

Maricopa County Department of Public Health



2012 Annual Summary Report

Unexplained Death (UNEX) Investigations with History of Fever

Maricopa County

July 7, 2014



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Introduction

Unexplained deaths with a history of fever (UNEX) cases have been reportable in the state of Arizona since 2004. According to the Arizona Administrative Code (A.A.C. R9-6-202), health care providers, including medical examiners, are required to report a suspect UNEX case by notifying Maricopa County Department of Public Health (MCDPH) within 24 hours of detection. The Arizona Administrative Code (A.A.C. R9-6-384) requires MCDPH to notify the Arizona Department Health Services (ADHS) upon initiation of a UNEX case investigation.

The purpose of UNEX case investigations is to identify deaths that might be of public health significance in order to prevent the spread of disease. This could include deaths due to infectious diseases transmitted person-to-person; deaths that require a public health intervention; deaths that could represent a new or emerging infectious disease; or deaths that are due to an act of bioterrorism. These investigations involve close collaboration with outside health agencies including healthcare facilities and the medical examiner (ME). The official cause of death is determined by the Office of Medical Examiner (OME) and is a separate process from the UNEX investigation led by public health agencies.

UNEX reports can be received from health care providers and community members; however, the vast majority of cases come from the OME via a Preliminary Report of Death (PROD). MCDPH receives the PRODs through an electronic communication system and reviews them for evidence of illness or conditions that may warrant investigation.

UNEX Case Definition and Criteria

The A.A.C. defines a UNEX case as the “demise of an individual who has had a fever within 48 hours before death and whose illness has not been diagnosed at time of death”. The ADHS case definition uses the following criteria to identify potential UNEX cases:

- Hospital or facility-based death, or patient reported death with no known cause AND history of fever ($>38.0^{\circ}\text{C}/100.4^{\circ}\text{F}$) OR temperature $<36^{\circ}\text{C}/96.8^{\circ}\text{F}$ within 48 hours of death

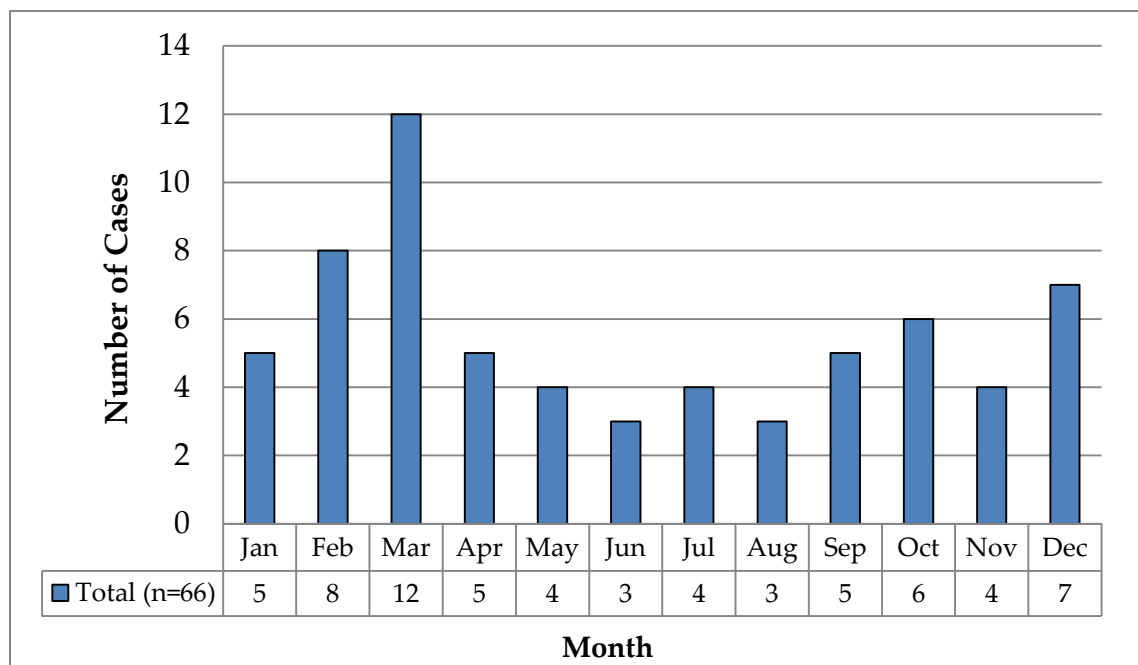
MCDPH recognizes the ADHS UNEX case definition. In addition, if a reported death is suspicious for an infectious disease or other reportable public health threat, but does not meet the ADHS case definition, MCDPH evaluates the case using the following investigative criteria:

