



Retail Inspection Data Warehouse: A collaborative solution for measuring the food safety impact of regulatory inspection programs

Association of Food and Drug Officials

This project was supported by the Food and Drug Administration (FDA) of the U.S. Department of Health and Human Services (HHS) as part of a financial assistance award U18FD007051 totaling \$1,000,000 with 100 percent funded by FDA/HHS. The contents are those of the author(s) and do not necessarily represent the official views of, nor an endorsement by, FDA/HHS or the U.S. Government.

April 7, 2023

ACKNOWLEDGEMENTS

The Association of Food and Drug Officials is pleased to present the results from the Retail Inspection Data Analytics Pilot project. This project was only possible with the contributions of our information technology partner, Precise Software Solutions, including Drew Polulak, who led this initiative for Precise, and CEO Zhensen Huang. Additional support was provided by subcontractor Intact Solutions.

Further, this project was made possible with the support of the following state and local agencies:

- Alaska Department of Environmental Conservation
- Arkansas Department of Health
- Harris County Public Health, Harris County, Texas
- Iowa Department of Inspections and Appeals
- Kansas Department of Agriculture
- Pennsylvania Department of Agriculture
- Rhode Island Department of Health
- South Carolina Department of Health and Environmental Control
- Tennessee Department of Health

These agencies provided inspection data and guidance throughout the pilot. The initial dataset came from Alaska, Arkansas, Iowa, and Kansas and included over 117,000 inspections conducted from January 1, 2017, through December 31, 2019, all pre-COVID-19. The remaining five state and local inspection agencies added an additional 318,000 inspections over the same inspectional time frame. The agency participants have provided extensive feedback for continuing the development, reporting, and desired functionality of the combined dataset through a series of virtual meetings that began in January 2021.

We appreciate the project input received from the U.S. Food and Drug Administration (FDA), including the Office of State Cooperative Programs within the Office of Human and Animal Foods of the Office of Regulatory Affairs. Specific individuals who provided feedback and suggestions include Laurie Farmer, John Marcello, and Michael Nordos. We are also grateful for input from the Centers for Disease Control and Prevention (CDC) and Laura Brown and Adam Kramer, specifically.

The AFDO project team included Steven Mandernach, Elizabeth Nutt, Carrie Rigdon, Brenda Morris, Steve Moris, and Pat Kennelly. Mandernach led the project, Nutt provided substantial retail subject matter expertise, and Rigdon conducted preliminary analysis and co-authored the white paper.

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EXECUTIVE SUMMARY

The Association of Food and Drug Officials (AFDO) has a long history of supporting federal, state, local, tribal, and territorial food safety programs and has helped improve their operations and personnel since 1896. AFDO's mission is to protect public health and safety by working collaboratively with public and private sectors, advocating with a unified voice to make a positive impact on food and medical product safety laws, rules, and regulations.

In 2020, AFDO was awarded funding as part of the Retail Food Safety Association Collaboration (HHS/FDA U18FD007051) cooperative agreement to further its mission by improving the regulatory approach, competency, and food safety culture in the retail food regulatory community. Retail regulatory inspection programs play an important public health role in monitoring the retail food industry – the restaurants, grocery stores, convenience stores and other businesses that sell food directly to consumers – and the industry's control of key factors that are associated with foodborne illness. There are more than 2,000 (2,243) regulatory retail food inspection programs throughout the United States that monitor these risk factors in their routine inspections. However, there is not a good understanding of how effective these programs are or the ultimate impact they have on reducing foodborne illness.

There are several challenges in measuring the impact that regulatory retail food inspections are having on reducing the occurrence of the risky practices, behaviors, and conditions that are linked to foodborne illness. Advances have been made to standardize the many retail inspection programs, but there remain great differences in what, how, and how often information is collected during inspections. Furthermore, retail inspection data has not been effectively shared, aggregated, and analyzed in the public sector space. While commercial aggregations of retail inspection data exist and have been made available to retail businesses and others, they are extremely costly.

In 2021, AFDO conducted a Retail Inspection Data Analytics Pilot study to examine how these challenges could be overcome. The pilot's purpose was to characterize the reasons why retail inspection information may not be effectively shared and analyzed, to test methods for standardizing and combining retail inspection information, and recommend solutions based on the results. Ultimately, AFDO and nine participating state and local agencies created a single dataset of 172,243 unique retail facilities and 436,125 routine retail inspections that were conducted from January 2017 to December 2019.

Based on the challenges and lessons discovered during the pilot, this white paper presents a proposed solution to create and sustain a uniform, national Retail Inspection Data Warehouse. This would enable, for the first time, regulatory programs to measure their impact on reducing foodborne illness risk factors, target improvements, and assist to benchmark their program against a larger community of regulatory programs. In addition, we describe successful food safety data projects and how this proposed solution builds upon those successes to impact food safety across the country.

With the support of retail regulatory programs at the state, local, tribal, and territorial level, along with our public health partners, the FDA and the CDC, and food safety stakeholders, AFDO is committed to advancing the current pilot dataset into a full-fledged data warehouse. Through stakeholder engagement, road map planning, and road map execution, a **centralized and**

scalable Retail Inspection Data Warehouse will be built in a **secure data environment** with **clean, standardized, and easy-to-analyze data**, providing **powerful, user-friendly reports** to answer the important questions that lead to improved food safety and public health.

1. INTRODUCTION

Foodborne illness remains a major public health concern in the United States. Foodborne diseases cause approximately 48 million illnesses, 128,000 hospitalizations, and 3,000 deaths each year.^{1,2} More than half of foodborne illness outbreaks that occur each year are associated with food from restaurants.³ Surveillance data from the Centers for Disease Control and Prevention (CDC) have consistently identified a key set of factors within the retail food industry – restaurants, grocery stores, convenience stores, and other businesses that sell food directly to consumers – that contribute to foodborne illness. These foodborne illness risk factors include food preparation practices, behaviors, and conditions that lead to illness-causing bacteria, viruses, and parasites getting into food or growing in food. Most importantly, these factors are *preventable* causes of outbreaks.⁴ Most regulatory retail food inspection programs throughout the United States monitor risk factors in their routine inspections. However, an understanding of how effective these programs are in monitoring risk factors in the businesses they inspect or the ultimate impact they have on reducing foodborne illness has not been successfully evaluated.

Several challenges exist in measuring the impact that regulatory retail food inspections are having on reducing the occurrence of risky practices, behaviors, and conditions linked to foodborne illness. Over 2,200 government agencies regulate the 1.7 million retail food businesses nationwide. Advances have been made to standardize the many retail inspection programs, but there remain great differences in what, how, and how often information is collected during inspections. Furthermore, retail inspection data has not been effectively shared, aggregated, and analyzed among those government agencies.

In 2021, the Association of Food and Drug Officials (AFDO) conducted a pilot study to examine how these challenges could be overcome. The study was funded by the U.S. Food and Drug Administration (FDA) as part of the Retail Food Safety Regulatory Association Collaboration cooperative agreement. The goals of the study were to (1) devise methods for accurately combining data from disparate systems into a single, standardized dataset, (2) calculate the frequency of risk-based inspections using determinants such as practices observed and inspection

¹ Scallan, E., Hoekstra, R. M., Angulo, F. J., Tauxe, R. V., Widdowson, M.-A., Roy, S. L., Jones, J. L., & Griffin, P. M. (2011). Foodborne Illness Acquired in the United States—Major Pathogens. *Emerging Infectious Diseases*, 17(1), 7–15. <https://doi.org/10.3201/eid1701.P11101>

² Scallan, E., Griffin, P. M., Angulo, F. J., Tauxe, R. V., & Hoekstra, R. M. (2011). Foodborne Illness Acquired in the United States—Unspecified Agents. *Emerging Infectious Diseases*, 17(1), 16–22. <https://doi.org/10.3201/eid1701.P21101>

³ Centers for Disease Control and Prevention (CDC). (2019). Surveillance for Foodborne Disease Outbreaks, United States, 2017, Annual Report. US Department of Health and Human Services, CDC. https://www.cdc.gov/fdoss/pdf/2017_FoodBorneOutbreaks_508.pdf

⁴ Brown, L. G., Hoover, E. R., Selman, C. A., Coleman, E. W., & Rogers, H. S. (2017). Outbreak characteristics associated with identification of contributing factors to foodborne illness outbreaks. *Epidemiology & Infection*, 145(11), 2254–2262. <https://doi.org/10.1017/S0950268817001406>

duration, and (3) benchmark key successes and challenges to implementing risk-based inspections and controlling risk factor violations. At the same time, the CDC embarked on a complementary but distinct retail inspection consolidation project focusing on determinants of foodborne illness risk factors. In contrast, the AFDO project addresses advancing the practices in retail food protection and improving implementation of inspections focused on those foodborne illness risk factors.

The first step toward achieving these goals was to successfully consolidate disparate inspection data into an accurate and robust dataset. The Retail Inspection Data Analytics Pilot project was conducted to characterize the reasons why retail inspection information may not be effectively shared and analyzed, to test methods for standardizing and combining retail inspection information, and recommend solutions based on the results.

This report aims to create awareness among retail food regulatory authorities, industry, and policy makers of the challenges and opportunities in consolidating regulatory retail inspection data. It draws on current data sharing experiences and the pilot study to demonstrate the need for and feasibility of a proposed solution: create a Retail Inspection Data Warehouse (RDW). A national RDW would give participating authorities, for the first time, the ability to measure the impact on reducing foodborne illness risk factors and target improvements.

2. STATEMENT OF THE PROBLEM

Retail food businesses – particularly those where food preparation is occurring – have consistently been identified as a significant source of foodborne illness. Research and surveillance data have identified food preparation practices, employee behaviors, and environmental conditions that contribute to foodborne illness (risk factors) as well as behaviors and practices that protect consumer health (health interventions). Regulatory inspections that focus on these factors and interventions and thoroughly assess practices, behaviors, and conditions are called *risk-based inspections*.

Much work has been done to align regulatory inspections of retail food businesses and promote proper risk-based inspections. There are legal and programmatic standards for greater effectiveness and consistency across the state, local, tribal, and territorial regulatory agencies. A model set of retail food safety regulations, the *FDA Food Code*, has been regularly updated since 1996 and provides a consistent, scientifically based legal standard. The Voluntary National Retail Food Regulatory Program Standards, first published in 2002, establish a uniform framework for effective regulation of retail food businesses that focuses on reducing contributing factors. However, there is no direct way to measure to what extent regulatory programs are conducting risk-based inspections and what impact inspections are having on driving down the occurrence of risky food behaviors and practices.

