Impact of Preparing for OSHA Local Emphasis Program Inspections of New York Dairy Farms: Case Studies and Financial Cost Analysis

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Background *OSHA inspection of dairy farms began in July 1, 2014 in New York State. As of September 2014, a total of eight farms were randomly selected for inspection. This case study addresses how dairy farm managers prepared for these inspections, and identifies farm level costs preparing for inspection and/or being inspected.*

Methods *Four farms that were OSHA inspected and 12 farms that were not inspected were included in this mixed method evaluation using a multimodal (telephone, email, or mail) survey. Descriptive analysis was carried out using frequencies, proportions, means, and medians.*

Results *Overall, the impact of OSHA inspections was positive, leading to improved safety management and physical changes on the farm and worker trainings, although the farmers' perspectives about OSHA inspection were mixed.*

Conclusions *The cost of compliance was low relative to estimated overall production costs. Clarifications and engineering solutions for specific dairy farm hazard exposures are needed to facilitate compliance with OSHA regulations.* Am. J. Ind. Med.

KEY WORDS: dairy farm inspections; regulatory effectiveness; compliance costs; Occupational Safety and Health Administration; financial analysis

INTRODUCTION

Does preparing for a first time Occupational Safety and Health Administration (OSHA) complete inspection on a dairy farm affect safety and health risks and/or change behaviors associated with worker safety? Dairy farms historically have not been subject to OSHA random inspections. This changed as OSHA began randomly inspecting a few selected farms in Wisconsin in 2011 and then in New York (NY) in 2014. Because these are relatively new, the impact of OSHA inspections of dairy farms is not known in terms of the farmer's ability to comply with regulations.

Studies in other sectors have demonstrated that workers' compensation claims rates and costs may decrease after the worksite is inspected [Haviland et al., 2012], with or without a citation. However, a threefold larger effect was observed for inspections with citations [Foley et al., 2012]. In addition, a significant drop in claims incidence rates and costs was attributed to pre-inspection consultation visits [Foley et al., 2012]. In California, 409 randomly inspected workplaces in high hazard industries were compared with 409 matched-control workplaces that were eligible, but not chosen, for inspection. Randomly inspected employers experienced a 9% decline in injury rates and a 26% reduction in injury cost

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Contract grant sponsor: National Institute for Occupational Safety and Health; Contract grant number: 2U540H007542.
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Accepted 21 October 2015
DOI 10.1002/ajim.22546. Published online in Wiley Online Library (wileyonlinelibrary.com).

compared with controls [Levine et al., 2012]. The impact of inspections on workplace injuries has increased over time since 1998 [Haviland et al., 2012]. Therefore, particularly in the manufacturing sector, federal enforcement activities have been associated with improved worker safety and reduced injury [Michaels, 2012]. A recent Cochrane review suggests that inspections in other sectors decrease injuries long term; however, the magnitude of this effect is unknown given the paucity of experimental trials [Mischke et al., 2013].

Background

Dairy farms constitute the largest agricultural sector in NY with $2.6 billion in direct sales, $4.1 billion in impact and nearly 26,000 jobs, on and off the farm [Lopez et al., 2015]. In 2013, the US Department of Labor OSHA Region II announced a new Local Emphasis Program (LEP) in NY for Dairy Farm Operations [OSHA, 2013]. After Wisconsin, NY was the second state to have a LEP due to inspections for four fatalities on dairy farms since 2007 and an increasing awareness by OSHA of hazards found in this sector. In addition, language barriers were identified among Hispanic workers on NY dairy farms, precipitating concerns about worker training [Cornell University, 2009]. The OSHA LEP announcement listed the "Dairy Dozen," i.e., the most common hazards to be addressed by inspectors with guidance documents to assist dairy farmers in achieving compliance. These include Manure Storage and Collection Structures, Dairy Bull and Cow Behavior/Worker Positioning, Electrical Systems, Skid Steer Operation, Tractor Operation, Guarding of Power Take-Offs (PTOs), Machine Guarding for Field and Farmstead Equipment, Lockout—Unexpected Energy Release, Hazard Communication, Confined Spaces, Horizontal Bunker Silos, and Noise [OSHA, 2013].

