December 2016

Determining the Effects of the Think Risk Initiative as Implemented by the Southern Nevada Health District

Karalin Nichole Cronkhite
University of Nevada, Las Vegas, cronkhit@unlv.nevada.edu

DETERMINING THE EFFECTS OF THE THINK RISK INITIATIVE AS IMPLEMENTED BY THE SOUTHERN NEVADA HEALTH DISTRICT

By

Karalin Cronkhite

Bachelor of Science- Nutrition
California Polytechnic State University
2009

A thesis submitted in partial fulfillment
of the requirements for the

Master of Public Health

Department of Environmental and Occupational Health
School of Community Health Sciences
Division of Health Sciences
The Graduate College

University of Nevada, Las Vegas
December 2016

UNLV | GRADUATE COLLEGE

Thesis Approval

The Graduate College
The University of Nevada, Las Vegas

November 17, 2016

This thesis prepared by

Karalin Cronkhite

entitled

Determining the Effects of the Think Risk Initiative as Implemented by the Southern Nevada Health District

is approved in partial fulfillment of the requirements for the degree of

Master of Public Health
Department of Environmental and Occupational Health

Brian Labus, Ph.D., MPH
Examination Committee Co-Chair

Kathryn Hausbeck Korgan, Ph.D.
Graduate College Interim Dean

Patricia Cruz, Ph.D.
Examination Committee Co-Chair

Guogen Shan, Ph.D.
Examination Committee Member

Clark Kincaid, Ph.D.
Graduate College Faculty Representative

Abstract

In the United States, someone becomes infected with a foodborne illness every 2 seconds, is hospitalized by a foodborne illness every 4 minutes and dies due to a foodborne illness every 3 hours. Foodborne illness is preventable, yet each year, 1 in 6 Americans is affected by it from contaminated foods or beverages. There are over 250 different foodborne diseases, and in 2015, there were 73 confirmed cases of *Salmonella* infection in Southern Nevada alone. Since the emergence of public health, food establishment inspections have been an important part of the regulation of food safety. Risk-based inspections were developed by the U.S. Department of Agriculture (USDA) Food Safety and Inspection Service with the intention of focusing resources on the establishments that posed a greater risk to public health. The Southern Nevada Health District (SNHD) is the governmental agency in Clark County, NV, that is responsible for safeguarding over 2 million residents and over 42 million annual visitors, making it one of the largest health departments in the United States. In 2013, the Southern Nevada Health District developed and implemented the Think Risk Initiative, which is based on the USDA's risk-based inspections. The purpose of this initiative was to encourage food operators and food inspectors to consider the risk associated with each violation when working with food. SNHD modified the inspection report form to place greater emphasis on the violations that are associated with the highest risk of foodborne illness. The purpose of this study was to evaluate the effects of the Think Risk Initiative on the overall scores of the food establishments. The categories evaluated were the change in letter grades earned on routine inspections, the change in total demerits earned and the change in adjusted demerits. Data were collected from SNHD for all food establishments from 2011-2015. Data from 2011-2012 were compared to data from 2014-2015 for all food establishments that were operational for all 5 years. Facilities grades were a mean of 2.83 ± 0.38 pre-initiative and remained at 2.83 ± 0.36 post-initiative. The mean change of 0.00

(95% CI, -0.01 to 0.01) is not statistically significant (p=0.946). Facilities scores pre-initiative were 6.90 ± 5.65 and were reduced to 5.84 ± 5.57 post-initiative. The mean change of 1.06 (95% CI, 0.95 to 1.18) is statistically significant (p<0.001), t(10,334) = 18.51. Facilities adjusted demerits pre-initiative were 6.66 ± 7.36 and were reduced to 6.29 ± 6.94 post-initiative. The mean change of 0.37 (95% CI, 0.21 to 0.53) is statistically significant (p<0.001), t(9,811) = 4.49. No change in the letter grades was observed from the Think Risk Initiative and the total demerits decreased on average by only 1. When the demerits were rescored to be equal pre- and post-initiative, this was reduced to only an average of 0.37 demerit decrease, which would result in no change of score or grade. This suggests that the reduction in total demerits is due to rescoring the inspection forms and not due to any facility improvement. The guidelines recommended by the Food and Drug Administration (FDA), as implemented by the SNHD through the Think Risk Initiative, did not encourage the facilities to improve compliance with the regulations. The Think Risk Initiative did offer some benefits to the industry and community. It appears to have shifted the focus of inspections and inspection scores to violations that directly correspond to risk for foodborne illness. It also prevents facilities from receiving downgrades and closures caused by violations that are not directly related to foodborne illness.

Acknowledgements

This thesis was made possible with the time commitment, guidance, knowledge, and support of the following individuals: Dr. Brian Labus, for his guidance and helping me find a research project that would capture my interest, and giving me the confidence needed to complete this project; Dr. Patricia Cruz, for her high standards and scholarly guidance; Dr. Guogen Shan, for his assistance with data analysis and teaching me biostatistics; Dr. Clark Kincaid, for bridging the gap between hospitality and community health sciences for the purposes of this research; my committee members, thank you all for your time and flexibility; Jason Frame for providing the dataset with the historical date from the Southern Nevada Health District; Micah for his constant support; and lastly, Fred for keeping me company while I researched and wrote. You have all assisted me more than you know and helped me to utilize my knowledge in real world applications. Thank you.

Table of Contents

List of Tables

List of Figures

Introduction

There are over 54 billion meals served from restaurants annually in the United States (Jones et al., 2004). On average, 44% of U.S. adults eat at a restaurant every day (Jones et al., 2004). The Centers for Disease Control and Prevention (CDC) estimates that there are approximately 48 million people that become ill, 128,000 are hospitalized, and 3,000 die from foodborne illness every year (CDC, 2013). This means more people die annually from foodborne illness than died in the attack on the World Trade Center on 9/11. Foodborne illness is preventable, yet each year, 1 in 6 Americans is affected by it from contaminated foods or beverages (CDC, 2013).

The three main types of contamination of food that can lead to foodborne illness are chemical, physical, and biological (Council to Improve Foodborne Outbreak Response [CIFOR], 2014). The main cause of these diseases are bacteria, viruses or parasites (CDC, 2013). There are over 250 different foodborne diseases, with Norovirus, *Salmonella*, *Clostridium perfringens* and *Campylobacter* being the most common pathogens (CDC, 2013). In Southern Nevada, there were 73 confirmed cases of salmonellosis, 48 cases of campylobacteriosis, 19 cases of giardiasis and 12 cases of Shiga-toxin producing *E. coli* infection in 2015 (SNHD, 2016b). The food safety progress report for 2013 shows that *Vibrio* infection has increased by 75% since 2008 and campylobacteriosis by 13%. *E. coli* and *Salmonella* infection rates have not changed (CDC, 2016b). There are many different symptoms associated with foodborne illness; nausea, vomiting, abdominal cramps and diarrhea being the most common (CDC, 2013).The foods most commonly linked to foodborne illness are raw animal foods, raw shellfish, raw milk, pooled raw eggs, raw fruits and vegetables, raw seed sprouts, and unpasteurized juice (CDC, 2013).

There are several ways in which food may become contaminated, including at the source.

It is common for dangerous bacteria to survive in the intestines of healthy animals such *as E. coli* in cattle and *Salmonella* in poultry (CDC 2013). This poses a risk of contamination during slaughter. Contaminated water or manure can contaminate fruits and vegetables. Filter-feeding shellfish such as oysters are known to carry *Vibrio* bacteria and norovirus (CDC, 2013). Food can also become contaminated from poor handling procedures or cross contamination. *Shigella*, Hepatitis A Virus and norovirus are commonly transferred to food from infected food handlers that do not properly wash their hands (CDC, 2013). Not properly washing utensils between uses can transfer microbes from one food to another, and improper food storage can also contaminate food, such as raw foods dripping onto ready to eat items.

The handling of foods after they are contaminated can determine whether or not it may lead to an outbreak. With the exception of *Listeria* and *Yersinia*, refrigeration prohibits the bacteria from multiplying (CDC, 2013). High salt content, sugar content or acidity can also prohibit bacterial growth. Microbes can be killed by heat with the exception of spore-formers such as *Clostridium* spp. and toxins produced by bacteria such as staphylococcal toxins (CDC, 2013).