The biggest impediment to measuring the frequency and effectiveness of risk-based inspections and retail regulatory programs' impact on driving down foodborne illness risk factors is the inability to combine and compare inspection data across the many regulatory authorities. AFDO conducted the Retail Inspection Data Analytics Pilot to further characterize the nature and scope

of these data comparison challenges. The following sections describe the challenges elucidated by the pilot project.

2.1. Current State of Retail Inspection Programs

The challenge of effectively combining and analyzing inspection data begins with the large number of government authorities that regulate and inspect U.S. retail food businesses. In 2019, AFDO completed a survey to determine the number of retail facilities per state and the inspection responsibility for these retail facilities. AFDO surveyed each state and the District of Columbia and determined there are 67 state agencies regulating retail establishments and 2,176 local agencies for a total of 2,243. There are a total of 1,794,481 facilities nationwide being inspected by state, local, tribal, and territorial jurisdictions⁵. AFDO’s research suggests just over one-third of retail food establishments (34.0%) are directly regulated by state programs and two-thirds are regulated by locals (66.0%). See Figure 1.

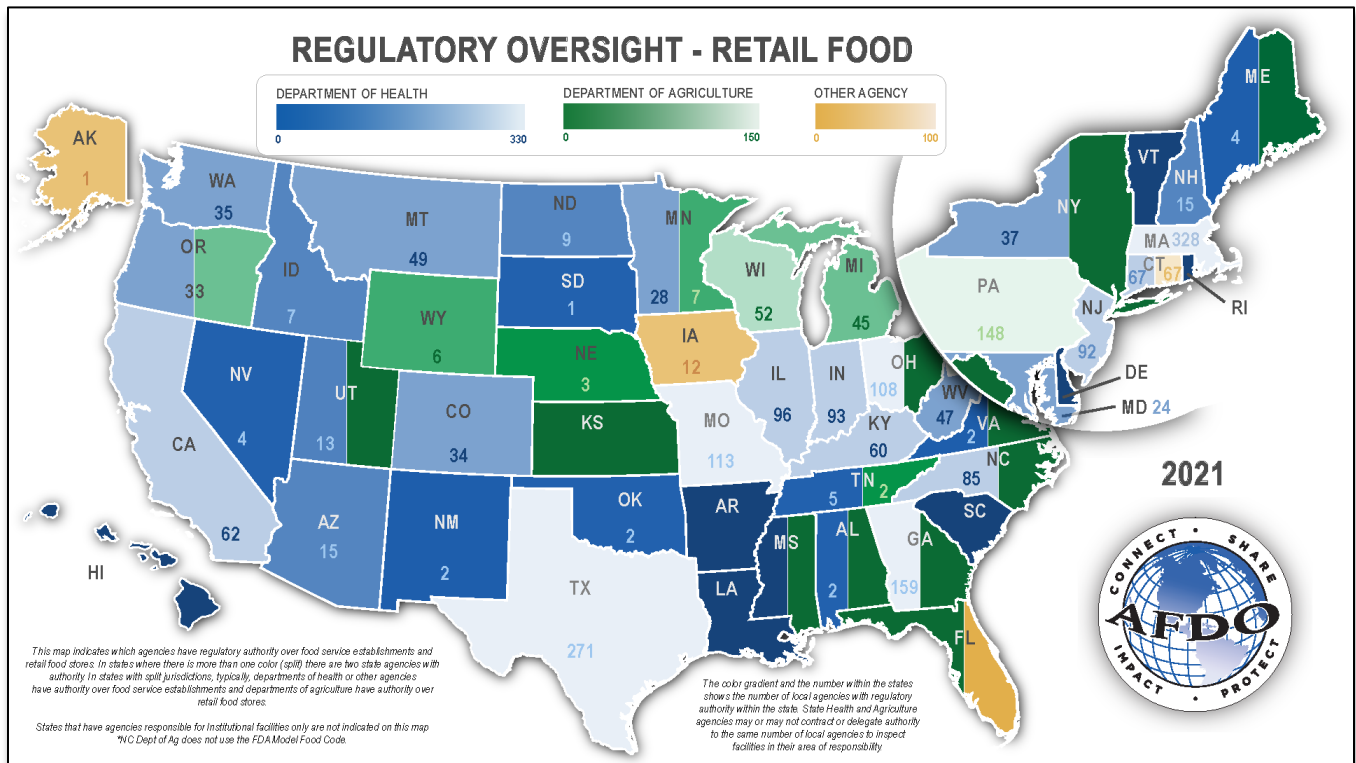


Figure 1. Regulatory oversight of retail food in the United States, 2021⁶

There are also significant differences in regulations that inspectors use to assess a retail food business’s compliance with food safety laws. These regulations, commonly referred to as the Food

⁵ Association of Food and Drug Officials. (2022). *Survey of State Regulatory Programs*. [Unpublished data].

⁶ Association of Food and Drug Officials. (2021). *Regulatory Oversight – Retail Food, 2021* [Infographic].

Code, form the basis of retail food inspections and the type of information that is collected during an inspection. The U.S. FDA publishes a collection of guidelines, the *FDA Food Code*, that serves as a model for state, local, tribal, and territorial governments to update their own laws. There have been nine (9) versions of the *FDA Food Code* since it was first published in 1993.⁷ While the goal of this model code is to establish consistent food regulatory policy nationwide, significant variability exists across the country, causing a lack of standardized regulations. State, local, tribal, and territorial food safety agencies have adopted many versions of the Food Code. Agencies also may modify portions of the Food Code. As of May 2021, there were 13 different versions of the Food Code being used across the United States, making cross-comparisons of inspection results difficult. See Figure 2.

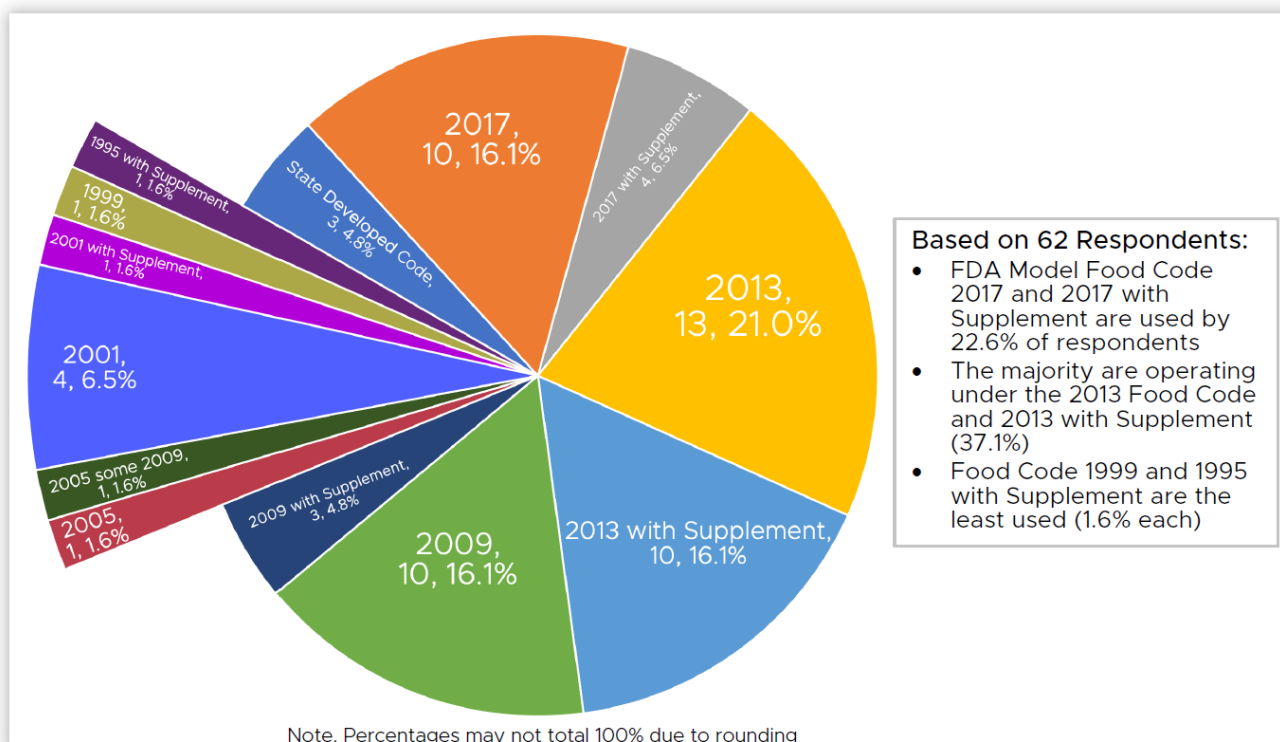


Figure 2. Number and frequency of versions of the FDA Food Code in use in May 2021 by state retail food regulatory agencies⁸

The Retail Inspection Data Analytics Pilot enrolled retail regulatory programs from nine (9) agencies; eight (8) were state agencies and one (1) was a county agency. There were five (5)

⁷ U.S. Food and Drug Administration. (2021). *Adoption of the FDA Food Code by State and Territorial Agencies Responsible for the Oversight of Restaurants and/or Retail Food Stores*. <https://www.fda.gov/food/fda-food-code/adoption-fda-food-code-state-and-territorial-agencies-responsible-oversight-restaurants-and-retail>

⁸ Association of Food and Drug Officials. (2021). *Current Food Code and Plans for Adoption, State Survey, January-May 2021* [Infographic].

Department of Health programs, two (2) Department of Agriculture programs, and two (2) programs residing in other agency types. The pilot agencies represented a range of regulatory structures from centralized (one agency with retail oversight for an entire state) to decentralized (multiple agencies with regulatory oversight within a state). The participating agencies also differed in the version of the *FDA Food Code* adopted by their jurisdiction. See Appendices for more information on the pilot.

2.2. Current Limitations of Retail Inspection Data and How to Overcome Them

The challenges of combining and analyzing inspection data are multifaceted and rooted in the lack of data standardization. The Retail Inspection Data Analytics Pilot project identified several limitations in comparing information among the regulatory food safety agencies. These limitations impede the ability to identify trends in foodborne illness risk factors and make quick and timely interventions to reduce these risks. The current limitations identified include disparate data storage systems and tools, lack of standard regulations, varied inspection procedures, and lack of standard data elements. However, a standardized inspection form included in the *FDA Food Code* has contributed to greater uniformity in data collection.

