

Retail Deli Slicer Cleaning Frequency — Six Selected Sites, United States, 2012

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Listeria monocytogenes (*Listeria*) causes the third highest number of foodborne illness deaths (an estimated 255) in the United States annually, after nontyphoidal *Salmonella* species and *Toxoplasma gondii* (1). Deli meats are a major source of listeriosis illnesses (2,3), and meats sliced and packaged at retail delis are the major source of listeriosis illnesses attributed to deli meat (4). Mechanical slicers pose cross-contamination risks in delis and are an important source of *Listeria* cross-contamination (5,6). Reducing *Listeria* contamination of sliced meats in delis will likely reduce *Listeria* illnesses and outbreaks (6). Good slicer cleaning practices can reduce this foodborne illness risk (7). CDC's Environmental Health Specialists Network (EHS-Net) studied how often retail deli slicers were fully cleaned (disassembled, cleaned, and sanitized) at the Food and Drug Administration (FDA) Food Code–specified minimum frequency of every 4 hours and examined deli and staff characteristics related to slicer cleaning frequency (8). Interviews with staff members in 298 randomly-selected delis in six EHS-Net sites showed that approximately half of delis fully cleaned their slicers less often than FDA's specified minimum frequency. Chain-owned delis and delis with more customers, more slicers, required manager food safety training, food safety–knowledgeable workers, written slicer-cleaning policies, and food safety–certified managers fully cleaned their slicers more frequently than did other types of delis, according to deli managers or workers. States and localities should require deli manager training and certification, as specified in the FDA Food Code. They should also consider encouraging or requiring delis to have written slicer-cleaning policies. Retail food industry leaders can also implement these prevention efforts to reduce risk in their establishments. Because independent and smaller delis had lower frequencies of slicer cleaning, prevention efforts should focus on these types of delis.

The FDA Food Code is a model food code offered for adoption by state and local governmental jurisdictions that regulate retail food safety (i.e., states and localities). It contains science-based guidance to improve food safety in retail food service establishments. Although not all states and localities have adopted the latest version of the Food Code (2013), FDA and CDC strongly encourage its adoption at all levels of government.* The FDA Food Code states that food contact surfaces, including slicers, should be cleaned and sanitized at

least every 4 hours (4–602.11[C]) (8), and that food contact surfaces should be disassembled before cleaning and sanitizing (4–202.11[A][5]) (8). U.S. Department of Agriculture (USDA) guidance also recommends slicer disassembly before cleaning and sanitizing (6). Knowledge about retail delis' cleaning practices is critical to developing effective interventions. EHS-Net, a collaborative program of CDC, FDA, USDA, and six EHS-Net–funded state and local health departments,[†] assessed how often deli slicers were fully cleaned (disassembled, cleaned, and sanitized) at the FDA–specified minimum frequency of every 4 hours. EHS-Net also assessed deli and staff characteristics related to slicer cleaning frequency.

Within each EHS-Net site, data collectors chose a convenient geographic area, based on reasonable travel distance, in which to survey delis by telephone to determine study eligibility and request study participation. A software program was then used to select a random sample of delis within in each of the site geographic areas. Delis eligible for the study had at least one slicer, prepared or served ready-to-eat foods (with a delay between purchase and consumption), and had staff members who could be interviewed in English. Data collectors assessed approximately 50 delis in each site. Data were collected during January–September 2012.

Data collectors interviewed deli managers about their characteristics, their deli's characteristics; and how often slicers were fully cleaned (“On average, how many times are food slicers fully cleaned [disassembled, cleaned, and sanitized] during a shift?”). Deli managers also completed a written, eight-item food safety knowledge survey. Data collectors interviewed food workers, away from the manager, about their characteristics and food safety knowledge, and how often each slicer was fully cleaned (“How often do you break down, clean, then sanitize this slicer?”). Simple and multiple logistic regression models were used to examine associations between deli, manager, and worker characteristics and slicer-cleaning frequencies. The cut-off for variable inclusion in the multiple regression models was $p \leq 0.10$.

Among 691 managers of eligible delis who were contacted, 298 (43%) agreed to be interviewed. In 294 (98.7%) participating delis, data collectors were also able to interview a worker. The majority of delis were chains (55.0%) and had 1–2 slicers (56.8%) (Table 1).