Preventing foodborne illness outbreaks is a large focus of public health departments (Jones et al., 2004). Outbreaks in the community must be prevented and controlled at the earliest stage possible to limit further spread of the disease. The CDC emphasizes the importance of focusing on prevention methods for food safety (CDC, 2016a). There must be policies in place to guide public health departments in the prevention, detection and termination of outbreaks in the community.

Since the emergence of public health, inspections have been an important part of the regulation of food safety (FDA, 2016). The FDA describes routine inspections as “periodic

inspections conducted as part of an on-going regulatory scheme" (FDA, 2016). Food inspections have been described as "a crucial public service designed to prevent foodborne illnesses among retail food consumers" and have been shown to prevent foodborne illness outbreaks (Dyjack et al., 2007). A study by Johnson et al. found that facilities having at least one inspection per year would likely lead to a reduction in the risk of foodborne illness (1998). Higher frequency of food inspections has been linked to better inspection scores and reduced foodborne illness (Dyjack et al., 2007). The FDA also recommends an inspection frequency of 1-4 times per year (Dyjack et al., 2007).

Risk-based inspections were developed by the U.S. Department of Agriculture (USDA) Food Safety and Inspection Service with the intention of focusing resources on the establishments that posed a greater risk to public health (USDA, 2008). A study by Jones et al. demonstrated that the mean scores of food establishments that suffered a foodborne outbreak were not significantly different from those without a reported outbreak (Jones et al., 2004). This study was based in Tennessee where they were not implementing risk based inspections at the time. The authors found that the majority of violations noted on health inspection reports do not contribute to foodborne illness and would be categorized as good management practices (Jones et al., 2004). Dyjack et al. revealed that very few health departments had implemented risk-based inspections as recommended by the FDA (Dyjack et al., 2007). It is suggested that risk-based inspections better utilize staff and funding where it makes the biggest impact (Dyjack et al., 2007). Risk-based inspections emphasize the violations that are likely to lead to foodborne illness, assessing more demerits to high-risk items and no demerits to good management practices. This ensures that the scores are comparable to the facility's level of risk.

In Southern Nevada, the Southern Nevada Health District (SNHD) is the governmental

agency that is responsible for safeguarding over 2 million residents and over 42 million annual visitors, making it one of the largest health departments in the United States (Las Vegas Visitors and Convention Authority, 2016; SNHD, 2016e). The goal of SNHD is "to protect and promote the health, the environment and the well-being of Southern Nevada residents and visitors" (SNHD, 2016e). SNHD is the public health authority responsible for the surveillance of diseases and conditions that promote the spread of disease, investigation of complaints and disease outbreaks, and making efforts to control the spread and development of disease and sentinel health events (SNHD, 2016e). SNHD is responsible for ensuring that the environment is healthy and safe by monitoring, regulating and educating food establishments (SNHD, 2016e). SNHD states that their role is to provide guidance to the operators and provide regulation to ensure operator compliance, while the role of the operators is to train and monitor staff, conduct safe procedures and provide corrective actions (SNHD, 2014a).

As part of routine public health practice, the SNHD conducts unannounced food operations inspections at all permitted facilities. The Environmental Health Specialists conduct the inspections and document all their findings on the inspection form by hand. These data are entered into their tracking system by administrative staff. Each violation category is assigned a violation ID. That corresponding violation ID is selected when a violation category is marked out of compliance by the inspector.

The goal of risk-based inspections is to keep the inspectors focused on evaluating the degree of active managerial control over the major risk factors for foodborne illness, even in a short amount of time, with an emphasis on being proactive rather than reactive (FDA, 2016).

SNHD adopted this method in 2013 with the development and implementation of the Think Risk Initiative (SNHD, 2014b; SNHD, 2016d). The purpose of this initiative was to encourage food operators and food inspectors to consider the risk associated with each violation when working with food. In 2013, SNHD began to place emphasis on 5 major items: sharing information and collaboration among industry and regulatory, evaluating daily control of risk factors for foodborne illness, implementation and evaluation of the person-in-charge knowledge and implementation of regulations, immediately correcting any observed risk factors, and implementing behaviors to encourage long-term compliance with the regulations (SNHD, 2014b; SNHD, 2016d).

The main focus of risk-based inspections are the 5 categories that directly relate to food safety concerns, which the FDA has termed "foodborne illness risk factors" and SNHD refers to as the "5 major risk factors for foodborne illness" (FDA, 2016; SNHD, 2014a). These include: poor personal hygiene, food from unsafe sources, improper cooking temperatures/methods, improper holding time and temperature, and food contamination (FDA, 2016; SNHD, 2014a). In 2013, SNHD was able to incorporate these risk factors into the inspection reports through the Think Risk Initiative with minimal modifications.

The FDA has warned health departments that the use of a scoring system may result in inaccurate representation of risks, such as a facility with serious health risks observed receiving a very high score, so SNHD assesses demerits instead of points to shift focus onto items that require correction, and has done away with assessing demerits for violations that are not directly

linked to foodborne illness (FDA, 2016). SNHD modified the inspection process to place greater emphasis on the violations that are associated with the highest risk of foodborne illness. Minor violations that previously accounted for 1 demerit were determined to contribute to no direct risk of foodborne illness and were changed to good management practices, and are no longer weighed with demerits (SNHD, 2014b). Critical violations are assessed at 5 demerits, Major violations are assessed at 3 demerits, and good management practices that once were assessed at 1 demerit are now 0 demerits. A score of 0-10 demerits results in an A grade, 11-20 demerits results in a B grade, 21-40 demerits results in a C grade, and 41 demerits or more, or observation of an imminent health hazard, results in a closure of the facility (Table 1). The idea was to reinforce the major and critical violations that have more of a direct correlation to foodborne illness, while reducing the focus on violations that do not directly contribute to foodborne illness (SNHD, 2014b).

Table 1: Corresponding grades per assessed demerits

Grade	Demerits
A	0-10
B	11-20
C	21-40
Closure	41+ or Imminent Health Hazard

SNHD implemented facility risk categorization of low, medium or high, as recommended by the FDA, with the Think Risk Initiative. These rankings are taken into consideration when the inspectors plan out their inspections, allocating additional time for higher risk facilities and inspecting high risk facilities at greater frequency (Dyjack et al., 2007). SNHD implements this based on failure rates and risk categories. Facilities that serve a high-risk population such as senior living facilities, as well as facilities that could potentially meet 3 out of 5 of the major risk

factors that contribute to foodborne illness, were categorized as high risk facilities. For example, a coffee shop or bakery was categorized as a lower risk than a full-service restaurant. High-risk facilities should be inspected at least twice per year. If a facility receives a B downgrade they are to be inspected again within 6 months, C downgrade within 60-90 days, and Closure within 30-60 days after re-opening. A study in Hamilton, Ontario evaluated the relationship between inspection frequency and food safety compliance, randomly assigned facilities with high risk for foodborne illness three to five inspections per year. The results demonstrated no significant difference in compliance with food safety based on their inspection frequency. Alternatively, the facilities that demonstrated improved compliance were those with a greater time between inspections, compared to those that were inspected more frequently (Hall et al., 2008).

FDA explains that the opportunity for facility operators to ask questions allows them to gain a better understanding of the significance of their actions (FDA, 2016). In 2013, all food establishments were provided education on how to reduce their risks of foodborne illness and were educated on which risk factors were associated with their specific establishment (SNHD, 2014b). This was completed during their annual routine inspection conducted by their designated inspector (SNHD, 2014b). Due to the high number of changes to the inspection process, all facilities that met a minimum of 3 of these categories were granted an audit in the year 2013 (SNHD, 2014b). When inspectors arrived for the facility's first annual unannounced routine inspection, if they were at risk of receiving a B or C grade based on the new inspection form, the facility would be granted a one-time audit with a pass or fail score. The facility was then required to have all corrections made and pass another unannounced inspection within 30 days. This provided a period of adjustment for the operators. Food establishments that were struggling to

understand or comply with the changes were offered free consulting through June 30, 2014 (SNHD, 2014b).

