4	.	16
HONORHEALTH SCOTTSDALE OSBORN MED CTR	4	1	1	8	2	16
STEWARD - MOUNTAIN VISTA MED CTR	6	2	6	1	1	16
HONORHEALTH JOHN C LINCOLN MED CTR	2	2	3	6	2	15
DIGNITY HEALTH - ST JOSEPH'S HOSPITAL AND MED CTR (PHX)	1	.	3	8	1	13
MARICOPA MED CTR	8	.	3	2	.	13
BANNER DEL E WEBB MED CTR	6	.	.	5	1	12
25 Other Maricopa County Facilities	57	10	21	22	6	116
Total	558	103	96	91	23	871

[77] The Table does not show the counts of cases that were referred for ongoing or sequela care.

The water type in which the incident occurred in Maricopa county according to age group and coded activity of the patient is presented in **Table 4**. For 114 (13%) of the 871 incidents we could not determine the water type from the diagnostic codes.

Among persons of all ages, most incidents (540 [62%] of the 871) occurred in swimming pools. So-called 'natural water' (e.g., lakes, streams) involved 136 persons of all ages. Watercraft and water skiing involved 67 incidents among persons of all ages.

Among the 558 incidents involving young children a swimming pool was involved in 401 (72%) of the 558 events. A bathtub was the water type for 57 young child cases.

For 523 incidents (359 of them in swimming pools) an activity of the victim was not stated or not specified in the record.

Table 4. Count by water type, activity, and age group of incidents occurring in Maricopa county, 2016-2018

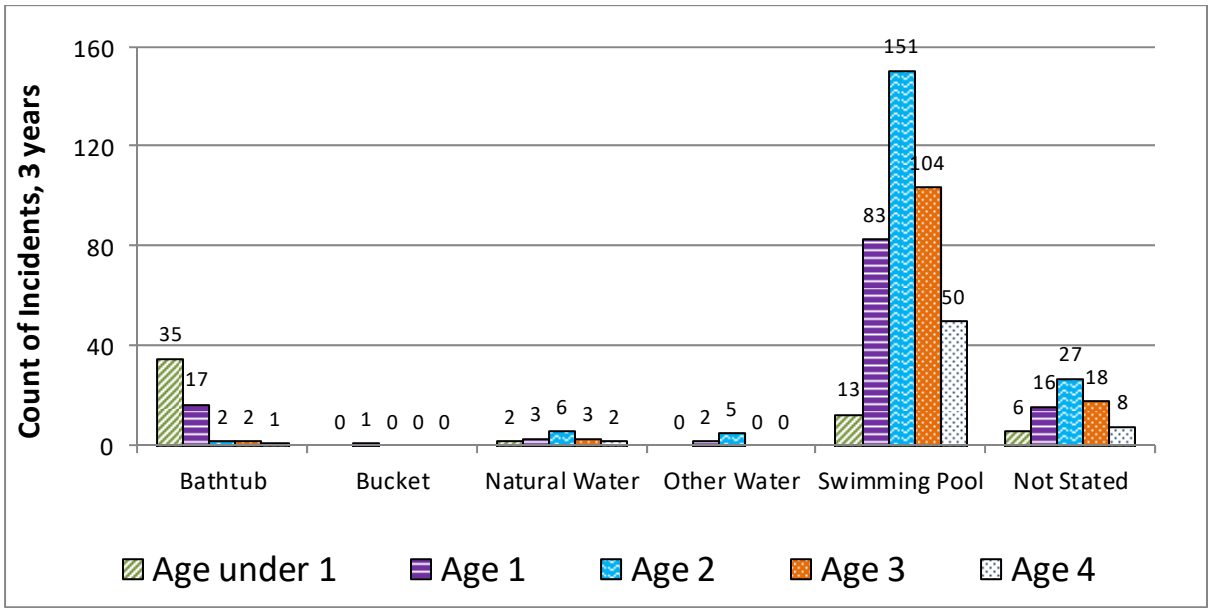
		Age Group					
Water_Type	Activity_Victim	0-4	5-14	15-34	35-64	65+	All
Not Stated	Not stated	67	18	6	6	2	99
	Other Specified	5	1	1	1	1	9
	Swimming	4	.	.	1	1	6
Bathtub	Not stated	7	.	2	3	1	13
	Bathing	49	2	3	1	1	56
	Other Specified	1	.	.	.	.	1
Bucket	Not stated	1	.	.	.	.	1
Natural Water	Not stated	9	2	11	4	2	28
	Golfing	.	.	.	.	1	1
	Involving Watercraft	1	2	19	27	2	51
	Other Specified	2	.	.	1	.	3
	Rafting/Tubing	.	1	13	4	1	19
	SCUBA	.	.	1	.	.	1
	Swimming	4	3	5	4	.	16
	Unspecified	.	.	1	.	.	1
	Water Skiing	.	1	11	4	.	16
Other Water	Not stated	7	1	.	1	.	9
	Diving Board	.	.	1	.	.	1
Swimming Pool	Not stated	254	34	14	26	7	335
	Animal Care	1	.	.	.	.	1
	Climbing/Jumping	3	.	.	.	.	3
	Maintenance	.	.	.	1	1	2
	Other Specified	20	.	.	2	.	22
	Rafting/Tubing	1	.	.	.	.	1
	Swimming	120	38	8	5	3	174
	Unspecified	2	.	.	.	.	2
All		558	103	96	91	23	871

