Photos on cover page (by row):

*Influenza* - [http://virologyhistory.wustl.edu/influenza.htm](http://virologyhistory.wustl.edu/influenza.htm)

*Shigella* - [https://www.cdc.gov/shigella/](https://www.cdc.gov/shigella/)

*Norovirus* - [https://blogs.cdc.gov/publichealthmatters/2015/03/making-a-norovirus-vaccine-a-reality/](https://blogs.cdc.gov/publichealthmatters/2015/03/making-a-norovirus-vaccine-a-reality/)

*Cyclospora* - [https://www.brown.edu/Research/Primate/lpn39-2.html](https://www.brown.edu/Research/Primate/lpn39-2.html)

*Mycobacterium tuberculosis* - [http://www.microbiologybook.org/fox/mycobacteria.htm](http://www.microbiologybook.org/fox/mycobacteria.htm)
Williamson County Public Health Centers and Hospitals
Introduction

Williamson County and Cities Health District (WCCHD) is a nationally accredited health district in central Texas that has provided public health services to Williamson County, Texas citizens since 1943. The WCCHD Disease Control and Prevention Division’s (DCP) Communicable Disease Management Team (CDMT) focuses on protecting the health and safety of the public through the control and prevention of disease. Furthermore, the CDMT conducts surveillance and public health investigations of Texas Notifiable Conditions, provides disease control and reporting guidance to healthcare providers and facilities, and works collaboratively with internal and external stakeholders to collect, analyze, and distribute health and communicable disease data for the purpose of public education and evidence-based decision-making pertaining to the prevention and control of diseases in Williamson County.

To honor the WCCHD mission to “protect and promote the health of the people of Williamson County,” the CDMT compiled this epidemiologic report, with the intent to inform community stakeholders and citizens about communicable diseases, trends in disease surveillance, and WCCHD’s collaboration with other agencies in Williamson County. In addition, the CDMT acknowledges our obligation to provide pertinent disease surveillance information to the community and stakeholders to foster public health as a community responsibility.

This report highlights CDMT's epidemiological surveillance events in Williamson County during 2015. As outlined in each article, these efforts were not without collaboration, communication, and organization with other agencies. Furthermore, these events played a pivotal role in what CDMT hopes will build a solid foundation of communication, trust, accessibility, and expertise provided by WCCHD for all Williamson County citizens and stakeholders.

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WCCHD Vision and Mission

Our Vision

Healthy people thriving in healthy communities in Williamson County.

Our Mission

The Williamson County and Cities Health District, in partnership with communities, protects and promotes the health of the people of Williamson County.
Table of Contents

Active Tuberculosis (TB) in a Drug Treatment Facility in Williamson County, Texas: Contact Investigation Challenges and Successes ......................................................... 1

Active Monitoring of Travelers from West Africa in Williamson County, Texas during the 2014 Ebola Outbreak ................................................................................... 16

Cyclosporiasis: An Emerging Pathogen of Concern for Williamson County, Texas .................................................................................................................. 20

Summary of Submersion Events (Drownings & Near-Drownings) in Williamson County, Texas, 2010 – 2015 ................................................................. 25

Analysis of Foodborne Illness Complaint Data to Identify Trends in Food Safety in Williamson County, Texas, 2013 - 2014 ................................................................. 32

A Description of a Shigellosis Outbreak Investigation in an Elementary School in Williamson County, Texas, 2014 ................................................................. 44

Summary of Recent Influenza (Flu) Seasons in Williamson County, Texas, 2012 - 2015 ............................................................................................... 54

Summary of Notifiable Conditions Reported to the Williamson County and Cities Health District (WCCHD), 2010 – 2015 ................................................................. 64
Active Tuberculosis (TB) in a Drug Treatment Facility in Williamson County, Texas: Contact Investigation Challenges and Successes

Elise Huebner, MS, CPH, CIC; Ryan Moeller; Stella Mulholland, BSN, RN; and Margaret Richardson, BSN, RN
Williamson County and Cities Health District, Georgetown, Texas

Introduction
The Williamson County and Cities Health District (WCCHD) provides routine tuberculosis (TB) testing for organizations and agencies within Williamson County, for which a Memorandum of Understanding (MOU) exists. The purpose of this WCCHD service is to provide the requesting organization with baseline or current TB status for employees, staff, and residents, and to prevent the spread of TB. Upon identification of an active TB case (TB disease), WCCHD initiates an investigation to identify people exposed to the active TB case, who is contagious until he receives treatment. People exposed to an active case of TB at risk for contracting the disease are referred to as contacts to the case. During the investigation, WCCHD offers contacts with appropriate screening to determine if they contracted TB from an active case. If someone contracted TB but is not contagious himself, the infection is called a latent TB infection (LTBI). For both TB disease and LTBI, WCCHD provides medical referral services and recommendations, appropriate antibiotic treatment, and health education to reduce the spread of TB in Williamson County. In addition, WCCHD implements the Centers for Disease Control and Prevention (CDC) TB disease control measures in settings where a person worked or resided during their illness. The implementation of these control measures can be challenging as TB is spread through air droplets, especially in congregate settings such as dormitories, hospitals, jails, and prisons. The intent of this article is to describe the successes and challenges associated with a WCCHD-led active TB contact investigation in a congregate setting, a drug treatment facility, in Williamson County, Texas.

Background
In January 2015, during a drug treatment facility’s routine TB testing, WCCHD Clinical Services Nursing staff noted several drug treatment facility staff now tested positive for TB infection who had previously tested negative. In response, WCCHD initiated a public health investigation to learn how staff contracted the infection. At this drug treatment facility, all residents were routinely tested for TB prior to admission using the Mantoux tuberculin skin test (TST), which is also commonly referred to as a purified protein derivative (PPD) skin test. All staff are tested upon hire and annually thereafter by WCCHD Clinical Services Nursing staff using a U.S. Food and Drug Administration-approved blood screening test, the T-SPOT® TB test (T-Spot)\(^1\) or a TST. For both groups, positive TB test results prompt a

chest x-ray (CXR), commonly performed by Austin Radiological Association, to rule out active TB disease. If the CXR is normal, the contact likely has LTBI. If the CXR is abnormal, further tests are performed, including lab specimens, to determine if someone has TB disease. WCCHD obtained records of baseline information of TB tests and, if available, CXR results on all staff and residents, whether from annual testing by the facility or Texas Department of Criminal Justice system, respectively.

The residents housed at this facility are considered at especially high risk for TB infection. This risk status is based on factors such as previous incarceration at other correctional facilities and social behaviors including substance abuse and intravenous drug use. Substance abuse can inhibit the immune system from functioning properly and, notably, intravenous drug users can contract blood borne infections such as hepatitis and AIDS through contaminated needles. These infections further damage the body's ability to fend off additional infections. Furthermore, adding to their high-risk status, residents were participating in a structured drug treatment program with an average length of stay at approximately six to nine months before graduation. While this timeline is helpful for rehabilitation success, medications for TB infections require a minimum of three months for completion. A sense of urgency developed among WCCHD and the drug treatment facility staff to identify and treat infected residents because a resident's graduation timeline could not be altered to accommodate TB medication completion.

The Contact Investigation

Identification of the Active TB Patient

The first goal of WCCHD and the drug treatment facility was to identify the source of infection, whether the active case was a staff member, current resident, or discharged resident. Typically, a TB contact investigation begins with a known active TB case (the index case), and public health and medical investigators attempt to quickly identify and screen contacts of that index case to ensure appropriate disease prevention and control measures are implemented. This contact investigation was atypical because the initial contacts were identified (through annual staff testing in January 2015) before the active case was identified (confirmed February 2, 2015). The active case was a current resident of the drug treatment facility. **Figure 1** visualizes the differences between the typical and atypical nature of contact investigations.
Incident Management

Incident management is a crucial component for a successful public health and emergency response to prioritize needs, delegate tasks, create a clear command lineage, and, in the process, alleviate stress from staff. WCCHD initiated an Incident Command System (ICS), a standardized on-scene incident management concept, on January 30, 2015, to assist WCCHD DCP in delineating duties, creating objectives for response teams, and following up on discussed deadlines. One of the first tasks for incident management was for WCCHD to answer initial assessment questions.

Initial Incident Assessment:
- Who is in charge?
- How long will this TB investigation last?
- Are there multiple jurisdictions involved?
- Are there multiple agencies involved?
- Could this incident have political sensitivities?
- Could this incident have media interest?
- Is the incident under control?
- Could this incident develop negative public perception?

Based on these answers, WCCHD created an Incident Action Plan which identified all participating agencies; established a routine meeting/conference call schedule, established SMART (Specific, Measurable, Achievable, Relevant, Time-based) objectives for each participating agency, established a Situation Report (SITREP) schedule, and established clear lines of communication and planning. To coordinate the participating agencies, which consisted of multiple departments within WCCHD and Williamson County, WCCHD created an organizational chart to establish respective roles and specific focuses (Figure 2). The organizational chart further visualizes leadership and all members held accountable for specific, relevant focus areas.
**Treatment of Latent TB Infection (LTBI) Patients**

While WCCHD Clinical Services Nursing staff had tested the drug treatment facility staff previously during routine exams, most of the new TB infections detected in the investigation were in residents, whom staff had never interacted with prior to the investigation. To foster a strong relationship and increase TB medication compliance, WCCHD Clinical Services Nursing staff developed a rapport with the drug treatment facility staff and residents, enabling them to successfully provide directly observed therapy (DOT), examinations, and expertise. While facility staff were tested and treated at WCCHD sites, and often at the same location as previous routine exams, residents could not leave the facility due to their incarceration status in the facility. Because of this limited mobility, two primary nurses initiated and managed latent TB infection (LTBI) therapy onsite, served as
on-call subject matter experts for residents and staff, performed monthly toxicity assessments, and coordinated post-discharge continuation of LTBI therapy, as residents could be discharged from the facility after program completion regardless of LTBI therapy completion. LTBI therapy continuation involved coordinating with agencies in other jurisdictions, delivering medication, constant communication with newly discharged residents, and many other feats to ensure medication completion. In addition, WCCHD’s medical director provided onsite physical examinations to the residents, a population with multiple risk factors. The examinations were required as many residents stated in initial interviews with WCCHD staff that they had not seen a physician in at least one year.

Contact Investigation

The contact investigation was a critical component of this incident to identify those infected with TB and offer treatment to reduce the risk of developing TB in the future. Because approximately one-third of residents had contracted LTBI based on preliminary TB tests, WCCHD cast a wide net to identify more potential contacts (Table 1). While the drug treatment facility was the original setting, after delving into histories of the residents, visitors to the facility, and public health involvement, the number of potential contacts rose significantly.

Table 1. WCCHD TB Contact Investigation at a Drug Treatment Facility – Initial Categories and Counts of Potential Contacts

<table>
<thead>
<tr>
<th>Categories of Contacts Initially Identified</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract Workers</td>
<td>25</td>
</tr>
<tr>
<td>Drug Treatment Facility Discharged Residents</td>
<td>129</td>
</tr>
<tr>
<td>Drug Treatment Facility Residents</td>
<td>107</td>
</tr>
<tr>
<td>Drug Treatment Facility Staff</td>
<td>40</td>
</tr>
<tr>
<td>Drug Treatment Facility Visitors</td>
<td>132</td>
</tr>
<tr>
<td>Drug Treatment Facility Volunteers</td>
<td>157</td>
</tr>
<tr>
<td>Jail Contact - Inmates</td>
<td>171</td>
</tr>
<tr>
<td>Jail Contact - Officers</td>
<td>24</td>
</tr>
<tr>
<td>Public Health Staff</td>
<td>11</td>
</tr>
<tr>
<td>Social Contacts to the Active Case</td>
<td>3</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>799</strong></td>
</tr>
</tbody>
</table>

*Data Source: Disease Control and Prevention Program, WCCHD*
After the initial assessment yielded almost 800 possible contacts, WCCHD prioritized contacts by testing those that spent at least six hours with the active TB case (Table 2).