- Unknown cause AND history of fever within 48 hours of death
- Unknown cause AND temperature of $< 36^{\circ}\text{C}$ within 48 hours of death
- Unknown cause AND abnormal white blood cell count, including both leukocytosis or leukopenia
- Unknown cause AND signs of inflammation/infection in normally sterile fluid/sites
- Unknown cause AND high clinical suspicion of infectious etiology by health care provider and/or medical examiner
- Other

Summary of 2012 UNEX Case Investigations

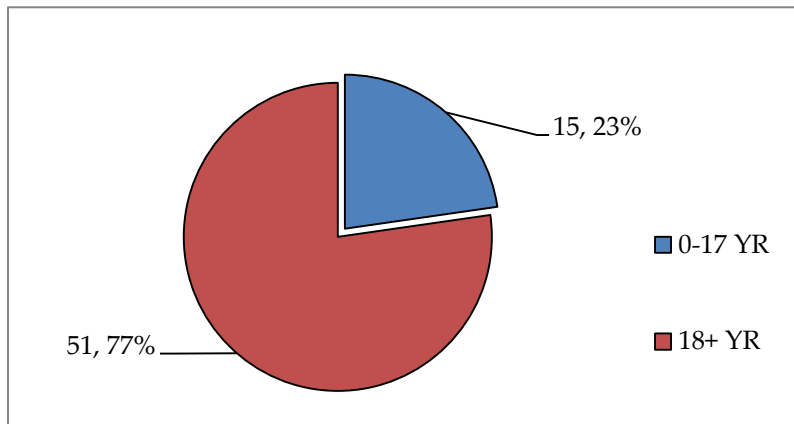
In 2012, Maricopa County investigated a total of sixty-six UNEX cases. [Graph 1](#) shows 2012 UNEX cases reported by month. UNEX reports were highest from January through March and lowest during the summer months.

Graph 1. UNEX Cases (n=66) by Month Reported, Maricopa County, 2012

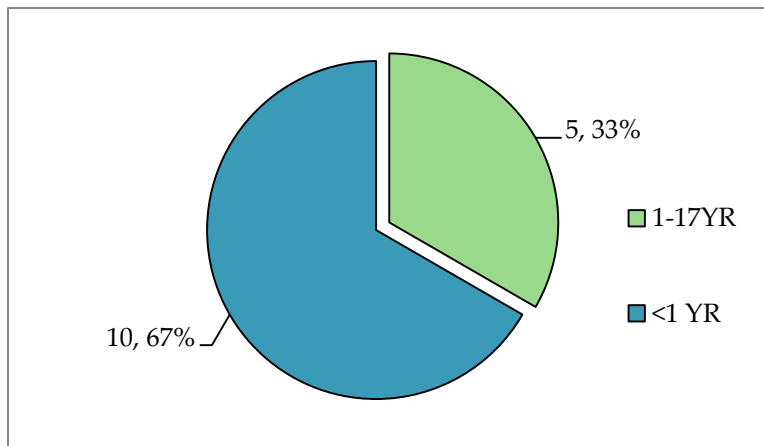


The majority of the UNEX cases (77%) occurred in adults 18 years of age and older ([Graph 2](#)). As shown in [Graph 3](#), there were fifteen (23%) pediatric UNEX cases under the age of 18 years, the majority of which were infants younger than 1 year old (n=10, 67%).