[†] California Department of Public Health, Minnesota State Department of Health, New York State Department of Health, New York City Department of Health and Mental Hygiene, State of Rhode Island Department of Health, and Tennessee State Department of Health.

* *Introduction to the 2013 Food Code*. <http://www.fda.gov/downloads/Food/GuidanceRegulation/RetailFoodProtection/FoodCode/UCM374510.pdf>.

TABLE 1. Reported slicer cleaning frequency, and deli, manager, and worker characteristics, obtained from manager interviews and surveys, and worker interviews*— six EHS-Net sites,† 2012

Reported slicer cleaning frequency (fully cleaned) [§]	No. (%)
Manager-reported (N = 297)	
Every 4 hours	147 (49.5)
Less frequently than every 4 hours	150 (50.5)
Worker-reported (N = 273)	
Every 4 hours	125 (45.8)
Less frequently than every 4 hours	148 (54.2)
Deli characteristic	
Ownership type (N = 298)	
Chain	164 (55.0)
Independent	134 (45.0)
Number of managers (N = 298)	
1	102 (34.2)
>1	196 (65.8)
Average number of workers per shift (N = 298)	
<2	106 (35.6)
≥2	192 (64.4)
Number of shifts in typical day (N = 298)	
1–2	150 (50.3)
≥3	148 (49.7)
Number of hours in typical shift (N = 298)	
<8	91 (30.5)
≥8	207 (69.5)
Number of customers on busiest day (N = 262)	
0–99	85 (32.4)
100–299	92 (35.1)
≥300	85 (32.5)
Number of slicers (N = 294)	
1–2	167 (56.8)
≥3	127 (43.2)
Maximum number of chubs sold daily (N = 274)	
<30	134 (48.9)
≥30	140 (51.1)
Manager food safety training required by deli (N = 295)	
Yes	220 (74.6)
No	75 (25.4)
Manager food safety certification required by deli (N = 291) [¶]	
Yes	145 (49.8)
No	146 (50.2)
Written policy for cleaning and sanitizing slicers (N = 296)	
Yes	194 (65.5)
No	102 (34.5)
Worker-rated difficulty of slicer cleaning (N = 293)	
Easy	216 (73.7)
More difficult**	77 (26.3)

Half of managers (49.5%) said that slicers were fully cleaned at least every 4 hours (Table 1). The remaining managers said that slicers were fully cleaned less frequently. Workers reported that 63.0% (393 of 624) of slicers were fully cleaned at least every 4 hours. Deli-level aggregation of these worker-reported data indicated that in 45.8% of delis, all slicers were fully cleaned at least every 4 hours (Table 1). In the remaining delis, at least one slicer was fully cleaned less frequently. Managers and workers agreed on cleaning frequency in 79.0% of delis (215 of 279, $r = 0.587$, $p < 0.001$).

TABLE 1. (Continued) Reported slicer cleaning frequency, and deli, manager, and worker characteristics, obtained from manager interviews and surveys, and worker interviews*— six EHS-Net sites,† 2012

Reported slicer cleaning frequency (fully cleaned) [§]	No. (%)
Manager characteristic	
Experience in retail food industry (yrs) (N = 298)	
≤10	77 (25.8)
>10–15	50 (16.8)
>15	171 (57.4)
Experience as manager in current deli (yrs) (N = 298)	
≤5	156 (52.3)
>5	142 (47.7)
Ever food safety certified (N = 297) [¶]	
Yes	203 (68.4)
No	94 (31.6)
Currently food safety certified (N = 297) [¶]	
Yes	164 (55.2)
No	133 (44.8)
Food safety knowledge assessment (N = 298)	
<75% correct	97 (32.6)
≥75% correct	201 (67.4)
Worker characteristic	
Experience in retail food industry (yrs) (N = 293)	
≤10	163 (55.6)
>10–15	57 (19.5)
>15	73 (24.9)
Experience in current deli (yrs) (N = 294)	
≤5	190 (64.6)
>5	104 (35.4)
Food safety knowledge assessment (N = 294)	
<100% correct	157 (53.4)
100% correct	137 (46.6)

Abbreviation: EHS-Net = Environmental Health Specialists Network.

* Numbers vary because of missing data.

† California, Minnesota, New York, New York City, Rhode Island, and Tennessee.

§ Disassembled, cleaned, and sanitized.

¶ Certification defined as having taken and passed a food safety test and been issued a certificate.