Several methods were employed over the course of the pilot project to overcome these limitations and create a unified dataset of comparable records across the participating agencies. Some problems could be solved with automated scripts. Many, however, required some form of manual intervention or conversion.

2.2.1. Disparate Data Systems, Storage, and Retrieval

The main, overarching limitation to combining and analyzing inspection data was that each agency dataset was separate and unique.

- **Data stored across disparate, disconnected systems.** Commonly, each retail food regulatory agency has separate, disconnected data repositories and IT systems. This results in thousands of disconnected systems across state and local retail regulatory agencies. In addition, information is stored in different formats and structures based on the state and local health department implementation, as noted above. The pilot included five (5) different systems across the nine participating agencies, including one agency with an in-house inspection system (see Appendix **Section 6.1, Table 2**). Even for the four agencies that were using the same IT system, the datasets were separate, not integrated, and there were many unique fields with different data formats and structures. However, many states with local jurisdictions providing retail food regulatory inspections, such as Pennsylvania, Iowa, Tennessee, and Colorado, are moving toward statewide data systems and datasets.
- **Data that is often hard to access and difficult to interpret.** Inspection data systems are often more focused on data entry than data retrieval, and reports are frequently not designed with data analysis and interpretation in mind. Retail food regulatory programs are often limited in what information they can retrieve from the systems they use. Data is often presented in a format that is not easy to understand, making the information hard to interpret. For example, several systems used by pilot agencies had limited standard reports

generated from the data. Those systems that supported ad hoc reports still had data fields that could not be pulled into a report, meaning that programs were entering data into the systems but could not pull data out. One pilot participating agency stated that they were charged extra support fees for each new report they wanted to generate. Furthermore, programs lacked the resources and capacity to create and interpret the robust, intuitive reports that could provide meaningful feedback and actionable information.

Overcoming these limitations: To address the first limitation, interviews were conducted with both the retail inspection program staff and the IT administrators for the inspection systems to better understand the data and the systems. Standards were created for the data fields based on the 2017 *FDA Food Code*, and data elements were mapped to those standards. Data import scripts were created for each agency dataset based on the data standards. Imported data was reviewed for errors, import scripts were updated, and the scripts were run again. This iterative process was fairly successful at creating a uniform dataset that contained all of the inspection data. These steps were made easier for the five (5) agencies that used the same inspection system and because the vendor employed by AFDO for the pilot was supporting that system and had knowledge of the system and the data. However, certain data fields presented unique challenges and required manual data cleanup. These challenges, successes, and areas for further improvement are outlined below. To address the second limitation, the pilot dataset was designed to have full access to all the data elements. A data visualization and reporting tool, Microsoft Power BI (Business Intelligence), was employed to create reports to answer top programmatic questions; it was made available to pilot agencies through a simple website. Further work is needed to improve the user experience, value, and engagement with these reports.

2.2.2. Lack of Standard Food Safety Regulations

- **Inconsistent adoption of Food Code.** As mentioned in Section 2.1. above, regulatory food safety agencies have adopted many versions of the *FDA Food Code*. There were seven different versions of the Food Code in use by the nine pilot agencies (see Appendix **Section 6.1, Table 2**). Agencies may also modify portions of the model code increasing dissimilarities. For example, one pilot participant, Harris County, Texas, used the Texas Food Establishment Rules, a modified version of the 2013 FDA Food Code. These differences in the Food Code result in differences in the type of information collected during an inspection.
- **Dissimilarities in key factors.** In the states included in the pilot, the most common differences in the Food Code related to (1) the number of employees required to be trained as a certified food protection manager, (2) definitions of bare-hand contact, and (3) definitions of *approved source*. These differences make like-to-like comparisons challenging, since being in compliance or out of compliance with the Food Code means different things, depending on the jurisdiction.
- **Inconsistent treatment of corrected on-site.** Some agencies recorded Food Code violations that were corrected on-site during the inspection as violations; other agencies treated them not as violations but as being in compliance.

Overcoming these limitations: To minimize variability in the initial pilot dataset, we recruited agencies that had similar characteristics. These characteristics included agencies that were responsible for most retail food inspections in the state and used a statewide Food Code and inspection report. The 2017 version of the *FDA Food Code* was used as the standard for food safety regulations during the pilot. Food Code versions used by participating agencies were mapped to this standard. Further work is needed to standardize and control for dissimilarities among participating agencies when they occur, particularly for extremely disparate Food Codes or Food Code interpretations that would lead to incorrect analytical conclusions.

2.2.3. Varied Inspection Procedures and Reports

- **Dissimilar data collected on inspection reports.** In addition to differences in Food Code regulations and inspection procedures, there are also cross-agency differences in the inspection reports themselves and what information is collected. For example, some agencies combine the requirement that the person in charge be present and demonstrate knowledge with the requirement for the facility to have a Certified Food Protection Manager on their inspection report; other agencies have these as separate and distinct inspection report items. Additionally, many agencies have requirements specific to their jurisdiction. The state of Alaska, for instance, has unique water and wastewater system requirements. These differences make it difficult to analyze nationwide trends and measure the degree of standardization, effectiveness, and impact of retail regulatory inspections. As demonstrated in **Appendix 6.2**, the sample state retail inspection reports from Alaska, Arkansas, Kansas, and Iowa highlight the report line-item differences in the adoption and implementation of retail inspection programs.
- **Varied approach to inspection report marking instructions.** Participating retail food programs varied on their approach to how inspections were conducted and how – and whether – to note violations on inspection reports. For example, participants differed in how inspectors were instructed to mark violations. In some agencies, inspectors were instructed to mark a violation out of compliance if they witnessed any instance of the violation. In other jurisdictions, the instructions were to only mark a violation if it was seen as a systematic issue or occurring repeatedly. In another example, agencies differed in how inspectors were instructed to record violations that were subsequently corrected by the business before the inspection ended (known as “corrected on-site”). In some agencies, those violations were marked out of compliance along with a “corrected on-site” notation. In others, those violations were marked as being in compliance.

Overcoming these limitations: The model food inspection report from the 2017 *FDA Food Code*, Form 3-A Food Establishment Inspection Report, was used as the standard for the pilot. Inspection report data fields from each participating agency were mapped to the fifty-six (56) items in the 2017 inspection report. This approach worked well for many participating agencies with most inspection report items matching directly to the standard: two agencies matched 100%, five agencies matched all but one or two items, and two states matched 80% of the items. Further work is needed for items with one-to-many relationships with the standard.

This occurred most often for the first two standard items: (1) Person in charge present, demonstrates knowledge, and performs duties and (2) Certified Food Protection Manager; several participants had one field representing both factors. There was good agreement when mapping each agency's compliance statuses to the standard of IN, OUT, N/O (not observed), and N/A (not applicable). All nine agencies used these statuses; four used only those four compliance statuses, the other four had additional statuses. Further work is needed to account for differences in marking instructions explained above.

2.2.4. *Lack of Standard Data Elements for Assessing Risk-Based Inspections*

There are several retail food inspection data fields that lack standardization. In addition to the elements mentioned above, facility naming conventions and risk categorization are uniquely problematic for identifying frequency and effectiveness of inspections truly focused on foodborne illness risk factors.

- **Lack of naming consistency for top brands.** Part of the rationale for a model Food Code and Retail Food Program Standards is to have similar regulatory approaches toward similar food safety risks nationwide. One way to measure that consistency is to compare inspections for the same food companies – also called brands – located in different jurisdictions, with the assumption that the same brand will be preparing and serving the same types of food and be operating under the same policies and procedures in all locations. This comparison was hampered in two ways, first by the diversity of store names under a single brand parent company and next, by inconsistent facility names in the inspection data. As an example of the first limitation, Kroger, a large grocery store brand, operates under nineteen (19) different store names including: Baker's, City Market, Dillons, Food 4 Less, Foods Co, Fred Meyer, Fry's, Gerbes, Jay C Food Store, King Soopers, Kroger, Mariano's, Metro Market, Pay-Less Super Markets, Pick'n Save, QFC, Ralphs, Ruler, and Smith's Food and Drug. The second – and more problematic – limitation is that there may be many ways a brand may be spelled in inspection databases, across or even within the same retail food program. This is especially true for brands with often confused apostrophes or hyphens, or in the instances of a store within a store. For example, a Starbucks coffee store inside a Walmart grocery store may be entered as Starbuck's, or Starbucks, or Walmart #1234 – Starbuck's, or Wal-mart #1234 - Starbucks. A common naming convention needs to be applied before any comparisons can be made.
- **Lack of uniform risk categorization.** Risk categorization is a foundational aspect of risk-based inspections outlined in both the *FDA Food Code* and the Retail Food Program Standards. Retail and foodservice businesses are to be grouped by inspection programs into categories based on potential and inherent food safety risks, including types of food served, preparation processes used, and population served. Inspection frequency is then to be based on risk, with highest risk businesses inspected most frequently. While many agencies have created some type of risk categorization, the definition and assignment of risk categories have not been consistent, resulting in the inability to compare inspection data based on risk level. This lack of standardization was evident in the pilot study. There

was one participating agency that didn't have any risk categorization data. For the remainder that did, two agencies had three risk levels, three had four levels, one had five levels, and two had six levels. Furthermore, the criteria applied for categorization varied widely. Some participating agencies considered businesses with all pre-packaged foods – some of which were frozen and some refrigerated – as a medium risk level and others considered the same type of businesses as very low risk. Lastly, when comparing risk categories for the same brand stores across the pilot agencies' inspection data, there were several instances of the same brands being assigned different risk levels.

Overcoming these limitations: To address naming convention discrepancies, AFDO used industry data to identify the 450 top non-franchise brands, based on number of stores, in each retail sector: food service, retail/grocery, and convenience store. Automated name-matching scripts were applied to the store names across the combined dataset. Results were manually reviewed, and improvements were made to the matching process as new jurisdictional data were added. Further work is needed to improve matching for common words, short words, and short abbreviations. Further work is also needed to improve matching when two store names occur in the name field, such as the Starbucks in a Walmart example given above. To address risk categorization discrepancies, AFDO used knowledge about the food operations of the top brands to create a new risk category field. All top brands were assigned a high, medium, or low risk, which was applied consistently to all locations for those brands.

2.2.5. Time-Intensive Data Cleanup and Consolidation Prevents Timely, Actionable Analysis

Over the course of the pilot project, we found the process to obtain data from the pilot agencies to be time-consuming, and the data standardization and collation required a significant amount of effort. Several meetings were needed with retail food program and IT administrator staff. Import scripts needed to be created, run, improved, and re-run. Manual data cleanup was needed. As a result, the data were over a year old by the time the dataset was analyzed. While the insights gleaned from the dataset were novel and important, it did not allow the agencies to react timely to food safety trends.