Young Children

Children, ages 0-4 years, comprised the largest group experiencing a water-related incident. Although older individuals are equally important to consider in terms of loss of life, society generally feels a greater sense of responsibility to prevent injury to persons in the youngest, highly vulnerable, age group. The next few graphs analyze the findings among the 0-4 year old age group.

The distribution of emergency department or inpatient cases among single ages of the 0-4 year old group is shown in **Figure 1**. Among children 1-4 years old, the count of incidents in swimming pools far overshadows the count in all other bodies of water combined. In contrast, among infants (i.e., under one year of age) the bathtub is the most common water body in which incidents occur.

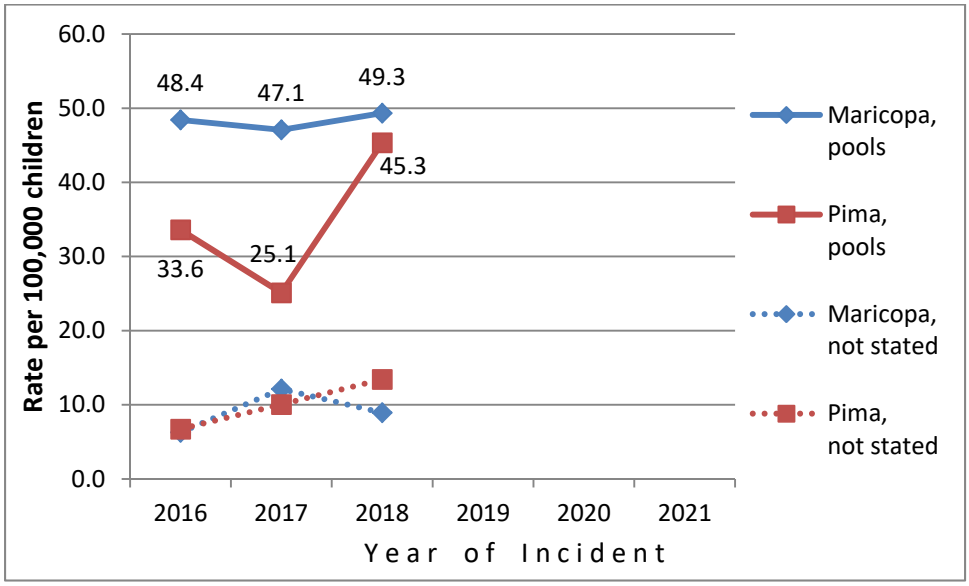
Figure 1. Count of incidents according to the body of water in which incidents occurred, by single age category, reported in Maricopa County, 2016-2018



To account for the changes in the number of children residing in Maricopa County we calculate the rate of incidents expressed per 100,000 children. A rate adjusts for changes in the size of the population. For example, in 2016 the incidence rate is calculated as 131 incidents in pools ÷ 270,572 resident children = 48.4 incidents per 100,000 resident toddlers (see **Figure 2**). The calculated rates for 2016, 2017, and 2018 are shown in Figure 2. Additional years of observation are needed to determine if there is a clear trend of hospitalization for incidents among young children in swimming pools. The count of "not stated" water types may contain some incidents in pools, and may affect the counts and rates attributed to swimming pools.