Graph 2. UNEX Cases (n=66) by Age Group, Maricopa County, 2012

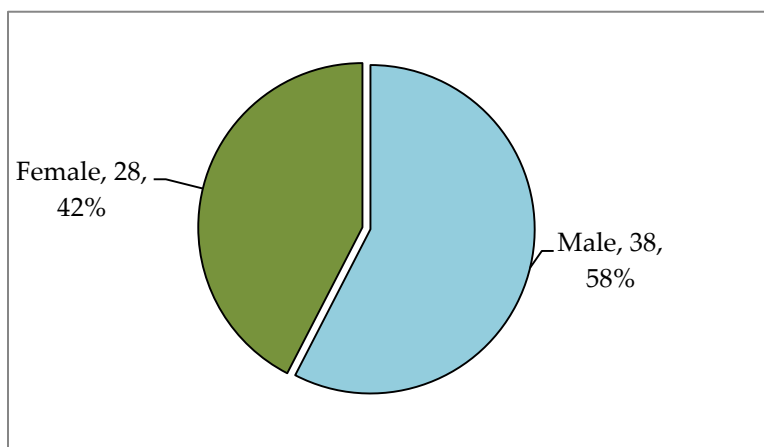


Graph 3. UNEX Pediatric Cases (n=15) by Age Group, Maricopa County, 2012



UNEX cases by gender is shown in [Graph 4](#). Most of the UNEX cases occurred in males (n=38, 58%).

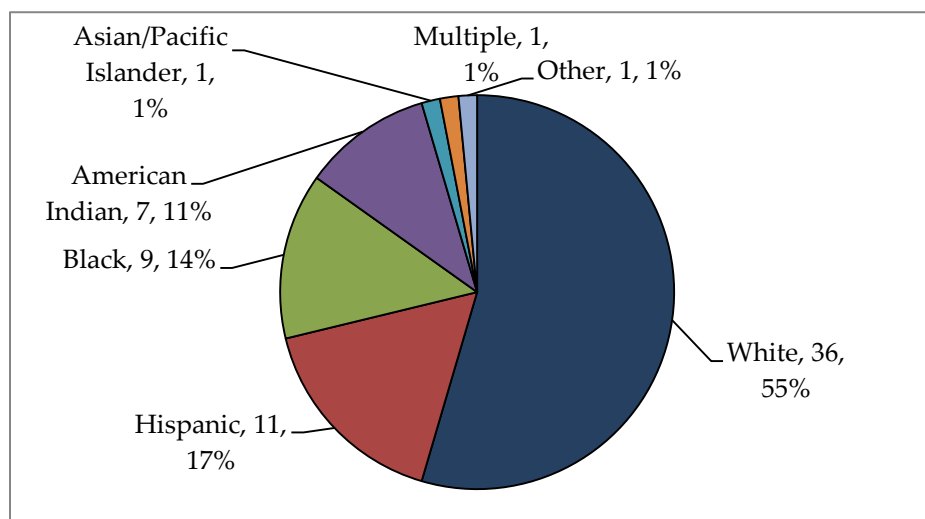
Graph 4. UNEX Cases (n=66) by Gender, Maricopa County, 2012



[Graph 5](#) shows UNEX cases by race. In 2012, the majority of UNEX cases were White (n=36, 55%).

The second highest frequency of cases occurred in Hispanics (n=11, 17%), followed by Blacks (n=9, 14%), and American Indians (n=7, 11%).

Graph 5. UNEX Cases (n=66) by Race, Maricopa County, 2012



Of the twelve cases that met the ADHS case definition, 5 (42%) tested positive for a pathogen, and of the 54 cases that met the Maricopa County investigative criteria, 18 (33%) tested positive ([Table 1](#)).

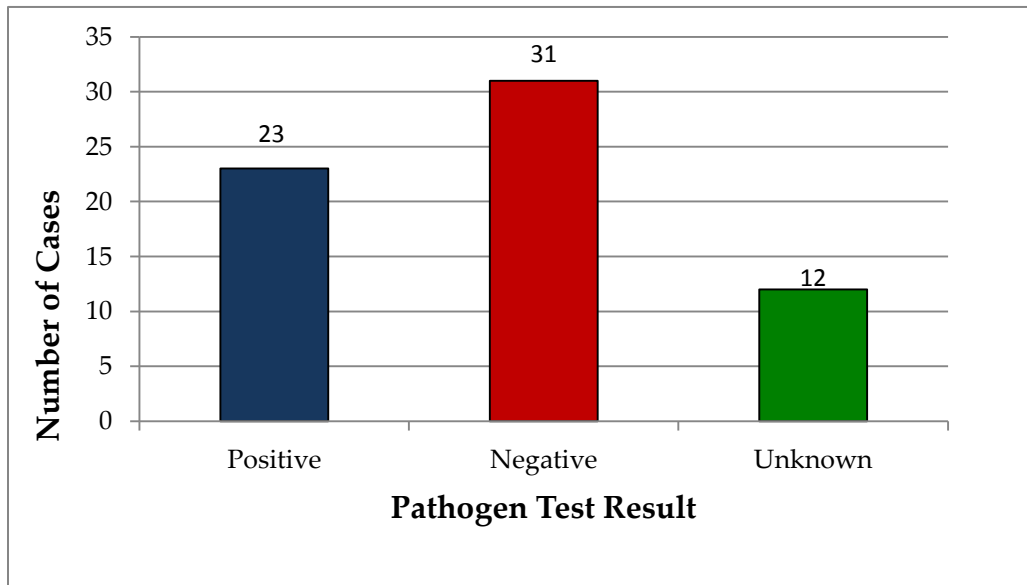
Table 1. UNEX Cases (n=66) by Case Definition and Test Result, Maricopa County, 2012

