

Baseline Study on the Occurrence of Foodborne Illness Risk Factors in Retail Food Establishments

11/15/2021



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Summary

Preventing illness from food is a shared goal within the retail food sector. This includes industry, regulatory, academia, and other stakeholders. Food is best protected when informed workers take the steps necessary to control hazards while food is received, stored, prepared, held, and displayed. This is supported by Centers for Disease Control and Prevention (CDC) research which finds that certain food handler practices contribute to the majority of foodborne illness outbreaks. These practices fall into five broad categories known as foodborne illness risk factors. They focus on areas including food sources, cooking, food temperatures, sources of contamination, and hand hygiene. Systematically reducing the occurrence of the risk factors reduces the risk to food safety and consumer health.

In 2018, the Minnesota Department of Agriculture (MDA) began a study to better understand the occurrence of foodborne illness risk factors in retail food businesses. Inspectors collected data from 325 randomly selected deli, meat, seafood, and produce facilities on-site from July 2018 to August 2019. To be considered for the study, these facilities had to engage in several food handling activities that increase risk to food safety. Inspectors used a uniform inspection data sheet that enabled them to assess how well food handlers performed practices linked to the risk factors.

Overall, this baseline study found a high number of safe food handling practices in most foodborne illness risk factors. No single risk factor occurred at a high level, but there are opportunities for targeted improvement within each type of facility.

The risk factors with the safest outcomes included:

- 1) Obtaining foods from safe sources (i.e. not prepared in a home)
- 2) Cooking foods to the required temperatures
- 3) Hand hygiene (i.e. not touching ready-to-eat foods with bare hands)

The risk factors with highest unsafe outcomes included:

- 1) Food temperatures and storage, specifically date marking open refrigerated food held for more than a day
- 2) Sources of contamination (i.e. unsanitized equipment used to prepare food)

Results of this survey are part of a long-term study and efforts to increase knowledge and reduce the occurrence of practices linked to foodborne illness risk factors. To do this, the MDA is developing resources and other tools to aid in outreach, education, and assessment efforts. Current food safety fact sheets are being translated into multiple languages to increase information access and knowledge. The MDA developed a needs survey for retail food establishments to help identify specific safety topics and methods of delivery to best suit the needs of businesses. In addition, the MDA developed compliance tools to assist food businesses find and document solutions to specific practices linked to foodborne illness risk factors.

Most gaps or deficiencies are readily corrected with education. The goal is lasting compliance with science-based food safety practices. The MDA will conduct another survey in a few years to see how well efforts to reduce the occurrence of risk factors are working.

Study Design and Methods

This was a baseline observational study where the MDA collected data from a set of randomly selected food facilities using a uniform data collection sheet. In total, retail food inspectors from the MDA and the City of Minnetonka (an agency to which the MDA delegates inspection authority) collected data from 325 facilities from July 2018 to August 2019.

To be included in the study, a food facility had to perform deli, meat, seafood, or produce activities where food workers engage in a number of higher risk food handling practices such as cutting, slicing, assembling, heating, chilling, or keeping food at a certain temperature in heated or refrigerated units. For example, the workers might handle raw animal foods such as eggs, meat, poultry, or seafood and also prepare food that is ready-to-eat (RTE) such as juice, sushi, sandwiches, salads, and various kinds of foods served hot. A focus of the data collection included foods that need to be kept at hot or cold temperatures to stop spoilage or prevent germs from growing. These foods are known as Time/Temperature Control for Safety (TCS) foods.

All data collection sheets, and data entry fields, were checked for completeness prior to running preset reports in a software system designed to calculate risk factor study results.

Data Collection

Data was collected for this study using a uniform data collection sheet, which was organized by the five established CDC foodborne illness risk factors. Each foodborne illness risk factor is represented on the survey data sheet by main food safety practices that can minimize that risk, also called a main information item, and specific actions of those food safety practices, also called sub information items (see Table 1).

Retail food inspectors completed survey data sheets for each food facility by observing employees. Each facility was visited once, unannounced, by the inspector to complete the survey data sheets. Each main or sub information item was then marked with one of the following, based on those observations:

- In compliance (IN): activity was observed, and food safety practices were being done correctly
- Out of compliance (OUT): activity was observed, and food safety practices were not being done correctly
- Not Observed (NO): activity typically occurs at the facility but was not observed when the inspector was there
- Not Applicable (NA): this type of activity does not typically occur at the facility

Inspectors observed many practices happening in the facilities at the time of the survey. When they saw practices related to the data collection, they assessed the performance for compliance with food safety standards. Inspectors marked an information item IN compliance on the data sheet when all observations for that item were assessed as IN compliance. They marked an item OUT of compliance when at least one observation for that item was assessed as OUT of compliance.