The inverse of the 2016 rate (100,000 / 48.4) reveals that for every 2,066 resident children, at least one child experienced a pool incident requiring hospitalization in 2016 in Maricopa county. Rates for Pima county appear somewhat lower than for Maricopa County.

Figure 2. Rate of hospitalizations (per 100,000 children age 0-4 years) for Maricopa and Pima county incidents occurring in swimming pools and water type not stated.



In 2016-2018 the incidents in Maricopa county swimming pools occurred among 173 young girls and 228 young boys (data not shown). The higher count among boys has been observed in many previous analyses of drowning data.

White Hispanic young children in Maricopa county accounted for 112 (28%) of 401 incidents, while white non-Hispanic accounted for 241 (60%) (data not shown). The remaining race categories together accounted for 48 (12%) of the incidents.

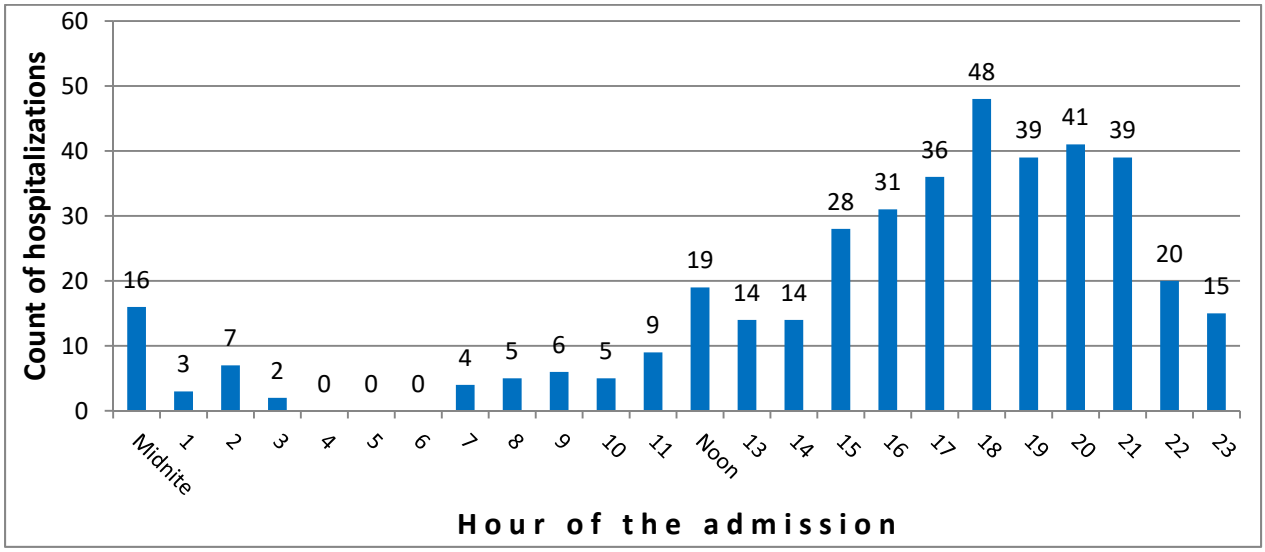
The hospitalization data for 0-4 year olds show a considerably higher risk for incidents in swimming pools on weekend days than on other days of the week (**Table 5)**. Almost half (46%) of all pool incidents occurred on weekends.