	Tested positive	Tested negative	Unknown test result	Total cases
Cases that met ADHS Case Definition	5 (42%)	5 (42%)	2 (16%)	12 (100%)
Cases that met Maricopa County investigative criteria	18 (33%)	26 (48%)	10 (19%)	54 (100%)
Total cases	23	31	12	66 (100%)

2012 UNEX Cases by Pathogen Results

Out of sixty-six UNEX cases investigated in 2012, 25 (38%) were positive for a pathogen, 29 (44%) were negative, and 12 (18%) were unknown ([Graph 6](#)).

Graph 6. UNEX Cases (n=66) by Type of Test Result, Maricopa County, 2012



Pathogens identified: Twenty-three UNEX cases tested positive for bacterial or viral pathogens. Some cases had multiple positive test results. Most of the positive cases had bacterial pathogens identified and only 2 cases tested positive for viral infection. The type of pathogens identified and which ones are reportable to MCDPH are shown in [Table 2](#). The reportable pathogens were: Beta-hemolytic Streptococcus Group A, *Rickettsias rickettsia*, *Streptococcus pneumoniae*, and Influenza A(H3).

Table 2. Pathogens by Reporting Type in UNEX Cases, Maricopa County 2012

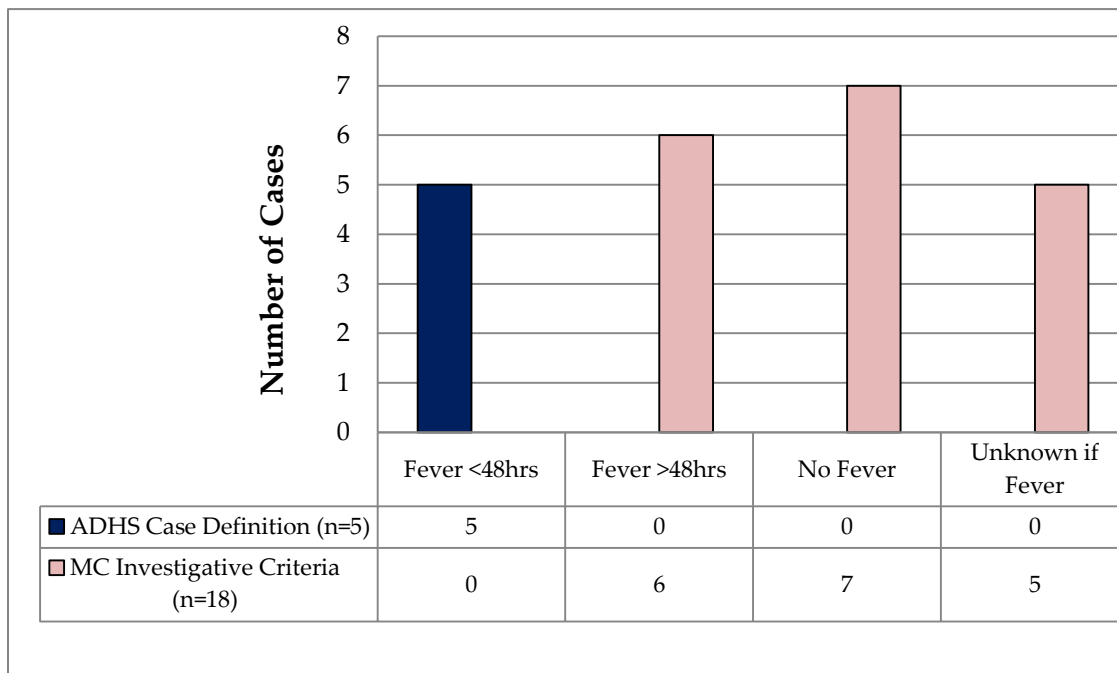
Pathogen	Reportable (Yes/No)*	Number of
<u>Bacteria</u>		
Bacillus (unspecified)	No	1
Corynebacterium (unspecified)	No	1
<i>Enterobacter cloacae</i>	No	1
Enterococcus (unspecified)	No	1
<i>Escherichia coli</i>	No	1
<i>Escherichia hermanii</i>	No	1
<i>Haemophilus influenza</i> (non-invasive)	No	3
<i>Klebsiella (oxytoca, pneumoniae)</i>	No	2
<i>Moraxella catarrhalis</i>	No	1
<i>Rickettsias rickettsii</i>	Yes	1
<u>Staphylococcus</u>		
<i>Staphylococcus aureus</i>	No	4
<u>Streptococcus</u>		
Beta-hemolytic Streptococcus, Group A (invasive disease)	Yes	4
Beta-hemolytic Streptococcus, Group B (invasive disease)	No	1
Beta-hemolytic Streptococcus, Group A (noninvasive)	No	2
Beta-hemolytic Streptococcus, Group B (noninvasive)	No	1
<i>Streptococcus anginosus</i>	No	1
<i>Streptococcus pneumonia</i> (invasive disease)	Yes	2
Streptococcus (unspecified)	No	1
<u>Viral</u>		
Influenza A (H3)	Yes	1
Parechovirus	No	1
<u>Fungal</u>		
<i>Candida tropicalis</i>	No	1
Total Number of Pathogens Found		32

