



# Investigating trends in foodborne illnesses in Lubbock and other counties in Texas

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## Abstract

**Aim** Each year, about 48 million people in the United States are affected by foodborne illnesses, with approximately 3000 of these cases resulting in death. In Texas, the incidence of illnesses like campylobacteriosis and salmonellosis has increased since 2015. In Lubbock County, Texas, however, published data on foodborne illness are scarce. The purpose of this study was to describe trends in foodborne illness in Lubbock and other counties in Texas and to evaluate the potential role of environmental inspector shortages on foodborne illnesses in Lubbock.

**Subjects and methods** County-level infectious disease cases were obtained from the Texas Department of State Health Services (DSHS) for the years 2005 and 2016–2018 and were further categorized into food-based and non-food-based. Odds ratios for the association between public health region and cases of foodborne illness over time were estimated using logistic regression. A qualitative framework analysis of environmental health inspector interview responses was conducted.

**Results** Region 1 had the highest odds of foodborne illness cases among all regions. In Lubbock, an inverse relationship was observed between the number of environmental inspectors and cases of foodborne illness, with an increase in inspectors from six to nine over the period of 2016–2018 associated with a decreasing trend in the cumulative incidence of foodborne illnesses.

**Conclusion** The increase in the number of inspectors in the city of Lubbock could be a factor in decreasing the incidence of foodborne illnesses, as their work is vital to ensuring adequate food safety practices.

**Keywords** Foodborne illness · Health inspection · Epidemiology · Statistical method · Surveillance

## Introduction

Foodborne illness is a major cause of death in the United States. According to the Centers for Disease Control and Prevention (CDC), one in six Americans (approximately 48 million) will become infected with a foodborne pathogen each year, resulting in 128,000 hospitalizations and 3000 deaths (Switaj et al. 2015). Many of these disease-causing pathogens

can contaminate food, giving rise to more than 250 different types of foodborne infections (Switaj et al. 2015). The top five pathogens known to cause such illnesses are *Norovirus*, *Salmonella*, *Clostridium perfringens*, *Campylobacter*, and *Staphylococcus aureus* (CDC 2019). The U.S. Department of Agriculture reports that foodborne illnesses are responsible for more than \$15.6 billion per year in healthcare costs (CDC 2018). An understanding of foodborne illness is thus imperative in order to explore ways to prevent disease occurrence and reduce healthcare costs associated with treatment.

At the Texas state level, some of these pathogens are well documented with regard to recent trends in foodborne illnesses. For example, the number of cases of campylobacteriosis increased from a low of 1075 (4.6 cases per 100,000) in 2006 to a high of 3944 (14.2 per 100,000) in 2015 (Texas Department of State Health Services 2019a). Diseases like salmonellosis have also been fairly problematic in Texas, with an average of 5205 cases (range 4946–5727) reported between 2011 and 2015 (Texas Department of State Health Services 2019b).

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In Lubbock County, however, published data on foodborne illness are scarce. Additionally, the number of environmental health inspectors or lack thereof is a potential factor that is rarely studied. Instead, a study conducted by Jones et al. (2004) in Tennessee looked at the effect of restaurant inspection scores on foodborne illnesses. They found that these scores alone did not predict the likelihood of a foodborne outbreak in a particular establishment, and they did not observe a meaningful difference in scores on the basis of inspection frequency (Jones et al. 2004). Nevertheless, it is possible that a meaningful difference was not detected because the researchers did not take into account inspector workload and quality of work. In fact, high workload and job stress are often associated with lower performance and reduced quality of work, as was reported in a study conducted among physicians in their general practices (van den Hombergh et al. 2009). Therefore, inspector workload is a potential factor to consider when looking at outbreaks of foodborne illnesses.

An environmental health inspector's job is to promote the city's public health through inspection of various locations such as restaurant establishments, swimming pools, and body art establishments (City of Lubbock Health Department 2020). Chief among their goals is educating the public about proper food safety practices and the prevention of foodborne illnesses.

The overall aim of this study was to analyze trends in foodborne illness in Lubbock and other Texas counties and to address the possible inspector shortage in Lubbock through an analysis of interview responses. This study's relevance and contribution to public health stems from the fact that it highlights the importance of food safety in preventing foodborne illnesses for the betterment of community health, especially because of the high burden these diseases place on the healthcare system.