The South Carolina Department of Health and Environmental Control (DHEC) has implemented some recommendations for risk-based inspections, focusing on the 5 major risk factors for foodborne illness. They have not implemented demerits in place of points (DHEC, 2015). No information is available on the effectiveness of their implementation. Studies show that a certified food protection manager may improve compliance with regulations for some specific critical violations, but not all. Facilities with a certified food protection manager on staff were less likely to suffer a foodborne illness outbreak (Cates et al., 2009).

Objective

The purpose of this study was to evaluate the effects of the Think Risk Initiative on the overall scores of food establishments. This study evaluated the change in letter grades earned on routine inspections, the change in total demerits earned on routine inspections and the change in adjusted demerits (rescoring the 2014 and 2015 inspections using the pre-initiative scoring values to allow for direct comparison) on routine inspections, reviewing the same facilities before and after implementation of the initiative.

Research Questions

There were three research questions evaluated in this study:

1. Did the Think Risk Initiative result in a change in letter grades on routine inspections?
2. Did the Think Risk Initiative result in a change in total demerits assessed on routine inspections?
3. Did the Think Risk Initiative result in a change in adjusted demerits on routine inspections?

Hypotheses

There were three hypotheses evaluated in this study:

$H1_o$: Implementation of the Think Risk Initiative did not change the distribution of letter grades during routine restaurant inspections in Southern Nevada.

$H1_a$: Implementation of the Think Risk Initiative changed the distribution of letter grades during routine restaurant inspections in Southern Nevada.

$H2_o$: Implementation of the Think Risk Initiative did not change the distribution of total demerits assessed.

$H2_a$: Implementation of the Think Risk Initiative changed the distribution of total demerits assessed.

$H3_o$: Implementation of the Think Risk Initiative did not change the distribution of adjusted demerits assessed.

$H3_a$: Implementation of the Think Risk Initiative changed the distribution of adjusted demerits assessed.

Approach- Research Design and Methods

In this longitudinal study, data were obtained from SNHD for all food establishments from 2011-2015. During 2013, facilities were granted an audit in place of a routine inspection and were provided guidance to prepare for the modified inspections. The year 2013 was excluded from the analysis as it was a transition year, and the exclusion allows a clear differentiation between the pre- and post-initiative data. Only the first unannounced routine inspection of each year was included. This is due to the adjustment in inspection frequency from the Think Risk Initiative. If all routine inspections were included, more data would come from facilities that score poorly. This exclusion ensures that each facility has equal numbers of inspections included in the data set. Data from the first unannounced routine inspections for each facility in 2011 and 2012 was compared to data from the first unannounced routine inspections for each facility in 2014 and 2015 for all food establishments that were operational for all 5 years.

To determine if there was a significant difference pre- and post-initiative, only establishments that experienced the pre-initiative process and the post-initiative process were included in the analysis. Excluding facilities that were not operational for all 5 years produced a complete dataset and ensured that there were sufficient measurements on each restaurant pre- and post-initiative. This produced individual data rather than aggregated data, as well as minimized bias. The inclusion of facilities that were not operational for all 5 years may not be able to accurately represent the potential effect that the Think Risk Initiative could have had long term. The inclusion of facilities that were revoked after repeated downgrades and closures before the initiative, or those that had recently opened and were not operational long enough to develop routine behaviors after the initiative, would not demonstrate any effect from the Think Risk

Initiative. Therefore, only restaurants that were operational for all 5 years were included in the analysis.

The count of total demerits and letter grades for each facility was plotted on a bar graph to visualize any change that occurred from the initiative. To determine if there was any shift in the type of demerits being cited after implementation of the Think Risk Initiative, the count of minor demerits for each year was then analyzed, as well as the count of major and critical demerits.

Hypothesis 1- Approach and Methods

The letter grades earned for all applicable facilities were separated out by year for 2011, 2012, 2014 and 2015 for their first unannounced routine inspections for the year. The possible letter grades include A, B, C or it could result in a facility Closure. The grades were assigned a numeric value to conduct a paired t-test. An A was valued at 3, B valued at 2, C valued at 1, and a closure was valued at 0. The pre- and post-initiative values were then compared using a paired t-test to determine if implementation of the Think Risk Initiative changed the distribution of letter grades during routine restaurant inspections in Southern Nevada. If the paired t-test demonstrated a significant difference, a linear regression model was used to determine whether the slope of the regression lines differed significantly from zero. A significance value of <0.05 was used. If the p value was determined to be less than 0.05, the null hypothesis was rejected.

Hypothesis 2- Approach and Methods

The total demerits assessed for all applicable facilities were collected for 2011, 2012, 2014 and 2015 for their first unannounced routine inspections for the year. The total number of demerits for all facilities as assigned by SNHD were compared using the first unannounced

routine inspections of each year. The pre- and post-initiative values were compared using a paired t-test to determine if implementation of the Think Risk Initiative changed the distribution of unadjusted total demerits assessed during routine restaurant inspections in Southern Nevada. If the paired t-test produced significant results, a linear regression model was used to determine whether the slope of the regression lines differed significantly from zero. A significance value of <0.05 was used. If the p-value was determined to be less than 0.05, the null hypothesis was rejected.

Hypothesis 3- Approach and Methods

The study adjusted for the initiative changes made to the inspection report in 2013 by rescoring demerits assessed for all categories that were modified between 2011 and 2015. For example, fruits and vegetables not washed prior to preparation or service was assessed 1 demerit in minor violation category #34, with no other possible violations in that category, pre-initiative. Post-initiative, it is a major violation category #19, assessed at 3 demerits and paired with the violation of not properly thawing frozen potentially hazardous foods/ time and temperature controlled for safety (PHF/TCS) foods (SNHD, 2016c). The two violations would be indistinguishable from one another with the data that are available. It is not possible to see the specific violation that the facility had due to the fact that the entire report is not available and only the violation category is visible. For this reason, each category that was modified was rescored. See Appendix A for a list of rescoring values for each category.

Several violation IDs were related to each other in some manner, so 7 were rescored at a value of 3 demerits each. These categories were assessed at 1, 3 or 5 demerits initially. Rescoring all categories to a value of 3 provided the ability to adequately evaluate them all as the same

value pre- and post-initiative. Several good management practices assessed at zero demerits post-initiative were rescored at 1 demerit to match the corresponding minor violations pre-initiative.

The adjusted demerits assessed for all applicable facilities were collected for 2011, 2012, 2014 and 2015 for the first unannounced routine inspection for each year. The adjusted demerits for all facilities were compared using the first unannounced routine inspections of each year. The pre- and post-initiative values were compared using a paired t-test to determine if implementation of the Think Risk Initiative changed the distribution of adjusted demerits assessed during routine restaurant inspections in Southern Nevada. If the paired t-test produced significant results, a linear regression model was used to determine whether the slope of the regression lines differed significantly from zero. A significance value of <0.05 was used. If the p value was determined to be less than 0.05, the null hypothesis was rejected.

Inclusion and Exclusion Criteria

Beginning with all operational inspections from 2011-2015, all data from 2013 were excluded due to implementation of the audit. This was also a transition year. Annual Itinerant permits were excluded from all data sets due to their unique grading scale of pass or fail with 20 or fewer demerits receiving the facility a passing score. Only the first unannounced routine inspection of each year was included due to the adjustment in inspection frequency from the Think Risk Initiative. For the adjusted demerits section, some early 2011 data were excluded due to incomplete data in the SNHD systems and the fact that specific violations were not correctly entered. In addition, all facilities with a calculated demerit value that did not match the reported demerit value were excluded due to data input error.

Human Subjects Protection

The data collected in this study only apply to the process of food inspections and do not include any data collected from human subjects. These data do not meet the requirements for review covered by 45 CFR part 46, and are not required to undergo review or approval by the Institutional Review Board at the University of Nevada, Las Vegas for the protection of human subjects.

Results

The full dataset for all 5 years included 19,328 facilities, totaling 117,375 inspection reports. After excluding facilities that were not operational for all 5 years, data from 2013, facilities receiving a "pass" letter grade (n=2) and all data from inspections that were not the first routine inspection of each year, 10,337 facilities were included which had 4 inspections each. There were a total of 41,348 inspections included in the analysis of letter grades and total demerits, half of which represent the pre-initiative data and half represent the post-initiative data (Figure 1).