Table 2. WCCHD TB Contact Investigation at a Drug Treatment Facility – Final Categories and Counts of Contacts

<table>
<thead>
<tr>
<th>Categories of Contacts Prioritized for Testing</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract Workers</td>
<td>14</td>
</tr>
<tr>
<td>Drug Treatment Facility Discharged Residents</td>
<td>63</td>
</tr>
<tr>
<td>Drug Treatment Facility Residents</td>
<td>80</td>
</tr>
<tr>
<td>Drug Treatment Facility Staff</td>
<td>40</td>
</tr>
<tr>
<td>Drug Treatment Facility Visitors</td>
<td>0</td>
</tr>
<tr>
<td>Drug Treatment Facility Volunteers</td>
<td>29</td>
</tr>
<tr>
<td>Jail Contact - Inmates</td>
<td>171</td>
</tr>
<tr>
<td>Jail Contact - Officers</td>
<td>24</td>
</tr>
<tr>
<td>Public Health Staff</td>
<td>11</td>
</tr>
<tr>
<td>Social Contacts to the Active Case</td>
<td>3</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>435</strong></td>
</tr>
</tbody>
</table>

Data Source: Disease Control and Prevention Program, WCCHD

Several epidemiological tools helped WCCHD locate and test many contacts that were outside of Williamson County, such as the Texas Department of Criminal Justice Offender Information Search and the Texas Department of State Health Services Tuberculosis Referral Form. WCCHD also developed and administered an Epidemiological Questionnaire, which focused on demographics, symptoms, lifestyle choices, and room assignments for the drug treatment facility staff, volunteers, and residents (discharged and current) and previous or current roommates for any type of resident.
### Table 3. WCCHD TB Contact Investigation at a Drug Treatment Facility – Final Contact Case Status in the Investigation

<table>
<thead>
<tr>
<th>Categories of Contacts</th>
<th>Confirmed</th>
<th>LTBI*</th>
<th>Previous Treatment</th>
<th>Not a Case</th>
<th>Lost to Follow Up</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract Workers</td>
<td></td>
<td></td>
<td></td>
<td>8 (57%)</td>
<td>6 (43%)</td>
<td>14 (100%)</td>
</tr>
<tr>
<td>Drug Treatment Facility Discharged Residents</td>
<td>9 (25%)</td>
<td>11 (31%)</td>
<td>16 (44%)</td>
<td>36 (100%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug Treatment Facility Residents</td>
<td>1 (1%)</td>
<td>36 (34%)</td>
<td>1 (1%)</td>
<td>60 (56%)</td>
<td>9 (8%)</td>
<td>107 (100%)</td>
</tr>
<tr>
<td>Drug Treatment Facility Staff</td>
<td>7 (18%)</td>
<td>1 (3%)</td>
<td>32 (80%)</td>
<td>40 (100%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug Treatment Facility Visitors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Drug Treatment Facility Volunteers</td>
<td>1 (3%)</td>
<td>1 (3%)</td>
<td>21 (72%)</td>
<td>6 (21%)</td>
<td>29 (100%)</td>
<td></td>
</tr>
<tr>
<td>Jail Contact - Inmates</td>
<td>5 (3%)</td>
<td>44 (26%)</td>
<td>122 (71%)</td>
<td>171 (100%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jail Contact - Officers</td>
<td>23 (96%)</td>
<td>1 (4%)</td>
<td>24 (100%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Health Staff</td>
<td>1 (9%)</td>
<td>10 (91%)</td>
<td></td>
<td>11 (100%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Contacts to the Active Case</td>
<td>3 (100%)</td>
<td>3 (100%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>1 (0%)</strong></td>
<td><strong>53 (12%)</strong></td>
<td><strong>9 (2%)</strong></td>
<td><strong>212 (49%)</strong></td>
<td><strong>160 (37%)</strong></td>
<td><strong>435 (100%)</strong></td>
</tr>
</tbody>
</table>

*LTBI: Latent Tuberculosis Infection

Data Source: Disease Control and Prevention Program, WCCHD

Conclusions: Strengths, Challenges and Limitations, and Recommendations and Lessons Learned

**Strengths**

During the “Identification of active TB patient” phase, WCCHD experienced full cooperation from the facility. Administrators adjusted schedules, provided documentation, and participated in routine discussions, as each site visit and testing day involved detailed planning discussions. Partnerships with Austin-Travis County Health and Human Services Department (ATCHHSD, now Austin Public Health), Texas Department of State Health Services (DSHS) Region 7, and DSHS Central Office provided additional nurses,
epidemiologists, and phlebotomists to complete initial testing of the residents within five days.

Throughout the “Incident Management” phase, ICS was effective and appropriate in managing a large-scale contact investigation to disseminate specific objectives to individual teams. Planning and partnerships with other local emergency organizations proved valuable for timely communication and cooperation, from transportation needs to hospital care. Also, WCCHD Social Services assisted the active TB patient with personal needs as he had to continue with in-home isolation until sputum tests were negative for active TB and he was no longer infectious.

In the “Contact investigation” phase, Texas Department of Justice, Williamson County Jail, DSHS Region 7, ATCHHSD, and other local health departments were essential in tracking down and testing contacts that were no longer within Williamson County. The drug treatment facility provided contact information on former residents and volunteers to aid in this process of locating and testing.

During the “Treatment of latent TB patients” phase, WCCHD Clinical Services Division nurses provided DOT training to the facility staff so that they would be able to administer the LTBI medication to the residents. For staff with LTBI, their DOT completion rate at local WCCHD sites was 100 percent. For residents, the completion rate of WCCHD-initiated LTBI Treatment was 97 percent (the national average is 46%\(^2\)).

**Challenges and Limitations**

During the “Identification of active TB patient” phase, nurses experienced several difficult blood draws on the residents (former substance abusers) due to damaged veins and various intense emotions. These experiences required counseling by facility staff post-blood draw. In general, WCCHD recognized that they did not have sufficient staffing surge capacity, specifically for phlebotomy.

During the “Incident Management” phase, an informal request for information from an outside agency was submitted to a WCCHD staff member. This brought up questions about following the proper channels of communication that had been established by the ICS structure. Additionally, a post on social media created a confidentiality concern for all staff and residents of the drug treatment facility, risking their privacy by releasing health information and details about the investigation that could jeopardize the anonymity of all involved.

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Throughout the “Contact investigation” phase, WCCHD had trouble creating, maintaining, and disseminating an electronic repository of ongoing patient information, including testing results, case status, and next steps. This challenge created delays in identifying missing information, providing accurate and timely updates, and maintaining a secure and protected database. In addition, some discharged residents were difficult to locate and test, due to incorrect addresses and wrong phone numbers given. Also, because the discharged residents had the ability to move after leaving the facility, WCCHD distributed referrals to many other counties and jurisdictions for testing requests, resulting in referral paperwork retrieval taking several months, a considerable time during a sensitive, large contact investigation.

During the “Treatment of latent TB patients” phase, some residents had contraindications to 12-week therapy and needed either 4-month or 9-month therapy, extending the need for the nurses to continue visiting the facility monthly. Moreover, prior to therapy completion, some residents were discharged and left the county. This made making transitional care difficult, by requiring WCCHD staff to travel outside of their jurisdiction to maintain care, or by transferring their care to another county.

Recommendations and Lessons Learned
For WCCHD, recommendations for future large-scale contact investigations include more efficient use of ICS, and improvement to communications and documentation. For future investigations, initiating ICS sooner would avoid testing delays and miscommunication with other organizations and improve coordinated efforts. To improve communication, the WCCHD and Williamson County public information officers need involvement sooner to prepare for potential inquiries and WCCHD should update the drug treatment facility more frequently during initial ICS and potential next steps. Lastly, WCCHD must develop an improved method of electronic documentation of contacts, allowing for quick location of information, ability to locate missing data easily, and track encounter dates. An improvement could be the development of a more robust spreadsheet with cleaner design, or a more sophisticated Access database or electronic medical record.

For DSHS Region 7, WCCHD and DSHS Region 7 disagreed about which organization was serving as the primary organization for decision making, priorities, planning, communication, and beginning the contact investigation. Initial agreement of WCCHD’s ICS structure, which places WCCHD as the lead organization and DSHS Region 7 as a consultant, would have eliminated some confusion, frustration, and misunderstandings among several organizations. Also, while DSHS Region 7 staff provided STD testing for residents, DSHS did not return testing results (negative or positive), which was disconcerting and confusing for some residents. Lastly, the primary contact investigator at the DSHS Region 7 left for another position, resulting in a rough transition for the incoming contact investigator who was not well informed of the investigation.
The Drug Treatment Facility proactively developed and approved new policies after WCCHD expressed concern at the lack of some potentially helpful information on residents and volunteers. The new policies included logging all room and roommate assignments for each resident, requiring residents to undergo TB testing immediately prior to admission, and maintaining up-to-date volunteer information and annual TB tests.

Overall, the entire incident took place from January 16, 2015, to February 12, 2016 – 392 days total (Figure 3). Each stage of the investigation, from identifying the active case to administering the last dose of LTBI therapy, represents a significant time period. Major events are noted along the timeline.

**Significant Findings**

WCCHD analysis included combining the contacts' demographics, testing results, and Epidemiological Questionnaire for an overall view of trending demographics, significant risk factors, and potential pathways for how TB spread throughout the facility in relation to room assignments and roommates.
One area of concern was transmission of TB inside the facility and what factors may have impacted the spread of infection. During the development of the Epidemiological Questionnaire, WCCHD learned that every resident must complete various job assignments (kitchen duty, cleaning, etc.), co-ed counseling with multiple groups and staff members, and that most meetings require attendance in order to qualify for discharge from the drug treatment facility. These findings negated studying the differences in rooms frequented between genders, ages, infected individuals, and other data because every resident was required to perform duties or counseling in similar common areas of the facility.

For example, to visually study how the active case could have spread TB throughout the facility, WCCHD compared the drug treatment facility diagram with common areas, the active case’s bedroom, and known current bedroom numbers of LTBI residents.

**Figure 4. WCCHD TB Contact Investigation at a Drug Treatment Facility – Facility Diagram with Common areas and Bedrooms of those infected with TB identified**

![Diagram of drug treatment facility with common areas and bedrooms of those infected with TB](image)

_data source: Disease Control and Prevention Program, WCCHD_

While the impact of having a known, male, active case seemed apparent by the spread across the male hallway, the main issue with using this diagram for reference was that many of the females’ room numbers were not collected (46% completion compared to 100% completion by males), as this variable was not deemed necessary until later. The female hallway may have been equally impacted, if not more, but without all the necessary data, using this diagram alone to suggest significance of “hot spots” in the facility was not recommended by WCCHD. In addition, the spread of TB in the male hallway and the
proliferation of common areas throughout the facility greatly reduces the value of using the HVAC system’s intake and flow as a contributing variable.

Moreover, WCCHD identified over 80 variables through the Epidemiologist Questionnaire and TB evaluation and tested them against those who contracted TB (LTBI or active disease) and those who did not contract TB. Odds ratio (OR) measures the association between an exposure and an outcome, which in this investigation, the exposure is a variable or characteristic among contacts and the outcome was TB infection. If an OR is greater than 1, the exposure is associated with higher likelihood of the subject having the outcome. Among the 36 variables that had an OR value greater than 1, 21 variables’ OR values were less than 2, six variables’ OR were between 2-3, and five variables’ OR were between 3-4. The variables with the highest OR values are shown in Figure 5.

![Figure 5. WCCHD TB Contact Investigation at a Drug Treatment Facility: Odds Ratio Comparison of Characteristics among those Infected with TB Compared to Those Not Infected with TB](image)

*Characteristics of the confirmed TB case

The characteristics of those infected with TB included risk factors, such as high daily cigarette use (OR=10.86, 95% CI [2.8, 41.6]) and as a resident of the drug treatment facility (OR=5.71, 95% CI [3.0, 10.9]). However, the characteristics were relevant to each other, as many of them occur congruently. For instance, research has shown that tobacco use makes one more susceptible to bacterial infections, including TB\(^3\); therefore, a high daily cigarette use corresponds with TB infection, as well as productive cough, as the body produces

excessive mucous in response to smoking⁴. In addition, the high odds ratios for current or previous incarceration as an exposure (whether in the drug treatment facility or elsewhere) is unsurprising, as correctional facilities act as congregate settings, in which large numbers of people closely work or live together, creating the perfect environment for microbes to transmit easily among individuals (potentially another factor in the high odds ratio for productive cough). The longer one resides or works in a congregate setting, the higher likelihood for one to develop an infection such as TB, which requires close contact for an extended period. For instance, in 2012 in the United States, four percent of diagnosed TB cases were among currently incarcerated persons⁵. Because TB is a slow-growing bacterial infection, those previously incarcerated were still at risk to developing TB later.