Overcoming this limitation: Many of these limitations are to be expected with the development and implementation of any new dataset. The enhancement of additional, more recent data from the pilot agencies is expected to be significantly faster, although adding routine inspections conducted since January 1, 2020 was out of scope for the pilot. Ideally, application programming interfaces (APIs) could be created to automatically update the dataset with additional data from participating agencies' inspections systems. Implementing frequent updates, along with corresponding data quality checks, would provide near real-time, actionable information to improve food safety.

* * *

AFDO conducted the Retail Inspection Data Analytics pilot project with the purpose of combining and analyzing retail regulatory inspection report data from nine state and local datasets over a 24-month period. This pilot successfully demonstrated that many of the limitations preventing the creation of a single dataset for retail food regulatory inspections can be overcome. Based on the

challenges and lessons discovered during the pilot, this white paper presents a proposed solution to create and sustain a uniform, national Retail Inspection Data Warehouse to enable, for the first time, the ability to measure the impact on reducing foodborne illness risk factors and target improvements. In addition, we describe successful food safety data projects (see Section 4) and how this proposed solution builds upon those successes to impact food safety across the country.

3. PROPOSED SOLUTION

AFDO proposes to work with state, local, tribal, and territorial retail food inspection programs and other stakeholders to create a Retail Inspection Data Warehouse (RDW) to better understand the impact that regulatory retail food inspections are having on reducing foodborne illness risks. The impediments to reaching this goal have been carefully analyzed. To achieve these food safety and public health aims, data will need to be gathered from various sources, then be cleaned and standardized into a single consolidated data warehouse. The creation of an RDW would eliminate the aggregation and comparison limitations and enable the participating agencies to effectively share and analyze retail inspection report data gathered nationwide.

3.1. Expanding on Prior Successes to Create a Retail Inspection Data Warehouse

Given the limitations of data sharing across systems, a successful data warehouse solution needs to have the following characteristics:

- **Standardized data elements.** Before a data warehouse solution can be built, we must first create standards for the data we want to combine. Although there have been tremendous gains in adopting a common *FDA Food Code* and conforming to a single set of national retail food regulatory program standards, a concerted effort is needed to define a common set of data standards for participating agencies to follow. These data standards will provide a common "language" to support communication, comparison, and interpretation of the data across all participating agencies. It will also make it easier to communicate results to industry, academia, and the public, allowing food regulatory agencies across the nation to speak with one voice. This will pave the way for a comprehensive solution that is much easier to maintain and enhance. The solution needs to be driven by the regulatory agencies themselves, because each has the best knowledge of its own data and its needs and wants for data sharing. Only when all partners are involved and motivated can a joint success be achieved. Further, this standardization can drive more consistent and uniform data collection and implementation of risk-based inspections, and perhaps trigger more uniform adoption of the *FDA Food Code*.
- **Centralized and scalable solution.** The goal is to support efficient and effective data sharing across all participating partners to improve food safety. Therefore, the solution must require that each dataset be stored in one central location and mapped to a common standard. This will enable the participating agencies to share and analyze the data effectively and with common understanding. The solution also needs to be scalable for both an increased number of data sharing partners and an increased amount of data over time.

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- **Secure data environment.** Keeping the data secure is of utmost importance. The data warehouse environment, including the applications used to transfer and store data, would need to meet high information security standards, such as Federal Risk and Authorization Management Program (FedRAMP) certification for the cloud-based products and services. Access to information would be monitored and managed based upon rules mutually agreed upon by AFDO and agency participants. Though, generally almost all the data provided is publicly available via online portals or public information requests, just not in a consolidated fashion.
 - **Ongoing good data governance.** The elements identified above are just a part of employing good data governance to the RDW. The data governance structure put in place will be a straightforward, actionable framework to maintain data quality, utility, and security.

3.2. Potential Uses of a Retail Data Warehouse

The Retail Inspection Data Warehouse presents several known and likely unknown opportunities.

- **Internal program performance.** The standardized data will make it easier to generate accessible, intuitive reports for the regulatory programs. Many systems currently used by state and local food safety agencies have limited reporting capabilities or generate reports that are hard to interpret. A data warehouse with common data elements would make it easier for programs to set and assess key performance indicators.
- **Cross-program benchmarking and assessment.** Food safety programs are frequently questioned by policy leaders asking for comparisons with other programs in other states – norms to key performance indicators such as inspection frequency, average inspection times, and violations. Data that allows for comparisons with other programs can assist in looking at violation frequency, length of inspections, and practices not observed during the inspection and potentially provide information that may assist in assessing program strengths or weaknesses.

Historically, providing such data was very difficult and required substantial amounts of time to collect and analyze to be valuable.

Recently, during a state demonstration, a state participant commented:

"I was excited to see how quickly you could compare metrics among states as well as look at trends within a specific state. I just spent the past week running multiple reports, sorting through six months of inspection data, and creating graphs and charts to illustrate how our staff is performing only to see (RDW) create the same information within seconds using the tools from this project! Not only was the data analytics software able to instantly show the same graphs and charts that took hours for me to create, but it also has the ability to make instant comparisons among similar jurisdictions.

This type of program is needed as I am often asked by agency leaders and legislators how our program compares to neighboring states and 'why is this change to the food code necessary in Arkansas?' I have to reach out to the states and compile the information they provide me into a report. I believe the tools in this software will allow me to make these comparisons effortlessly. I

am eagerly anticipating the official release of this project as I know it will be a great benefit to myself and the Arkansas Retail Food Program.”

*Jeff Jackson, Arkansas Department of Health
Retail Food Section Standardization/Quality Assurance Officer*

- **Trending retail inspection data.** Centralized data allows for trending of inspection results including violations, activities not observed, and compliance and violation trends for retail brands, industry segments, and small operators. In the future, this data combined with modern data science techniques such as artificial intelligence, machine learning, and predictive analytics will result in a powerful tool for retail regulatory programs to identify trends and tell their story. For example, this could allow for early identification of multi-state violation trends in a single, common retail brand. While some of this beneficial information is available to retail companies through commercial service providers, it is cost prohibitive for government agencies to access. Early identification of these trends and prompt discussion with potentially compromised brands could lead to quick interventions and reduction in the potential for illness.
- **Trending risk-based inspection practices.** While jurisdictions have attempted to implement risk-based inspection methods, large datasets can assist in identifying effectiveness and help programs identify areas for emphasis allowing for the most impact.
- **Adding GIS and non-food safety datasets.** With a larger dataset, additional GIS data can be overlaid upon the inspection data to look at societal and economic interactions. Data can be added for potentially relevant factors such as flood plains, fault lines, and utility companies to assist in identifying firms that may be impacted by emergency events.

3.3. Identified Challenges and Mitigations for a Centralized Data Warehouse

As the Retail Inspection Data Analytics Pilot demonstrated, a significant challenge in realizing effective information sharing is the variety of systems being used by state, local, tribal, and territorial food safety agencies. These agencies may have multiple systems, each supporting different business processes that were built using different technologies. Those technologies were often developed to support business processes very different from regulatory food safety inspections. Integrating disparate systems across government agencies is a challenging task. Even agencies utilizing the same technology solution often have differing customized implementations and processes that can impact comparability. A more practical approach is to enable information sharing with published common standards, as described above.

Based on the challenges and lessons learned from the pilot, we have identified the risks to successful data consolidation along with mitigation strategies to address the challenges and risks associated with managing projects in a highly diverse environment with a wide range of stakeholders:

Table 1. Potential risks to consolidating data and creating a Retail Inspection Data Warehouse and strategies to mitigate those risks

Potential Risk to Data Consolidation	Risk Mitigation Strategy
--------------------------------------	--------------------------

If the onboarding agency's subject matter experts and IT support have limited availability, the timeline could be negatively impacted.	<ul style="list-style-type: none"> • Work with onboarding agency to assess resource readiness early on and align schedules accordingly.
If the agency's current system does not capture all of the important data elements, then the dataset analysis and effectiveness could be impacted.	<ul style="list-style-type: none"> • Work with the participating organization to identify its technical readiness based on its inspection report and IT system. • Outline a minimal level of required fields to ensure that any missing data elements will not impact the overall dataset for trending and analysis.
If the technical enhancements and business requirements for the RDW have not been established and approved to support the timeline, it results in schedule slippage.	<ul style="list-style-type: none"> • Work with stakeholders early to identify dependencies. • Work with stakeholders to assess resource readiness and align schedule. • Reduce scope and integrate only key components identified by AFDO.

3.4. Phase 1: Project Initiation

The successful creation of a Retail Inspection Data Warehouse will be determined by a few key factors.

- **Stakeholder engagement:** A vision for the RDW project needs to be clearly defined by AFDO and the data sharing community. Creating this vision requires direct involvement from the regulatory retail inspection programs and retail food safety stakeholders. Success of the solution will require continuous momentum, support, and commitment from AFDO and these RDW partners.
- **Road map planning:** A road map for a successful RDW project needs to be created with input from all stakeholders. The solution will not be successful without recognizing the jurisdictional differences in food safety regulations and retail inspection programs and without full collaboration from all participating agencies. Additionally, the solution needs to be developed on an incremental basis, adding a few agency datasets at a time, identifying and correcting issues, and applying those lessons to the next datasets to be added.

3.4.1. Establishing an RDW Workgroup and Project Team

The project would start with AFDO initiating an RDW workgroup. This workgroup would consist of the AFDO User Group Governance Council members (a body governing a current multi-state regulatory inspection system), other state regulatory inspection system points of contact, and retail food program subject matter experts, including the FDA and the CDC. The group would meet monthly with an AFDO Project Manager, who would provide guidance to ensure good communication with the solution implementation team and that assumptions and

recommendations are met. Furthermore, an AFDO Core Team would meet monthly with the vendor's project team.

3.4.2. Road Map Planning

The key to success is outlining realistic goals and maintaining continuous momentum. This can be achieved by utilizing the agile methodology that delivers features incrementally to highlight the benefits and successes often and regularly. This can be accomplished by building initial functionality and rolling it out to the RDW participants while continuing to add to the overall catalog of enhanced functionality, services, or data being exchanged. For example, the initial participants would include the states from the AFDO Retail Inspection Data Analytics Pilot and an agency with a different data structure than those encountered in the pilot. This road map approach is beneficial because it supports step-wise progress, and it allows AFDO to balance priorities between building the functionality for current participants and expanding to new participating agencies.