A subset of the data was used to determine the adjusted demerits. From the 10,337 facilities, a total of 9,812 facilities were included which had 4 inspections each (Figure 1). There were 39,248 inspections included in this section, half of which represent the pre-initiative data and half represent the post-initiative data. The data entries were validated by comparing the reported demerits to what was calculated from the violation IDs that were entered in the SNHD system. Facilities with scores that could not be validated for any of the 4 years were excluded. The demerit values were then re-scored. See Appendix D for complete list of re-scored demerits. Annual Itinerant permits were also excluded from this section due to their unique pass or fail scoring system.

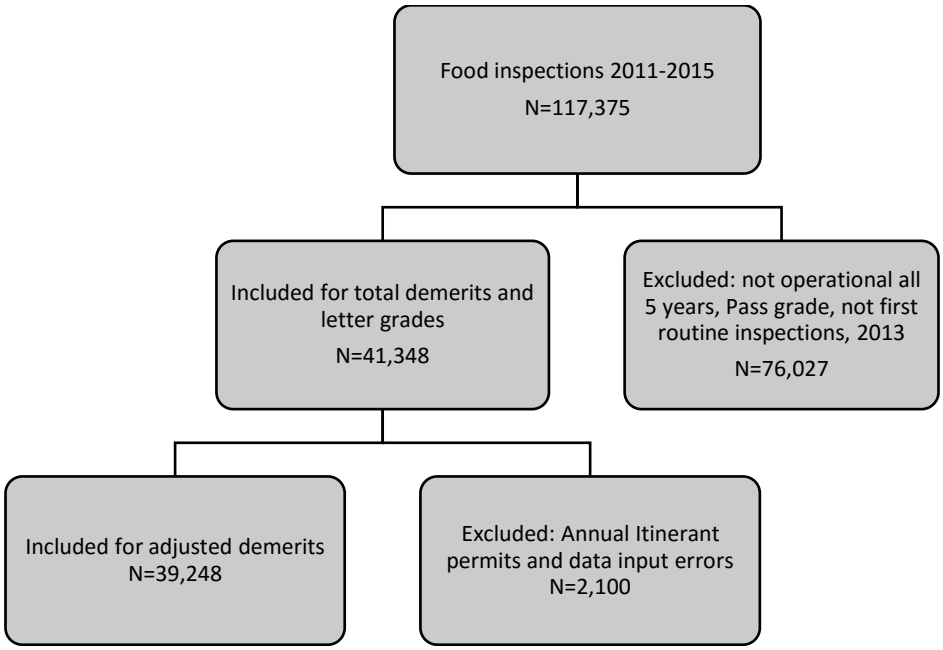


Figure 1: Results of Applying Exclusion Criteria

Pre-initiative grades were distributed with 86.2% A grades, 11.1% B grades, 2.3% C grades and 0.4% Closures. Post-initiative grades were distributed with 87.0% A grades, 9.5% B grades, 3.0% C grades and 0.5% Closures (Figure 2). After implementation, there was an increase in A grades, C grades and Closures, and a decrease in B grades. Pre-initiative, the highest number of demerits assessed on a single routine inspection was 89, post-initiative was 61.

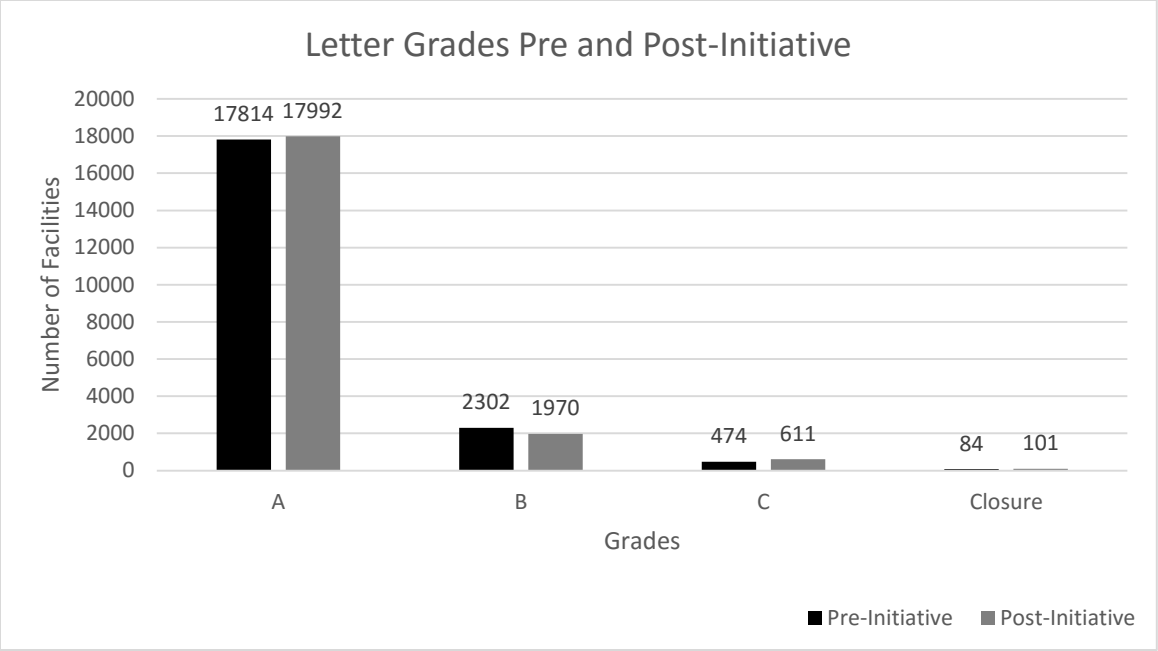
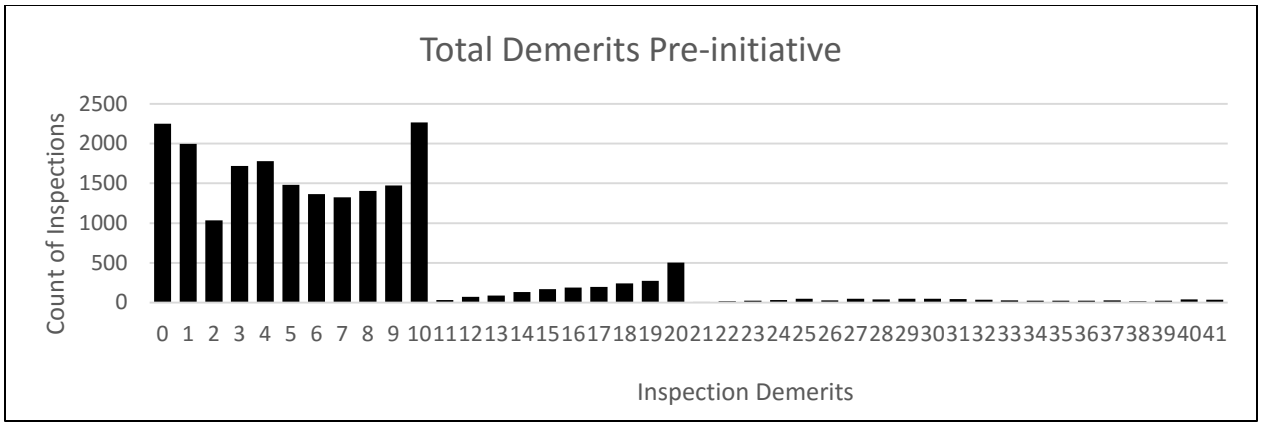


Figure 2: Letter Grade Comparison Pre- and Post-initiative

Total demerits followed similar trends, with peaks in the 0-10 demerit range pre- and post-initiative, as well as in the 16-20 demerit range (Figure 3). With the revisions made to the inspection form and scoring of violations post-initiative, several of the demerit scores are no longer possible. There is also a peak at 0 demerits post-initiative, due to the removal of the 1 demerit assessment for good management practices.