Table 1 The survey data sheet information items listed by main (numbered) and sub (lettered) items for each foodborne illness risk factor. Each item was marked as IN compliance, OUT of compliance, Not Observed, or Not Applicable based on what was observed by the retail food inspector at the facility.

Foodborne Illness Risk Factor	Survey Data Sheet Information Items <small>(The main information items are numbered followed by lettered sub items, where applicable)</small>
Food from Unsafe Sources	<p>1. Food received from safe sources:</p> <ul style="list-style-type: none"> A. No home prepared foods B. Shellfish is from listed sources C. Food is protected during receiving D. Food is received at proper temperature E. Food is safe, not adulterated F. Shellstock tags or labels are retained G. Documentation of parasite control
Inadequate Cooking Temperatures	<p>2. Raw animal foods cooked to proper temperatures:</p> <ul style="list-style-type: none"> A. Raw shell eggs, pork, fish, beef, and poultry cooked to proper temperatures B. Ground fish and meats cooked to proper temperature C. Stuffed fish, meats, pasta, or poultry cooked to proper temperature <p>3. Cooked foods reheated to correct temperatures:</p> <ul style="list-style-type: none"> A. TCS food cooked on site is reheated to proper temperature rapidly B. Commercially made RTE food reheated for proper hot holding temperature
Improper Holding Temperatures	<p>4. Foods that need refrigeration are held at the proper temperature:</p> <ul style="list-style-type: none"> A. TCS food at proper cold temperature when required B. Raw shell eggs are stored at proper temperature <p>5. Foods displayed or stored hot are held at the proper temperature:</p> <ul style="list-style-type: none"> A. TCS food at proper hot temperature when required

Foodborne Illness Risk Factor	Survey Data Sheet Information Items (The main information items are numbered followed by lettered sub items, where applicable)
Improper Holding Temperatures <i>Continued</i>	<p>6. Foods are cooled properly:</p> <ul style="list-style-type: none"> A. Cooked TCS food is cooled to proper temperature within correct timeframes B. TCS food made from room temperature ingredients is cooled to proper temperature within correct timeframe C. Proper cooling methods and equipment are used <p>7. Refrigerated, RTE foods are properly date marked and discarded if not used in correct timeframe:</p> <ul style="list-style-type: none"> A. RTE, TCS food is date marked as required B. RTE, TCS food is discarded when required
Contaminated Equipment	<p>8. Food is protected from cross-contamination:</p> <ul style="list-style-type: none"> A. Raw animal foods are separated from RTE foods B. Different raw animal foods are separated from each other C. Food is protected from environmental contamination <p>9. Food contact surfaces are properly cleaned and sanitized:</p> <ul style="list-style-type: none"> A. Food contact surfaces are clean and sanitized before use B. Food contact surfaces are cleaned and sanitized properly using manual washing procedures C. Food contact surfaces are cleaned and sanitized properly using mechanical washing equipment
Poor Personal Hygiene	<p>10. Workers practice proper handwashing:</p> <ul style="list-style-type: none"> A. Hands are properly cleaned using water, cleanser, time, and drying methods B. Hands are cleaned and washed when required <p>11. Workers do not contact RTE foods with bare hands</p>

TCS – Time/temperature control for safety; RTE – Ready to eat

How to Understand the Baseline Survey Results

The five foodborne illness risk factors are comprised of main information items as seen in Table 1. The results are reported in Figures 1 through 4 as the percent of information items marked IN compliance. Tables 2 through 7 show the number of survey information items marked IN compliance, OUT of compliance, not observed, and the percent of information items IN and not observed.

Percent IN compliance – what it means

Percent IN compliance is a measure based on food safety practices that were observed. It is calculated as the number of times an information item was marked IN compliance divided by the total number of times it was marked IN or OUT of compliance, multiplied by 100. Items marked NO or NA were not included in the percent IN compliance

calculation. For example, Figure 1 shows the risk factor “food from unsafe sources”, out of the total 325 observations (one observation per facility), 311 observations were marked IN compliance, which calculates to 96 percent IN compliance.