Possible other “index” case

Like all communicable diseases, the first case identified in an investigation at a given location is not necessarily the true “index” case, as that case may have contracted the disease from someone else at the location, and so forth. In this investigation, some data suggest that the residents of the drug treatment facility may have contracted the disease from another unidentified, undiagnosed resident, perhaps in addition to or before the known active case of this investigation.

Figure 6 depicts the length of stay in days by gender for every resident who contracted TB (either LTBI or active disease). The infected male residents generally had shorter lengths of stay than infected female residents (average stay of male = 168 days, average stay of female

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The known active case’s length of stay was 111 days. All infected females except one experienced lengths of stay longer than 111 days, up to 300 days (over 2.5 times the known active case’s length of stay). Again, length of stay can affect how long one was potentially exposed to another resident with TB through an extended period of close contact in a congregate setting, such as this drug treatment facility. Nevertheless, one of the ongoing challenges to this contact investigation was contacting and testing previously discharged residents of the drug treatment facility. Some former residents moved out of county, provided incorrect or incomplete address or phone numbers, or simply did not cooperate with the investigation. Overall, 7 (13%) discharged females and 9 (12%) discharged males were deemed lost to follow-up (LTFU). The evidence (Figure 6) suggests that perhaps the “index” case of the drug treatment facility was a female that had already been discharged prior to WCCHD’s investigation but could have been a resident concurrently to the known active case’s residency. This evidence stems from infected females (excluding one) having longer lengths of stay than males in the gender-segregated drug treatment facility. WCCHD cannot definitively demonstrate if the known active case contracted TB from the potential female “index” case by overlapping residencies or other prior location. Additionally, all active TB cases’ sputum specimens are sent to state or national labs for further testing. The laboratory analyzes the isolate for specific genetic components that make it unique. This analysis allows scientists to distinguish specific strains of TB; therefore, if two or more isolate match, those active cases likely were in the same chain of transmission, leading to the same M. tuberculosis infection. Unfortunately for this investigation, the known active case’s genotype did not match any genotypes discovered in the Central Texas area recently, only Houston, Texas, several years prior. The active case denied any known association with the Houston area. Without a known overlap between this investigation’s active case and the Houston area, the determination in how and where he was exposed remained unsubstantiated. Future specimen testing from newly diagnosed active TB cases may offer more information and provide a welcome conclusion to this investigation.

Conclusions

This atypical TB contact investigation, spanning over 13 months and 435 identified contacts, tested WCCHD’s surge capacity, expanded the ICS structure, and required multiple divisions’ participation for success. Throughout the investigation, challenges occurred, such as efficient electronic documentation, miscommunication or lack of, locating contacts for testing, and completing LTBI therapy with discharged residents. Despite these challenges, WCCHD prevailed in completing TB evaluations on almost two-thirds (63 percent) of the contacts and 97 percent completion rate of WCCHD-initiated LTBI

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treatment, reducing the likelihood of those with TB infection from developing TB disease later. WCCHD's largest-ever TB contact investigation encouraged staff to work effectively together and with other organizations, communicate frequently, and develop policies and processes to ensure the efficient and successful completion of the next contact TB investigation.

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Williamson County Adult Probation Department
Williamson County Emergency Communications
Williamson County Emergency Medical Services (EMS)
Williamson County Office of Emergency Management
Williamson County Sheriff’s Office
Active Monitoring of Travelers from West Africa in Williamson County, Texas during the 2014 Ebola Outbreak

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Williamson County and Cities Health District, Georgetown, Texas

Introduction
Ebola virus is a non-segmented, negative-stranded RNA filovirus which was first isolated in 1976. The virus has five known strains, each named after the regional location in which it was first discovered: Zaire, Sudan, Ivory Coast, Reston, and Bundibugyo. All but Reston are known to affect humans, and their primary pathophysiology culminates in hemorrhagic fever, often presenting with accompanying symptoms of fever, malaise, myalgia, headache, maculopapular rash, conjunctivitis, and pharyngitis. The virus is spread through direct contact with tissue or bodily fluids of an infected individual, and the incubation period ranges from 2 to 21 days. Case fatality rates vary widely by outbreak, but have historically ranged from 25% to 90%. Although the virus cannot be spread by air or water, it is extremely infectious, requiring just one virion to result in active infection.

Until recently, the word “Ebola” was unlikely to concern many Americans. Although the focal point of several best-selling books in the 90s, the virus generally only appeared in rural villages of African nations, where it would cause a quick flare-up of devastating illness, only to disappear in a matter of weeks. Outbreaks were small, self-contained, and infrequent. That all changed in March 2014, when cases of the Zaire strain of the disease began to emerge in Guinea’s capital and largest city, Conakry. Guinea, with a population of nearly 12 million people, is situated on the west coast of Africa and is bordered by seven countries. Geographically, it is well-placed to be the hub for a major global outbreak.

As months went by, transmission of Ebola virus was amplified by cultural practices (chiefly dietary and funerary behaviors) and social disorder. Despite warnings from Medicin san frontiers (known in the United States as Doctors Without Borders) and the World Health Organization (WHO), international assistance was slow to scale-up, and the outbreak soon spiraled out of control, spreading to Liberia, Sierra Leone, Nigeria, Senegal, and Mali. As international healthcare workers returned from assisting in West Africa, some began exhibiting symptoms, creating the first cases in non-African countries, namely Spain, Italy, and the United Kingdom.

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Ebola in the United States
In September 2014, Ebola virus appeared in the United States. A Liberian traveler named Thomas Eric Duncan was visiting family in Dallas, when he began exhibiting abdominal pain, dizziness, headaches, and nausea. He was admitted to the emergency department of Texas Health Presbyterian Hospital on September 25, 2014. The attending doctor gave a presumptive diagnosis of sinusitis (travel history was not a regular screening question at the time), and sent Mr. Duncan home. His health continued to decline and he returned to the hospital on September 28, where he began exhibiting the telltale signs of hemorrhagic fever: severe diarrhea and vomiting, intense fatigue. This time, the doctor noted Mr. Duncan’s travel history, initiated control procedures for suspected Ebola, and contacted the Centers for Disease Control and Prevention (CDC). The diagnosis of Ebola hemorrhagic fever was confirmed by the CDC lab on September 30. On October 8, 2014, Mr. Duncan died as a result of his infection.

The emergence of Ebola virus in Dallas provided a startling exposure of our health care infrastructure and its weaknesses. Health officials and the public alike started inquiring as to how the initial response to this viral threat had failed. As a result of such inquiries, health organizations created new procedures, training, and plans to resolve system shortcomings. Texas Governor Rick Perry appointed a number of infectious disease experts to a new Ebola Task Force. The CDC’s Division of Global Migration and Quarantine (DGMQ) implemented stringent background checks for all travelers arriving to the United States from an Ebola-affected country. This procedure included an initial assessment to determine country of origin, possible contact with ill persons, a temperature check for fever (and questions about fever-suppressing medications), and allowed health officials to log demographic and contact information for the purposes of case tracking. This step ushered in a long period where state and local health departments monitored each West African traveler arriving into the United States via commercial airline, for 21 days from their time of arrival, until the outbreak was declared over.

Ebola Monitoring in Williamson County, Texas
From October 2014 through December 2015, Williamson County and Cities Health District (WCCHD) epidemiologists monitored thirteen travelers from West Africa, comprising a total of 199 days of active monitoring for Ebola virus symptoms (Figures 1 and 2).

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**Figure 1.** The number of days that WCCHD performed active monitoring of West African travelers for symptoms consistent with Ebola infection. Note that monitoring periods commonly overlap months, and so there are days of active monitoring (in November 2014, for example) which do not have month corresponding travelers in Figure 2 below.

**Figure 2.** The number of individual travelers monitored, by month when their monitoring period under WCCHD jurisdiction began.
**Ebola Monitoring in Williamson County, Texas – Lessons Learned**

The extensive period of monitoring travelers from West Africa for Ebola virus symptoms provided some valuable lessons for public health practitioners. In several instances, travelers did not speak English. While French is the official language of many West African nations, some travelers were only fluent in lesser-known languages, or even specific regional dialects. This posed a challenge for communication. While WCCHD used phone translation services when necessary, even those services were unable to provide a translator where the traveler’s language was more obscure. In such cases, WCCHD relied upon the traveler’s family members or close friends to aid in communication. This situation highlights the importance of the public health entity’s ability to provide culturally-competent care, even in service areas that are more rural or linguistically homogenous.

Relatedly, WCCHD encountered some communication issues related to cultural perceptions of time orientation, where a traveler might agree to report symptoms at a specified time each day, but not necessarily view such an agreement as rigid. This resulted in problems when a staff member performing monitoring could not reach the traveler for the daily symptom checks. To a traveler from another culture, this sense of future obligation was more fluid, and subject to the variations of daily activities. If they visited friends, they might not contact health personnel to report until hours after the prearranged time, never realizing that this could pose a problem. Time orientation and cultural context have long been associated with lapses in adherence and procedure in various environments of care, and this is just as true when considering public health monitoring of travelers or cases, as evidenced here.

### Next Steps

Lessons learned will be used to inform how WCCHD and other health agencies respond to active monitoring events in the future. Public health practitioners should be culturally-sensitive and maintain resources for surge capacity and foreign language competencies. Difficulties in scheduling monitoring visits and phone checks should be expected and mitigated through contingency plans.

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Cyclosporiasis: An Emerging Pathogen of Concern for Williamson County, Texas

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Williamson County and Cities Health District, Georgetown, Texas

One emerging pathogen of particular concern for Williamson County and Texas at large, is *Cyclospora cayetanensis*, the agent responsible for cyclosporiasis. In most cases, infection with *C. cayetanensis* results in protracted gastrointestinal illness. Symptoms often feature intense abdominal cramping, watery diarrhea, nausea, anorexia, and fatigue. Patients with cyclosporiasis frequently exhibit weight loss and undergo a cyclical process, where the intensity of symptoms will subside, only to recrudesce in recurring waves over the week-long course of infection. The organism is diagnosed via microscopic observation of oocysts – the form of *Cyclospora* which is shed in the feces of an infected individual. Since this oocyst takes days to weeks after shedding to become infectious, person-to-person transmission is considered unlikely\(^1\). This protozoan parasite is mostly confined to tropical and sub-tropical regions, in countries all over the world.

Exposure to *Cyclospora* occurs when a person encounters a contaminated source – typically water or fresh produce – and unknowingly swallows the sporulated (infectious) oocysts. Within one week, the patient begins feeling symptomatic, and will begin shedding the unsporulated (non-infectious) oocysts in their feces, which generally lasts for three or more weeks\(^1\). Reports of outbreaks due to *Cyclospora* infection are a rather recent occurrence in the United States, and were first recorded in the mid-1990s\(^2\). Since then, both the frequency of outbreaks and the case counts involved have continued to increase over time (Figure 1).

CYCLOSPORIASIS: AN EMERGING PATHOGEN OF CONCERN FOR WILLIAMSON COUNTY, TEXAS

Data Source: Centers for Disease Control and Prevention (CDC)

Figure 1. Cyclosporiasis cases and positive trendline (polynomial, 4-order). Trend correlation is limited, due to missing data from years 2003, 2007, and 2010, and incomplete data for 2014 (R≈ 0.4).

Past outbreaks in the United States have been linked to imported foods (raspberries, basil, and salad), evidencing the fact that globalization of the food supply chain is an important epidemiological factor underpinning rising incidence. Texas had a large majority of cases in each of these recent outbreaks and, for the past three years, cases in Texas have been linked by U.S. Food and Drug Administration (FDA) traceback analysis to fresh cilantro imported from the Puebla region of Mexico. Based on these traceback findings, the FDA and Mexican food safety agencies implemented new safety controls on imported cilantro. These include 11 “minimal requirements” – agricultural and food safety guidelines – for cilantro producers in Mexico. Figure 2 illustrates the burden of locally-acquired cases of cyclosporiasis, excluding any states which had no cases.
Figure 2. In 2015, Texas had nearly 56% of the nation’s disease burden for locally-acquired cyclosporiasis. These cases were eventually linked to cilantro originating in the Puebla region of Mexico. Cilantro was also responsible for large outbreaks in 2013 and 2014.