## Methodology

A quantitative and qualitative framework was used in this study. For the quantitative aspect, infectious disease data were collected from the Texas Department of State Health Services (DSHS) for the years 2005 and 2016–2018, and the pathogens capable of causing foodborne illness were isolated. A breakdown of the most common foodborne illnesses found in this study can be found in Supplementary Table 1. The purpose for selecting 2016–2018 in this study was the focus on recent trends and comparison with the year that foodborne illness data was first available, 2005. For the comparison, trends in other counties with population demographics similar to those of Lubbock County were examined. The data were then stratified by public health region for further analysis, with regions 1, 3, 4, 5, 6, 7, 9, and 11 used for this study. For each region, an overall cumulative incidence of foodborne illness was

calculated. SPSS version 26 statistical software (IBM Corp 2019) was then used to calculate the odds ratios (OR) and 95% confidence intervals (CI) via logistic regression to assess the association between public health region and the incidence of foodborne illness. Data on the number of food and recreational permits along with the number of health inspectors were obtained from the Environmental Health Department of Lubbock to assess their relationship with trends in foodborne illnesses in Lubbock County. Lastly, qualitative analysis of eight Lubbock health inspector interview responses was performed in order to shed more light on the possible need for more health inspectors. This analysis consisted of the creation of a color-coded framework that highlighted the most common interview responses.

## Results

### Part I. quantitative analysis

Data collected from the Texas DSHS were used in combination with data from the Environmental Health Department of Lubbock to analyze the cumulative incidence of foodborne illness in the city and to relate that with the number of inspectors and the average number of food and recreational permits.

Figure 1 shows the number of inspectors and the cumulative incidence of foodborne illness in Lubbock County from 2016 to 2018. As the number of inspectors increased from six to nine, the cumulative incidence of foodborne illness decreased.

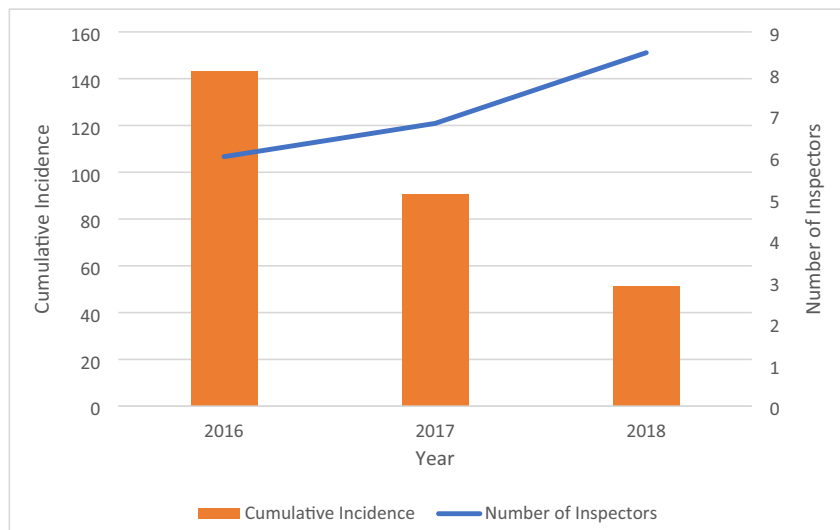
Next, Fig. 2 shows the cumulative incidence of foodborne illness in Lubbock County in relation to the average number of permits each inspector was tasked with covering. As the average number of food and recreational permits per inspector decreased, the cumulative incidence of foodborne illness also decreased.

Figure 3 shows the cumulative incidence of foodborne illness for all regions studied for the years 2005 and 2018. According to this graph, all regions except region 1 showed an increase in cumulative incidence of foodborne illness from 2005 to 2018.

Table 1 depicts the odds ratio estimates for foodborne illness for the years studied using 2005 as a referent group. There was a significant difference overall in years with regard to cases of foodborne illness ( $p < 0.001$ ). From 2016 to 2018, the odds ratios for cases of foodborne illness decreased every year but were still higher than cases reported for 2005. Of all the years studied, 2016 had the highest odds (103%) of foodborne illness cases when compared with 2005 (OR: 2.03; 95% CI: 1.92–2.14).

Table 2 shows the odds ratio estimates for foodborne illness for the public health regions studied using region 11 as a referent group. There was a significant difference overall in

**Fig. 1** Number of inspectors vs. cumulative incidence of foodborne illness in Lubbock County, 2016–2018



public health region with regard to cases of foodborne illness ( $p < 0.001$ ). Region 1 had the highest odds of foodborne illness cases among all the regions studied. When compared with region 11, region 1 had 128% higher odds of foodborne illness cases (OR = 2.28; 95% CI: 2.12–2.45).