** Somewhat easy, neither easy nor difficult to clean, somewhat difficult, or difficult.

Simple regression models showed that the characteristics of deli chain ownership, a higher average number of workers per shift, more shifts per day, more customers served on the busiest day, more slicers, more chubs (plastic tubes of meat) sold daily, deli-required manager food safety training, a written policy on slicer cleaning, manager certification (current or ever), and manager and worker food safety knowledge were significantly associated with both managers and workers indicating that their slicers were fully cleaned at least every 4 hours (Table 2). Worker rating of deli slicers as easy to clean was significantly associated with managers indicating that slicers were fully cleaned at least every 4 hours. Deli-required manager food safety certification and more worker experience in the deli were significantly associated with workers indicating that slicers were fully cleaned at least every 4 hours.

TABLE 2. Simple logistic regression models of deli, manager, and worker characteristics associated with managers and workers reporting that slicers in their delis are fully cleaned* at the FDA–specified frequency (at least every 4 hours) — six EHS-Net Sites,† 2012

Characteristic	Comparison [§]	Managers reported that slicers are fully cleaned at least every 4 hours			Workers reported that slicers are fully cleaned at least every 4 hours		
		No. [¶]	OR (95% CI)	p-value for comparisons	No. [¶]	OR (95% CI)	p-value for comparisons
Deli characteristic							
Ownership type	Chain versus independent	293	4.41 (2.36, 8.25)	≤0.001	272	5.21 (2.50, 10.85)	<0.001
Number of managers	1 versus >1	293	0.74 (0.41, 1.33)	0.310	272	1.02 (0.53, 1.94)	0.960
Average number of workers per shift	≥2 versus <2	293	3.51 (1.85, 6.65)	0.003	272	3.48 (1.63, 7.40)	0.007
Number of shifts in a typical day	≥3 versus 1 or 2	293	2.92 (1.60, 5.32)	<0.001	272	2.63 (1.37, 5.02)	0.004
Number of hours in a typical shift	<8 versus ≥8	293	1.06 (0.59, 1.93)	0.841	293	1.52 (0.80, 2.87)	0.198
Number of customers on busiest day**	100–299 versus 0–99	257	5.84 (2.59, 13.21)	<0.001	236	8.71 (3.12, 24.33)	<0.001
	≥300 versus 0–99	257	5.05 (2.29, 11.13)	<0.001	236	6.75 (2.49, 18.26)	<0.001
Number of slicers	≥3 versus 1 or 2	293	3.23 (1.77, 5.91)	<0.001	272	4.47 (2.33, 8.55)	<0.001
Maximum number of chubs sold daily	≥30 versus <30	269	2.68 (1.47, 4.91)	0.001	250	3.66 (1.86, 7.20)	0.001
Manager food safety training required by deli	yes versus no	291	2.29 (1.08, 4.85)	0.032	270	4.55 (1.69, 12.46)	0.003
Manager food safety certification required by deli††	yes versus no	286	1.48 (0.81, 2.69)	0.200	270	2.82 (1.42, 5.59)	0.003
Written policy for slicer cleaning and sanitizing	yes versus no	291	4.46 (2.21, 9.01)	<0.001	271	6.02 (2.59, 14.00)	<0.001
Worker-rated difficulty of slicer cleaning	Easy versus more difficult ^{§§}	292	1.98 (1.02, 3.82)	0.043	271	1.54 (0.77, 3.10)	0.223
Manager characteristic							
Experience in retail food industry (yrs) ^{¶¶}	≤10 versus ≥15	293	0.88 (0.46, 1.69)	0.532	272	0.82 (0.39, 1.70)	0.600
	>10–15 versus ≥15	293	1.18 (0.54, 2.59)	0.554	272	1.00 (0.43, 2.33)	0.808
Experience as manager in current deli (yrs)	≤5 versus >5	293	1.51 (0.87, 2.63)	0.140	272	1.22 (0.67, 2.24)	0.517
Ever food safety certified	yes versus no	292	1.72 (0.90, 3.27)	0.099	271	2.29 (1.12, 4.72)	0.024
Currently food safety certified	yes versus no	292	2.06 (1.08, 3.93)	0.028	271	1.74 (0.97, 3.12)	0.063
Food safety knowledge assessment	≥75% correct versus <75% correct	293	3.28 (1.65, 6.53)	0.001	272	3.15 (1.42, 7.01)	0.005
Worker characteristic							
Experience in retail food industry (yrs) ^{***}	≤10 versus >15	293	1.47 (0.76, 2.88)	0.209	272	0.87 (0.41, 1.78)	0.287
	>10–15 versus >15	293	1.04 (0.45, 2.40)	0.675	272	1.48 (0.59, 3.69)	0.251
Experience in current deli (yrs)	≤5 versus >5	293	0.99 (0.56, 1.75)	0.962	272	0.51 (0.27, 0.97)	0.039
Food safety knowledge assessment	100% correct versus <100% correct	293	2.53 (1.41, 4.52)	0.002	272	1.93 (1.03, 3.62)	0.041