Data Source: Centers for Disease Control and Prevention (CDC)

For Williamson County residents who do not travel abroad, cyclosporiasis has only posed a threat within the last three years, as development and proximity to the Austin metropolitan area have expanded the distribution pathways for imported food items, increasing potential for exposure. In 2013 and 2014, there were four cases per year in Williamson County; in 2015, that number increased to 15. Cases similarly increased in Travis County over the same three years, culminating in a large 2015 outbreak which had 113 cases (Figures 2 - 4).
Figure 3. Annual reported Cyclosporiasis cases in Williamson and Travis Counties, with data from the previous three years.

Data Source: Texas Department of State Health Services (DSHS), Foodborne Epidemiology Program

Figure 4. Annual incidence rates of reported cyclosporiasis cases in Williamson and Travis Counties, with data from the previous three years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Williamson</th>
<th>Travis</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>0.85</td>
<td>1.51</td>
</tr>
<tr>
<td>2014</td>
<td>0.82</td>
<td>0.87</td>
</tr>
<tr>
<td>2015</td>
<td>2.95</td>
<td>9.60</td>
</tr>
</tbody>
</table>
Even though cyclosporiasis comprises a relatively small portion of the overall burden created by foodborne and waterborne illnesses, the protracted nature of this illness makes it relevant to community health in other ways. According to a recent study by the USDA, 63% of the economic burden imposed by cyclosporiasis is attributable to productivity loss\(^3\). This translates to lost wages, days off from work, loss of ability to perform uncompensated work, and the time lost by others who must care for the ill. The latter two factors are not accounted for by the USDA’s simple estimation of productivity loss, indicating that this cost is underestimated. The per-case economic burden for cyclosporiasis is estimated to be $202, with a hospitalization rate of 6.5%. Overall, this compares quite favorably to more common food- and waterborne infections, like Salmonellosis, which are associated with much higher per-case burdens.

Since cyclosporiasis is not a pathogen that is spread from person to person, prevention is focused on reducing contamination of food sources and limiting exposure to the parasite. The CDC recommends that persons preparing food first thoroughly wash all utensils, as well as their hands, with soap and warm water\(^4\). All produce that is not labeled “pre-washed” should be scrubbed and rinsed under running water, then consumed immediately or stored in the refrigerator. Additionally, consumers should periodically check www.CDC.gov and www.FDA.gov for health alerts, news on outbreaks, and implicated or recalled food items.

WCCHD continues to focus on prevention and surveillance activities, in conjunction with state and federal agencies. These combined efforts reduce the risk of *Cyclospora* exposure to public health, by improving sanitation and import procedures, and allowing us to identify disease clusters and their sources.

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Summary of Submersion Events (Drownings & Near-Drownings) in Williamson County, Texas, 2010 – 2015

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Williamson County and Cities Health District, Georgetown, TX

Introduction
According to the Centers for Disease Control and Prevention (CDC), drowning is a significant public health concern, as it is a major cause of death – approximately ten people die each day from unintentional drowning in the United States. More specifically, drowning is the fifth leading cause of unintentional death for people of all ages, and the second leading cause of death for children ages 14 and younger\(^1\). In many circumstances, drowning is a highly preventable occurrence\(^2\). To prevent drownings, public health education and awareness campaigns across the nation include drowning prevention messages (i.e. safe swimming, bathtub safety, recreational water safety, flood water safety, etc.). However, unintentional drownings continue to occur annually and still exist as a substantial issue in the United States. Per the World Health Organization (WHO), once a person starts to drown, the outcome is often fatal. Unlike other injuries, survival is determined almost exclusively at the scene of the incident, and depends on two highly variable factors: how quickly the person is removed from the water, and how swiftly proper resuscitation is performed. Prevention, therefore, is vital.

The intent of this report is to summarize submersion events reported to the Williamson County and Cities Health District (WCCHD) in residents of Williamson County, Texas, during 2010-2015. These data may be used by WCCHD divisions, healthcare providers, emergency medical personnel, and community stakeholders to tailor public health messaging, education, and interventions to prevent drownings and improve the health and safety of Williamson County citizens.

Methods
In Texas, drownings and near-drownings (submersion events) are listed on the Texas Notifiable Conditions list, legally requiring these events to be reported to health departments in Texas within 10 working days\(^3\). The WCCHD Disease Control and Prevention Division (DCP) collects and maintains data on submersion events occurring within the county. Drowning and near-drowning data are received through passive surveillance reports from the Williamson County Emergency Management Services (EMS) to the WCCHD DCP. Each submersion event is documented on a WCCHD-specific report form and contains input from EMS and, if applicable, the attending medical provider. For this summary, WCCHD DCP queried and analyzed data from historical submersion event reports (drownings, near-drownings, and drowning with traumatic brain injury [TBI]) in Williamson County residents during 2010-2015, from the WCCHD Outbreak Management System (OMS), a WCCHD database used to track conditions not entered through the TX – National Electronic Disease Surveillance System (TX-NEDSS).

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Case Definitions
In Texas, submersion events are classified into three categories:
1.) Drowning: death, secondary to asphyxia while immersed in a liquid, usually water, or within 24 hours of submersion;
2.) Near-drowning: a non-fatal submersion event; and
3.) Near-drowning with traumatic brain injury (TBI): a non-fatal submersion event resulting in damage to the brain.

Data Limitations
WCCHD DCP relies on a passive surveillance system to receive submersion reports. Only submersion events reported to WCCHD by Williamson County EMS are documented in the WCCHD OMS. Unreported submersion events may occur annually, but are not captured by WCCHD. This stated, these summarized data indicate case counts and descriptions, but do not completely represent the risk or burden of submersion events in Williamson County.

Description of Reported Submersion Events – Williamson County

Reports
During 2010 – 2015, WCCHD DCP received and recorded a total of 53 submersion reports (21- drownings 32- near-drownings, 0- drownings with TBI) in Williamson County residents from Williamson County EMS. Submersion event counts were mostly consistent each year. However, an increase in reports was observed during 2012 and 2013. Since 2010, reports of fatal events remained consistent. (Figure 1).

![Figure 1. Count of Reported Submersion Events in Williamson County Residents by Year, 2010 - 2015](image)

Data Source: WCCHD Outbreak Management System (OMS)
**Age and Sex**

Ages of reported submersion event victims (fatal and non-fatal) ranged from less than 1 year to 87 years. Children between the ages of 0-4 years (<1 age and 1-4 age categories) accounted for over half (52.83%) of the total submersion reports to WCCHD. In addition, over half (66.03%) of all reported submersion events occurred in males, while females accounted for less than one-third (31.96%) of the reported submersion events. In addition, reports indicated males were documented in more fatal submersion events, than females (Figure 2).

**Figure 2. Reported Submersion Events in Williamson County Residents by Age and Sex, 2010-2015**

Data Source: WCCHD Outbreak Management System (OMS)

**Figure 3. Reported Submersion Events in Williamson County Residents by Age & Sex, 2010-2015**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Drowning (fatal)</th>
<th>Near Drowning</th>
<th>Combined Total</th>
<th>% Fatal*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>&lt; 1 year</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>1-4 years</td>
<td>5</td>
<td>0</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>5-10 years</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>11-17 years</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>18-34 years</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>35-54 years</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>55-74 years</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>75+ years</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>2</td>
<td>19</td>
<td>14</td>
</tr>
</tbody>
</table>

% Fatal = Number of drowning for the age group / Combined total for the age group

*WCCHD Outbreak Management System (OMS)*
While children between the ages of 1-4 had the highest number of reports to WCCHD, submersion events reported in the 35-54 age group were more often fatal (80%), followed by the 18-34 age group (66.7%). For both of these age groups, Williamson County EMS reported alcohol or drug use in almost one-quarter (24%) of the reported cases. Submersion events for all age groups resulted in 18 fatalities (33.96%) (Figure 3).

**Race and Ethnicity**

White, non-Hispanics were noted as the racial/ethnic group with the highest number of reported submersion events (16 drownings, 18 near-drownings) in Williamson County; followed by White, Hispanics (1 drowning, 5 near-drownings). Black/African Americans (Hispanic and non-Hispanic) had a reported 6 near-drownings. Reports for the Asian and “Other” race categories were almost always fatal (Asian – 67%, other – 100%) (Figure 4). Note: The “Other” race category submersion events (count of 2) involved the drowning of siblings in a natural body of water during the same incident. Thus, these data are not completely indicative of risk associated with the “Other” race/ethnicity.

**Figure 4. Reported Submersion Events in Williamson County Residents by Race & Ethnicity, 2010-2015**

<table>
<thead>
<tr>
<th>Race &amp; Ethnicity</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian</td>
<td>1</td>
</tr>
<tr>
<td>Black/African American, Hispanic</td>
<td>5</td>
</tr>
<tr>
<td>Black/African American, non-Hispanic</td>
<td>4</td>
</tr>
<tr>
<td>White, Hispanic or Latino</td>
<td>11</td>
</tr>
<tr>
<td>White, non-Hispanic or Latino</td>
<td>15</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
</tr>
</tbody>
</table>

*Data Source: WCCHD Outbreak Management System (OMS)*
**Seasonality**

Over the five-year period (2010-2015), reported submersion events mostly occurred in similar seasonal patterns, with the majority of events peaking during the summer months of June & July of each year. However, in 2010 & 2015, submersion events occurred slightly later, with a higher number of events being reported in August (2015) and September (2010). In 2010, 2013, and 2014, some submersion events occurred earlier (and later) than normally expected (during the summer months) (Figure 5). These reports involved incidents associated with swimming pools. These data are an indicator to ensure water safety guidelines and drowning prevention methods are followed, regardless of season.
**Incident Location and Factors**

*Community or Private Swimming Pools*
Over half of reported submersion events to WCCHD, with known incident location, occurred in community or private swimming pools. Community/apartment pools were noted in over one-quarter of events (2 drownings, 12 near-drownings). Private pools accounted for 8 drownings and 3 near drownings (**Figure 6**). Over three-quarters of reported combined pool submersion events were in children less than 18 years old (76%). Of those, three-quarters of reports noted immediate action by parents, bystanders, or medical personnel by Williamson County EMS. For those 18 years and older, 50% had reported alcohol or drug use, as reported by Williamson County EMS, prior to exposure to a pool. Of the submersion events associated with alcohol or drug exposure, 71% of resulted in deaths.

*Natural Water*
The reported submersion events associated with natural bodies of water were almost always fatal (4 drownings, 2 near-drownings) and accounted for 12% of reported submersion events (**Figure 6**).

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**Figure 6. Reported Submersion Events in Williamson County by Residents Location of Incident, 2010-2015**

- Bathtub: 15 (29%)
- Community/Apartment Pool: 14 (27%)
- Hot Tub: 1 (2%)
- Natural Body of Water: 11 (18%)
- Pool (Unknown location): 5 (10%)
- Private Pool: 6 (12%)
- Unknown: 1 (2%)

*Data Source: WCCHD Outbreak Management System (OMS)*
Discussion
Per the CDC, drownings are a leading cause of injury death for young children ages 1 to 14, and three children die every day as a result of drowning. Furthermore, drowning kills more children ages 1-4 years than anything else except birth defects. A similar trend was observed in the Williamson County submersion event counts during 2010 – 2015. The majority of these submersion events occurred in white, non-Hispanic children under the age of 4 years of age. In addition, most reported submersion events were associated with community or private swimming pools. The incidents were less likely to be fatal when immediate action was taken by parents, bystanders, or medical personnel. Thus, it remains essential that children (and adults) be monitored while in the water.

However, while a majority of health education information is focused on seasonal, summer fun and water safety for children, it is also important to note that drownings or near-drownings may affect any person, regardless of age, sex, race/ethnicity, or type of water activity. During 2010-2015, submersion events reported to WCCHD for the 35-54 and 18-34 age groups were likely to be fatal. These incidents involved swimming pools, bath tubs, and natural bodies of water. Of these reports, almost one-quarter involved drug or alcohol consumption prior to the incident.

It is also notable that four (nearly 8%) of the reported submersion events in Williamson County occurred during the months of November – January. These events serve as an important reminder that water safety guidelines and drowning prevention methods should be followed, regardless of season.