3.5. Phase 2: Architecture Definition & Documentation

Building upon the AFDO Retail Inspection Data Analytics Pilot and other data projects outlined in the next section, the RDW will aggregate retail inspection data from different sources into a single, central, consistent data store to support business intelligence (BI), data analysis, data mining, artificial intelligence (AI), and machine learning. **Figure 1** depicts an initial architecture for the RDW, which can serve as a starting point of architecture definition. Microsoft applications were used for the pilot and suggested for the RDW because they are in common use by state and local government agencies. During the initial phase, we used a proprietary tool that had significant licensing costs. Subsequently, after proof-of-concept demonstration, the system was transitioned into use of the significantly less-expensive Microsoft applications.

The RDW will enable participating organizations to run powerful analytics on large volumes of historical retail inspection data in ways that a standard database cannot. The following major components outline the overall solution:

- **AFDO RDW Project Portal** – The project portal would be a Microsoft SharePoint site that uses external and internal views to share all project information. The external view would display information about the project and contents; the internal view would house restricted information including project details, functionality, technical documentation, and user guides based on the AFDO-identified roles and permissions.
- **Microsoft Azure Government** – Microsoft Azure Government, a cloud services provider, has a secure and dedicated cloud for government agencies. This platform would be used to extract, transform, and load the data for the RDW.
- **OneDrive** – Participating organizations will have the option to get instant access to an extract of the data. Based on the RDW extract sizes, a secure Microsoft OneDrive would be used to transfer data extracts between the participating agency and the AFDO Support team.

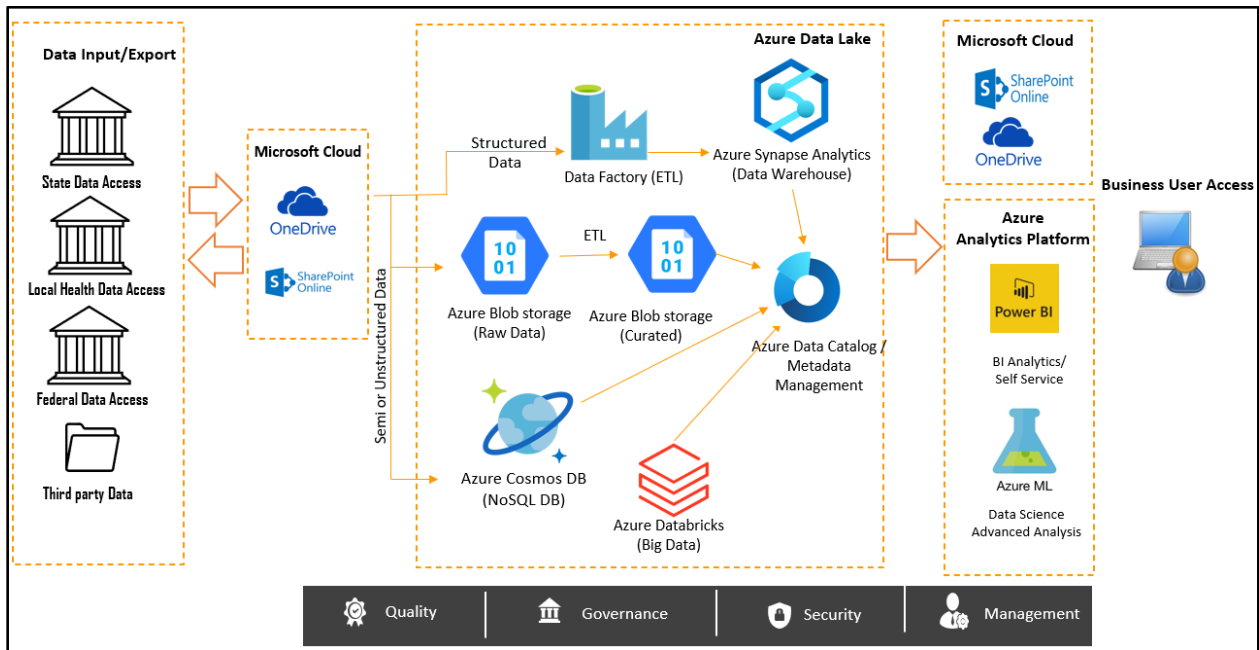


Figure 3. Notional Retail Inspection Data Warehouse (RDW) Data Architecture

- **Microsoft PowerBI** – The PowerBI platform has numerous interactive visualizations and layouts to see and analyze large datasets. A PowerBI tool would be customized for the project for participants to analyze and trend the data for making important decisions.
- **Machine Learning/Deep Learning** – Microsoft PowerBI also has built-in functionality called *AI Insights*. RDW participants would use this tool to discover hidden, actionable insights in their data and drive better business outcomes with easy-to-use AI.

3.5.1. Documentation and Processes

In the pilot, the project team focused on the analysis of a single upload of a dataset and did not require supporting documentation or standard operating procedures to load, refresh, and extract datasets from other sources. As part of the full RDW project deployment, the project team recommends expanding the documentation to include standard data warehouse project documentation: Data Architecture and schema diagrams; Data Validation Reports; Data Dictionaries; Data Quality Plan; ETL Architecture and Data Dictionary; ETL Design Specification, Scheduling, and Technical Documentation; Standard Operating Procedures; Mapping Documentation; Testing Documentation; and Operation & Maintenance Manual.

3.5.2. Data Quality and Data Management

Users of the RDW can only make the right data-driven decisions if the data in the warehouse are correct. This project would implement a Data Quality Process, which requires an iterative process of analyzing, cleansing, and monitoring data quality. The concept of a cycle emphasizes that data quality is not a one-time project but an ongoing commitment. One limitation in the AFDO Retail Inspection Data Analytics Pilot that needed to be overcome was that each participating agency was implementing the retail regulations and capturing inspection data slightly differently. Appendix 6.2 demonstrates the mapping and standardization of data elements needed across the pilot states. For expansion, additional data transformation will be needed to accommodate the variations in data sources and state adoption of different versions of retail regulations.

3.5.3. Data Analytics Reporting

To consume the vast amount of data, Business Intelligence (BI), data analytics, and machine learning tools will be built to provide business analysis and insight to stakeholders, enabling them to make business decisions quickly and accurately. Using the Microsoft PowerBI platform, interactive visualizations and layouts would be customized to analyze and trend the data for making important and timely decisions. In this phase, initial PowerBI reports would be created to highlight the capabilities that can be expanded upon in future releases.

3.6. Phase 3: Road Map Execution

As outlined in the AFDO Retail Inspection Data Analytics Pilot, a key factor to success is maintaining continuous momentum by building initial functionality and rolling it out to the participating agencies as soon as possible, while continuing to add to the overall catalog of enhanced functionality and services.

- **Make initial rollout to pilot states** - To quickly transition to this new platform, the nine participating agencies from the pilot would be onboarded.
- **Expand to additional participating agencies based on technical readiness** – Next, data from additional agencies would be added, prioritizing those that have been identified as having a mature, defined dataset that meets the technical readiness for participation. The AFDO Core Team would then work with additional agencies needing more assistance to become technically ready.
- **Expand functionality** – Based on the direction of the RDW workgroup, the project team would expand the functionality of the RDW platform. For example, adding other regulatory program data like consumer complaints or enforcement actions, building PowerBI analytics to assist with Retail Food Regulatory Program Standard reporting requirements, or building APIs for automatic, more real-time uploading of data.

4. CURRENT DATA SHARING PROJECTS ACROSS LOCAL, STATE, AND FEDERAL PARTNERS

The foundations for building a Retail Inspection Data Warehouse come from several past data sharing and data consolidation projects across local, state, and federal food regulatory agencies. The challenges and successes of these projects inform the best approaches for future success.

4.1. FDA and State Data Exchange Pilots

As a pilot project for the FDA Partnership for Food Protection (PFP) IT Workgroup in 2012, FDA and the Pennsylvania Department of Agriculture successfully completed a three-month effort to implement a secure and seamless mechanism to transfer bovine spongiform encephalopathy (BSE) inspection data between the two agencies. The pilot was turned into a long-term, ongoing, daily transmission of data. Although a great success, the project had a limited scope and number of participating stakeholders.

Separately, the Minnesota Department of Agriculture (MDA) received grant funding from two FDA grants, RFA-FD-12-027 (Traceback) and RFA-FD-12-026 (Recall), to expand the event functionality within USAFoodSafety, an electronic inspection system, and conduct a two-state proof-of-concept food emergency traceback and recall exercise. This effort enabled the MDA to successfully complete a traceback and recall exercise in coordination with the Iowa Department of Inspections and Appeals (DIA) in August 2015. The data collection enhancements to USAFoodSafety were completed under the FDA grant; however, a real-time data exchange was not in scope, which limited the effectiveness and required manual data extracts to share data.

4.2. FDA National Food Safety Data Exchange (NFSDX) Project

As a continuation of the BSE and Traceback/Recall successful pilots, the NFSDX project was initiated in 2017 to automate food regulatory data between the FDA and state agencies. Its purpose is to facilitate and automate system-to-system data transfer and increase the sharing of accurate, timely, complete, and relevant food safety data. This information sharing results in improving the efficiency and efficacy of FDA inspections, which fulfills the Food Safety Modernization Act (FSMA) mandate and enhances the FDA's mission for protecting public health and assuring the safety and security of regulated products, and also implements comprehensive preventive controls across the nation's food supply. The NFSDX has proven the capability and value of inspectional data sharing. It has also demonstrated the importance of data standardization, which has been a time-intensive, iterative part of the project. Combining data into one secure, analyzable dataset is outside the current scope of NFSDX.

4.3. Retail Risk Factor Study – FoodSHIELD

Learning from a previous 10-year retail food risk factor study, in 2014, the FDA began using a new study protocol and data collection tool to gather information about risk factor control at the retail level. The study protocol and data collection tool are available to jurisdictions interested in conducting their own risk factor studies. These documents were then made available on the FoodSHIELD website, which is a web-based tool that enhances threat prevention and response,

risk management, communication and asset coordination, and public education. This is a good example of a combined dataset that can be analyzed to identify larger trends across the nation.