Table 5. Sum of hospitalizations of children age 0-4 years, by Water Type and Hospitalization Day of the Week, for Maricopa facilities, 2016-2018

	Admission day of the Week							
Water Type	Sun	Mon	Tues	Wed	Thur	Fri	Sat	All
Not stated	23	7	7	7	9	9	14	76
Bathtub	10	6	6	12	8	11	4	57
Bucket	.	.	1	.	.	.	.	1
Natural Water	6	3	2	.	1	1	3	16
Other Water	3	.	.	3	.	1	.	7
Swimming Pool	95	52	34	37	47	46	90	401

The hour of hospitalization derived from incidents in Maricopa county swimming pools provides a rough sense of the time of day most at risk. **Figure 3** indicates that late afternoon is considerably riskier than other times of the day. Few hours were free of risk.

Figure 3. Sum of hospital admissions for swimming pool-related incidents, by hour of the day, 2016-2018 data for Maricopa county facilities treating children age 0-4 years



The hospitalizations of young children by month are shown in **Table 6**. We note the typical pattern seen in previous years, with the number of pool-related incidents peaking during the summer months of June, July, and August in many counties. In

2016-2018 the count of incidents in Maricopa county pools in May, June, July, August, and September exceeded the Coalition's goal of seeing fewer than 10 incidents in any month.

Table 6. Monthly sum of hospitalizations, 0-4 year olds, 2016-2018 (3-year totals by month)

		Admission Month												
County of Facility	Water_Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All
Cochise	*Not stated*	.	.	.	.	.	.	1	.	.	.	.	.	1
	Other Water	.	.	.	1	.	.	.	.	.	.	.	.	1
	Swimming Pool	**1**	**.**	**1**	**.**	**.**	**1**	**1**	**1**	**.**	**.**	**.**	**.**	**5**
Coconino	*Not stated*	.	.	.	.	.	.	.	.	.	.	.	1	1
	Natural Water	.	.	.	.	.	1	.	1	.	1	.	.	3
	Swimming Pool	**1**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**1**	**.**	**.**	**2**
Gila	*Not stated*	.	.	.	.	.	.	.	1	.	.	.	.	1
Graham	*Not stated*	.	.	.	.	.	.	.	.	.	1	.	.	1
	Bathtub	.	.	.	.	.	.	1	.	.	.	.	.	1
	Swimming Pool	**.**	**.**	**.**	**.**	**.**	**1**	**.**	**.**	**.**	**.**	**.**	**.**	**1**
Maricopa	*Not stated*	1	1	7	5	12	15	14	10	7	2	.	2	76
	Bathtub	5	1	5	7	4	6	8	3	5	6	3	4	57
	Bucket	.	.	.	1	.	.	.	.	.	.	.	.	1
	Natural Water	1	.	2	1	1	5	5	1	.	.	.	.	16
	Other Water	.	.	3	2	1	.	1	.	.	.	.	.	7
	Swimming Pool	**5**	**14**	**25**	**34**	**44**	**69**	**88**	**58**	**37**	**11**	**13**	**3**	**401**
Mohave	*Not stated*	.	.	.	.	.	1	.	.	.	.	1	.	2
	Bathtub	.	1	1	.	.	.	.	1	.	.	.	.	3
	Natural Water	.	.	.	.	1	2	.	.	1	.	.	.	4
	Swimming Pool	**.**	**.**	**.**	**1**	**2**	**3**	**4**	**4**	**1**	**.**	**.**	**2**	**17**
Navajo	Bathtub	.	.	.	.	.	.	.	.	1	.	.	.	1
	Natural Water	.	.	.	.	.	1	.	.	.	.	.	.	1
Pima	*Not stated*	.	1	.	2	4	3	6	1	.	1	.	.	18
	Bathtub	.	.	3	1	1	4	.	1	.	1	.	2	13
	Natural Water	.	.	.	1	.	.	1	.	.	.	.	.	2
	Other Water	.	.	.	.	.	.	.	.	1	.	.	.	1
	Swimming Pool	**1**	**2**	**4**	**2**	**12**	**10**	**13**	**9**	**5**	**1**	**1**	**2**	**62**
Pinal	Bathtub	.	.	.	.	1	.	.	.	.	.	.	.	1
	Swimming Pool	**.**	**1**	**.**	**.**	**2**	**5**	**5**	**3**	**.**	**1**	**.**	**1**	**18**
Santa Cruz	*Not stated*	.	.	.	.	1	.	.	.	.	.	.	.	1
	Bathtub	.	.	.	.	.	1	.	.	.	.	.	.	1
Yavapai	*Not stated*	.	.	.	.	.	.	1	.	.	.	.	.	1
	Bathtub	.	.	.	.	.	.	.	.	1	.	.	.	1
	Natural Water	.	.	.	1	.	.	.	.	.	.	.	.	1
	Swimming Pool	**.**	**1**	**.**	**.**	**.**	**1**	**1**	**.**	**.**	**.**	**.**	**.**	**3**
Yuma	*Not stated*	.	.	.	.	.	2	.	1	.	.	.	.	3
	Bathtub	.	.	.	.	.	.	.	.	1	.	1	.	2
	Natural Water	.	.	.	.	.	.	.	.	1	.	.	.	1
	Swimming Pool	**.**	**.**	**2**	**3**	**.**	**3**	**5**	**5**	**.**	**.**	**1**	**.**	**19**
All		**15**	**22**	**53**	**62**	**86**	**134**	**155**	**100**	**61**	**26**	**20**	**17**	**751**