Percent IN compliance can be easily misunderstood because it is calculated as a proportion, not a rate. It is a measure of how many times a specific food safety practice or information item was marked IN or OUT of compliance after at least one observation on that practice. Using Figure 1 again, but now referring to the “improper holding temperature” risk factor, there were a total of 834 observations within the 325 facilities studied, with 678 observations marked IN. This calculates to an 81 percent IN compliance. The total IN or OUT observations is well above the 325 facilities studied because multiple information items make up this one food safety practice. Furthermore, these information items are comprised of sub items as seen in Table 1 and multiple information items and sub items, such as cold or hot holding temperatures, can be observed at a single facility. With that said, if a single sub item assessment, such as one out of ten cold holding observations, is found OUT of compliance then the entire information item “foods that need refrigeration are held at the proper temperature” is marked OUT of compliance.

Percent IN calculation is used to ensure that the number of IN or OUT markings are not dependent on how many times a food safety practice was observed by eliminating the frequency. Percent IN for this example ultimately means that “improper holding temperatures” were found 81 percent IN compliance out of the 834 possible observations at the 325 facilities sampled.

Results

The Overall Results for the Five Risk Factors

Study results for foodborne illness risk factors and food safety practices information items were classified into three groups to focus efforts on improving future outcomes:

- Result at 86 percent IN compliance or higher: Maintain current level of focus for reducing risk (**Maintain**)
- Result at 76 to 85 percent IN compliance: Moderate efforts necessary for reducing the risk (**Special Emphasis**)
- Result at 75 percent IN compliance or lower: Prioritize efforts for reducing the risk (**Priority**)

See the figures and tables below for overall survey results and those specific to each facility type. Results are initially classified by the five foodborne illness risk factors to identify the focus efforts necessary and further classified by information items to better understand the specific deficiencies within the risk factors.

Overall, the study found a high percentage (90% or greater) of IN compliance assessments among three of the five foodborne illness risk factors: Food from Unsafe Sources, Inadequate Cooking, and Poor Personal Hygiene. No risk factor was classified as Priority (Table 2). Food was generally sourced from an approved supplier (i.e., not prepared in a home). Food was cooked to a safe temperature at all types of facilities. Food workers were observed washing hands and generally did not touch food that is ready to eat with their bare hands.

Two risk factors were classified as Special Emphasis: Improper Holding Temperature and Contaminated Equipment. This was due mainly to not marking or discarding food that is ready-to-eat and held cold for safety, improper hot and cold holding of foods, and improper cleaning procedures utilized. See each facility type for more specific results and information.

Some risk factor items were not observed as many times as others (Table 2). This trend was more evident in meat, seafood, and produce facilities than deli facilities (Tables 3 through 7).

Table 2 Summary of all IN and OUT markings and number not observed, by risk factor category.

Foodborne Illness Risk Factor	Number of Observations Marked IN Compliance	Number of Observations Marked OUT of Compliance	Total IN and OUT Observations	Percent IN Compliance	Number of Information Items Marked Not Observed	Percent Not Observed
Food from Unsafe Sources◇	311	14	325	96.7	0	0.0
Inadequate Cooking □	164	6	170	96.4	131	43.5
Improper Holding Temperature •	678	156	834	81.3	215	20.5
Contaminated Equipment +	543	107	650	83.5	0	0.0
Poor Personal Hygiene *	435	47	482	90.2	161	25.0
All Risk Factors	2,131	330	2,461	86.6	507	17.1

The Overall Results for the Facility Types

The occurrence of foodborne illness risk factors was generally low within each type of facility. (Table 3). Produce facilities had the highest percent IN compliance. However, each type of facility did not conduct the same food safety practices equally, and the survey involved fewer produce and seafood facilities than deli and meat facilities.

Table 3 Summary of all IN and OUT markings and number not observed, by facility type.

Facility Type	Number of Observations Marked IN Compliance	Number of Observations Marked OUT of Compliance	Total IN and OUT Observations	Percent IN Compliance	Number of Information Items Marked Not Observed	Percent Not Observed
Deli	1,042	193	1,235	84.4	145	10.5
Meat	625	92	717	87.2	198	21.6
Seafood	188	26	214	87.9	47	18.0
Produce	276	19	295	93.6	117	28.4
All Facility Types	2,131	330	2,461	86.6	507	17.1

Deli Facilities

Deli facilities were the most active and complex. This means they resulted in the fewest Not Observed outcomes (Table 3). However, cooking and cooling were more difficult to assess as the practices did not always occur or could not be fully assessed at the time of the visit (Table 4).