4.4. FDA Center for Food Safety and Applied Nutrition (CFSAN) Cloud Data Warehousing Services (CDW) Project

This last example comes from the FDA Center for Food Safety and Applied Nutrition (CFSAN). CFSAN needed a more efficient method to analyze its data, streamline business processes, and better serve public needs. The resulting Cloud Data Warehousing (CDW) solutions play a critical role in transforming agency operations to meet ever-changing regulatory requirements by providing a more cost-effective alternative to traditional data warehouse storage and reporting analytics. The platform consumes data from various sources, such as CFSAN's on-premises and other cloud-based applications, other FDA centers and offices, and industry partners via many aggregation methods, including extract, transform, and load (ETL), data migration, data services APIs, data synchronization, and real-time data streaming. To consume the vast amount of data, Business Intelligence (BI), data analytics, and machine learning tools, such as Tableau, QuickSight, and Neo4j, are used to provide business analysis and insight to CFSAN stakeholders, which allows business decisions to be made quickly and efficiently.

5. CONCLUSION AND NEXT STEPS

The creation of a Retail Inspection Data Warehouse (RDW) would, for the first time, provide the ability to **measure the public health impact** of regulatory retail food inspections across multiple geographic jurisdictions and benchmark key successes and challenges with controlling the risk factors associated with foodborne illnesses. The Retail Inspection Data Analytics Pilot recently completed by AFDO and nine state and local agencies provided a proof of concept that an RDW will overcome existing barriers and enable the participating agencies to effectively share and analyze nationwide retail inspection report data.

With the support of retail regulatory programs at the state, local, tribal, and territorial level, along with our public health partners, the FDA and the CDC, and food safety stakeholders, AFDO is committed to advancing the current pilot dataset into a full-fledged Retail Inspection Data Warehouse. Through stakeholder engagement, road map planning, and road map execution, a **centralized and scalable RDW** will be built in a **secure data environment** with **clean, standardized, and easy-to-analyze data**, providing **powerful, user-friendly reports** to answer the important questions that lead to improved food safety and public health.

6. APPENDICES

Information and conclusions presented in this white paper are derived from the Association of Food and Drug Officials' (AFDO) Retail Data Analytics Pilot project. These appendices provide a summary of the pilot project, examples of routine retail regulatory inspection reports, an example of data element mapping to the 2017 *FDA Food Code* inspection standard, and a list of data elements.

6.1. Retail Data Analytics Pilot Project Summary

In 2021, AFDO, through financial assistance from the Retail Food Safety Association Collaboration (HHS/FDA U18FD007051), began the Retail Data Analytics Pilot project by engaging four state agencies:

1. Alaska Department of Environmental Conservation
2. Arkansas Department of Health
3. Iowa Department of Inspections and Appeals
4. Kansas Department of Agriculture

These agencies had several key characteristics in common:

- Statewide (or near statewide) authority for retail food regulation
- Inspectional authority for all retail food businesses, including restaurants and foodservice, grocery stores, and convenience stores
- Use of the same electronic inspection system, USAFoodSafety, for data entry, storage, and retrieval

AFDO worked with these four states and Precise Software Solutions (Precise), the information technology partner that supports USAFoodSafety, to review, standardize, import, and clean the retail inspection data for routine inspections conducted from January 1, 2017, through December 31, 2019. This pre-COVID-19 date range was selected to provide a robust amount of data representative of routine regulatory inspections. The resulting dataset contained 52,674 unique retail facilities and 117,991 unique routine retail inspections.

Following the successful creation of a four-state centralized dataset, AFDO and Precise worked with five additional regulatory agencies to expand the pilot dataset:

5. Pennsylvania Department of Agriculture
6. Rhode Island Department of Health
7. Tennessee Department of Health
8. Harris County Public Health, Harris County, Texas
9. South Carolina Department of Health and Environmental Control

These five additional agencies brought more complexity to the project, including three different inspection systems, and the addition of a local (rather than state) jurisdiction. The final pilot dataset contained 172,243 unique retail facilities and 436,125 unique routine retail inspections. See Table 2 for more information on the dataset.

Through strong collaboration with pilot participants, AFDO and Precise were able to identify and overcome the challenges in developing, standardizing, analyzing, and reporting of a combined retail regulatory inspection dataset. Preliminary findings from the pilot dataset are being compiled for subsequent publication.

Table 2. Retail Data Analytics Pilot regulatory inspection dataset characteristics

State	Coverage Area ¹	Population ²	Food Code Version(s)	Inspection System	Records Data Range	Number of Facilities	Number of Inspections
Alaska	Entire state, except city of Anchorage	443,545	2005	USAFoodSafety	1/3/2017 - 12/24/2019	2,905	4,979
Arkansas	Entire state	3,017,804	2009, 2013	USAFoodSafety	1/2/2018 - 12/31/2019	19,403	58,102
Iowa	Entire state	3,155,070	2013	USAFoodSafety	1/3/2017 - 12/31/2019	16,843	31,783
Kansas	Entire state	2,913,314	2009 w/ 2011 supplement ³	USAFoodSafety	1/2/2018 - 12/31/2019	13,523	23,127
Pennsylvania	61 of 67 counties ⁴	7,747,978	2015, 2017	USAFoodSafety	1/2/2017 - 12/31/2019	46,401	120,092
Rhode Island	Entire state	1,059,361	2017, 2019	Digital Health Department	1/3/2017 - 12/31/2019	9,648	13,287
South Carolina	Entire state	5,148,714	2013, 2017	RizePoint	3/3/2016 - 12/31/2019	24,144	74,418
Tennessee	Entire state - restaurants/food service only	6,829,174	2009	HealthSpace	1/3/2017 - 12/31/2019	29,135	70,496
Texas	Harris County	4,713,325	2013 ⁵	In-house system	1/3/2017 - 12/31/2019	10,241	39,841
Total		35,028,285				172,243	436,125

¹Geographic area included in regulatory retail inspection dataset from each participant state. All food service establishments (e.g., restaurants) and retail food stores (e.g., grocery and convenience stores) within the stated area are included, unless noted otherwise.

²Population of coverage area based on 2019 U.S. Census estimates.

³The 2012 Kansas Food Code was effective in 2013 and based on the 2009 FDA Food Code with the 2011 Supplement.

⁴Pennsylvania Department of Agriculture jurisdiction covered the entire state except for Bucks, Chester, Montgomery, Philadelphia, Allegheny, and Erie counties.

⁵The Texas state code used, Texas Food Establishment Rules (TFER), was substantially (99%) equivalent to the 2013 FDA Food Code.

6.2. Sample State Retail Inspection Reports

As identified during the Retail Data Analytics Pilot, each state implements retail food regulatory standards slightly differently. The following sample state retail inspection reports from Alaska, Arkansas, Kansas, and Iowa highlight inspection report line-item similarities and differences in data elements collected during a routine regulatory inspection.

Permit ID		Establishment Name		Type of Operation			
Establishment Mailing Address		City	State	Zip			
Physical Location				Telephone			
Responsible Party		Email		Person in Charge			
Purpose of Inspection			Permit Posted				
FOODBORNE ILLNESS RISK FACTORS AND PUBLIC HEALTH INTERVENTIONS Risk Factors are improper practices or procedures identified as the most prevalent contributing factors of foodborne illness or injury. Public Health Interventions are control measures to prevent foodborne illness or injury.							
Circle designated compliance status (IN, OUT, N/O, N/A) for each numbered item Mark "X" in appropriate box COS and / or R IN = in compliance OUT = not in compliance N/O = not observed N/A = not applicable COS = corrected on-site during inspection R = repeat violation							
Compliance Status		COS	R	Compliance Status		COS	R
Employee Knowledge				Potentially Hazardous Food Time/Temperature			
1	In			14	N/A		
Certified Food Protection Manager on staff				Proper cooking time and temperatures			
2	In			15	N/A		
Person in Charge appropriate knowledge, performs duties				Proper reheating procedures for items to be hot held			
3	In			16	N/A		
Food Worker Cards for all food workers				Proper cooling times and temperatures			
Employee Health				17	N/A		
4	In			Proper hot holding temperatures			
Proper reporting, restriction, and exclusion				18	In		
Preventing Contamination by Hands				Proper cold holding temperatures			
5	In			19	N/A		
Hands cleaned and properly washed				Proper use of time as a control; procedures & records			
6	In			Consumer Advisories			
No bare hand contact w/ ready to eat foods				20	N/A		
7	In			Consumer advisory for raw or undercooked food			
Hand washing facilities supplied and accessible				Highly Susceptible Population			
Approved Source				21	N/A		
8	In			Pasteurized food used, prohibited foods not offered			
Food/water obtained from approved source				Chemical			
9	In			22	In		
Food in good condition, safe & unadulterated				Food additives: approved, proper used			
10	In			23	In		
Shellstock Tags & Parasite Destruction: Required Records				Toxic substances properly identified, stored, used			
Protection from Contamination				Conformance with Approved Procedures			
11	In			24	N/A		
Food-contact surfaces properly cleaned and sanitized				Compliance with variance, HACCP plan			
12	In			25	N/A		
Food separated and protected				Compliance with Required Food Safety Management System			
13	In						
Proper disposition of returned, previously served, reconditioned, and unsafe food							
CHEMICAL SANITIZER OBSERVATIONS							
Chemical		Concentration(PPM)		Chemical		Concentration(PPM)	
By _____							

Figure 4a. Alaska Department of Environmental Conservation's Retail Inspection Report

ADEC Food Establishment Inspection

Establishment Name:

Permit ID:

GOOD RETAIL PRACTICES
 Good Retail Practices are preventive measures to control the addition of pathogens, chemicals, and physical objects into foods.
 ***Designates violation may contribute to Imminent Health Hazard

Mark "X" in box if numbered item is not in compliance. Mark "X" in appropriate box for COS and/or R
 COS=corrected on-site during inspection R=repeat violation

Compliance Status	COS	R	Compliance Status	COS	R
Food Temperature Control			Proper Use of Utensils		
26			37		
27			38		
28			39		
Food Identification			Utensils and Equipment		
29			40		
30			41		
31			42		
Prevention of Contamination			Physical Facilities		
32			43		
33			44		
34			45		
35			46		
36			47		
			48		
			Water and Wastewater		
			49		
			50		

NUMBER OF RISK FACTOR / INTERVENTIONS: 0
 NUMBER OF GOOD RETAIL PRACTICES: 0

OBSERVATIONS AND CORRECTIVE ACTIONS			
Item Number	Violation of Code	Violations cited in this report must be corrected within the time frames listed below, or as stated in section 18 AAC 31.900(e).	Correct By Date

Inspection Published Comment:

Visit Date	Received By (Printed Name)	Received By (Signature)	Date	Inspected By	Inspected By (Signature)	Sig. Date	Time In	Time Out