**Part II. Qualitative analysis**

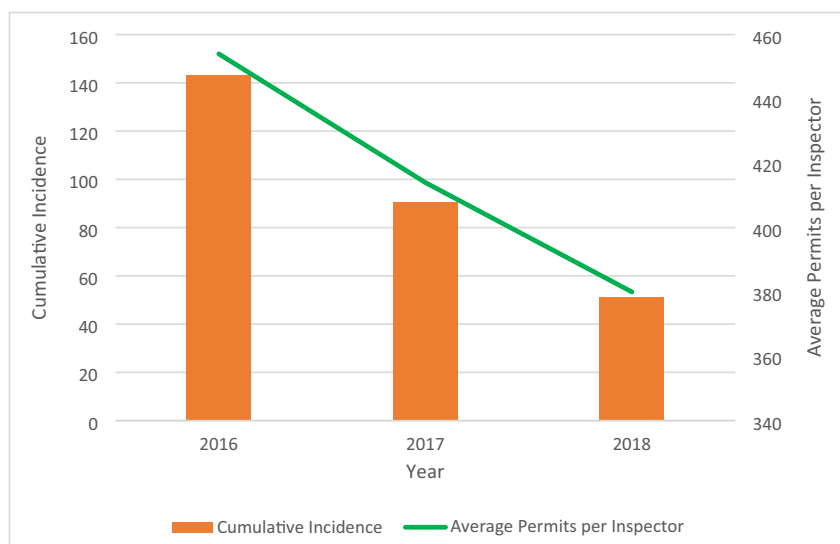
The color-coding system utilized for analysis of inspector interview responses was as follows: blue boxes indicate positive feedback from the interview, red boxes indicate negative feedback, and green boxes represent educational requirements and general aspects of the job (Fig. 4). The years of work experience for the environmental health inspectors interviewed ranged from 2 months to 8 years. For the most part, the inspectors had very similar responses to the interview questions.

They very much enjoy educating the public about proper sanitation methods and feel that they are contributing to a healthier community. The most negative aspects of the job are mainly related to the large amount of work the position entails. For instance, there were over 1800 permits to cover in Lubbock County in 2018 and not enough inspectors to handle all of them, so many places were only inspected once or twice a year.

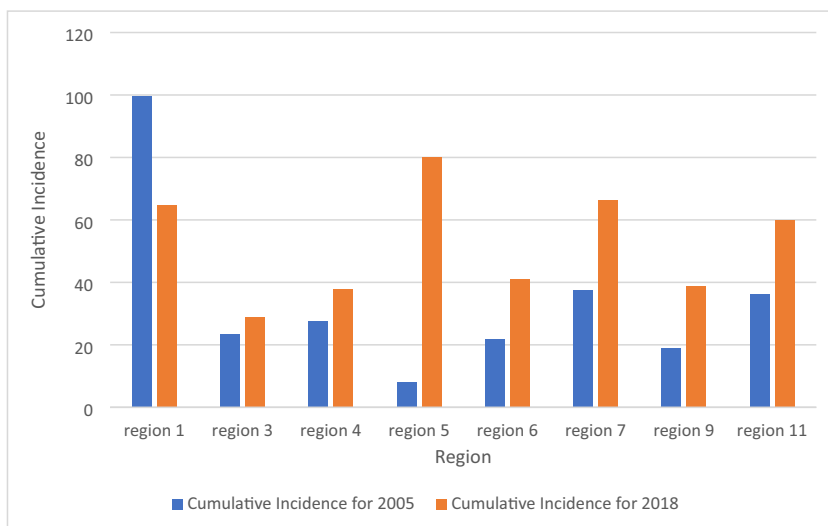
**Discussion**

Overall, Lubbock County has seen a decrease in the cumulative incidence of foodborne illness from 2016 to 2018. This decrease appears to be related to the increase in the number of food inspectors. As more inspectors were hired,

**Fig. 2** Average number of permits per inspector vs. cumulative incidence of foodborne illness in Lubbock County, 2016–2018