Abbreviations: CI = confidence interval; EHS-Net = Environmental Health Specialists Network; FDA = Food and Drug Administration; OR = odds ratio.

* Disassembled, cleaned, and sanitized.

† California, Minnesota, New York, New York City, Rhode Island, and Tennessee.

§ The reference level is the second category listed. Thus, the odds ratio is for the first category listed compared to the second category listed.

¶ Numbers vary because of missing data.

** P-values for the overall ORs: p = 0.001 and p < 0.001 for the manager and worker models, respectively.

†† Certification defined as having taken and passed a food safety test and been issued a certificate.

§§ Somewhat easy, neither easy nor difficult to clean, somewhat difficult, or difficult.

¶¶ P-values for the overall ORs: p = 0.803 and p = 0.856 for the manager and worker models, respectively.

*** P-values for the overall ORs: p = 0.441 and p = 0.445 for the manager and worker models, respectively.

A multiple regression model showed that deli chain ownership, more customers served on the busiest day, and worker food safety knowledge were significantly associated with managers indicating that slicers were fully cleaned at least every 4 hours. A second multiple regression model showed that deli chain ownership, more customers served on the busiest day, more slicers, more chubs sold daily, deli-required manager food safety training, and more worker experience in the deli were significantly associated with workers indicating that slicers were fully cleaned at least every 4 hours. (Table 3).

Discussion

These analyses indicate that many delis have insufficient slicer-cleaning frequency, which could lead to cross-contamination of deli meats with *Listeria* and other pathogens. In at least half of delis studied, managers and workers reported that slicers were not fully cleaned at the FDA–specified minimum frequency of every 4 hours.

Multiple regression findings indicate that chain delis reported more frequent slicer cleaning than did independent delis, and delis with more slicers, serving more customers, and selling more

TABLE 3. Multiple logistic regression models* of deli, manager, and worker characteristics associated with managers and workers indicating that in their deli, slicers are fully cleaned† at the FDA-specified frequency (at least every four hours) — six EHS-Net sites,§ 2012

Characteristic	Comparison¶	OR (95% CI)	p-value for comparisons
Manager model (N = 257)			
Ownership type	Chain versus independent	2.78 (1.30, 5.96)	0.008
Number of customers on busiest day**	100–299 versus 0–99	4.32 (1.85, 10.11)	<0.001
	≥300 versus 0–99	2.71 (1.10, 6.70)	0.031
Worker food safety knowledge assessment	100% correct versus <100% correct	2.15 (1.11, 4.17)	0.023
Worker model (N = 222)			
Ownership type	Chain versus independent	4.65 (1.52, 14.25)	0.007
Number of customers on busiest day††	100–299 versus 0–99	3.42 (0.96, 12.16)	0.057
	≥300 versus 0–99	0.76 (0.18, 3.26)	0.713
Number of slicers	≥3 versus 1 or 2	2.42 (0.92, 6.39)	0.074
Maximum number of chubs sold daily	≥30 versus <30	2.36 (0.85, 6.54)	0.098
Manager food safety training required by deli	yes versus no	4.30 (0.93, 19.87)	0.062
Worker experience in current deli (yrs)	≤5 versus >5	0.45 (0.20, 1.04)	0.061

Abbreviations: CI = confidence interval; EHS-Net = Environmental Health Specialists Network; FDA = Food and Drug Administration; OR = odds ratio.