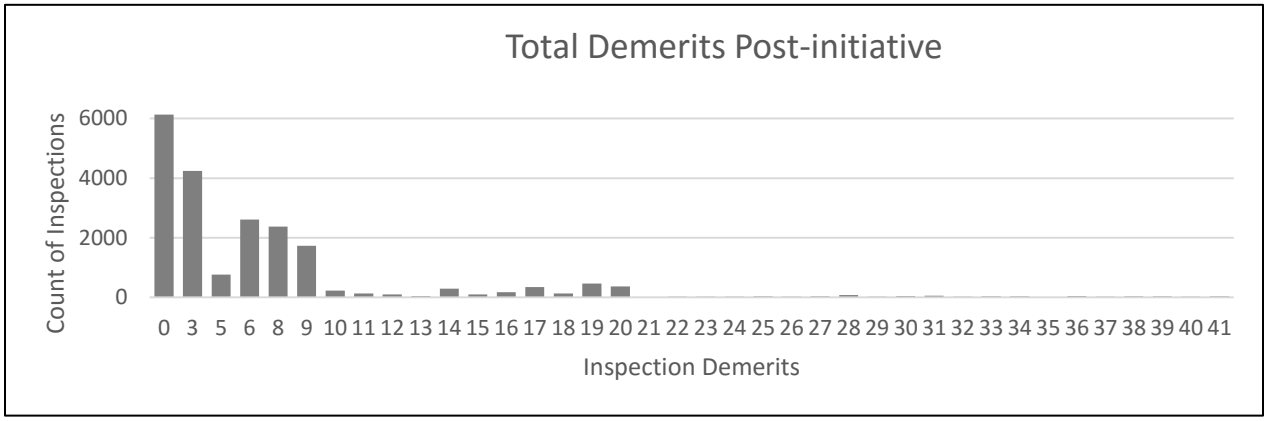


Figure 3: Total Demerits Comparison Pre- and Post-Initiative

The counts of minor violations pre-initiative and good management practices post-initiative were compared, as well as the counts of major and critical violations pre- and post-initiative. The mean of good management practices decreased by 0.38, and the mean of major and critical violations increased by 0.10 (Table 2). The first half of 2011 was removed from this data set due to data input errors in the data provided by SNHD.

Table 2: Comparison of Violations Count

Year	Minor/GMP	Major/Critical
2011	1.52	1.51
2012	1.59	1.71
2014	1.25	1.78
2015	1.11	1.63
Grand Total	**1.34**	**1.68**

*Good Management Practices (GMP)

Hypothesis 1 Results

A paired t-test was run on a dataset of 10,337 facility grades. Facilities grades were a mean of 2.83 ± 0.38 pre-initiative and remained at 2.83 ± 0.36 post-initiative. The mean change of 0.00 (95% CI, -0.01 to 0.01) is not statistically significant (p=0.95), and the null hypothesis is not rejected (Table 3). A linear regression analysis was not conducted due to the results of the paired t-test. See Appendix B for complete SPSS output.

Hypothesis 2 Results

A paired t-test was run on a dataset of 10,335 facility demerit scores. Two facilities were excluded due to data errors. The demerit scores were incorrectly entered into the provided data and recorded greater than the maximum demerits possible. Facilities scores pre-initiative were 6.90 ± 5.65 and were reduced to 5.84 ± 5.57 post-initiative. The mean change of 1.06 (95% CI, 0.95 to 1.18) is statistically significant ($p<0.001$), $t(10,334) = 18.51$ and the null hypothesis is rejected (Table 3).

A linear regression analysis was run on the sample. The F value of 2,757.26 and 10,334 degrees of freedom demonstrates that the test is highly significant and there is a linear

relationship between the variables with a beta of 0.46. See Appendix C for complete SPSS output.

Hypothesis 3 Results

A paired t-test was run on a dataset of 9,812 facility adjusted demerit scores. Facilities adjusted demerits pre-initiative were 6.66 ± 7.36 and were reduced to 6.29 ± 6.94 post-initiative. The mean change of 0.37 (95% CI, 0.21 to 0.53) is statistically significant ($p<0.001$), $t(9,811) = 4.49$ and the null hypothesis is rejected (Table 3).

A linear regression analysis was run on the sample. The F value of 1,378.40 and 9,811 degrees of freedom demonstrates that the test is highly significant and there is a linear relationship between the variables with a beta of 0.35. See Appendix D for complete SPSS output.

Table 3: Summary of Statistical Analyses (N/A = not applicable)

	N	**Pre-I Mean**	**Post-I Mean**	**Mean Change**	**CI**	**P Value**	**T**	**F**	**df**	**beta**
Grades	10337	2.83	2.83	0.00	-0.01 to 0.01	0.95	N/A	N/A	N/A	N/A
Total Demerits	10335	6.90	5.84	1.06	0.95 to 1.18	0.00	18.51	2757.26	10334	0.46
Adjusted Demerits	9812	6.66	6.29	0.37	0.21 to 0.53	0.00	4.49	1378.40	9811	0.35

Limitations

There are several limitations in this study due to data availability and other SNHD changes. The complete inspection report is not available, only the general data from the reports were used in the evaluation. Violations that changed categories cannot be evaluated with their current values and entire categories were rescored due to the fact that it is not possible to determine the specific violation that led to the demerits being assessed. This is not consistent across all categories, as some have multiple potential violations that can lead to demerits and others are narrower in score. Different inspectors may have received different levels of training, leading to inconsistent scores among inspectors. Changes in management of the facilities are unknown and cannot be accounted for. Other SNHD departmental changes not due to the Think Risk Initiative could affect the results. With all the potential bias considered, these findings are still valid. With such a large sample size and multiple years of data analyzed, any remaining bias that could not be accounted for would only have a minimal effect on the results and would not change the findings.

Discussion

SNHD implemented the Think Risk Initiative in an effort to incorporate a process in which the violations directly related to foodborne illness would be more heavily weighted and the items that are not directly linked to foodborne illness would be assessed no demerits. This would allow for the grades of restaurants to more accurately reflect their actual level of risk to public health and safety. With this initiative, a facility would no longer receive a poor rating for practices that do not threaten the health and safety of the public.

In this study, no change in the letter grades was observed from the Think Risk Initiative and the total demerits decreased on average by only 1. When the demerits were rescored to be equal pre- and post-initiative, this was reduced to only an average of 0.37 demerit decrease, which would result in no change of score or grade. The null hypotheses cannot be rejected. This suggests that the reduction in total demerits is due to rescoring the inspection forms and not due to any facility improvement. The scores and grades for the grouping of facilities evaluated in this dataset indicate that they did not benefit from the audits that were provided in 2013, the increased inspection frequency, or the increased education provided; however, this may not be true for individual facilities.

It was taken into consideration the fact that inspectors are possibly more inclined to cite good management practices post-initiative, since this would have no impact on the letter grade of the facility. However, this was ruled out by comparing the counts of minor violations pre-initiative and good management practices post-initiative. The mean of good management practices decreased by 0.38, and the mean of major and critical violations increased by 0.10. This demonstrates that inspectors slightly shifted their focus to the higher risk items, while reducing the number of good management practices cited. The shift in focus was not enough to

significantly impact grades and scores, and does not account for the lack of change. There was no instruction provided to SNHD inspectors to alter the number of citations noted, suggesting that facilities slightly worsened but the grades were not impacted due to the removal of the 1 demerit assessed for good management practices (SNHD, 2016a; SNHD, 2016f).

Prior to the implementation of the initiative, it is possible that inspectors used their discretion in not citing a minor violation in an effort to prevent downgrading a facility that was close to receiving an A grade. This becomes apparent with the spike in 10 demerit scores pre-initiative. This is also possible for B grades, as noted by the spike in 20 demerit scores pre-initiative. Now that this is not an issue, inspectors have reduced the number of good management practices cited since they no longer contribute to the letter grade, and might not view citing good management practices as a productive use of their time.

This initiative is unique to SNHD, and determination of its effectiveness in other jurisdictions is unknown. Past research has demonstrated some compliance improvement among facilities with a certified food protection manager in the kitchen. Facilities with a certified food protection manager also have been shown to suffer fewer foodborne illness outbreaks. This should be researched in Southern Nevada to determine the effectiveness of requiring food protection manager certification in all facilities. As new inspectors are hired and trained, it is possible that their training has been adjusted to focus more on high risk items than they were in the past, leading to a discrepancy among newly hired and veteran inspectors. It is recommended that the consistency among inspectors be evaluated for future research. Comparison of the cost to benefit of the Think Risk Initiative is also recommended for future research.