**Fig. 3** Cumulative incidence of foodborne illness by public health region, 2005 vs. 2018



their cumulative workload decreased, as they had fewer permits to cover. Even though we observed that the inspectors were covering more permits than the Lubbock Environmental Health Department’s maximum recommendation of 140 each year, this minimal reduction in their workload seems to have influenced foodborne illnesses in Lubbock. It stands to reason that perhaps further reductions in the cumulative incidence of foodborne illness can be achieved as the number of permits approaches the recommended counts. Reducing the incidence of foodborne illness is important, especially because some age groups and those who are immunocompromised are more susceptible. In the United States, these groups make up about 15–20% of the population and can include people with primary immunodeficiency, those with liver or kidney disease, pregnant women, infants, and the elderly (Lund and O'Brien 2011). The fact that foodborne illnesses are a financial burden and can cost billions of dollars to treat each year further increases the need for protecting at-risk populations (CDC 2018).

A subsequent analysis of the regions studied found that region 1 was the only region to experience a decrease in cumulative incidence of foodborne illness between 2005 and 2018, but further analysis of environmental health departments in this region besides Lubbock County will be needed before any definitive conclusions can be drawn

**Table 1** Odds ratio estimates for the association between year and cases of foodborne illness in Texas counties

Year	OR (95% CI)
2005	1
2016	2.03 (1.92–2.14)
2017	1.55 (1.46–1.64)
2018	1.48 (1.39–1.57)

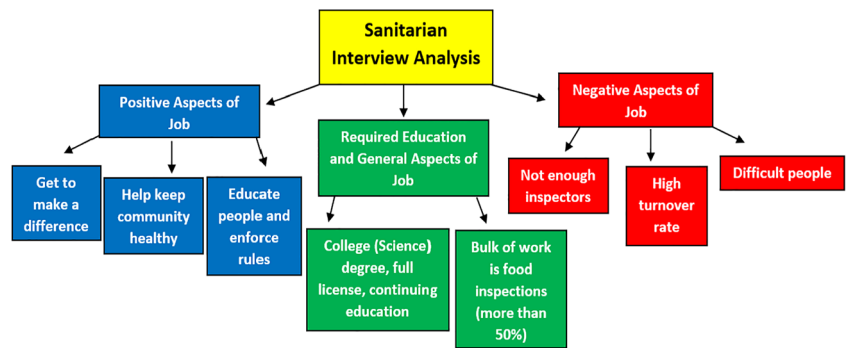
as to why that is the case. Next, odds ratio estimates showed an overall significant difference among years with regard to cases of foodborne illness ( $p < 0.001$ ). From 2016 to 2018, the odds ratios for cases of foodborne illness decreased every year but were still higher than cases in 2005.

One of the main strengths of this study is that it is one of the few studies to provide trends in foodborne illnesses in Texas, and is the only one to do so for Lubbock. It is also one of the few studies to look at foodborne illness in relation to the number of inspectors and average permits they are tasked with covering. A limitation of this study is that these findings may not be generalizable to all counties in Texas, since they were not all included in the study. However, they are generalizable to counties with similar population demographics as those of Lubbock County. Another limitation is that since this is an ecological study by design, there are no characteristics of individual cases of foodborne illness. Finally, all the inspectors interviewed had different years of experience, so it is possible that those who had more experience simply had more to share. Nevertheless, overall, these novel findings lay a good

**Table 2** Odds ratio estimates for the association between public health region and cases of foodborne illness in Texas counties

Public health region	OR (95% CI)
Region 11	1
Region 1	2.28 (2.12–2.45)
Region 3	0.75 (0.70–0.81)
Region 4	0.92 (0.84–1.01)
Region 5	0.65 (0.59–0.72)
Region 6	1.09 (1.00–1.18)
Region 7	1.56 (1.46–1.68)
Region 9	1.37 (1.25–1.51)

**Fig. 4** Qualitative framework summary analysis of Lubbock food inspector interview responses



foundation for future studies on the relation between health inspection and incidence of foodborne illness.

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**Author contribution statement** All authors contributed to the study conception and design. Material preparation, data collection, analysis, and revisions were performed by Obadeh Shabaneh, Mark Walker, Theresa Byrd, and Duke Appiah. The first draft of the manuscript was written by Obadeh Shabaneh, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

**Compliance with ethical standards**

**Conflict of interest** The authors declare that they have no conflict of interest.

**Financial disclosures** None reported.

**Ethics approval** This is an observational study. The local ethics committee of Texas Tech University Health Sciences Center has confirmed that no ethical approval is required.

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