*Additionally, one case was diagnosed with hemolytic-uremic syndrome, which is a reportable condition; however, no pathogen was identified.

2012 UNEX Cases with Positive Test Results

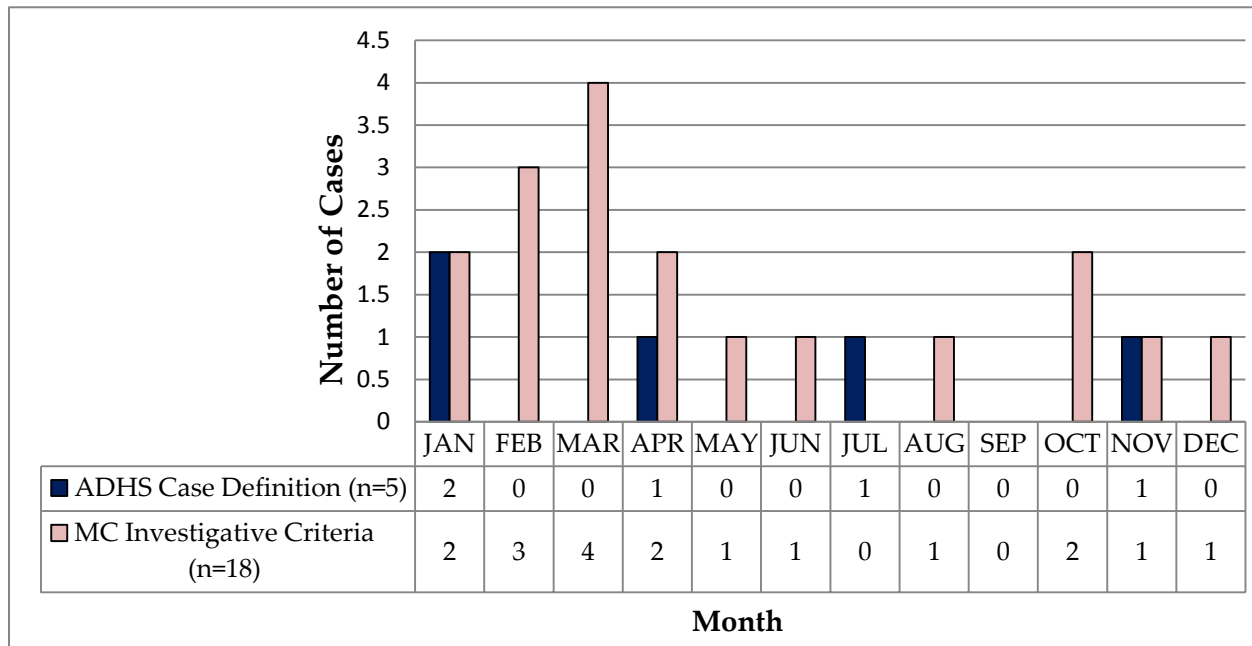
Of the twelve cases that met the ADHS case definition for investigation 5 (42%) had positive test result(s), whereas out of the 54 that met MCDPH investigative criteria, 18 (33%) had positive test result(s) ([Table 1](#)). In total, there were twenty-three positive cases. All five cases that met the ADHS case definition had a documented fever within 48 hours of death. Of the eighteen cases that met the MCDPH investigative criteria, 6(33%) had a fever without documented temperature and 13 either did not have fever or fever was unknown ([Graph 7](#)). Cases with no or unknown fever had other indicators warranting investigation (respiratory symptoms, gastrointestinal symptoms, etc.).