Figure 4b. Alaska Department of Environmental Conservation's Retail Inspection Report, continued



Food Establishment Inspection Report				
Arkansas Department of Health Environmental Health Protection Services	No. Of Risk Factor/Intervention Violations			
	No. Of Repeat Factor/Intervention Violations			
Establishment:	Address:	City/State:	Zip:	Telephone:
License/Permit#:	Permit Holder:	Inspection	Est. Type:	Risk Category:

FOODBORNE ILLNESS RISK FACTORS AND PUBLIC HEALTH INTERVENTIONS

IN = In compliance OUT = Not in compliance N/O = Not observed N/A = Not applicable (*) = Corrected on site during inspection (COS) R = Repeat violation

Foodborne Illness Risk Factors	Potentially Hazardous Food Time/Temperature
Demonstration of Knowledge	16 Proper cooking time and temperatures
1 Person in charge present, demonstrates knowledge, and performs duties	17 Proper reheating procedures for hot holding
	18 Proper cooling time and temperatures
Employee Health	19 Proper hot holding temperatures
2 Management, food employee and conditional employee; knowledge, responsibilities, and reporting	20 Proper cold holding temperatures
3 Proper use of restriction and exclusion	21 Proper date marking and disposition
	22 Time as a public health control; procedures & record
Good Hygienic Practices	Consumer Advisory
4 Proper eating, tasting, drinking, or tobacco use	23 Consumer advisory for raw or undercooked foods
5 No discharge from eyes, nose, and mouth	Highly Susceptible Populations
Preventing Contamination by Hands	24 Pasteurized foods used; prohibited foods not offered
6 Hands clean & properly washed	Chemical
7 No bare hand contact with RTE foods or approved alternate method properly followed	25 Food additives; approved & properly stored
8 Adequate handwashing facilities supplied & accessible	26 Toxic substances properly identified, stored, & used
Approved Source	Conformance with Approved Procedures
9 Food obtained from approved source	27 Compliance with variance, specialized process, & HACCP plan
10 Food received at proper temperature	
11 Food in good condition, safe and unadulterated	
12 Required records available: shellstock tags, parasite destruction	
Protection From Contamination	
13 Food separated/protected	
14 Food-contact surfaces: cleaned and sanitized	
15 Proper disposition of returned, previously served, reconditioned & unsafe food	

Risk Factors are improper practices or procedures identified as the most prevalent contributing factors to foodborne illness or injury. Public Health interventions are control measures to prevent foodborne illness or injury.

GOOD RETAIL PRACTICES
Good Retail Practices are preventative measures to control the addition of pathogens, chemicals, and physical objects into foods.

Good Retail Practices	Proper Use of Utensils
Safe Food and Water	41 In-use utensils: properly stored
28 Pasteurized eggs used where required	42 Utensils, equipment & linens: properly stored, dried & handled
29 Water and ice from approved source	43 Single-use & single-service articles: properly stored & used
30 Variance obtained for specialized processing methods	44 Gloves used properly
Food Temperature Control	Utensils, Equipment and Vending
31 Proper cooling method used; adequate equipment used for temperature control	45 Food & non-food contact surfaces cleanable, properly designed, constructed & used
32 Plant food properly cooked for hot holding	46 Warewashing facilities: installed, maintained, used; test strips
33 Approved thawing methods used	47 Non-food contact surfaces clean
34 Thermometers provided & accurate	Physical Facilities
Food Identification	48 Hot and cold water available; adequate pressure
35 Food properly labeled; original container	49 Plumbing installed; proper backflow devices
Prevention of Food Contamination	50 Sewage & waste water properly disposed
36 Insects, rodents & animals not present; no unauthorized persons	51 Toilet facilities: properly constructed, supplied and cleaned
37 Contamination prevented during food preparation, storage/display	52 Garbage and refuse properly disposed; facilities maintained
38 Personal cleanliness	53 Physical facilities installed, maintained and cleaned
39 Wiping cloths: properly used and stored	54 Adequate ventilation and lighting; designated areas used
40 Washing fruits and vegetables	55 Other violations: Code Number must be noted on following page.

Figure 5. Arkansas Department of Health's Retail Inspection Report

Food Establishment Inspection Report				
Iowa Department of Inspections and Appeals Department of Inspections and Appeals 321 E 12th ST FL 3 Des Moines, IA 50319-0083	No. Of Risk Factor/Intervention Violations			Date: Time In: Time Out:
	No. Of Repeat Factor/Intervention Violations			
Establishment:	Address:	City/State:	Zip:	Telephone:
License/Permit#:	Permit Holder:	Inspection	Est. Type:	Risk Category:

FOODBORNE ILLNESS RISK FACTORS AND PUBLIC HEALTH INTERVENTIONS

IN = In compliance OUT = Not in compliance N/O = Not observed N/A = Not applicable (*) = Corrected on site during inspection (COS) R = Repeat violation

<p>Supervision</p> <p>1. Person in charge present, demonstrates knowledge, and performs duties</p> <p>2. Certified Food Protection Manager</p> <p>Employee Health</p> <p>3. Management, food employee and conditional employee knowledge, responsibilities and reporting</p> <p>4. Proper use of exclusions and restrictions</p> <p>5. Procedures for responding to vomiting and diarrheal events</p> <p>Good Hygienic Practices</p> <p>6. Proper eating, tasting, drinking, or tobacco use</p> <p>7. No discharge from eyes, nose, and mouth</p> <p>Control of Hands as a Vehicle of Contamination</p> <p>8. Hands clean and properly washed</p> <p>9. No bare hand contact with ready to eat foods</p> <p>10. Hand washing sinks properly supplied and accessible</p> <p>Approved Source</p> <p>11. Foods obtained from an approved source</p> <p>12. Foods received at proper temperatures</p> <p>13. Food in good condition, safe, and unadulterated</p> <p>14. Required records available; shellstock tags, parasite destruction</p> <p>Protection from Contamination</p>	<p>15. Food separated and protected (Cross Contamination and Environmental)</p> <p>16. Food contact surfaces: cleaned and sanitized</p> <p>17. Proper disposition of returned, previously served, reconditioned, and unsafe food</p> <p>Potentially Hazardous Food Time/Temperature Control for Safety</p> <p>18. Proper cooking time and temperatures</p> <p>19. Proper reheating procedures of hot holding</p> <p>20. Proper cooling time and temperatures</p> <p>21. Proper hot holding temperatures</p> <p>22. Proper cold holding temperatures</p> <p>23. Proper date marking and disposition</p> <p>24. Time as a public health control: procedures and records</p> <p>Consumer Advisory</p> <p>25. Consumer advisory provided for raw or undercooked foods</p> <p>Highly Susceptible Populations</p> <p>26. Pasteurized foods used; prohibited foods not offered</p> <p>Food/Color Additives and Toxic Substances</p> <p>27. Food additives: approved, properly stored, and used</p> <p>28. Toxic substances properly identified, stored and used</p> <p>Conformance with Approved Procedures</p> <p>29. Compliance with variance, specialized process, reduced oxygen packaging criteria, and HACCP plan</p>
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GOOD RETAIL PRACTICES

Good Retail Practices are preventative measures to control the addition of pathogens, chemicals, and physical objects into foods.

<p>Safe Food and Water</p> <p>30. Pasteurized eggs used where required</p> <p>31. Water and ice from approved source</p> <p>32. Variance obtained for specialized processing methods</p> <p>Food Temperature Control</p> <p>33. Proper cooling methods used; adequate equipment for temperature control</p> <p>34. Plant food properly cooked for hot holding</p> <p>35. Approved thawing methods</p> <p>36. Thermometers provided and accurate</p> <p>Food Identification</p> <p>37. Food properly labeled; original container</p> <p>Prevention of Food Contamination</p> <p>38. Insects, rodents, and animals not present/outer openings protected</p> <p>39. Contamination prevented during food preparation, storage and display</p> <p>40. Personal cleanliness</p> <p>41. Wiping cloths: properly used and stored</p> <p>42. Washing fruits and vegetables</p>	<p>Proper Use of Utensils</p> <p>43. In use utensils: properly stored</p> <p>44. Utensils, equipment, and linens: properly stored dried and handled</p> <p>45. Single-use/single service articles: properly stored and used</p> <p>46. Slash-resistant and cloth glove use</p> <p>Utensils, Equipment, and Vending</p> <p>47. Food and non-food contact surfaces are cleanable, properly designed, constructed, and used</p> <p>48. Warewashing facilities: installed, maintained, and used; test strips</p> <p>49. Non-food contact surfaces clean</p> <p>Physical Facilities</p> <p>50. Hot and Cold water available; adequate pressure</p> <p>51. Plumbing installed; proper backflow devices</p> <p>52. Sewage and waste water properly disposed</p> <p>53. Toilet facilities; properly constructed, supplied, and cleaned</p> <p>54. Garbage and refuse properly disposed; facilities maintained</p> <p>55. Physical facilities installed, maintained, and clean</p> <p>56. Adequate ventilation and lighting; designated areas used</p> <p>57. Licensing; posting licenses and reports; smoking</p>
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Figure 6. Iowa Department of Inspection and Appeals' Retail Inspection Report

Food Establishment Inspection Report				
Kansas Department of Agriculture Department Of Agriculture Food Safety and Lodging Program 1320 Research Park Drive Manhattan, KS 66502	No. Of Priority Violations		Date:	
	No. Of Priority Foundation Violations		Time In:	
			Time Out:	
			Inspector Badge ID:	
			Follow Up Required:	
Establishment:	Address: 1	City/State:	Zip: 66105	Telephone: 7608083228
License #:	Permit Holder:	Inspection	Est. Type:	Risk Category:



Risk factors are improper practices or procedures identified as the most prevalent contributing factors of food-borne illness or injury. Public health interventions are control measures to prevent food-borne illness or injury.
 Good Retail Practices are preventative measures to control the addition of pathogens, chemicals and physical objects into foods.
 Violations cited in this report must be corrected within the time frames entered below, or as stated in sections 8-405.11 of the food code.
 P=Priority Violation, Pf=Priority foundation violation, HACCP=Hazard Analysis-Critical Control Point, BHC=Bare Hand Contact, RTE=Ready to Eat, HSP=Highly Susceptible Population, K.S.A.=Kansas Statutes Annotated, All temperatures are measured in degrees Fahrenheit (°F).
 IF YOU HAVE ANY QUESTIONS PLEASE VISIT www.agriculture.ks.gov, EMAIL kda.fsl@ks.gov, OR CALL (785) 564-6767.