Delis scored highest in Food from Unsafe Sources and Inadequate Cooking, 97 and 96 percent IN compliance respectively (Table 4). This means most foods were obtained from an approved supplier and brought to the proper temperature for safety. The risk factor Poor Personal Hygiene scored an 86 percent IN compliance overall for not touching food that is ready-to-eat with their bare hands, but hands properly washed scored 75 percent IN compliance, or Priority level overall for future focus (Table 4 and Figure 3).

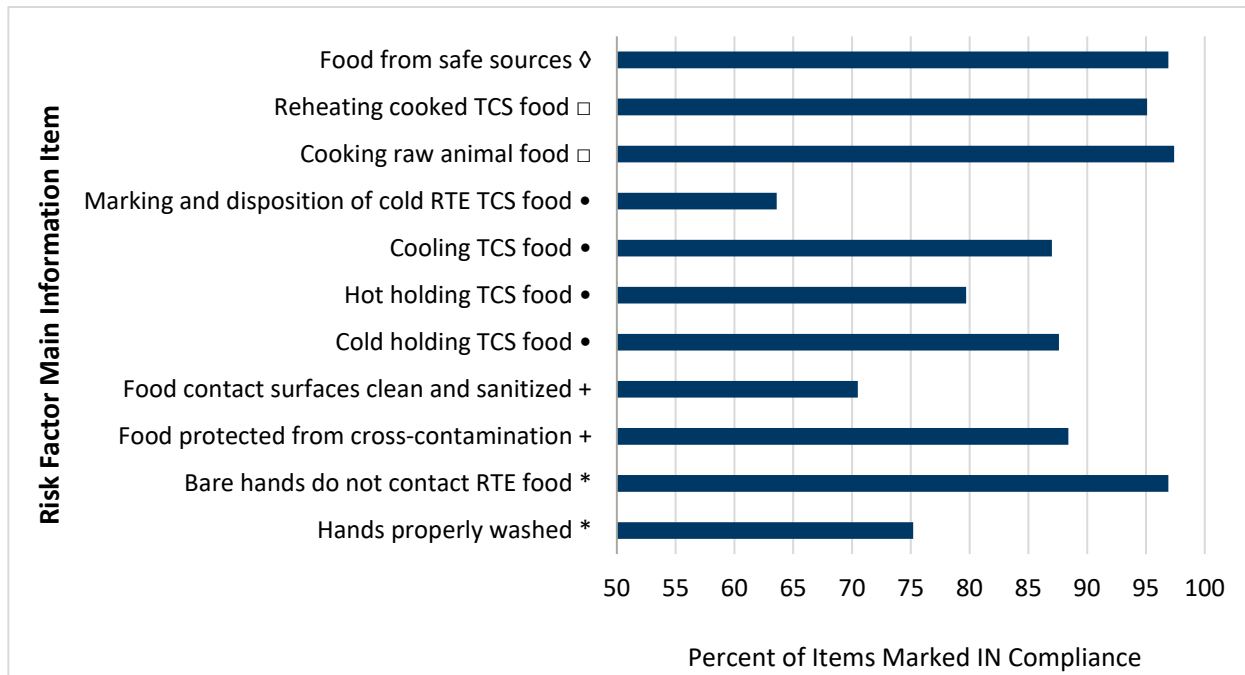
The risk factor Contaminated Equipment scored 79 percent IN compliance overall, placing it within the Special Emphasis level (Table 4). This was due to equipment and utensils that contact food, such as knives, spatulas, containers, and other items needing to be better cleaned or properly sanitized before use (Figure 3). Food contact surfaces scored 70 percent IN compliance, Priority overall for future focus.

The risk factor Improper Holding Temperatures scored 78 percent IN compliance overall, placing it within the Special Emphasis level (Table 4). This was due mainly to not marking or discarding food that is ready-to-eat and held cold for safety (Figure 3). A date mark is needed so workers know when to safely stop offering the food because germs can grow in it over time. Marking and Disposition scored 64 percent IN compliance, Priority overall for future focus (Figure 3). Foods not held hot enough as required for safety also contributed to occurrence of Improper Holding Temperature. Germs and their toxins can grow in TCS food not held at safe temperature for several hours or more. The result for hot holding makes this an item of Special Emphasis.

Table 4 Summary of all deli facility IN and OUT markings and number not observed, by risk factor category.