Severity of Incident

As a surveillance source, the hospital discharge database provides no direct measure of the severity, outcome, or functional status of the patient upon discharge. Instead, we rely upon indirect measures to inform the Coalition as to the severity and impact of water-related incidents. These indirect measure include the length of stay in the hospital, the financial charges accrued, and an assessment of the patient's outcome by counting deaths, survival with presumed impairment, and presumed normal status upon discharge.

Financial Impact

The financial impact of the incidents in all water types can be measured partially in terms of the hospital charges for the admissions. By county, the incurred charges at facilities in 2016-2018 are shown in **Table 7**. Hospitals in Maricopa county charged a total of $17.8 million for care related to drowning and submersion in the three-year period 2016-2018. Statewide, the hospital charges exceeded $25 million. For patients age 0-4 years, the statewide average charge was $13,073, while the median charge was $2,611. The average charge is highly skewed upward by charges in the tens of thousands of dollars for some admissions.

Table 7. Sum of hospital charges, 2016-2018, by the county in which the hospital is located. The row at the bottom of the table provides the statewide median of the charges by age group. The amounts show the charges among all water types.

County of the Facility	0-4	5-14	15-34	35-64	65+	All
Apache	.	.	.	$2,583	$6,579	$9,162
Cochise	$29,175	.	.	$1,272	.	$30,447
Coconino	$17,940	$19,221	$26,058	$43,533	$17,585	$124,337
Gila	$1,040	$9,897	$3,858	$21,980	$8,012	$44,787
Graham	$1,857	.	$6,095	.	.	$7,952
La Paz	.	.	$102,539	$92,668	$2,031	$197,238
Maricopa	$7,084,311	$940,102	$3,706,709	$5,103,353	$1,023,319	$17,857,794
Mohave	$951,259	$48,816	$614,990	$805,612	$157,666	$2,578,343
Navajo	$13,381	$7,728	$202,319	$9,587	$16,069	$249,084
Pima	$794,149	$464,229	$414,960	$376,384	$157,814	$2,207,536
Pinal	$276,544	$9,466	$14,896	$220,595	$3,002	$524,503
Santa Cruz	$147,177	.	$8,980	.	$6,570	$162,727
Yavapai	$27,104	$5,658	$34,242	$17,896	$195,995	$280,895
Yuma	$474,164	$17,907	$12,304	$148,374	$105,763	$758,512
All counties	$9,818,101	$1,523,024	$5,147,950	$6,843,837	$1,700,405	$25,033,317
Median charges	$2,611	$2,629	$4,692	$10,792	$13,600	$3,700

Length of Hospital Stay

The duration of admission can inform about the case severity. In this analysis we combine the admissions to emergency departments and the inpatient setting, and we show the range of days in the hospital. If the patient was transferred from one hospital facility to another facility we summed the admission days from all facilities for that case. The data only for children age 0-4 years is shown in **Table 8**, according to the presumed outcome status.