Additional Water Safety & Drowning Prevention
The following links contain drowning prevention education and information:

CDC Drowning Prevention:

CDC Water Safety and Drowning Prevention:
http://www.cdc.gov/HomeandRecreationalSafety/Water-Safety/waterinjuries-factsheet.html

Texas Drowning Prevention Alliance:
http://www.txdpa.com/
Analysis of Foodborne Illness Complaint Data to Identify Trends in Food Safety in Williamson County, Texas, 2013 - 2014

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Introduction
Foodborne illnesses are preventable gastrointestinal infections caused by pathogens or noxious substances in food or water. Pathogens are the most common source of infection, with only five pathogens causing approximately 91 percent of estimated number of foodborne illnesses. These pathogens include: Norovirus (58 percent), Salmonella nontyphoidal (11 percent), Clostridium perfringens (10 percent), Campylobacter spp. (9 percent), and Staphylococcus aureus (3 percent)1. Annually, 1 in 6 Americans (or 48 million) contract a foodborne illness, which can cause digestive disruptions such as nausea, vomiting, diarrhea, and abdominal cramping. While many infections are self-limiting and do not require the use of antibiotics, an estimated 128,000 people are hospitalized and 3,000 people die annually from foodborne-related illnesses.

In addition to gastrointestinal-related symptoms, hospitalization, and fatalities, foodborne illness also imposes serious economic burden. The United States Department of Agriculture (USDA) estimates the total direct economic cost of all foodborne pathogens is over 15.5 billion dollars annually2. Salmonellosis, alone, accounts for 24 percent (nearly 3.7 billion dollars) of these reported costs. While these numbers are staggering, analysis of individual cost burden is necessary to provide insight into cost on a personal level. More specifically, each reported case of Salmonella infection in the U.S. bears a direct cost of approximately $3,568. "Direct cost" means that these estimates are conservative and cannot account for lost value of time spent engaging in uncompensated activities, such as house work and leisurely hobbies, nor the time or expense lost by family or friends who must care for the ill patient. For the top five foodborne illnesses, per-case cost burden varies from $413 (Norovirus) to $3,568 (Salmonella)2. In considering the impact of foodborne illness upon public health, the economic burden posed by these pathogens should be a substantive component of any comprehensive discussion.

At the grassroots level, state and local health departments can encourage the community to report unsanitary conditions in food establishments and foodborne illness post-exposure to a food establishment. Consequently, the health departments then can utilize sanitarians and environmental health programs to conduct routine inspections of food establishments.

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for compliance with local, state, and federal regulations. An overarching relationship between food inspectors and epidemiologists is vital to foster these grassroots level successes. In addition, these interventions have been adopted at the federal level, as The Food and Drug Administration (FDA) created the Voluntary National Retail Food Regulatory Program Standards in October 2010. In total, the FDA released nine standards: Regulatory Foundation, Trained Regulatory Staff, Inspection Program Based on HACCP Principles, Uniform Inspection Program, Foodborne Illness and Food Defense Preparedness and Response, Compliance and Enforcement, Industry and Community Relations, Program Support and Resources, and Program Assessment. The purposes of these standards are to provide prevention-based strategies and foster partnerships among state, local, and tribal jurisdictions.

Within Williamson County and Cities Health District (WCCHD), Regulatory Program Standard Five: Foodborne Illness and Food Defense Preparedness and Response (VS5) unites the Disease Control and Prevention (DCP) and Environmental Health Services (EHS) Divisions. VS5 focuses on surveillance, investigation, response, and subsequent review of alleged food-related incidents and emergencies, either unintentional or deliberate, which result in illness, injury and outbreaks. Requirements for WCCHD to be enrolled include: detecting, collecting, investigating and responding to complaints and emergencies that involve foodborne illness, injury, and intentional and unintentional food contamination. Individually, both divisions participate in public health practices on a routine basis, with DCP investigating food establishment complaints and EHS inspecting food establishments for Texas Food Establishment Rules (TFER) compliance. The divisions join forces when a foodborne illness complaint (FBIC) has been alleged against a food establishment. Initially, DCP receives the FBIC and investigates the incident, including foods eaten, onset date and time, symptoms, physician or laboratory involvement, other parties involved, and a three-day food history. Once DCP collects the complainant’s information, DCP assigns a tier level to each event with an alleged foodborne illness. The tier level directs DCP and EHS response efforts, including establishment inspection timeframes. Tier 4 events are investigated by DCP but not EHS, as DCP believes food is unlikely as source of illness as described in complaint or the Food establishment is not under WCCHD jurisdiction for response. Tier 3 events are investigated by DCP and inspected by EHS within 72 hours, as DCP believes food has the potential to be a source of illness. In addition, two or more Tier 4 complaints for same retail food establishment within a 7-day period from unrelated parties.

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with similar symptoms qualify as Tier 3 events. Tier 2 events are investigated by DCP and inspected by EHS within 24 hours, as DCP believes food is the likely source of illness and potentially the risk for exposure could be ongoing. Tier 1 events are investigated by DCP and inspected by EHS immediately, as DCP believes food is highly likely the source of illness, risk for exposure is current with potential for becoming ongoing, and risk for severe illness or mass casualties is high. EHS returns all completed inspection reports to DCP for data analysis and storage.

While the alliance between DCP and EHS had been established for several years, basic data and analysis had yet to surface on this partnership. This study aimed to delve into the data captured during investigations and inspections and next steps for WCCHD.

**Methods**

WCCHD queried all FBICs reported to DCP and EHS from the WCCHD Outbreak Management System (OMS), a WCCHD database designed to collect information on reported non-notifiable diseases, and narrowed the data to include only records of FBICs reported between September 1, 2013-August 31, 2014. Symptoms analyzed included the five most common gastrointestinal problems with foodborne illnesses: nausea, vomiting, diarrhea, cramping, and fever. For the time period of the study, EHS had current records on 1,165 permitted food establishments, which were then divided and analyzed by 15 food service types, associated with the Texas Nutrition Environment Assessment (Tx-NEA) classifications. Analysis included TFER regulations for food establishments categorized into 27 critical points of process control. Locations of the food establishments were analyzed by city and number of active food permits in August 2013. To measure the relationship between establishments and complaints numerically, WCCHD calculated number of permitted food establishments by location (“expected”) during the study period against the number of complaints received by location (“observed”) to determine if the expected values of population size matched the observed values of number of complaints. For this analysis, WCCHD used Fischer’s Exact Test, as the data did not satisfy the Cochran Criteria for use of the more customary Chi Square analysis. Other associated illnesses or other persons with similar symptoms to the complainant were also considered.

Additionally, WCCHD performed a hot spot analysis to determine if any significance existed in the location of the implicated food establishments in comparison to all food establishments. WCCHD conducted the hot spot analysis within ESRI’s ArcMap for Desktop program. The tool works by comparing nearby z-scores and p-values for similarity or difference to determine significance, whether “hot” (high value surrounded by other high values) or “cold” (low value surrounded by other low values). Then, according to ESRI, “The resultant z-scores and p-values tell you where features with either high or low values cluster spatially. This tool works by looking at each feature within the context of neighboring features. A feature with a high value is interesting but may not be a statistically
significant hot spot. ...The local sum for a feature and its neighbors is compared proportionally to the sum of all features; when the local sum is very different from the expected local sum, and when that difference is too large to be the result of random chance, a statistically significant z-score results. 6"

**Results**

Between September 1, 2013-August 31, 2014, WCCHD received 43 FBICs. Of the total, 28 complaints received no follow-up inspection for various reasons including: Tier 4 violations or simply not enough information to investigate (Figure 1).

![Figure 1. Monthly Foodborne Illness Complaints made by Williamson Co. Citizens to WCCHD, September 1, 2013 - August 21, 2014](image)

**Data Source:** WCCHD Outbreak Management System (OMS)

**Figure 1.** Foodborne Illness Complaints by month between September 1, 2013-August 31, 2014. January 2014 received the most complaints during the study period.

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Of the 15 FBICs with inspections, WCCHD received the most complaints during January 2014, with four total. Forty (40) FBICs included symptoms experienced by the complainant(s), with the most common symptom as diarrhea, followed by cramps, nausea (tied), vomiting, and fever, respectively (Figure 2).

![Figure 2. Williamson Co. Foodborne Illness Complainants' Self-Reported Symptoms to WCCHD, September 1, 2013 - August 21, 2014](image)

Data Source: WCCHD Outbreak Management System (OMS)

**Figure 2.** Foodborne Illness Complainants' Self-Reported Symptoms: September 1, 2013-August 21, 2014. Diarrhea was alleged in 35 out of 40 FBIC with known symptoms.

While the majority (58%) of FBICs were alleged against establishments in urban areas, WCCHD used statistical analysis to determine if the relative frequency of such complaints varied by location or establishment type. EHS inspected stand-alone table service food establishments ("restaurants") most frequently for FBICs, followed by fast food service establishments (Figure 3).
Common TFER violations included: cooking temperature, holding temperatures, and hand washing, all considered the most useful preventive methods to reduce causes of foodborne illness (clean, separate, cook, and chill)\(^7\). Specifically, the two most common TFER violations were cold hold temperature and proper handwashing, both at 16% of total violations at inspected food establishments, followed by hot hold temperature, sanitizing/machine wash requirements, and sanitization of food contact surfaces, all at 8% of total violations (Figure 4).

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In addition, 83% (n=5) of establishments with cold hold violations were restaurants, and 67% (n=4) of establishments with hand-washing violations were restaurants, while the other 33% (n=2) were fast food service food establishments.

In addition to TFER violations, WCCHD analyzed the location of the alleged food establishments to determine any statistical significance to support anecdotal evidence of more FBICs in urban areas (for more information on this anecdotal evidence, see Figure 7). To measure the relationship spatially, WCCHD used ESRI ArcMap for Desktop to map the locations of food establishments with FBICs against all food establishments (Figure 5).
While some clustering was apparent, a second map containing hot spot analysis demonstrated significant hot spots in urban areas such as Cedar Park/Leander, Georgetown, and Round Rock while the rest of the county did not have significant data, despite complainants alleged at food establishments in those areas (Figure 6).
ANALYSIS OF FOODBORNE ILLNESS COMPLAINT DATA TO IDENTIFY TRENDS IN FOOD SAFETY IN WILLIAMSON COUNTY, TEXAS, 2013-2014

WCCHD also statistically compared the number of expected complaints, based on population, against the number of observed complaints, to determine if the expected values were consistent with the observed values (Figure 7). Cities with FBICs included Cedar Park, Georgetown, Jarrell, Leander, Round Rock, and Taylor. Observed values for Round Rock and Georgetown exceeded what WCCHD expected for those cities, as Round Rock’s population comprised 36% of Williamson County but received 48% of the FBICs, and Georgetown’s population comprised 17% of Williamson County but received 29% of the FBICs. Additionally, the remaining smaller cities in Williamson County (“Other Areas”) comprised 15% of the population but received no FBICs.
To measure this relationship statistically, WCCHD calculated the observed and expected values for number of complaints by city. These values were entered as a matrix and processed in R. Using Fisher’s Exact Test for a 2x6 table, the analysis showed slightly higher-than-expected numbers of complaints in urban areas, but this result was not statistically significant (p=0.6641). Given this result, there is not enough evidence to reject the null hypothesis (the difference between Observed and Expected could be due merely to chance).

**Discussion**

One of the original purposes of this study was to determine the viability and importance of the VS5 in encouraging a partnership and increased communication between WCCHD DCP and EHS programs. Through Tier assignments, notification of FBICs, and inspection reports, the partnership held strong through 43 incidents. Most notably for VS5’s focus on surveillance, investigation, response, and subsequent review of alleged food-related incidents and emergencies, the most common TFER violations noted on inspections included cooking temperature, holding temperatures, and hand washing. These violations are pertinent to foodborne illnesses, as they are control measures that are considered the most useful preventive methods to reduce causes of foodborne illness (clean, separate, cook, and chill). If increased illness-related inspections at alleged food establishments found common risk factors for foodborne illness, VS5 proved its capability to promote...
communication and teamwork in combating and reducing foodborne illnesses. Inspections are vital in curbing dangerous practices and give inspectors the opportunity to educate managers and staff of safer methods and their importance. Food establishments receive point penalties for violations found during inspections. These scores are available to the public for their use in making informed consumer safety choices.