Foodborne Illness Risk Factor	Number of Observations Marked IN Compliance	Number of Observations Marked OUT of Compliance	Total IN and OUT Observations	Percent IN Compliance	Number of Information Items Marked Not Observed	Percent Not Observed
Food from Unsafe Sources ◊	125	4	129	96.9	0	0.0
Inadequate Cooking □	154	6	160	96.3	70	30.4
Improper Holding Temperature •	336	94	430	78.1	75	14.8
Contaminate Equipment +	205	53	258	79.5	0	0.0
Poor Personal Hygiene *	222	36	258	86.0	0	0.0

Figure 1 The percent of deli facility risk factor main information items marked IN compliance. Symbols designate which foodborne illness risk factors the main information items are associated with from Table 4.



Meat Facilities

In meat facilities, cooking, cooling, and personal hygiene items were difficult to assess as the practices did not always occur or could not be fully assessed at the time of the visit. This reduced the number of IN or OUT of compliance markings for three of the five risk factors. In particular, the result for Inadequate Cooking is based on 10 total IN and OUT markings (Table 5).

Meat facilities scored highest in the risk factor categories Food from Unsafe Sources, Inadequate Cooking, and Poor Personal Hygiene (Table 5). This means they scored very well in getting food from safe sources, cooking, reheating, hand hygiene practices, and in not touching food that is ready-to-eat with their bare hands.

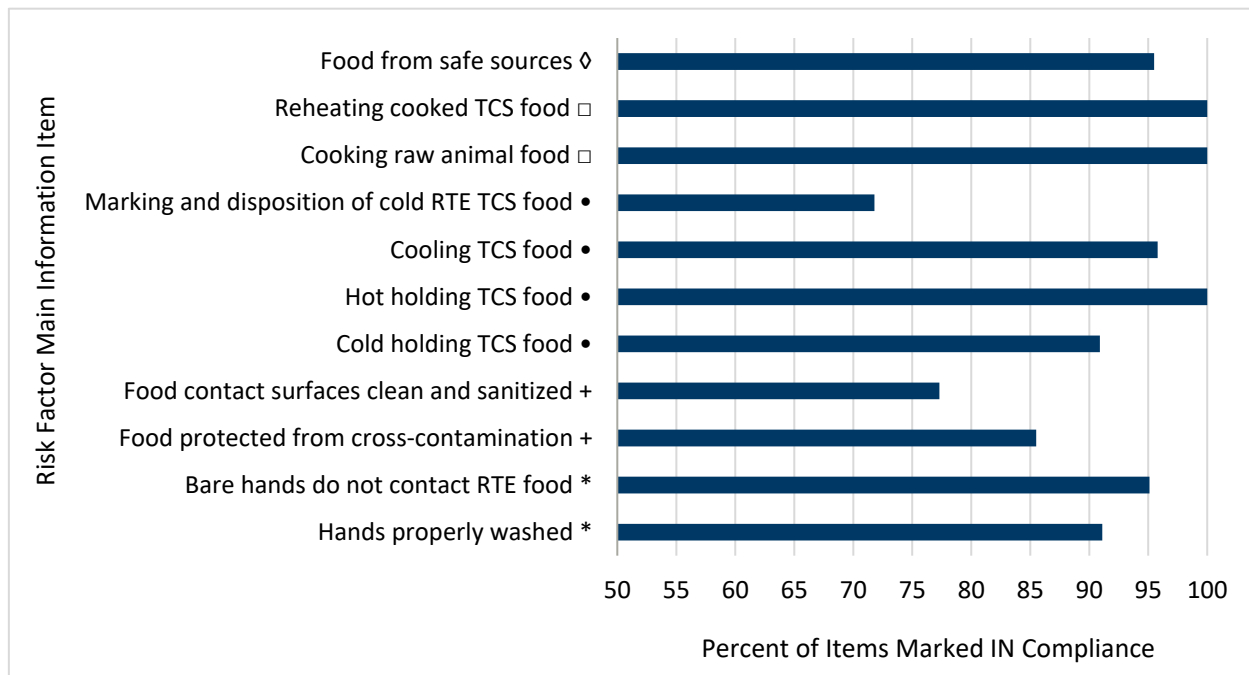
The risk factor Improper Holding Temperatures scored 85 percent IN compliance overall, placing it within the Special Emphasis level (Table 5). Although high scores were noted within cooling, hot and cold holding, this score was due to not marking or discarding open food that is ready-to-eat and held cold for more than a day (Figure 4). Because germs can grow in food over time, a date mark is needed so workers know when to safely stop offering the food. Marking and Disposition scored 72 percent IN compliance overall, Priority overall for future focus (Figure 4).