* Manager overall model ($X^2 = 36.54$, degrees of freedom (df) = 4, $p < 0.001$) created using forward selection criteria of $p \leq 0.10$. Worker overall model ($X^2 = 54.96$, df = 7, $p < 0.001$) created using forward selection criteria of $p \leq 0.10$. When employing a forward selection procedure, all predictors of interest (i.e., deli, manager, and worker characteristics in this study) are systematically individually tested to see which is most significant within the model. Once identified, this predictor is added to the model and the remaining predictors are retested. This procedure is repeated until all remaining predictors fail to meet the entrance criteria. Each final model presented above simultaneously included all variables shown in the table. Individual inclusion steps are not presented.

† Disassembled, cleaned, and sanitized.

§ California, Minnesota, New York, New York City, Rhode Island, and Tennessee.

¶ The reference level is the second category listed. Thus, the odds ratio is for the first category listed compared to the second category listed.

** P-value for the overall OR: $p = 0.003$.

†† P-value for the overall OR: $p = 0.006$.

chubs daily reported more frequent slicer cleaning than did delis with fewer slicers, serving fewer customers, or selling fewer chubs daily. These characteristics are likely indicators of deli size, and these data are consistent with other findings suggesting that both chain and larger establishments' food safety practices tend to be better than those of independent and smaller establishments (9,10). Compared with both independent and smaller delis, chain and larger delis might have more resources, more or better trained staff, or more standardized cleaning procedures.

The association of required manager food safety training and certification with more frequent reported slicer-cleaning is consistent with other findings indicating that training and certification are important in retail food safety (9,10), and highlights the important role that management can play in food safety. The finding that delis with workers with more food safety knowledge and experience had more frequent reported slicer cleaning suggests that workers also play an important role in food safety.

Simple logistic regression findings suggest other characteristics that might improve cleaning frequencies. Written slicer-cleaning policies and worker ratings of slicers as being easy to clean were both associated with more frequent reported cleaning, suggesting that workplace policies and slicer design can affect cleaning frequency. Finally, delis with a food safety-certified manager had better reported cleaning frequencies, again pointing to the importance of training and certification.

Because slicer-cleaning frequency and disassembly guidance are presented separately from each other in the FDA Food

Code, some deli managers might be unaware that cleaning should include disassembly, and might clean and sanitize slicers without disassembling them. It is also possible that some slicers included in this study, especially newer ones, do not need to be disassembled to be fully cleaned.

The findings in this study are subject to at least three limitations. First, the interview data might be affected by social desirability bias, which might have resulted in overreporting of cleaning frequency. Second, because interviewed workers were selected by managers, and not at random, worker data might not represent all workers. Finally, because the data were collected from English-speaking staff members only, they might not reflect practices in delis with no English-speaking staff. It is also important to note that the data from this study do not allow causal inferences about relationships between characteristics and cleaning frequency nor do they link slicer cleaning frequency with foodborne illness.

States and localities should require deli manager training and certification, as specified in the FDA Food Code. They should also consider providing education on the topics of slicer-cleaning frequency and the importance of slicer disassembly, and encouraging or requiring delis to have written slicer-cleaning policies. Retail food industry leaders can also implement these prevention efforts to reduce risk in their food establishments. Because frequencies of slicer cleaning were lower at independent and smaller delis, prevention efforts should focus on these types of establishments.

References

Summary

What is already known about this topic?

Listeria monocytogenes (*Listeria*) causes the third highest number of foodborne illness deaths in the United States annually. *Listeria* contamination of sliced deli meats at retail locations contributes to *Listeria* illness and outbreaks. Mechanical slicers pose cross-contamination risks in retail delis and are an important source of *Listeria* cross-contamination. Good slicer cleaning practices can reduce this risk.

What is added by this report?

In approximately half of retail delis studied in six Environmental Health Specialists Network sites, slicers were fully disassembled, cleaned, and sanitized less frequently than the minimum 4 hours specified in the Food and Drug Administration (FDA) Food Code. Slicers were fully cleaned more frequently in chain delis, and in delis with more customers, more slicers, required manager food safety training, food safety–knowledgeable workers, written slicer cleaning policies, and food safety–certified managers than in delis in other categories.

What are the implications for public health practice?

To help ensure that deli slicers are cleaned at least every 4 hours as a foodborne illness prevention measure, states and localities should require deli manager training and certification, as specified in the FDA Food Code. They should also consider encouraging or requiring delis to have written slicer-cleaning policies. Retail food industry leaders can also implement these prevention efforts to reduce risk in their food establishments. Because independent and smaller delis show lower frequencies of slicer cleaning, prevention efforts should focus on these types of delis.

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