Table 8. Duration of hospitalization for children age 0-4 years, by outcome status, for admissions to facilities in Maricopa County, 2016-2018.

Length of Stay (days)	Died	Not Died
0	21	295
1	7	191
2	4	19
3	2	5
4	.	2
5-9	3	3
10-14	1	.
15-19	.	3
20-24	1	.
25-29	.	1

Outcome Status

For children 0-4 years of age we determined the outcome status at the time of discharge as presented in **Table 9**. The analysis looks at the combined years 2016-2018. Of the 558 children admitted, 39 (7%) died, with 30 of these deaths resulting from incidents in swimming pools. To count the "impaired" outcome status we conservatively assumed the child was impaired if they were discharged other than to home (e.g., to a care facility), or if they stayed 7 or more total days in hospital. Eight (1.4%) children were classified with the "impaired" outcome status. For the discharge status of "normal" outcome we assumed that children who stayed less than 7 total days in hospital were discharged with status of "normal". The vast majority of children (497 [89%] of the 558) would be considered to have a "normal" outcome under this definition.

Currently, we do not have resources to conduct a longer term assessment of the needs or functional outcome status, such as educational achievement in school, of the surviving children.

Table 9. Outcome status of children 0-4 years of age hospitalized in Maricopa county for a drowning or submersion-related incident in 2016-2018.

	Presumed outcome status				
WATER TYPE	Died	Impaired	Normal	Unknown	All
Not stated	7	.	67	2	76
Bathtub	2	3	52	.	57
Bucket	.	.	1	.	1
Natural Water	.	.	16	.	16
Other Water	.	.	6	1	7
Swimming Pool	30	5	355	11	401
TOTAL	**39**	**8**	**497**	**14**	**558**

Limitations of Completeness and Accuracy of Incidence Data

Cases that generally lack a hospital record include those that are obviously dead when the law enforcement or EMS first responders arrive on scene or do not transport for hospital care. Previous years' reports often missed cases under the jurisdiction of the sheriff's office or a tribal government. This shortcoming is no longer present because the cases are recorded at a hospital level.

Information from the 2017-2018 death certificates reveals that 9 of 34 child drowning deaths from incidents in Maricopa county were not included in the hospitalization data source. For counting deaths by drowning, this match rate of 25/34 indicates a surprisingly low, 74% agreement of the hospitalization data with the death certificate data. Match rates in previous years were greater than 90%. The recent low match rate suggests an issue related to coding of injury in the hospital records that requires further clarification.

DEATH CERTIFICATE DATA

Death certificates serve an independent data source to measure the counts, rates, and trends of child drownings. In addition, mortality data can provide insight as to the accuracy and completeness of the incidence surveillance system for the cases who die. However, it should be noted that case definitions used for vital statistics differ slightly compared to those used in the HDD incidence data.

Customarily, mortality data show resident deaths of the resident population during a given year. However, for this report we present an unconventional analysis that more precisely reflects the local, year-to-year findings. We reviewed Arizona death statistics to find cases of young children who died in Arizona, regardless of where they resided, and we include only the cases whose incident occurred in Maricopa county. Thus, we present a crude Maricopa county rate of drowning deaths, regardless of residency. To calculate this mortality rate, we divided the count of deaths by the estimated number of children age 0-4 residing in Maricopa county in each year. This method improves the accuracy of identifying locally occurring events which is important for the Coalition that relies upon this surveillance system to provide yearly feedback about the effectiveness of their local prevention programs.