In addition to reducing foodborne illness sources, review of illness-related inspections also highlighted that most inspections (79%) for FBICs took place at restaurants and fast foods establishments, as opposed to other types of establishments, such as buffets, grocery stores, super stores, carry-outs, other takeaways, cafeterias, and food trucks, which totaled together 21%. Furthermore, food establishments in urban areas received more than the expected number of FBICs compared to less urban and rural areas, but this was not statistically significant. More research is needed to determine the reasons for these observations.

This study contained several limitations. First, the sample size of 43 FBICs is small, resulting in small changes seemingly creating a large impact on analysis. Moreover, foodborne illnesses are historically under-reported, meaning this report does not capture the true counts or burden of foodborne illnesses in Williamson County. Finally, often people associate the most recently eaten item as the cause of gastrointestinal illness. However, most foodborne illnesses are a result of consumption of a pathogen multiple hours to days prior to the report. This misunderstanding of incubation period results in misattribution of cause of symptoms and can lead people to allege foodborne illness complaints against food establishments without the consideration of other potential sources of illness.

**Next Steps**

To improve future processes, WCCHD EHS can use the information from this study to advise their policies for food handling and education for establishment managers and owners, and to better understand FBIC patterns and risks in Williamson County.

This data can be used as a baseline year in order to obtain an accurate picture of foodborne illness trends in Williamson County in the years ahead. If WCCHD implements an intervention, baseline data and future data are necessary for recognizing potential change.

In addition, this data may be used to help direct targeted interventions among several divisions, such as DCP, EHS, and Marketing and Community Engagement, through the development of reporting and education campaigns aimed at FBIC reporting and food safety.

Lastly, WCCHD DCP should evaluate and improve the current FBIC reporting process to attempt to increase the number of FBIC reports received by DCP. Higher numbers of FBIC
reports from the community would increase the sample size, provide more accurate patterns and trend identification, and increase the applicability of the data.

**Conclusion**

Foodborne illnesses are a common source of infection in the United States, causing millions of infections annually. Because of the large proportion of illnesses, the FDA created the Voluntary National Retail Food Regulatory Program Standards to promote partnership and cooperation among food inspectors and epidemiologists, notably with Standard 5. Within WCCHD, DCP and EHS Divisions collaborate for response to FBICs to gather data regarding suspect illnesses, alleged common food items, and timeliness of inspections. Each year provides WCCHD with more data, patterns, and the ability to re-check previous implementations or suggest new ideas for improvements.
A Description of a Shigellosis Outbreak Investigation in an Elementary School in Williamson County, Texas, 2014

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Introduction

*Shigella* spp. is a genus encompassing several species of gram-negative, rod-shaped bacteria, which are closely related to *Salmonella*. The four *Shigella* species of public health concern include *sonnei*, *dysentariae*, *boydii*, and *flexneri*. Of these, *S. sonnei* tends to result in the mildest course of illness, and is by far the most frequent *Shigella* species isolated in developed countries. Like most transmissible enteric pathogens, *Shigella* is passed via the fecal-oral route. The infectious dose is extremely low, and less than 10 bacteria can cause illness. Due to this fact, hand hygiene and sanitation measures are paramount in controlling the spread of this infection. *Shigella* generally presents with diarrhea (often bloody, called “dysentery”), nausea, vomiting, intense cramping, and tenesmus (a persistent urge to have a bowel movement when there is nothing to evacuate).

Epidemiologically, *Shigella* is of greatest importance in relation to child health. More than two-thirds of all cases occur in children under 10 years of age. *Shigella* is estimated to cause 125 million illnesses and 14,000 deaths annually. 500,000 of these cases occur in the United States every year. Due to its high transmissibility, this pathogen tends to cause outbreaks of disease in congregate childhood settings, such as schools and daycares. As a notifiable condition in Texas, providers (including school nurses) are required to report all cases of *Shigella* to the local health authority upon identification. All reported cases are then fully investigated by Williamson County and Cities Health District (WCCHD) Disease Control and Prevention (DCP). In the event of a cluster or outbreak of cases, DCP staff works closely with the affected facility to implement control measures and to mitigate the continued spread of disease. The largest known *Shigella* outbreak in the history of Williamson County occurred in an elementary school setting in 2014, and provides an excellent glimpse into the workings of an outbreak investigation. The purpose of this article is to describe this outbreak, the public health investigation techniques, and control measures implemented to prevent the further spread of *Shigella* in the school and, ultimately, the community.

Background and Initiation of Investigation

On October 8, 2014, a local elementary school nurse notified WCCHD DCP of one laboratory-confirmed case of *Shigella sonnei* and several other pending stool samples in students, with an atypically high number of student absences due to vomiting, diarrhea, and fever. WCCHD DCP immediately initiated a public health investigation to attempt to...
evaluate the reported illnesses and to prevent the spread of *Shigella* in the school. Within 24 hours, a WCCHD DCP epidemiologist sent a pre-designed outbreak protocol packet to the school nurse, with instructions for reporting additional confirmed and suspected *Shigella* cases to WCCHD DCP, including an initial report form, blank line listing sheets, and Centers for Disease Control and Prevention (CDC)-recommended guidelines for cleaning the environment.

WCCHD DCP used the following case definitions during their response, to classify the reported illnesses – including laboratory-confirmed *Shigella* infection – at the local elementary school:

- **Confirmed** – A patient with positive laboratory results via validated methods, per Texas Department of State Health Services (DSHS) definitions.

- **Probable** – A patient with exposure to the elementary school (within infectious period of a confirmed case) AND absence due to symptoms of diarrhea, vomiting, and/or fever.

- **Suspect** – A case that would otherwise be probable, but has extenuating circumstances that reduce likelihood of shigellosis (i.e. chronic diarrhea which has been ongoing for months, with no other symptoms and no laboratory results).

Any report(s) which did not fall within one of the three definition categories was considered as “not a case” and was not considered for this investigation.

**Investigation Methods**

WCCHD DCP used the following public health investigation procedures during the investigation:

- WCCHD DCP immediately requested laboratory results and clinical documentation from healthcare providers and laboratories for index and early-onset cases, and conducted investigations promptly; other cases were investigated by DCP as they were reported to WCCHD.
- WCCHD DCP collected data using a pre-developed, standard WCCHD *Shigella* Investigation Form.
- WCCHD DCP maintained daily communication with the school nurse, who submitted line listings of new cases to DCP every two to three days.
- A database of cases and epidemiological curve (Figures 1 and 2) were updated by DCP staff as line listings arrived, throughout the course of the outbreak.
- DCP obtained maps of the school from school administrators and cases were plotted graphically to determine if any apparent spatial relationship existed which might explain transmission patterns (Not shown, to protect the school’s identity).
- A Pareto chart was created by DCP staff to maintain record of case frequency by classroom, for all cases with information available (Figure 3).
DCP staff monitored continuance of the outbreak via epidemiological curve against intervention strategies, to determine if interventions were sufficiently working in the school-setting or if additional measures were needed (strategies outlined below).

**Initial Intervention Strategies and Recommendations**

WCCHD DCP provided combined school staff (administrative, nursing, and custodial) with the following recommendations for stopping further disease transmission within the school environment:

**Initial Recommendations:**

**Intervention start date:** October 8, 2014

- Custodial staff should perform a “complete” disinfection routine daily, at minimum (to include bathrooms, cafeteria, common class areas -- tables, desks, door knobs, etc.).
- A student sign-in/out sheet should be used for bathroom visits (there had been documented problems with students smearing feces on the walls).
- Faculty should supervise student hand-washing immediately prior to lunch and preferably after bathroom use, if the latter is possible with present staff capacity.
- Staff should perform more frequent bathroom inspections, to check for maintenance issues, adequate supplies, flushed toilets, and general cleanliness.
- Hand sanitizer stations should be placed in classrooms, with faculty supervising student use upon entry or exit.
- Student chairs, desks, and shared tables should be sanitized with disinfectant wipes after each class period.
- Notices should be posted conspicuously in all main entryways, discouraging unnecessary visitation and informing visitors of gastrointestinal (GI) illness and advising of proper precautions.
- School authorities should exclude students where appropriate, per the Texas Administrative Code (no diarrhea or fever for 24 hours, without use of suppressing medications).
- Written outbreak notifications and accompanying *Shigella* fact sheets should be sent home to parents, and an advisory posted on the school’s website.
- Hand-washing instructional videos should be played on morning announcements, or an alternative form of instruction provided, to ensure student awareness of good hygiene practices.
Communication and Environmental Inspection
The local elementary school first reported an unusual cluster of Shigella cases to WCCHD on October 8, 2014. The health district responded promptly, by sending initial cleaning guidelines to the school as part of a WCCHD DCP-designed comprehensive outbreak protocol packet. These guidelines and other strategies were subsequently discussed with the nursing staff upon receipt of that packet and again, as a follow-up, four days later, on October 13. On October 14, WCCHD contacted the school RN to verify that disinfection guidelines and other control measures had, in fact, been implemented. The custodial staff claimed to be following the discussed procedures in their daily cleaning regimens. Over the next few days, the school continued to report new cases, and WCCHD DCP responded by hosting a conference call with the school principle, the entire custodial staff (including the Regional Head Custodian, who supervises staff at other local schools), and nursing staff (the school RN and Regional Nursing Supervisor). Topics included: a status update (31 reported cases, at the time of the call), explanation of the epidemic curve and its significance, and the urgency of implementing further protocols to break the chain of Shigella transmission. Conference call participants discussed the pathogen, effectiveness of various disinfectants/sanitizers, and likely “hot spots” of transmission, particularly common areas and surfaces (i.e. the cafeteria, library, bathrooms, and classroom tables/desks). Conference participants asked informed questions and appeared engaged. The call concluded with a consensus that all items of concern were addressed and agreeable, and that interventions would be implemented post-haste.

Despite enacted control measures, the number of reported cases continued to increase over the following ten days. In response, on October 28, WCCHD performed an on-site inspection at the school, with the WCCHD DCP lead investigator and two WCCHD Environmental Health Services (EHS) sanitarians. This inspection revealed a high degree of inconsistency about reported disease prevention and cleaning protocols to WCCHD. Specifically, student groups entering the cafeteria for lunch were not following a clear hand-sanitizing procedure. For example, WCCHD observed unsupervised students using an alcohol-based sanitizer station placed inside the cafeteria, others were simply walking past the station, and some students were provided a sanitizing solution, carried by the teachers, in the hallway prior to cafeteria entry. In addition to inconsistent hand-washing procedures, the WCCHD investigation also revealed that school custodial staff used large mop heads, soaked in quaternary ammonia, to quickly wipe down the cafeteria tables, before each subsequent group of students arrived for lunch. It was evident surface contact time instructions for the product were not being appropriately followed, rendering the cleaning attempt ineffective at sanitizing the table surfaces. Lastly, it was clear that bathrooms were not inspected hourly by staff, as the floor in one restroom revealed a large puddle of urine on the floor, and some stalls had questionable materials stuck to the interior walls. Students were unsupervised in the restrooms, and many were observed exiting without washing their hands. The school inspection lasted approximately three hours. WCCHD discussed the inspection findings and recommendations with custodial staff and subsequently emailed recommendations to the school principal. Later, WCCHD DCP follow-up communication with the school nurse confirmed the school implemented the
procedures in full, post-inspection. The last laboratory-confirmed case had an onset date of October 31.

**Post-Inspection Recommendations**
WCCHD DCP provided the following recommendations to the school administration and nursing staff based on feedback from the school staff and findings from WCCHD’s on-site inspection. The intent of these guidelines was to stop further disease transmission in the school environment.

**Intervention start date:** October 28th, 2014

- The hand washing/sanitizing protocol should be revised to be explicit and consistent. There should be one uniform type of sanitizer in use (*either* 70% isopropyl alcohol or 0.13% benzalkonium chloride), and the station should be supervised. An ideal approach would include a station outside and proximate to the cafeteria, where students who were already assembled under their teacher for lunch would be supervised sanitizing their hands just prior to entry.