The risk factor Contaminated Equipment scored 81 percent IN compliance overall, placing it within the Special Emphasis level (Table 5). This was due to equipment and utensils, such as knives, containers, and other items used to prepare, hold, or serve food needing more cleaning or needing to be properly sanitized before use (Figure 4).

Table 5 Summary of all meat facility IN and OUT markings and number not observed, by risk factor category.

Foodborne Illness Risk Factor	Number of Observations Marked IN Compliance	Number of Observations Marked OUT of Compliance	Total IN and OUT Observations	Percent IN Compliance	Number of Information Items Marked Not Observed	Percent Not Observed
Food from Unsafe Sources ◊	105	5	110	95.5	0	0.0
Inadequate Cooking □	10	0	10	100	55	84.6
Improper Holding Temperature •	191	35	226	84.5	79	25.9
Contaminate Equipment +	179	41	220	81.4	0	0.0
Poor Personal Hygiene *	140	11	151	92.7	64	29.8

Figure 2 The percent of meat facility risk factor main information items marked IN compliance. Symbols designate which foodborne illness risk factors the main information items are associated with from Table 5.



Seafood Facilities

In seafood facilities, cooking, cooling, and personal hygiene items were difficult to assess as the practices did not always occur or could not be fully assessed at the time of the visit. This reduced the number of IN or OUT of compliance markings for three of the five risk factors. This survey included fewer seafood facilities than meat and deli facilities resulting in fewer observations than desired. In fact, the risk factor Inadequate Cooking had no IN or OUT of compliance observations (Table 6, Figure 3).

Seafood facilities scored highest in the risk factor categories Poor Personal Hygiene and Contaminated Equipment, 100 and 89 percent IN compliance respectively (Table 6). This means they performed good hand hygiene practices to include not touching food that is ready-to-eat with their bare hands as well as protecting food from contamination.

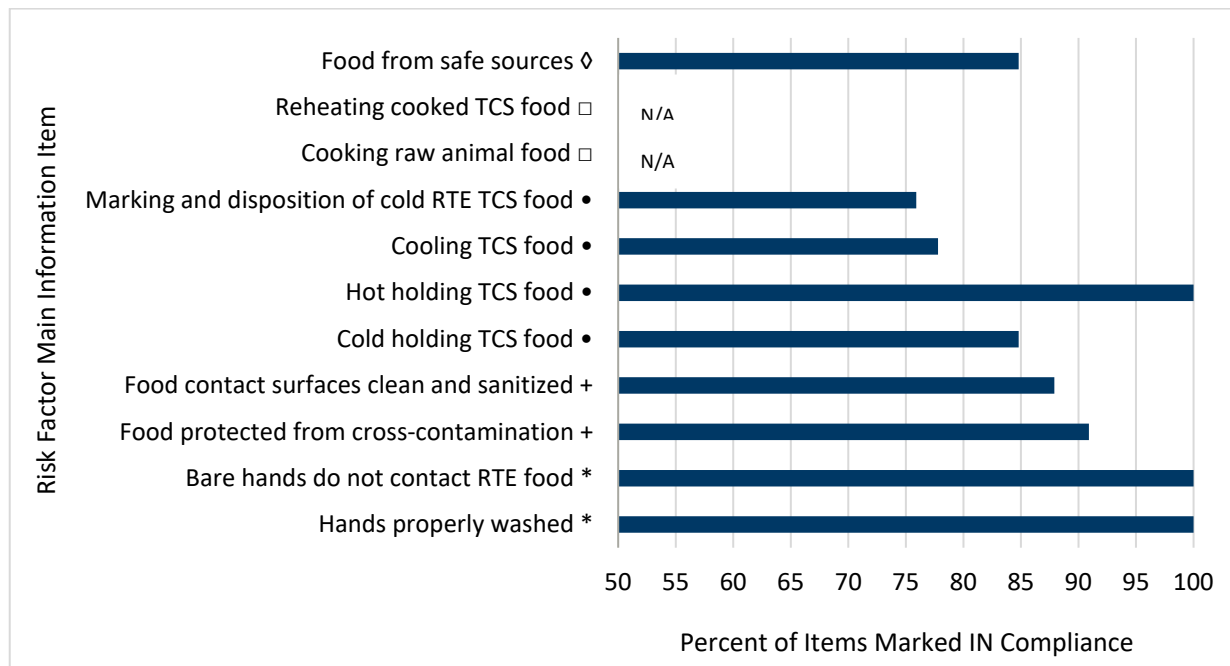
The risk factor Food from Unsafe Sources scored 85 percent IN compliance overall, placing it within the Special Emphasis level (Table 6). This was due to facilities that carried oysters, clams, mussels, or scallops not keeping batch tags or labels for the necessary period. The tag and label information are important to identifying harvest locations if necessary during a foodborne illness outbreak investigation. Molluscan shellfish filter feed in waters that can have germs that cause serious illness and oftentimes it can take up to 15 days for illness to occur. Foods in seafood facilities otherwise came from approved sources.