Figure 4 (see next page) shows drowning death rates for children under five years of age.[8] The data are shown for drownings in all bodies of water, and separately for drownings that occurred in swimming pools (including spas), and in bodies of water other than pools and spas.[9] In 2018, the Maricopa drowning rate for all bodies of water increased to 6.4 deaths per 100,000 resident children. Similarly, the death rate for incidents in pools increased to 6.1 deaths per 100,000 young children. For comparison, the goal of *Healthy Arizona 2010* was to reduce drowning fatalities to no more than 0.9 deaths per 100,000 young children.[10,11] Maricopa County's drowning rate in the 2010's remains about 4-6 times higher than the statewide goal. Although we see an overall decline in the pool death rate since the 1980's and 1990's, the rate since the early 2000's has been relatively flat, and even trended upward in the past 3 years. The current Arizona injury prevention plan continues to include a section dedicated to reducing drowning.[12]

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[8] To calculate this rate, the numerator includes non-residents and Arizona residents, age 0-4 years old, whose death occurred in Maricopa County. The denominator, however, is the Maricopa County population of children 0-4 years old. We chose this unconventional method for calculating the rate because we occasionally encounter nonresident visitors whose incident and death occurred in Maricopa county. We count these cases because the Drowning Prevention Coalition is focused on reducing the number of local incidents regardless of whether the child is a county resident or a visitor.

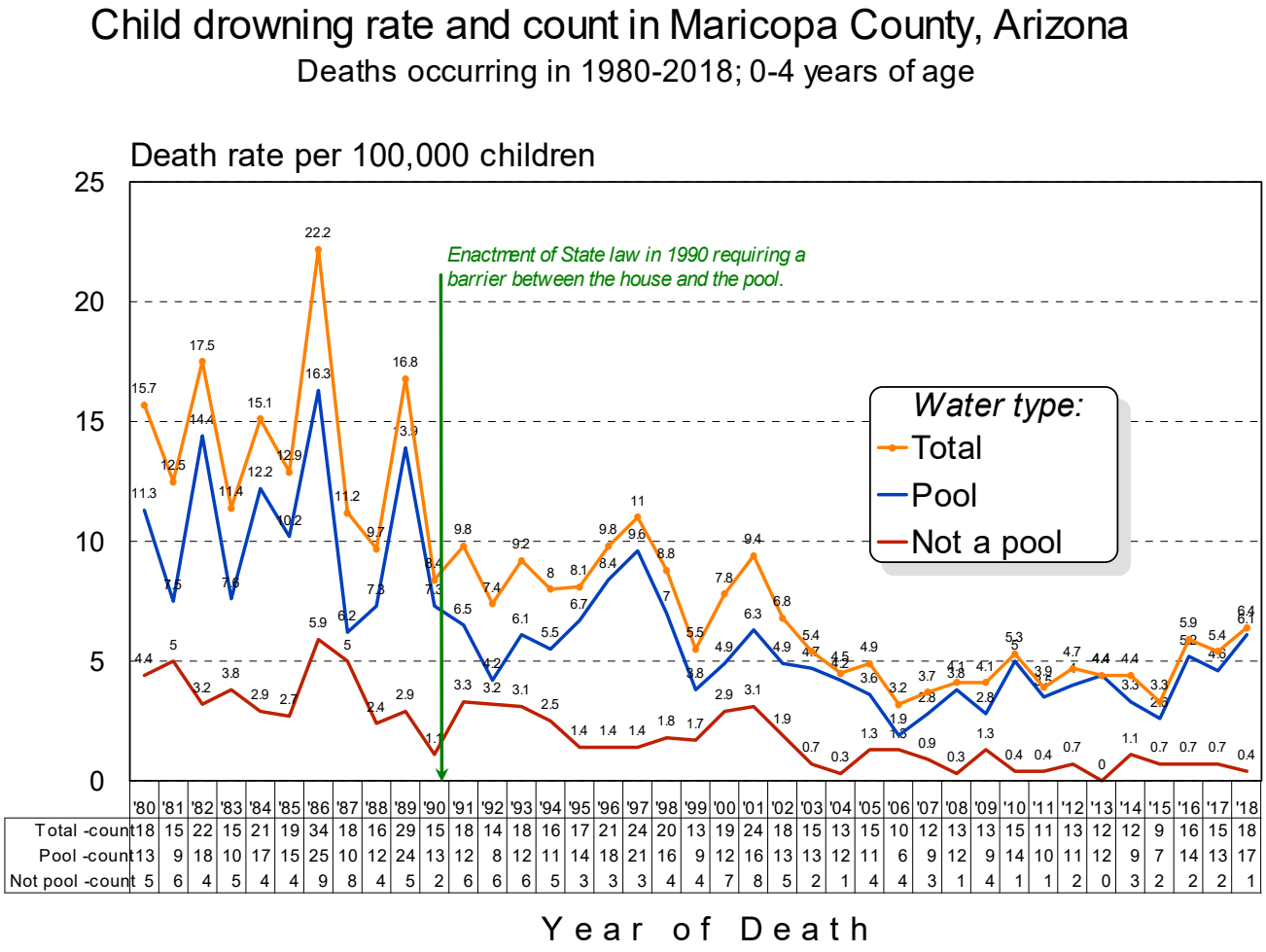
[9] Here we consider a hot tub or spa in the same category as swimming pool.