- Quaternary ammonia (“Quat”), as currently used by custodial staff, is not effective for disinfecting or sanitizing. Many studies have documented the neutralizing result that occurs when organic materials (like cotton mop heads) bind with the active ingredients in ammonia compounds. Quat, poured into an open bucket and allowed to sit with cotton pads soaking in the solution, exhibits a dramatic drop in effective concentration in a matter of minutes, and creates a serious concern for cross-contamination when those mop heads are subsequently used to wipe cafeteria tables. A better alternative would be to use a 10% bleach solution (1-part bleach to 9-parts water) that is freshly prepared each day. If Quat must be used, it should be sprayed directly onto the target surface, allowed to sit for a minimum of five minutes, and then dried with disposable wipes. An accelerated hydrogen peroxide-based cleaner would also be acceptable. Only one of these methods should be chosen and employed consistently, every time.

- The school bathrooms still have some sporadic problems with cleanliness. Hourly inspections are not occurring and students aren’t consistently washing hands after use. Ideally, a custodian performing hourly checks (or other timely, periodic checks per staff capacity) should complete a circuit, using disinfectant wipes to clean drinking fountains and hand rails as he/she works from bathroom to bathroom.
Discussion
Based on the spatial distribution and symptom onset dates, it seems likely that transmission of this outbreak occurred primarily through an area in common for all students, such as the library or cafeteria. Given the noted inconsistency with pre-lunch hand hygiene, in addition to ineffective sanitation methods, the cafeteria was regarded as the area of highest suspicion for cross-contamination and disease amplification. However, despite thorough, prompt interviews with the index and early-onset cases, no originating source was determined definitively. Although the secondary cases in associated households represented approximately 16.5% of all captured cases, there was no evidence for spill-over into other schools, daycares, or facilities. This may be attributable to the swift notification dispatched to parents, as 100% of all interviewed cases reported receiving a notification letter and WCCHD-provided fact sheets on *Shigella*.

Interestingly, this outbreak coincided temporally with other *Shigella* clusters across the state. Isolates from clinical labs were requested for transfer to DSHS for genetic typing, but due to the high clonality of *Shigella sonnei*, it remains uncertain whether such testing revealed pertinent information about the geographic distribution or other possible associations between these clusters.

Summary Statistics

Table 1. Confirmed, Probable, and Suspect Case Counts Associated with a Shigellosis Outbreak in a Williamson County Elementary School, 2014 – WCCHD Disease Prevention and Control

<table>
<thead>
<tr>
<th>Case Count</th>
<th>Confirmed</th>
<th>Probable</th>
<th>Suspect</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td># Students</td>
<td>9 (75.0%, 10.7%)</td>
<td>73 (74.5%, 86.9%)</td>
<td>2 (40%, 2.4%)</td>
<td>84 (73.0%)</td>
</tr>
<tr>
<td># Staff</td>
<td>0 (---, ---)</td>
<td>11 (11.2%, 91.7%)</td>
<td>1 (20%, 8.3%)</td>
<td>12 (10.4%)</td>
</tr>
<tr>
<td># Household</td>
<td>3 (25.0%, 15.8%)</td>
<td>14 (14.3%, 84.2%)</td>
<td>2 (40%, 10.5%)</td>
<td>19 (16.5%)</td>
</tr>
<tr>
<td># Male</td>
<td>7 (58.3%, 12.5%)</td>
<td>47 (47.0%, 83.9%)</td>
<td>2 (66.7%, 3.6%)</td>
<td>56 (48.7%)</td>
</tr>
<tr>
<td># Female</td>
<td>5 (41.7%, 8.5%)</td>
<td>51 (51.0%, 86.4%)</td>
<td>3 (60%, 5.1%)</td>
<td>59 (51.3%)</td>
</tr>
</tbody>
</table>

Data Source: WCCHD Disease Prevention and Control
Table 2. Count of Shigellosis by Age during an Outbreak in an Elementary School in Williamson County, 2014

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Count</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 Year</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>1 - 4 Years</td>
<td>13</td>
<td>13%</td>
</tr>
<tr>
<td>5 - 8 Years</td>
<td>55</td>
<td>56%</td>
</tr>
<tr>
<td>9 - 13 Years</td>
<td>20</td>
<td>20%</td>
</tr>
<tr>
<td>14 - 18 Years</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>19 - 49 Years</td>
<td>6</td>
<td>6%</td>
</tr>
<tr>
<td>50 - 64 Years</td>
<td>3</td>
<td>3%</td>
</tr>
<tr>
<td>&gt; 65 Years</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>98</td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

* DOB was unknown for 17 individuals.

Data Source: WCCHD Disease Prevention and Control
**Figure 3.** Pareto chart of case frequency by classroom, including probable cases, through November 7 (last probable onset).
Figure 4. WCCHD Public Health Investigation of Shigellosis at an Elementary School, 2014

Event Timeline

- **09/05/2014**: First confirmed symptom onset date
- **09/11/2014**: First probable symptom onset
- **10/08/2014**: First notification to WCCHD; Protocol packet and initial guidelines sent to school
- **10/13/2014**: Follow-up assessment of control measures; First line-listing of cases received by WCCHD; Initial notification to State
- **10/14/2014**: Verification of control measure implementation with nursing staff (via phone)
- **10/17/2014**: Conference call with administration, custodial, and nursing staff
- **10/28/2014**: On-site inspection performed at elementary school
- **10/29/2014**: Further control recommendations sent to principle and school staff
- **10/31/2014**: Last confirmed onset date
- **11/07/2014**: Last probable onset date
Recommendations for Future Shigellosis Outbreaks

Clusters that occur in institutional settings can proliferate quickly, and timely reporting is crucial for enabling a local health authority to work with facility staff to provide guidelines and resources where needed. Too often, while investigating an outbreak, it becomes apparent that institutional staff are unaware of, or unclear on, reporting procedures and standard prevention measures. One future DCP goal is to address this issue by proactively meeting with stakeholders in the community to deliver protocol packets, review reporting steps, and forge stronger relationships with local institutions. Prompt reporting and enactment of control measures remain the most effective ways to mitigate outbreak magnitude and effect, and ongoing public health efforts should be directed towards improvement in these key areas.

Additional Resources

- WCCHD, Shigella Outbreak Detection and Management: Guidance for Schools and Daycare Facilities in Williamson County, Texas. V1.0, last updated on 11/01/2014.
Summary of Recent Influenza (Flu) Seasons in Williamson County, Texas, 2012 - 2015

Prepared by Elise Huebner, MS, CPH, Disease Control and Prevention Epidemiologist
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The Williamson County and Cities Health District (WCCHD) Disease Prevention and Control Program (DCP) collects data on influenza-like illness (ILI) throughout each season from a variety of sources within Williamson County. On a weekly basis, WCCHD DCP receives reports of ILI in patients from the following sources:

- School districts in Williamson County report to WCCHD absences due to ILI;
- Hospitals in Williamson County report numbers of patients seen with ILI and/or flu (rapid test by type: A, B, or not differentiated);
- Lone Star Circle of Care (LSCC) reports total counts of ILI seen in their clinics, and they provide additional data derived from their electronic medical record system aggregated by age, gender and zip code of residence;
- RediClinics and Texas MedClinic report total observed ILI in patients to the Centers for Disease Control and Prevention (CDC) ILINet and their data is available to WCCHD one week later;
- Hospital emergency departments report chief complaint data to a syndromic surveillance system;
- Occasionally, other health departments relay information on cases from Williamson County seen by providers in other jurisdictions.

WCCHD DCP analyzes each of these data streams weekly to identify trends in ILI in Williamson County. The WCCHD influenza surveillance system is a passive surveillance system, which relies heavily on external reporting entities to provide weekly information to WCCHD DCP. The number of reporters sending in ILI and flu reports to WCCHD DCP varies from week to week. While these data are useful to monitor trends in ILI, the system does not capture all cases of influenza or influenza-like illness (ILI) in Williamson County. Therefore, these data should be used to observe trends over time rather than for estimating the total number of cases. The following figures represent aggregate data reported by external entities to WCCHD DCP for various influenza seasons in Williamson County (Figures 1 - 10) and CDC reported influenza vaccine effectiveness (Table 1).
Figure 1. Influenza-like Illness (ILI) and Flu by Week (End Date): 2012-2013 Season

Figure 2. Influenza-like Illness (ILI) and Flu by Week (End Date): 2013-2014 Season

Data Source: WCCHD Disease Prevention and Control Influenza Report Database
Figures 1-3. Influenza-Like Illness (ILI) and Flu by Week (End Date), 2012-2015. The three previous influenza seasons followed similar patterns for season onset, peak weeks, and waning periods. The peaks generally occur in December, within increased ILI reported beginning in November and lasting through February. The 2012-2013 and 2014-2015 both experienced two peaks of high reporting, while the 2013-2014 season was condensed into a shorter, more acute season.
Figure 5. Influenza-like Illness (ILI) by Reporting Source: 2013-2014 Season

No or Reduced School Reports: Holidays

Figure 6. Influenza-like Illness (ILI) by Reporting Source: 2014-2015 Season

No or Reduced School Reports: Holidays
**Figures 4-6.** Influenza-Like Illness by Reporting Source: 2012-2015. The four main types of reporters were consistent during the study time, including clinics, hospitals, school districts, and emergency room syndromic surveillance. During the summer months, school districts do not report. However, during the school year, school district reports the highest number of ILI.

**Figure 7.** %ILI by Residence Area: 2012-2013 Season

*Data Source: Lone Star Circle of Care Report to WCCHD Disease Prevention and Control*
Figure 8. %ILI by Residence Area: 2013-2014 Season

%ILI of Total LSCC Clinic Visits

Data Source: Lone Star Circle of Care Report to WCCHD Disease Prevention and Control
Figures 7-9. %ILI [of Total LSCC Clinic Visits] by Residence Area: 2012-2015. Despite geographical differences, the major cities in Williamson County followed a similar pattern of ILI during the season.

Data Source: Lone Star Circle of Care Report to WCCHD Disease Prevention and Control
Figure 10. Past Influenza-like Illness (ILI). Previous seasons of ILI, including 2008-2015, follow different patterns, seeming to change every few years. Before the 2012-2013 season, ILI reporting was inconsistent with too few reporters. In Fall 2012, WCCHD recruited more providers and created policies for reporting. A collective group of school districts, acute care hospitals, and major clinics serve as approximations to the overall ILI burden. Because WCCHD does not receive reports on every case of ILI in Williamson County, in which the height of this graph would be taller, this graph is best used to determine the change from season to season on the timing of the peak among reporters.
Annually, the CDC collects information on vaccine effectiveness. According to the CDC website on Influenza,

CDC conducts studies to measure the benefits of seasonal flu vaccination each flu season to help determine how well flu vaccines are working. These vaccine effectiveness (VE) studies regularly assess and confirm the value of flu vaccination as a public health intervention. Study results of vaccine effectiveness can vary based on study design, outcome(s) measured, population studied and the season in which the flu vaccine was studied.

CDC has been working with researchers at universities and hospitals since the 2003-2004 flu season to estimate how well flu vaccine works through observational studies using medically attended laboratory-confirmed flu as the outcome. This is the U.S. Flu Vaccine Effectiveness (VE) Network. The U.S. Flu VE Network currently consists of five study sites across the United States that measure the flu vaccine’s effectiveness at preventing outpatient medical visits due to laboratory-confirmed influenza. CDC’s observational studies at U.S. Flu VE Network sites measure outpatient visits* for laboratory-confirmed influenza infections using a highly accurate lab test called rRT-PCR to verify the outcome. These studies compare the odds of vaccination among outpatients with acute respiratory illness and laboratory-confirmed influenza infection to the odds of vaccination among outpatients with acute respiratory illness who test negative for influenza infection.

The overall, adjusted vaccine effectiveness estimates for influenza seasons from 2005-2016 are noted in [Table 1] below. (Estimates are typically adjusted for study site, age, sex, underlying medical conditions, and days from illness onset to enrollment.)