IN = In compliance OUT = Not in compliance N/O = Not observed N/A = Not applicable (*) = Corrected on site during inspection (COS) R = Repeat violation

FOODBORNE ILLNESS RISK FACTORS AND PUBLIC HEALTH INTERVENTIONS	
FOODBORNE ILLNESS RISK FACTORS AND PUBLIC HEALTH INTERVENTIONS	13 Food separated and protected.
Supervision and Demonstration of Knowledge	14 Food-contact surfaces: cleaned and sanitized
1 Certification by accredited program, compliance with Code, or correct responses; Duties.	15 Proper disposition of returned, previously served, reconditioned and unsafe food
Employee Health	Temperature Control for Safety Time/Temperature
2 Management awareness; policy present.	16 Proper cooking time and temperatures.
3 Proper use of reporting, restriction and exclusion.	17 Proper reheating for hot holding procedures.
Good Hygienic Practices	18 Proper cooling time and temperatures.
4 Proper eating, tasting, drinking, or tobacco use.	19 Proper hot holding temperatures.
5 No discharge from eyes, nose and mouth.	20 Proper cold holding temperatures.
Preventing Contamination by Hands	21 Proper date marking and disposition.
6 Hands clean and properly washed.	22 Time as a public health control: procedures and records.
7 No bare hand contact with RTE foods or approved alternate method properly followed.	Consumer Advisory
8 Adequate handwashing facilities supplied and accessible.	23 Consumer advisory provided for raw or undercooked foods.
Approved Source	Highly Susceptible Populations
9 Food obtained from approved source.	24 Pasteurized foods used; prohibited foods not offered.
10 Food received at proper temperature.	Chemical
11 Food in good condition, safe and unadulterated.	25 Food additives: approved and properly used.
12 Required records available: shellstock tags, parasite destruction.	26 Toxic substances properly identified, stored and used.
Protection from Contamination	Conformance with Approved Procedures
	27 Compliance with variance, specialized process and HACCP plan.
GOOD RETAIL PRACTICES	
Good Retail Practices are preventative measures to control the addition of pathogens, chemicals, and physical objects into foods.	
GOOD RETAIL PRACTICES	Proper Use of Utensils
Safe Food and Water	41 In-use utensils: properly stored.
28 Pasteurized eggs used where required.	42 Utensils, equipment and linens: properly stored, dried and handled.
29 Water and ice from approved source.	43 Single-use and single-service articles: properly used.
30 Variance obtained for specialized processing methods.	44 Gloves used properly.
Food Temperature Control	Utensils, Equipment and Vending
31 Proper cooling methods used; adequate equipment for temperature control.	45a Food and non-food contact surfaces cleanable, properly designed, constructed and used - Priority and Priority foundation items.
32 Plant food properly cooked for hot holding.	45b Food and non-food contact surfaces cleanable, properly designed, constructed and used - Core items.
33 Approved thawing methods used.	46 Warewashing facilities: installed, maintained and used; test strips.
34 Thermometers provided and accurate.	47 Non-Food contact surfaces clean.
Food Identification	Physical Facilities
35 Food properly labeled; original container.	48 Hot and cold water available; adequate pressure.
Prevention of Food Contamination	49 Plumbing installed; proper backflow devices.
36 Insects, rodents and animals not present.	50 Sewage and waste water properly disposed.
37 Contamination prevented during food preparation, storage and display.	51 Toilet facilities: properly constructed, supplied and clean.
38 Personal cleanliness.	52 Garbage and refuse properly disposed; facilities maintained.
39 Wiping cloths: properly used and stored.	53 Physical facilities installed, maintained and clean.
40 Washing fruits and vegetables.	54 Adequate ventilation and lighting; designated areas used.
	Administrative/Other
	55 Other violations

Figure 7. Kansas Department of Agriculture's Retail Inspection Report

6.3. Mapping of Retail Regulatory Codes Across Organizations

As highlighted in Appendix 6.2, to effectively analyze and trend the data, each participating organization's data needs to be mapped to a common data standard. Figure 7 shows a side-by-side comparison of the retail regulatory code for Iowa and Kansas. It highlights how the retail inspection report data elements for the two agencies have been mapped to a common standard based on the 2017 *FDA Retail Food Code* so the data can be further analyzed across the agencies.

Iowa				Kansas			
State	LineItemKey	Line Item #	Line Item Description	State	LineItemKey	Line Item #	Line Item Description
IA	1831	NULL	Foodborne Illness Risk Factors	Kansas	25330	NULL	FOODBORNE ILLNESS RISK FACTORS AND PUBLIC
IA	1833	NULL	Supervision	Kansas	25333	NULL	Supervision and Demonstration of Knowledge
IA	1851	1	Person in charge present, demonstrates knowledge, and performs duties				
IA	8469	1	Certified Food Protection Manager	Kansas	25357	1	Certification by accredited program, complian
IA	1852	1	Management, food employee and conditional employee knowledge, responsibilities and reporting				
IA	1834	NULL	Employee Health	Kansas	25334		Employee Health
IA	1853	4	Proper use of exclusions and restrictions	Kansas	25361	4	Proper use of reporting, restriction and exclus
IA	8470	5	Procedures for responding to vomiting and diarrheal events	Kansas	25338	2	Management awareness; policy present.
IA	1835	NULL	Good Hygienic Practices	Kansas	25335		Good Hygienic Practices
IA	1854	6	Proper eating, tasting, drinking, or tobacco use	Kansas	25362	4	Proper eating, tasting, drinking, or tobacco us
IA	1855	7	No discharge from eyes, nose, and mouth	Kansas	25339	5	No discharge from eyes, nose and mouth.
IA	1836	NULL	Control of Hands as a Vehicle of Contamination	Kansas	25336		Preventing Contamination by Hands
IA	1856	8	Hands clean and properly washed	Kansas	25363	6	Hands clean and properly washed.
IA	1857	9	No bare hand contact with ready to eat foods	Kansas	25364	7	No bare hand contact with RTE foods or appr
IA	1858	10	Hand washing sinks properly supplied and accessible	Kansas	25365	8	Adequate handwashing facilities supplied a
IA	1837	NULL	Approved Source	Kansas	25332		Approved Source
IA	1859	11	Foods obtained from an approved source	Kansas	25366	9	Food obtained from approved source.
IA	1860	12	Foods received at proper temperatures	Kansas	25358	10	Food received at proper temperature.
IA	1861	13	Food in good condition, safe, and unadulterated	Kansas	25359	11	Food in good condition, safe and unadulterat
IA	1862	14	Required records available; shellstock tags, parasite destruction	Kansas	25360	12	Required records available; shellstock tags, p
IA	1838	NULL	Protection from Contamination	Kansas	25337		Protection from Contamination
IA	1863	15	Food separated and protected (Cross Contamination and Environmental)	Kansas	25367	13	Food separated and protected.
IA	1864	16	Food contact surfaces: cleaned and sanitized	Kansas	25368	14	Food-contact surfaces: cleaned and sanitized
IA	1865	17	Proper disposition of returned, previously served, reconditioned, and unsafe food	Kansas	25369	15	Proper disposition of returned, previously ser
IA	1839	NULL	Potentially Hazardous Food Time/Temperature Control for Safety	Kansas	25344		Temperature Control for Safety Time/Temperatur
IA	1866	18	Proper cooking time and temperatures	Kansas	25370	16	Proper cooking time and temperatures.
IA	1867	19	Proper reheating procedures of hot holding	Kansas	25371	17	Proper reheating for hot holding procedures.
IA	1868	20	Proper cooling time and temperatures	Kansas	25372	18	Proper cooling time and temperatures.
IA	1869	21	Proper hot holding temperatures	Kansas	25373	19	Proper hot holding temperatures.
IA	1870	22	Proper cold holding temperatures	Kansas	25374	20	Proper cold holding temperatures.
IA	1871	23	Proper date marking and disposition	Kansas	25375	21	Proper date marking and disposition.
IA	1872	24	Time as a public health control: procedures and records	Kansas	25376	22	Time as a public health control: procedures a
IA	1840	NULL	Consumer Advisory	Kansas	25342		Consumer Advisory
IA	1873	25	Consumer advisory provided for raw or undercooked foods	Kansas	25377	23	Consumer advisory provided for raw or underc
IA	1841	NULL	Highly Susceptible Populations	Kansas	25343		Highly Susceptible Populations
IA	1874	26	Pasteurized foods used; prohibited foods not offered	Kansas	25378	24	Pasteurized foods used; prohibited foods not
IA	1842	NULL	Food/Color Additives and Toxic Substances	Kansas	25340		Chemical
IA	1875	27	Food additives: approved, properly stored, and used	Kansas	25379	25	Food additives: approved and properly used.
IA	1876	28	Toxic substances properly identified, stored and used	Kansas	25345	26	Toxic substances properly identified, stored a
IA	1843	NULL	Conformance with Approved Procedures	Kansas	25341		Conformance with Approved Procedures
IA	1877	29	Compliance with variance, specialized process, reduced oxygen packaging criteria,	Kansas	25346	27	Compliance with variance, specialized proces
IA	1832	NULL	Good Retail Practices	Kansas	25331		GOOD RETAIL PRACTICES
IA	1844	NULL	Safe Food and Water	Kansas	25350		Safe Food and Water
IA	1878	30	Pasteurized eggs used where required	Kansas	25351	28	Pasteurized eggs used where required.

Figure 8. Regulatory Code Data Mapping for Iowa and Kansas

6.4. Pilot Primary Data Elements

The following initial thirty-two common data elements were identified during the 'Pilot AFDO Retail Analytics Project' that would be expanded upon based on the data analysis needs.

Table 3. Primary data elements of the Retail Inspection Data Analytics Pilot dataset

Data Elements			
1	State	17	Inspector PrimaryKey
2	InspectionID	18	Inspector FirstName*
3	InspectionDate	19	Inspector LastName*
4	Facility ID	20	Organization
5	BusinessName	21	Line Item Group
6	BusinessStatus	22	Line Item #
7	Classification	23	Line Item Description
8	ProgramType	24	Compliance Status
9	SiteAddress	25	Risk Level
10	SiteCity	26	Corrected On Site
11	SiteStateCode	27	Repeat Violation
12	SiteState	28	Inspection time in
13	SiteZipCode	29	Inspection time out
14	SiteCounty	30	ViolationCode
15	SiteRegion	31	ViolationCodeDesc
16	InspectionReason	32	ViolationComment

* Inspector first name and last name are optional data elements

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