[10] U.S. Department of Health and Human Services. *Healthy People 2010*, 2nd ed., Volume 2. Injury Prevention, Section 15-29: Reduce Drownings, page 15-40. U.S. Government Printing Office, November 2000.

[11] ADHS Injury Surveillance and Prevention Plan, 2002-2005. The plan was developed within the Bureau of Emergency Medical Services.

[12] ADHS. Arizona Injury Prevention Plan, 2012-2016.

Figure 4. Drowning death rate for children, 0-4 years of age, where the occurrence of the death and the incident was in Maricopa County. [Data Source: ADHS, Vital Statistics, death certificates coded with underlying cause of death as: E830, E832, or E910 (prior to year 2000); orT75.1, W65-W74, V90-V92, or Y21 (year 2000 and later). Manner of death: accidental or undetermined].



	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18
Total -count	18	15	22	15	21	19	34	18	16	29	15	18	14	18	16	17	21	24	20	13	19	24	18	15	13	15	10	12	13	13	15	11	13	12	12	9	16	15	18
Pool -count	13	9	18	10	17	15	25	10	12	24	13	12	8	12	11	14	18	21	16	9	12	16	13	13	12	11	6	9	12	9	14	10	11	12	9	7	14	13	17
Not pool -count	5	6	4	5	4	4	9	8	4	5	2	6	6	6	5	3	3	3	4	4	7	8	5	2	1	4	4	3	1	4	1	1	2	0	3	2	2	2	1

DISCUSSION

This new approach to monitor drowning incidents using hospital discharge data allows analysis of many, but not all, of the data items previously reported to the DPCA from the system that relied on reports from fire departments. Significant differences include loss of specific water types (e.g., bucket, hot tub), and details such as the city in which the incident occurred, the type of dwelling, and whether the incident occurred at the victim's own home or a neighbor's home. Also, it is not possible to use the HDD dataset to assign an attributed cause of an incident as we have done in the past by reading the fire department personnel's brief narrative description.

Nonetheless, several advantages are noted using the new approach. First, it expands drowning surveillance to a statewide level, rather than only in Maricopa or Pima counties. Second, the ICD-10-CM codes are robust and allow the inclusion of drowning and immersion incidents that are related to water transportation, such as boat crashes or falls off boats and inflatable craft. Previously these incidents were rarely included in our statistics. Third, the HDD is documenting 3 times as many incidents as were being reported by relying upon fire department personnel using the paper collection form. While collecting epidemiologic data about individual incidents is important for designing primary prevention activities, fire department personnel's priority will always be in stabilizing injured patients and transporting them to care. This leaves little time for them to collect information about the risk factors associated with the incident.

While the ADHS personnel resources required to process the HDD data are not trivial, with a relatively modest investment of staff time it is possible to generate a summary report addressing drownings in a more automated and efficient manner.

Now with 3 years of compiled data statewide, the new approach builds the foundation upon which time trends in future years can be seen. We welcome comments from the Coalition and community concerning the new monitoring approach.