In October 2013, the NY OSHA Work Group was formed to offer new and expanded services to all dairy farm managers to inform them about the OSHA inspection process. This statewide workgroup included the Northeast Dairy Producers Association (NEDPA), NY Farm Bureau, Cornell Pro Dairy and Cooperative Extension, the NY Center for Agricultural Medicine and Health (NYCAMH) and the NY Department of Labor (NYDOL). The workgroup compiled and disseminated farm management educational materials including guidance from NEDPA and ProDairy about the inspection process [Dairy Business East, 2014], OSHA educational publications, NYCAMH templates for written safety protocols for each defined topic, training requirements, and contact information for all available resources. Starting in October 2013, the work group sent out promotional materials to all dairies who were members of those organizations, or on newsletter lists (NYCAMH, for one, has 602 dairy farms on its mailing list). These were also distributed to anyone attending trade shows. Other resources included OSHA online resources, the NYDOL On-Farm Consultation program, milk cooperatives presentations, insurance companies, and consultants (hired advisees). NYCAMH created a pre-inspection program [NYCAMH, 2014] that included on-farm consultation with walkthrough, on-farm worker safety trainings, as well as subsidized Roll-over Protection Systems, affordable Personal Protective Equipment (PPE), and respirator fit-testing services. These services were promoted through work-group partners, on the partner websites, through train-the-trainer programs, at outreach events and in local farm publications.

From July 1st to September 30th, 2014, three NY OSHA Offices (Albany, Syracuse, Buffalo) conducted complete inspections on randomly selected dairy farms that had over 10 non-family employees or had a temporary labor camp. Farmers had 9 months to prepare for potential inspections and were not notified of the inspections in advance. To be compliant and avoid violations and their associated penalty fees, farm managers had to invest time and money in updating all necessary documentation records, making physical changes to the farm according to the OSHA guidance, and train employees in a relatively short time frame.

Study Objectives

This study was designed to explore the costs to the dairy farms of the OSHA inspection process, including preparation and the inspection itself, to address a gap in knowledge regarding the impact of OSHA inspection on farm safety. The specific objectives of this study were to

- describe the intermediate effects of an actual or potential OSHA inspection on dairy farms in NY that prepared for inspection using consultants or other services,
- explore the costs of implementing work safety programs or physical changes on the dairy farm to comply with OSHA regulations,
- estimate the impact of general deterrence, that is, the effect of the threat of an OSHA inspection on compliance at farms that were not inspected in 2014,
- describe the attitudes and perspectives of dairy farm owners/managers pertaining to OSHA inspections.

METHODS

Survey Methods

Information about completed farm inspections was obtained from the OSHA public information website which lists all businesses they inspect. The NAICS code for dairy

farm (112120) and state name were used to select all dairy farms that OSHA reported visiting in NY during the LEP targeted time period. We focused only on those farms OSHA randomly selected for inspection from July 1 to September 30, 2014, omitting those that were partial inspections triggered by referrals, complaints or fatalities reported to OSHA. A list of 48 dairies that were not inspected was compiled using NYCAMH contact lists and dairy farm lists (available online from Upstate Niagara Cooperative, Dairylea Cooperative Inc., Agri-Mark, and Environmental Working Group (EWG) Farm Subsidies Listing). Farms eligible to be included in the survey had to be large enough to be subject to OSHA regulations and use one or more of the educational resources offered by work-group members or consultants. The sampling frame consisted of all eight OSHA randomly inspected farms, and 48 uninspected farms. The eligibility of the uninspected farms was not known until they were called.

A 20 question survey was developed by the authors (see Supplementary Material). The survey included questions about time invested to create the necessary documentation, costs of specific physical farm improvements identified by OSHA in their LEP announcement, and the cost of safety trainings for farm workers. The survey also assessed the farmer's perspective on inspections, regulation, and changes made on the farm. For example, respondents were asked, "In retrospect, was the inspection process (specified as the process from start to finish, i.e., preparation to day of interview) worthwhile to you?" The survey was reviewed for clarity and readability by NYCAMH outreach staff who work closely with dairy farmers, and thus are familiar with the terminology farmers use. It was piloted on one dairy farm known to NYCAMH.