Graph 7. UNEX Cases with Positive Test Results (n=23) by Presence of Fever, Maricopa County, 2012



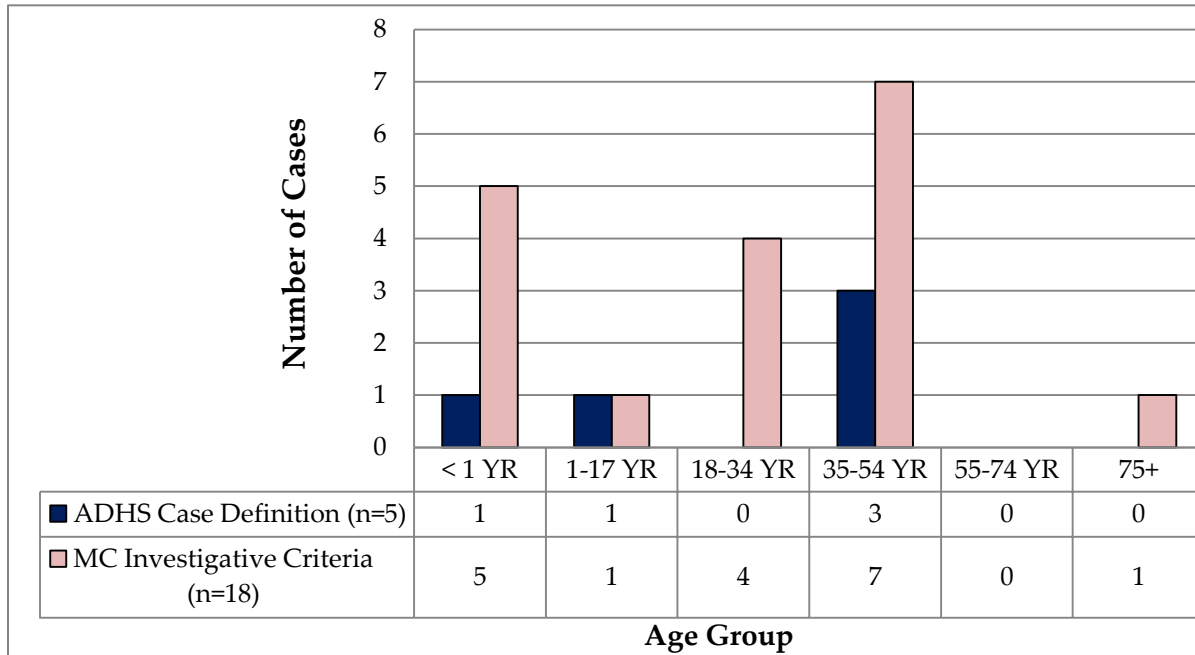
UNEX cases were most frequently reported in the winter and early spring. Over half of all positive UNEX cases occurred between January and March ([Graph 8](#)).

Graph 8. UNEX Cases with Positive Test Results (n=23) by Month, Maricopa County, 2012