Conclusion

The resources allocated to educating the facilities, increasing inspection frequency and training both inspectors and food operators, had no impact on the facility scores or grades. The guidelines recommended by the FDA, as implemented by the SNHD through the Think Risk Initiative, did not encourage the facilities to improve compliance with the regulations. The observed change of an average decrease of 1 demerit on inspections is due to the removal of the 1 demerit assessed for good management practices, and not due to facility improvement. Inspectors are less inclined to cite good management practices than they were pre-initiative, but not many more major and critical violations are being cited. The change in number of violations cited is too small to alter the scores or letter grades of facilities. The initiative resulted in a rise in the number of A grades, fewer B grades, and more C grades and Closures than pre-initiative.

The Think Risk Initiative did offer some benefits to the industry and community. It appears to have shifted the focus of inspections to violations that directly correspond to risk for foodborne illness. Restaurant grades more accurately reflect their actual level of risk to public health and safety. With the removal of the 1 demerit assessment for good management practices, facilities no longer receive a poor rating for practices that do not threaten the health and safety of the public. The increased contact between inspectors and operators may be helping to bridge the gap between industry and regulators.

Appendix A: Rescored values of violations

ID	Code	Demerits	Rescore value	SNHD Violation Description (SNHD, 2016c)
4	4	3	3	Inadequate hot and cold holding equipment
14	14	3	3	Kitchenware and/or food contact surfaces of equipment improperly cleaned, sanitized and/or air dried.
16	16	5	5	No hot and cold running water as required and/or water not from an approved source.
18	**18**	**1**	**3**	**Foods not stored off the floor.**
19	**19**	**1**	**3**	**Required labels not present on food or containers of food. Required signs not posted.**
22	22	1	1	In-use utensils improperly handled and/or stored.
27	27	1	1	Unclean wiping cloths, stored in an unapproved sanitizer, and/or unrestricted in use.
29	29	1	1	Plastic used for food contact surfaces is not of approved food grade quality.
30	30	1	1	Non-food contact surfaces improperly constructed and/or installed.
31	31	1	1	Non-food contact surfaces and/or cooking devices not maintained and/or unclean.
33	33	1	1	Garbage storage and/or removal inadequate and/or unclean. Garbage containers not clean, pest proof, non-absorbent and covered. Wash area unclean and/or not maintained.
36	36	1	1	Plumbing and/or fixtures improperly sized, installed and/or maintained. Plumbing and/or fixtures improperly drained.
201	**1**	**5**	**3**	**Verifiable time as a control with approved procedure when in use. Operational plan, HACCP plan, waiver or variance approved and followed when required. Nevada Clean Indoor Air Act compliant.**
202	2	5	5	Handwashing (as required, when required, proper glove use, no bare hand contact of ready to eat foods). Foodhandler health restrictions as required.
203	3	5	5	Commercially manufactured food from approved source with required labels. Parasite destruction as required. Potentially hazardous foods/time temperature control for safety (PHF/TCS) received at proper temperature.
204	4	5	5	Hot and cold running water from approved source as required.

ID	Code	Demerits	Rescore value	SNHD Violation Description (SNHD, 2016c)
205	5	5	5	Imminently dangerous cross connection or backflow. Waste water and sewage disposed into public sewer or approved facility.
206	6	5	5	Food wholesome
207	7	5	5	PHF/TCSs cooked and reheated to proper temperatures.
208	8	5	5	PHF/TCSs properly cooled.
209	9	5	5	PHF/TCSs at proper temperatures during storage, display, service, transport, and holding.
210	**10**	**5**	**3**	**Operating within the parameters of the health permit.**
211	11	3	3	Food protected from potential contamination during storage and preparation.
212	12	3	3	Food protected from potential contamination by chemicals. Toxic items properly labeled, stored and used.
213	13	3	3	Food protected from potential contamination by employees and consumers.
214	14	3	3	Kitchenware and food contact surfaces of equipment properly washed, rinsed, sanitized and air dried. Sanitizer solution provided and maintained as required.
215	15	3	3	Handwashing facilities adequate in number, stocked, accessible, and limited to handwashing only.
216	16	3	3	Effective pest control measures. Animals restricted as required.
217	17	3	3	Hot and cold holding equipment present
218	18	3	3	Accurate thermometers (stem & hot/cold holding) provided and used.
219	19	3	3	PHF/TCSs properly thawed.
220	20	3	3	Single use items not reused or misused.
221	21	3	3	Person in charge available and knowledgeable/management certification.
222	22	3	3	Backflow prevention devices and methods in place and maintained.
223	23	3	3	“B” or “C” grade card and required signs posted conspicuously. Consumer advisory as required. Records/logs maintained and available when required.
224	24	1	1	Acceptable personal hygiene practices, clean outer garments, proper hair restraints used. Living

ID	Code	Demerits	Rescore value	SNHD Violation Description (SNHD, 2016c)
				quarters and child care completely separated from food service.
225	**25**	**1**	**3**	**Food and food storage containers properly labeled and dated as required. Food stored off the floor when required. Non-PHF/TCS not spoiled and within shelf-life. Proper retail storage of chemicals.**
226	26	1	1	Facilities for washing and sanitizing kitchenware approved, adequate, properly constructed, maintained and operated.
227	27	1	1	Appropriate sanitizer test kits provided and used. Ware washing thermometer(s) as required. Wiping cloths & linens stored and used properly.
228	28	1	1	Food contact surfaces and equipment approved, food grade material, smooth, easily cleanable, properly constructed and installed.
229	29	1	1	Utensils, equipment, and single serve items properly handled, stored, and dispensed.
230	30	1	1	Nonfood contact surfaces and equipment properly constructed, installed, maintained and clean.
231	**31**	**1**	**3**	**Health cards as required. Foodhandler not aware of employee health policy. "A" grade card posted conspicuously.**
232	32	1	1	Restrooms, mop sink, and custodial areas maintained and clean. Premises maintained free of litter, unnecessary equipment, or personal effects. Trash areas adequate, pest proof, and clean.
233	33	1	1	Facility in sound condition and maintained (floors, walls, ceilings, plumbing, lighting, ventilation, etc.).
234	**34**	**1**	**3**	**Fruits and vegetables washed prior to preparation or service.**
301	IHH-1	0	0	Imminent Health Hazard - (Immediate Closure) - Interruption of electrical service
302	IHH-2	0	0	Imminent Health Hazard - (Immediate Closure) - No potable water or hot water
303	IHH-3	0	0	Imminent Health Hazard - (Immediate Closure) - Gross unsanitary occurrences or conditions including pest infestation
304	IHH-4	0	0	Imminent Health Hazard - (Immediate Closure) - Sewage or liquid waste not disposed of in an approved manner

ID	Code	Demerits	Rescore value	SNHD Violation Description (SNHD, 2016c)
305	IHH-5	0	0	Imminent Health Hazard - (Immediate Closure) - Lack of adequate refrigeration
306	IHH-6	0	0	Imminent Health Hazard - (Immediate Closure) - Lack of adequate employee toilets and handwashing facilities
307	IHH-7	0	0	Imminent Health Hazard - (Immediate Closure) - Misuse of poisonous or toxic materials
308	IHH-8	0	0	Imminent Health Hazard - (Immediate Closure) - Suspected foodborne illness outbreak
309	IHH-9	0	0	Imminent Health Hazard - (Immediate Closure) - Emergency such as fire and/or flood
310	IHH-10	0	0	Imminent Health Hazard - (Immediate Closure) - Other condition or circumstance that may endanger public health
2907	**10**	**3**	**1**	**Food and warewashing equipment approved, properly designed, constructed and installed.**
2908	19	3	3	PHF/TCSs properly thawed. Fruits and vegetables washed before preparation or service.
2909	23	3	3	Grade card and required signs posted conspicuously. Consumer advisory as required. Records/logs maintained and available when required. NCIAA compliant. PHF's labeled and dated as required. Food sold for offsite consumption labeled properly.
2910	**25**	**0**	**3**	**Non-PHF and food storage containers properly labeled and dated as required. Food stored off the floor when required. Non-PHF/TCS not spoiled and within shelf-life. Proper retail storage of chemicals.**
2911	**27**	**0**	**1**	**Appropriate sanitizer test kits provided and used. Equipment and warewashing thermometer(s) as required. Wiping cloths and linens stored and used properly.**
2912	**28**	**0**	**1**	**Small wares and portable appliances approved, properly designed and in good repair.**
2925	**24**	**0**	**1**	**Acceptable personal hygiene practices, clean outer garments, proper hair restraints used. Living quarters and child care completely separated from food service.**
2926	**26**	**0**	**1**	**Facilities for washing and sanitizing kitchenware approved, adequate, properly constructed, maintained and operated.**