Farm owners or managers were recruited for the survey by phone. Surveys were conducted by NYCAMH staff from December 2014 to June 2015. Survey completion often required one or more phone calls as participants often needed time to collect specific cost information. This was a multimodal survey that was completed by telephone, email, or mail, depending on the respondent's preference. In appreciation for their time, the respondent was offered a $25 gift certificate for completing the survey.

Cost Calculations

The survey queried costs related to various aspects of management, worker trainings, and physical changes made on the farm. Cost calculations took into account both monetary expenses as well as person-hours dedicated to the task, using US Bureau of Labor Statistics (BLS) data on farm wages in NY. When the respondent was unsure of certain elements of cost, the missing data were viewed as "minimum costs," and given the value of zero, assuming that some cost was incurred but could not be quantified accurately. Thus our cost estimates should be considered conservative.

Management costs

With regard to office management costs, the survey collected time spent on injury logs, chemical inventory, hazard communication plans, buying PPE, and written safety protocols.

$$\text{Office management cost} = \text{total preparatory hours} \times \$26.63 \text{ average wage for supervisors} \quad \text{(i)}$$

where $26.63 represents the hourly wage for front line supervisors in farming [BLS, 2014a]. For owners not drawing a wage, the $26.63 represents the opportunity cost of their time.

Worker training costs

Worker training costs were estimated for each farm by summing total costs attributable to all OSHA-compliant trainings in animal handling, tractor safety, skidsteer safety, PTO safety, machinery safety, lockout–lagout procedures, electrical, manure management, confined space, horizontal silo hazards, or noise safety. For each training topic, the cost was calculated as:

$$\begin{aligned}\text{Training cost} = {} & [(\#\text{ employees attending}) \\ & \times (\text{hours per employee spent at the training}) \\ & \times [\$12.79 \text{ average wage for employees}] \\ & + [\text{training cost per person trained} \times \#\text{ employees}] \\ & + [\text{hours per employee spent at training} \\ & \times \$22.63 \text{ average wage for supervisors conducting trainings in house}] \end{aligned} \quad \text{(ii)}$$

where $12.79 represents the hourly wage for farm laborers and $26.63 represents the hourly wage for front line supervisors in farming [BLS, 2014b]. For owners not drawing a wage, the $26.63 represents the opportunity cost of their time.

Physical change costs

Costs of physical changes made on the farm were calculated by summing the total of costs incurred in a variety of categories: electrical, buildings, manure management, machinery, skidsteer/tractor, PPE, grain/silage storage, cleanup, and signage. For each category, the cost was calculated as

$$\text{Physical changes cost} = [\text{materials cost}] + [\text{contractor cost}] + [\text{on farm labor cost}] \quad \text{(iii)}$$

$$\text{On farm labor cost} = (\text{paid hours} \times [(0.5 \times \$12.79) + (0.5 \times \$26.63)]) + (\text{unpaid hours} \times \$26.63) \quad \text{(iv)}$$

These labor calculations assumed that the paid hours were evenly split between management and workers. Unpaid work time was assumed to be conducted by the farm owner or supervisor, with our dollar estimates reflecting the opportunity cost of that time.

The grand total cost for preparation for OSHA inspection was calculated as

$$\text{Total preparation cost} = \text{office management cost} + \text{worker training cost} + \text{physical changes cost} \quad \text{(v)}$$

Means, medians, and ranges were presented for each cost metric for the sample as a whole, and for inspected and uninspected farms separately. In the summary of training costs, one farm that was not inspected was excluded because the respondent reported trainings were done but could not provide accurate cost or time measures for said trainings.

We were unable to consider other likely costs associated with preparation for and the inspections themselves, such as whether workers were idle when the inspections took place, or lost income if the inspections disrupted farm operations, such as delaying haying or other timely farm activity in a way that diminished the value of the crop.