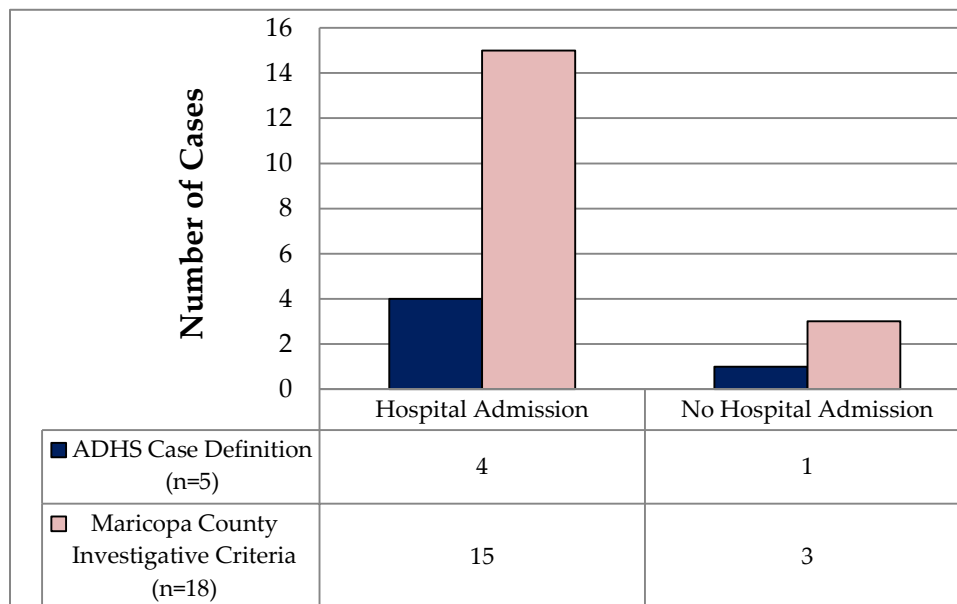
Of the twenty-three cases with positive test results, 8 (35%) were pediatric (<18 years old) and 15 (65%) were 18 and older ([Graph 9](#)). Seventy-five percent of the positive pediatric cases were younger than one year old. The median age of death was 30, with a range of <1 year to 91 years. The majority of adult deaths occurred in the 35-54 year age category (n=10).

Graph 9. UNEX Cases with Positive Test Results (n=23) by Age Group, Maricopa County, 2012



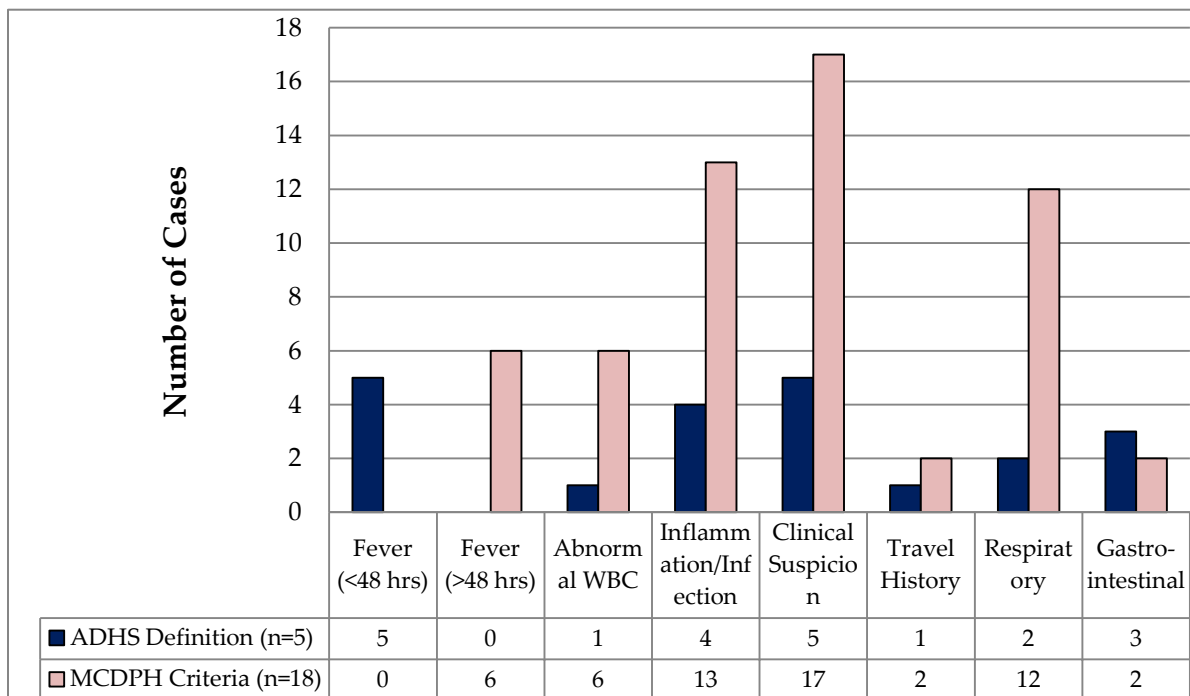
Twenty of the positive cases were hospitalized ([Graph 10](#)).