The risk factor Improper Holding Temperatures scored 81 percent IN compliance overall, placing it within the Special Emphasis level (Table 6). This was due in part to not date marking food that is ready-to-eat and held cold for more than a day from the date it was opened or made. It was also due to some foods not being held cold enough as required for safety.

Table 6 Summary of seafood facility IN and OUT markings and number not observed, by risk factor category.

Foodborne Illness Risk Factor	Number of Observations Marked IN Compliance	Number of Observations Marked OUT of Compliance	Total IN and OUT Observations	Percent IN Compliance	Number of Information Items Marked Not Observed	Percent Not Observed
Food from Unsafe Sources ◇	28	5	33	84.8	0	0.0
Inadequate Cooking □	0	0	0	N/A	6	100
Improper Holding Temperature •	61	14	75	81.3	16	17.6
Contaminate Equipment +	59	7	66	89.4	0	0.0
Poor Personal Hygiene *	40	0	40	100	25	38.5

Figure 3 The percent of seafood facility risk factor main information items marked IN compliance. Symbols designate which foodborne illness risk factors the main information items are associated with from Table 6.



Produce Facilities

In produce facilities, cooling and personal hygiene items were difficult to assess as the practices did not always occur or could not be fully assessed at the time of the visit. This reduced the number of IN or OUT of compliance markings for two of the five risk factors. This survey included fewer produce facilities than meat and deli resulting in fewer observations than desired. In fact, the risk factor Inadequate Cooking, and the hot holding information item (a component of Improper Holding Temperatures) had no IN or OUT of compliance observations (Table 7, Figure 4).

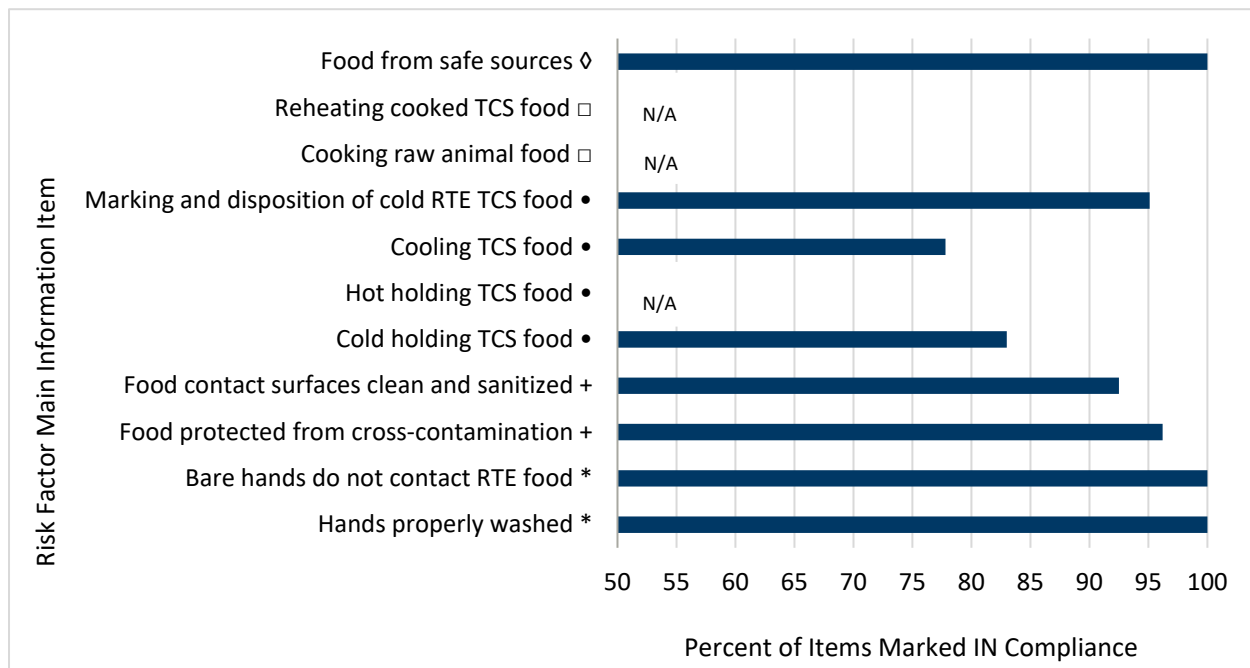
Produce facilities scored highest in the risk factor categories Food from Unsafe Sources and Poor Personal with 100 percent IN compliance for both (Table 7). Contaminated Equipment scored at 94 percent IN compliance. This means they scored very well in getting food from safe sources, hand hygiene practices to include not touching food that is ready-to-eat with their bare hands and protecting food from contamination.