---

## Table 1. Adjusted vaccine effectiveness estimates for influenza seasons from 2012-2015.

<table>
<thead>
<tr>
<th>Influenza Season</th>
<th>Reference</th>
<th>Study Site(s)</th>
<th>No. of Patients †</th>
<th>Adjusted Overall VE (%)</th>
<th>95% CI</th>
<th>Strains included in the vaccine², ³, ⁴</th>
<th>Strains most common (order of frequency)², ³, ⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-13</td>
<td>McLean 2014</td>
<td>WI, MI, PA, TX, WA</td>
<td>6452</td>
<td>49</td>
<td>43, 55</td>
<td>A/California/7/2009(H1N1)pdm09-like virus</td>
<td>Influenza A (H3N2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A(H3N2) virus antigenically like the cell-propagated A/Victoria/361/2011 virus (A/Texas/50/2012)</td>
<td>2009 Influenza A (H1N1)</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>B/Massachusetts/2/2012-like (B/Yamagata lineage) virus</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>B/Brisbane/60/2008-like (B/Victoria lineage) virus*</td>
<td></td>
</tr>
<tr>
<td>2013-14</td>
<td>Unpublished</td>
<td>WI, MI, PA, TX, WA</td>
<td>5990</td>
<td>51</td>
<td>43, 58</td>
<td>A/California/7/2009 (H1N1)pdm09-like virus</td>
<td>Influenza A (H3N2)</td>
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<td></td>
<td>A(H3N2) virus antigenically like the cell-propagated prototype virus A/Victoria/361/2011</td>
<td>2009 Influenza A (H1N1)</td>
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<td></td>
<td>B/Massachusetts/2/2012-like virus</td>
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<td></td>
<td></td>
<td></td>
<td>B/Brisbane/60/2008-like virus*</td>
<td></td>
</tr>
<tr>
<td>2014-15</td>
<td>ACIP presentation, Flannery</td>
<td>WI, MI, PA, TX, WA</td>
<td>9329</td>
<td>23</td>
<td>14, 31</td>
<td>A/California/7/2009 (H1N1)pdm09-like virus</td>
<td>Influenza A (H3N2)</td>
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<td></td>
<td></td>
<td>A/Texas/50/2012 (H3N2)-like virus</td>
<td>Influenza B</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>B/Massachusetts/2/2012-like virus</td>
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<td></td>
<td></td>
<td></td>
<td>B/Brisbane/60/2008-like virus*</td>
<td>Influenza A (H1N1)pdm09</td>
</tr>
</tbody>
</table>

† Number of patients used in VE calculation.

*Quadrivalent vaccine only

Because ILI is a common illness affecting millions each year in the United States, WCCHD collects information weekly from a variety of sources to determine the overall burden of ILI in Williamson County. Using historical data through the most current data, WCCHD can monitor trends, differences, and peaks among flu seasons. After a flu season concludes, more detailed information becomes available from other sources, such as the CDC and Texas Department of State Health Services (DSHS), that further inform and potentially explain the patterns seen in Williamson County. Determining the impact of ILI in Williamson County is an important factor in determining the effectiveness of public health measures used to reduce ILI spread and the overall health of Williamson County residents.

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Introduction
Several Texas laws (Health & Safety Code, Chapters 81, 84, and 87) require specific information regarding notifiable conditions (diseases) be provided to the Texas Department of State Health Services (DSHS) and local health departments, including the Williamson County and Cities Health District (WCCHD). In addition, health care providers, hospitals, laboratories, schools, and others are legally required to report, to state and local health departments, patients who are suspected or confirmed of having a notifiable condition (Chapter 97, Title 25, Texas Administrative Code) in specific time-frames, depending on the disease. The Texas Notifiable Conditions List contains a list of the diseases which are legally required to be reported to state or local agencies in Texas and indicates when the reporting entity must report each condition (see link below for current Texas Notifiable Conditions List). Confirmed or suspected cases of illness considered to be public health emergencies, outbreaks, exotic diseases, and unusual group expressions of disease must also be reported to the local health department or DSHS immediately. Diseases which require immediate public health response must be reported immediately. All other conditions must be reported to the local health department or DSHS within one week. Without such data, unusual occurrences of diseases might not be detected, trends cannot be accurately monitored, and the effectiveness of intervention activities cannot be easily evaluated.

To view the current DSHS Texas Notifiable Conditions List: 
https://www.dshs.texas.gov/idcu/investigation/conditions/

To view national reports for CDC/MMWR Summary of Notifiable Conditions: 
www.cdc.gov/osels/ph_surveillance/nndss/annsum/index.htm

Limitations of Disease Surveillance Data
WCCHD relies on a passive surveillance system to collect reports of Texas Notifiable Conditions. A limitation is that this system only captures illnesses that are reported to health departments, potentially missing possible cases of undetected or unreported illnesses. In contrast, over-reporting is also possible due to misclassification of cases, false positive laboratory results or a probable case classification based solely on a symptom profile, which mimics other conditions. Therefore, these data are helpful to observe trends and counts to apply interventions, but do not completely represent the actual burden of these illnesses. WCCHD conducts ongoing quality assurance to minimize the impact of these issues and ensure the validity and consistency of surveillance data.

Calculation of Incidence
Incidence is the number of new cases of a disease that arise during a specific period of time. In this report it is expressed as:

\[
\text{Incidence} = \left( \frac{\text{# cases of a disease or condition reported for a year}}{\text{population at risk}} \right) \times 100,000 = \text{reported cases per 100,000 population}
\]

Disease incidence is only calculated if there are five or more cases reported. The reliability of incidence statistics based on a low number of reported cases should be questioned. Whenever
possible, WCCHD utilizes the most current population estimates produced by the United States Census or the Texas State Data Center and Office of the State Demographer to calculate incidence. For current year data, incidence is calculated using a population projection.

### Summary of Selected Notifiable Conditions Reported to WCCHD, 2010 – 2015

<table>
<thead>
<tr>
<th>Notifiable Condition</th>
<th>Reported Cases</th>
</tr>
</thead>
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<tr>
<td></td>
<td>2010</td>
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<tr>
<td>AIDS</td>
<td>9</td>
</tr>
<tr>
<td>HIV</td>
<td>13</td>
</tr>
<tr>
<td>Amebiasis</td>
<td>3</td>
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<tr>
<td>Campylobacteriosis*</td>
<td>47</td>
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<tr>
<td>Chickenpox (Varicella)</td>
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<tr>
<td>Chlamydia</td>
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<tr>
<td>Cryptosporidiosis</td>
<td>9</td>
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<tr>
<td>Cyclosporosis</td>
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<tr>
<td>Dengue Fever</td>
<td>2</td>
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<tr>
<td>Drowning</td>
<td>6</td>
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<tr>
<td>Near Drowning</td>
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<tr>
<td>Encephalitis, non-arboviral</td>
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<tr>
<td><em>Escherichia coli STEC</em></td>
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<tr>
<td>Gonorrhea*</td>
<td>230</td>
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<tr>
<td>Hepatitis A, acute</td>
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<tr>
<td>Hepatitis B, acute</td>
<td>5</td>
</tr>
<tr>
<td>Hepatitis C, acute</td>
<td>-</td>
</tr>
<tr>
<td>Hepatitis other, acute</td>
<td>2</td>
</tr>
<tr>
<td>Influenza-Associated Pediatric Mortality</td>
<td>-</td>
</tr>
<tr>
<td>Legionellosis</td>
<td>-</td>
</tr>
<tr>
<td>Listeriosis</td>
<td>-</td>
</tr>
<tr>
<td>Lyme disease</td>
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<tr>
<td>Malaria</td>
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<td>Meningitis, Aseptic</td>
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<td>Meningitis, Bacterial/Other</td>
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<td>Multidrug-resistant organism (MDRO)</td>
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<td>Pertiussis</td>
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<td>Salmonellosis***</td>
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<tr>
<td>Shigellosis***</td>
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<tr>
<td>Streptococcus pneumonia*, invasive</td>
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<td>Group A Streptococcus, invasive</td>
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<tr>
<td>Group B Streptococcus, invasive</td>
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<tr>
<td><em>Streptococcus, non-A/B, invasive</em></td>
<td>2</td>
</tr>
<tr>
<td>Syphilis**</td>
<td>10</td>
</tr>
<tr>
<td>Primary and secondary syphilis</td>
<td>35</td>
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<td>Total syphilis – all stages including congenital syphilis</td>
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<td>Typhoid Fever (Salmonella typhi)</td>
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<td>Vibrio spp., non-toxigenic, other unspecified</td>
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<td>West Nile Fever</td>
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<td>West Nile Neuroinvasive Disease</td>
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<td>Yersiniosis</td>
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</tbody>
</table>

*Summary table includes those conditions with at least two reports in the eleven year period. Conditions with single reports for the period include: Chikungunya [2014], Creutzfeldt Jakob Disease [2010], Cysticercosis [2010], Encephalitis, Mumps [2011], Neisseria meningitidis - invasive (meningococcal meningitis) [2010], Pediatric influenza-associated mortality [2007], Perinatal Hepatitis B [2008], Q Fever [2012], St. Louis Encephalitis Virus (Non-neuroinvasive infection) [2012], Taenia [2012], Tetanus [2014], Trichinosis [2011], and Vibrio parahaemolyticus [2011], Vancomycin Intermediate Staphylococcus aureus [2013]. Notifiable conditions with no reports in the time period indicated are not listed.

**Data source: Texas HIV Surveillance Report: [http://www.dshs.state.tx.us/hivstd/reports/default.shtm](http://www.dshs.state.tx.us/hivstd/reports/default.shtm)

***As of January 1, 2013, cases of Campylobacteriosis with a Suspect case definition are included as notifiable conditions

**No longer notifiable as of January 1, 2013.

***As of January 1, 2014, cases of Salmonellosis and Shigellosis with Suspect case definitions are included as notifiable conditions
<table>
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<td>Streptococcus, non-A/B, invasive</td>
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<td>Primary and secondary syphilis</td>
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<td>7.0</td>
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<td>Total syphilis – all stages including congenital syphilis</td>
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<td>3.1</td>
<td>2.8</td>
<td>1.6</td>
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</tr>
<tr>
<td>Tuberculosis</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Typhoid Fever (Salmonella typhi)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Typhus fever-murine</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Vibrio spp., non-toxigenic, other unspecified</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>West Nile Fever</td>
<td>-</td>
<td>-</td>
<td>3.3</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>West Nile Neuroinvasive Disease</td>
<td>-</td>
<td>-</td>
<td>2.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Yersiniosis</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>

1 Summary table excludes all notifiable conditions with no reports or only one in the ten year period. Incidence is calculated only for those conditions with at least five cases reported in a year.
### WILLIAMSON COUNTY: Population Estimates Used to Calculate Incidence 2010 – 2015

<table>
<thead>
<tr>
<th>Year</th>
<th>Population Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010*</td>
<td>426,722</td>
</tr>
<tr>
<td>2011†</td>
<td>442,291</td>
</tr>
<tr>
<td>2012‡</td>
<td>456,232</td>
</tr>
<tr>
<td>2013⁠</td>
<td>471,014</td>
</tr>
<tr>
<td>2014⁠</td>
<td>489,428</td>
</tr>
<tr>
<td>2015⁠</td>
<td>508,514</td>
</tr>
</tbody>
</table>

*Data Source: U.S. Census Bureau, Population Division, Annual Estimates of the Resident Population for Selected Age Groups by Sex for the United States, States, Counties, and Puerto Rico Commonwealth and Municipalities: April 1, 2010 to July 1, 2012; Release Date: June 2013

†Date Source: U.S. Census Bureau, Population Division, Annual Estimates of the Resident Population for Selected Age Groups by Sex for the United States, States, Counties, and Puerto Rico Commonwealth and Municipalities: April 1, 2010 to July 1, 2013; Release Date: June 2014

‡Date Source: U.S. Census Bureau, Population Division, Annual Estimates of the Resident Population for Selected Age Groups by Sex for the United States, States, Counties, and Puerto Rico Commonwealth and Municipalities: April 1, 2010 to July 1, 2014; Release Date: June 2015

⁠Date Source: Annual Estimates of the Resident Population for Selected Age Groups by Sex for the United States, States, Counties and Puerto Rico Commonwealth and Municipalities: April 1, 2010 to July 1, 2015
Source: U.S. Census Bureau, Population Division
Release Date: June 2016

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³Data source: Texas HIV Surveillance Report: [http://www.dshs.state.tx.us/hivstd/reports/default.shtm](http://www.dshs.state.tx.us/hivstd/reports/default.shtm)

⁴Data source: Texas STD Surveillance Report: [http://www.dshs.state.tx.us/hivstd/reports/default.shtm](http://www.dshs.state.tx.us/hivstd/reports/default.shtm)