Graph 10. UNEX Cases with Positive Test Results (n=23) by Hospital Admission, Maricopa County, 2012



Clinical suspicion reported by health providers, inflammation/infection in normally sterile sites, and indication of respiratory or gastrointestinal symptoms in the PROD are the most frequent reasons for investigation ([Graph 11](#)). Most cases had more than one indicator listed as reasons for investigation.

Graph 11. UNEX Cases with Positive Test Results (n=23) by Reason for Investigation, Maricopa County, 2012



As shown in [Table 3](#) , twenty (87%) of the 23 positive cases had infectious disease mentioned in the cause of death.

Table 3. 2012 UNEX Cases with Positive Test Results (n=23) by Mention of the Category of Disease in Cause of Death, Maricopa County, 2012

Cause of Death	Number of Cases
Infectious Disease	9 (39%)
Infectious/Chronic Disease	6 (26%)
Infectious/Sudden Unexplained Infant Death	1 (4.3%)
Infectious/Drug or Alcohol Related	3 (13%)
Infectious/Chronic/Drug or Alcohol Related	1 (4.3%)
Chronic Disease	2 (9%)
Sudden Unexplained Infant Death	1 (4.3%)
Total	23 (100%)

2012 UNEX Cases with Negative Test Results

Of the sixty-six investigated cases, 31 had negative lab results. Out of these cases, 5 fit the ADHS Case Definition and 26 met the Maricopa County investigative criteria ([Table 1](#)).

Reasons for negative test results may include: specimens collected too late after death, specimens not stored at the proper temperature; specimens not collected properly; or true negative results. Of the 31 cases, 10 (32%) had infectious disease mentioned in the cause of the death ([Table 4](#)).

Table 4. 2012 UNEX Cases with Negative Test Results (n=31) by Mention of the Category of Disease in Cause of Death, Maricopa County, 2012

Cause of Death	Number of Cases
Chronic Disease	14 (45.1%)
Possible Infectious Disease	5 (16.1%)
Drug or Alcohol Related	3 (9.7%)
Possible Infectious/Chronic Disease	2 (6.5%)
Sudden Unexplained Infant Death/Possible Infectious Disease	3 (9.7%)
Drug or Alcohol Related/Chronic Disease	2 (6.5%)
Unspecified Natural Causes	1 (3.2%)
Heat Caused	1 (3.2%)
Total	31 (100%)

2012 Investigated Cases with Unknown Test Results

For twelve UNEX cases, specimens were not collected and tested for pathogens and are categorized as having unknown results. Two of the 12 unknown cases met the ADHS Case Definition and 10 met the Maricopa County investigative criteria ([Table 1](#)). None of the 12 cases had infectious disease mentioned on the cause of death, as shown in [Table 5](#).

Table 5. 2012 UNEX Cases with Unknown Test Results (n=12) by Mention of the Category of Disease in Cause of Death, Maricopa County, 2012

Cause of death	Number of cases
Chronic Disease	10 (83.3%)
Chronic Disease/Alcohol Related	1 (8.3%)
Unspecified Natural Causes/Chronic Disease	1 (8.3%)
Total	12(100%)

Conclusions

- Six reportable pathogens were found in 10 of the positive cases. Two cases required public health intervention (Influenza A (H3) and Rocky Mountain Spotted Fever). These findings allowed MCDPH to do follow-up investigations and take appropriate control measures.
- Categorical tests (Fischer's exact, Chi-square) were performed to detect risk factors for cases with positive lab results. However, all of the statistical findings were not significant, likely due to small sample sizes, so they were not discussed in the body of the report.
- Overall, most UNEX cases were reported from winter to early spring (December- March).
- The majority of all 2012 UNEX cases were adults aged 18 years or older. However, juveniles (0-17 years of age) accounted for 35% of all UNEX cases that tested positive for pathogens.

Recommendations

- Continue to develop criteria for identifying cases warranting investigation.
- Special attention should be given to cases reported during times of high influenza activity and cases with a travel history.
- In the future, consider employing categorical testing and multi-year analyses for larger sample sizes.

Glossary of Terms:

COD: Cause of Death

PROD: Preliminary Report of Death

OME: Office of Medical Examiner