The risk factor Improper Holding Temperatures occurred most, scoring 87 percent IN compliance overall. This was due in part to methods used to cool some foods from room temperature to refrigerated within the safe time period as well as some foods not being held cold enough for safety (Figure 4).

Table 7 Summary of produce facility IN and OUT markings and number not observed, by risk factor category.

Foodborne Illness Risk Factor	Number of Observations Marked IN Compliance	Number of Observations Marked OUT of Compliance	Total IN and OUT Observations	Percent IN Compliance	Number of Information Items Marked Not Observed	Percent Not Observed
Food from Unsafe Sources ◊	53	0	53	100	0	0.0
Inadequate Cooking □	0	0	0	N/A	0	0.0
Improper Holding Temperature •	90	13	103	87.4	45	30.6
Contaminate Equipment +	100	6	106	94.3	0	0.0
Poor Personal Hygiene *	33	0	33	100	72	68.6

Figure 4 The percent of produce facility risk factor main information items marked IN compliance. Symbols designate which foodborne illness risk factors the main information items are associated with from Table 7.



Survey Limitations

The results of this survey serve as benchmark for future surveys on the occurrence of foodborne illness risk factors. This survey measured how often these factors occurred in randomly selected facilities that met the survey criteria. Results of future surveys will be compared against this survey to look for trends. Though inspectors collected data over a 14-month period, the survey results convey a point-in-time measurement from each assessment. These results are not predictive of future conditions.

All survey items do not have an equal chance of being observed and assessed during each site visit. Factors which impact this include:

- Food preparation activities are not as frequent as other activities and may not have occurred at the time of visit
- Some food preparation activities may have taken longer to fully assess than the visit time allowed
- Facility types differ in observable practices; for example, TCS food is cooked and held hot more often in delis than in meat facilities

For these reasons, practices like cooking, reheating, and cooling are more likely than others to result in a not observed (NO) outcome rather than an IN or OUT of compliance outcome (Tables 2 through 7).

Percentage results based on fewer observed practices are more variable. This means the data is less reliable as the data is more subject to change with additional observations. The more observed practices the more confident the data and less subject to change.

Next Steps

The results of this baseline survey will shape the MDA's activities and interactions within the retail food sector to reduce risks to food safety and consumer health. The MDA looks to improve future outcomes through outreach, education, risk-based assessment, and other services. More specifically, the MDA aims to:

- Focus upon improving outcomes for the practices that were classified as Priority or Special Emphasis levels
- Keep the level of performance for the food safety practices with high conformance scores
- Survey retail food businesses to identify their training and information needs, and their preferences for how that information is delivered
- Develop and target tools and materials based on the results of this study and identified business needs to increase knowledge and performance; possible actions include expanding the information available on the MDA website, translating fact sheets to multiple languages, and utilizing existing tools such as corrective action plans and risk control plans during inspections to help operators identify and demonstrate corrective actions.

The goal is lasting compliance with science-based food safety practices throughout the food system to protect food and consumer health. At retail, food workers and inspectors work together to control food hazards and increase knowledge and performance. Most gaps or deficiencies are readily corrected with education.

The MDA will conduct another foodborne illness risk factor study in a few years after targeted outreach and more assessment have been done. The intent is to measure the impact and see how well these efforts are working to reduce the occurrence of risk factors.

Questions

Please contact us by calling the Food and Feed Safety Division main line at 651-201-6027 or by sending an email message to MDA.FFSD.Info@state.mn.us.