ID	Code	Demerits	Rescore value	SNHD Violation Description (SNHD, 2016c)
2927	**29**	**0**	**1**	**Utensils, equipment and single service items properly handled, stored and dispensed.**
2928	**30**	**0**	**1**	**Non-food contact surfaces and equipment properly constructed, installed, maintained and clean.**
2929	**31**	**0**	**1**	**Restrooms, mop sink and custodial areas maintained and clean. Premises maintained free of litter, unnecessary equipment or personal effects. Trash areas adequate, pest proof and clean.**
2930	**32**	**0**	**1**	**Facility in sound condition and maintained (floors, walls, ceilings, plumbing, lighting, ventilation, etc.).**
2954	**1**	**5**	**3**	**Verifiable time as a control with approved procedure when in use. Operational plan, waiver or variance approved and followed when required. Operating within the parameters of the health permit.**
2955	14	3	3	Kitchenware and food contact surfaces of equipment properly washed, rinsed, sanitized and air dried. Equipment for warewashing operated and maintained. Sanitizer solution provided and maintained as required.
2956	21	3	3	Person-in-charge available and knowledgeable/management certification. Food handler card as required. Facility has an effective employee health policy.

*Items in bold were re-scored

Appendix B: Letter Grades SPSS Output

Grades Paired T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre_Grades	2.83	10337	.376	.004
	Post_Grades	2.83	10337	.358	.004

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre_Grades & Post_Grades	10337	.285	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pre_Grades - Post_Grades	.000	.439	.004	-.008	.009	.067	10336	.946

Appendix C: Total Demerits SPSS Output

Total Demerits Paired T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre_Demerits	6.90	10335	5.647	.056
	Post_Demerits	5.84	10335	5.569	.055

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre_Demerits & Post_Demerits	10335	.459	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre_Demerits - Post_Demerits	1.062	5.834	.057	.950	1.175	18.510	10334	.000

Total Demerits Linear Regression

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.459[a]	.211	.211	4.948

a. Predictors: (Constant), Pre_Demerits

b. Dependent Variable: Post_Demerits

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	67495.720	1	67495.720	2757.258	.000[b]
	Residual	252944.548	10333	24.479		
	Total	320440.268	10334			

a. Dependent Variable: Post_Demerits

b. Predictors: (Constant), Pre_Demerits

Coefficients[a]

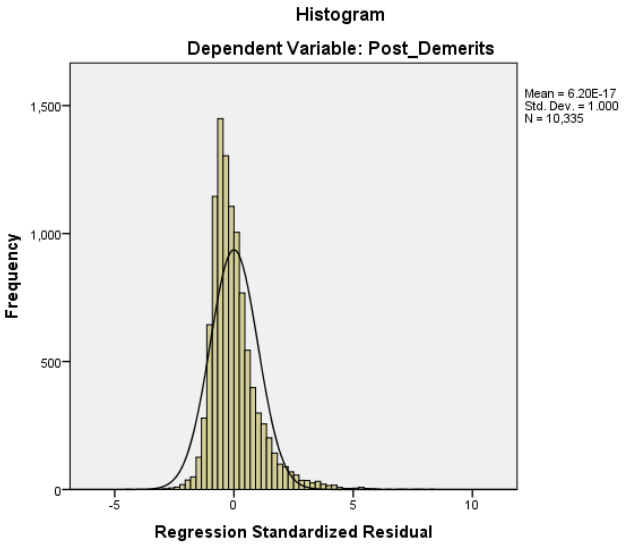
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	2.715	.077		35.336	.000	2.565	2.866
	Pre_Demerits	.453	.009	.459	52.510	.000	.436	.469

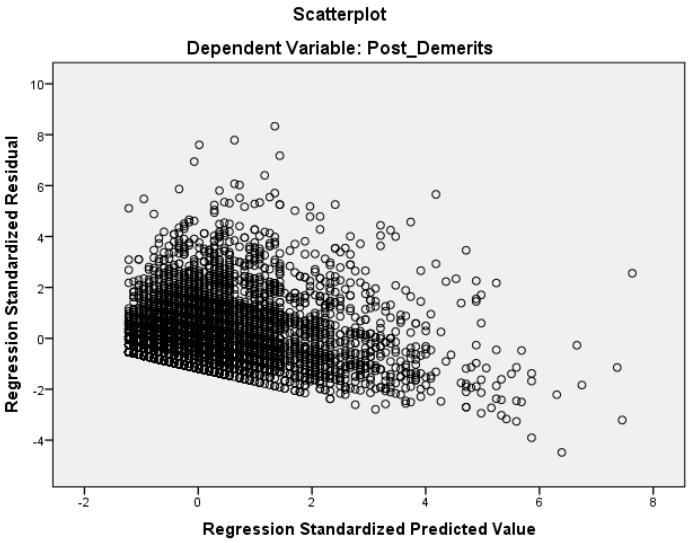
a. Dependent Variable: Post_Demerits

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.72	25.34	5.84	2.556	10335
Residual	-22.175	41.223	.000	4.947	10335
Std. Predicted Value	-1.222	7.632	.000	1.000	10335
Std. Residual	-4.482	8.332	.000	1.000	10335

a. Dependent Variable: Post_Demerits


Histogram
Dependent Variable: Post_Demerits
Mean = 6.20E-17
Std. Dev. = 1.000
N = 10,335
Frequency
1,500
1,000
500
0
-5
0
5
10
Regression Standardized Residual


Scatterplot
Dependent Variable: Post_Demerits
Regression Standardized Residual
10
8
6
4
2
0
-2
-4
-2
0
2
4
6
8
Regression Standardized Predicted Value

Appendix D: Adjusted Demerits SPSS Output

Adjusted Demerits Paired T-test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre_Adjusted	6.66	9812	7.359	.074
	Post_Adjusted	6.29	9812	6.940	.070

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre_Adjusted & Post_Adjusted	9812	.351	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pre_Adjusted - Post_Adjusted	.369	8.153	.082	.208	.530	4.485	9811	.000

Adjusted Demerits Linear Regression

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.351[a]	.123	.123	6.499

a. Predictors: (Constant), Pre_Adjusted

b. Dependent Variable: Post_Adjusted

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	58222.051	1	58222.051	1378.395	.000[b]
	Residual	414364.777	9810	42.239		

	Total	472586.828	9811			

a. Dependent Variable: Post_Adjusted

b. Predictors: (Constant), Pre_Adjusted

Coefficients[a]

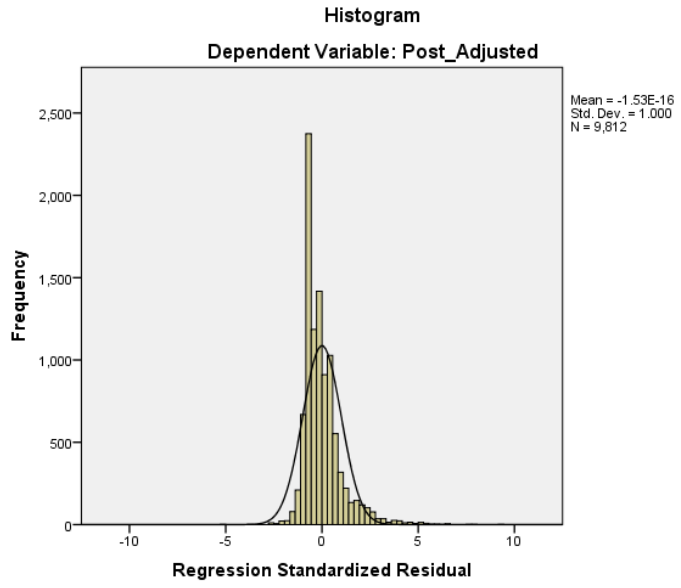
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	4.085	.088		46.172	.000	3.912	4.259
	Pre_Adjusted	.331	.009	.351	37.127	.000	.314	.348

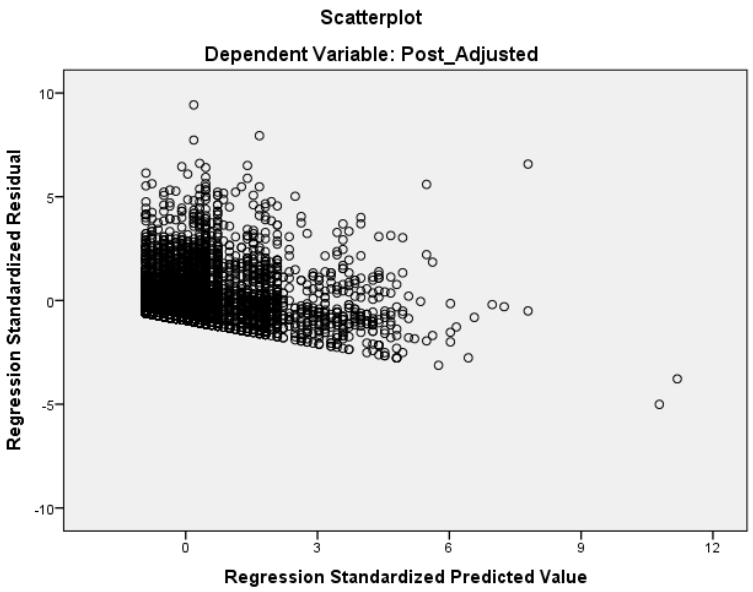
a. Dependent Variable: Post_Adjusted

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	4.09	33.55	6.29	2.436	9812
Residual	-32.553	61.266	.000	6.499	9812
Std. Predicted Value	-.905	11.189	.000	1.000	9812
Std. Residual	-5.009	9.427	.000	1.000	9812

a. Dependent Variable: Post_Adjusted




Scatterplot
Dependent Variable: Post_Adjusted
Regression Standardized Residual
10
5
0
-5
-10
0
3
6
9
12
Regression Standardized Predicted Value

References

Campbell M., Gardner C., Dwyer J., Isaacs S., Kruger P., Ying J. (1998). Effectiveness of Public Health Interventions in Food Safety; a Systematic Review. Canadian Journal of Public Health. Volume 89(3): 197-202. Available from: https://www.researchgate.net/profile/Paul_Krueger/publication/13629609_Effectiveness_of_public_health_interventions_in_food_safety_a_systematic_review/links/02e7e52164cc76e961000000.pdf

Cates S., Harrison J., Karns S., Penne M., Karns S., Radke V., Stone C. Certified Kitchen Managers: Do They Improve Restaurant Inspection Outcomes? Journal of Food Protection. Volume 72(2): 384-391. Available from: http://www.cdc.gov/nceh/ehs/EHSNet/Docs/JFP_Certified_Kitchen_MGRs.pdf

Centers for Disease Control and Prevention. Retrieved July 17, 2016. CDC and Food Safety. Retrieved from: http://www.cdc.gov/foodsafety/cdc-and-food-safety.html

Centers for Disease Control and Prevention (2014, January 8). Estimates of Foodborne Illness in the United States. Retrieved from: http://www.cdc.gov/foodborneburden/index.html

Centers for Disease Control and Prevention (2013, December 21). Foodborne Germs and Illnesses. Retrieved from: http://www.cdc.gov/foodsafety/foodborne-germs.html

Centers for Disease Control and Prevention. Retrieved July 17, 2016. Trends in Foodborne Illness in the United States. Retrieved from: http://www.cdc.gov/foodborneburden/trends-in-foodborne-illness.html

Committee on Communicable Diseases Affecting Man. International Association for Food Protection. (1999). Procedures to Investigate Foodborne Illness. 5th Edition. Des Moines, IA: International Association for Food Protection.

Council to Improve Foodborne Outbreak Response (CIFOR). (2014). Guidelines for Foodborne Disease Outbreak Response. 2nd Edition. Atlanta: Council of State and Territorial Epidemiologists.

South Carolina Department of Health and Environmental Control (DHEC). Risk-Based Inspections. Retrieved November 18, 2016. Retrieved from: http://www.scdhec.gov/FoodSafety/RiskBasedInspections/

Dyjack D., Hoag M., Porter C., Uppala P. (2007). A Risk-Based Food Inspection Program. Journal of Environmental Health. Volume 69 (7): 33-36.

Food and Drug Administration. Annex 5- Conducting Risk-based Inspections. Retrieved July 17, 2016. Retrieved from: http://www.fda.gov/downloads/Food/GuidanceRegulation/UCM188556.pdf

Hall R., Hart R., Mckearny M., Newbold K. Restaurant Inspection Frequency and Food Safety Compliance. Journal of Environmental Health. Volume 71 (4): 56-61.

Jones T.F., Pavlin B.I., LaFleur B.J., Ingram L.A., Schaffner W. (2004). Restaurant inspection scores and foodborne disease. Emerg Infectious Diseases. Volume 10 (4): 688-692.

Las Vegas Visitors and Convention Authority. (2016). Stats and Facts. Retrieved from: http://www.lvcva.com/stats-and-facts/

Southern Nevada Health District (April 10, 2014a). Food Establishment Resource Library. Retrieved from: http://www.southernnevadahealthdistrict.org/ferl/handouts.php

Southern Nevada Health District (January 6, 2014b). Food Establishment Resource Library. Retrieved from: http://www.southernnevadahealthdistrict.org/download/eh/ferl-2014-think-risk-initiative.pdf#search="think%20risk"

Southern Nevada Health District. Retrieved October 28, 2016a. Board Meeting Minutes November 26, 2013. Retrieved from: http://southernnevadahealthdistrict.org/boh13/112613m.php

Southern Nevada Health District (July 28, 2016b). Community Health Division Monthly Report. Retrieved from: https://www.google.com/url?q=http://southernnevadahealthdistrict.org/download/boh16/20160728/xii.3.monthly_report_-_community_health.pdf&sa=D&ust=1469731324345000&usg=AFQjCNEgKOpVUgA7Hevb3w2HYNSdhpivYg

Southern Nevada Health District. Retrieved July 14, 2016c. Food Establishment Inspection Process. Retrieved from: http://www.southernnevadahealthdistrict.org/download/eh/fe-inspection-report.pdf

Southern Nevada Health District. Retrieved July 14, 2016d. Food Establishment Resource Library. Retrieved from: http://www.southernnevadahealthdistrict.org/ferl/think-risk-initiative.php

Southern Nevada Health District. Retrieved July 14, 2016e. General Information. Retrieved from: http://www.southernnevadahealthdistrict.org/general-information.php

Southern Nevada Health District. Retrieved October 28, 2016f. Think Risk Initiative and Audit Update Presentation. Retrieved from: http://www.southernnevadahealthdistrict.org/download/boh13/112613-hosr1.pdf

U. S. Department of Agriculture (2008). Executive Summary: Issues Impacting the Development of Risk-Based Inspection at Meat and Poultry Processing Establishments (Audit Report No. 24601-07-Hy)

Curriculum Vitae

Graduate College

University of Nevada, Las Vegas

Karalin Nichole Cronkhite

Degrees:

Bachelor of Science in Nutrition, 2009

California Polytechnic State University

Research Experience/Internship:

Initial Outbreak Response Guidance for the Southern Nevada Health District

Thesis Title: Determining the Effects of the Think Risk Initiative as Implemented by the Southern Nevada Health District

Thesis Examination Committee:

Chairperson, Brian Labus, Ph.D.

Chairperson, Patricia Cruz, Ph.D.

Committee Member, Guogen Shan, Ph.D.

Graduate Faculty Representative, Clark Kincaid, Ph.D.