Use of Existing Data

The average dairy farm expense estimate, using data collected from 112 Large Herd Dairy Farms in NY in 2013 by Cornell University, College of Agriculture and Life Science, School of Applied Economics and Management [Karszes et al., 2014] was used to estimate a ratio of the cost of compliance to overall farm expenses. Accrual expenses are the costs of inputs actually used in 2013 production and are the sum of cash paid, changes in inventory, prepaid expenses, and accounts payable.

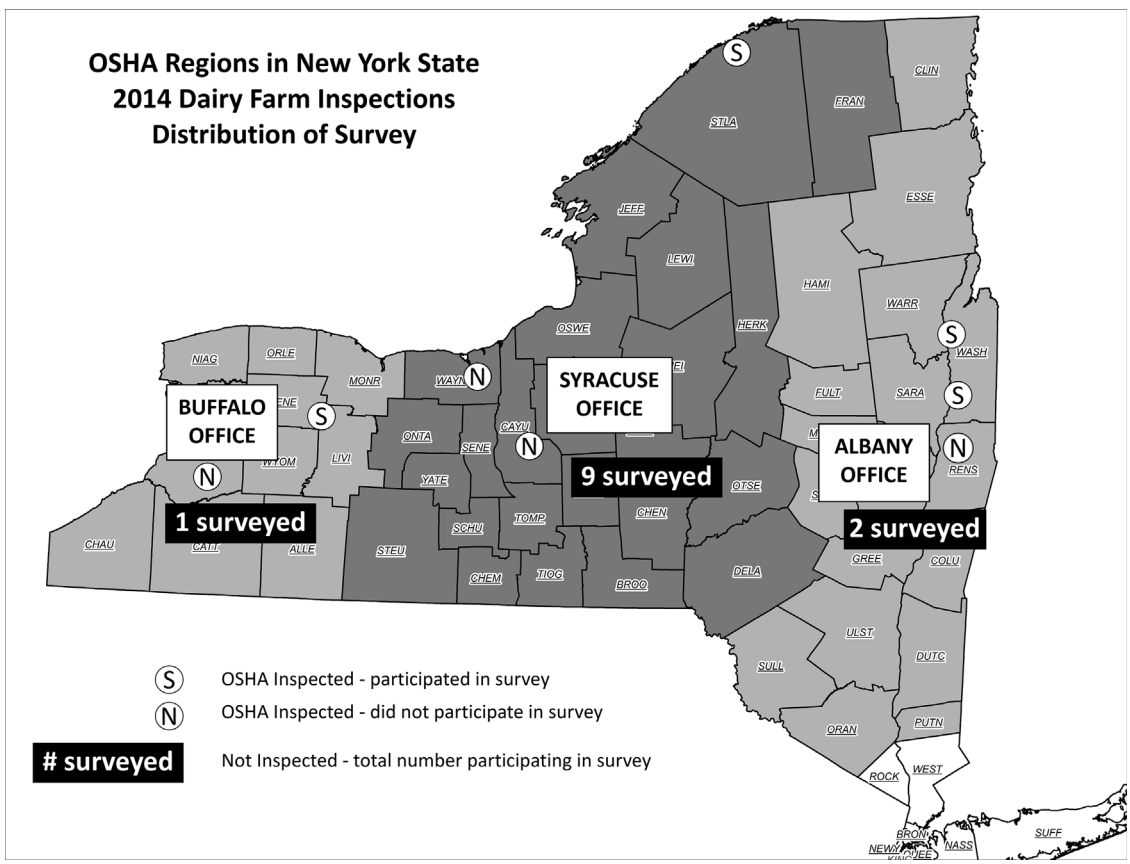

FIGURE 1. Location of dairy farms that were inspected in 2014 by respective OSHA Offices in NYS.

Statistical Analysis

To compare farm characteristics between inspected and uninspected farms, the Wilcoxon Rank sum test was used. A P-value of <0.05 was considered statistically significant. Statistical analyses were conducted using SAS version 9.3.

RESULTS

Between July 1, 2014 and September 30, 2014, OSHA randomly selected 11 dairy farms in NY for workplace inspection. Farms were not notified that they had been selected for inspection. Three farms had 10 or fewer employees, not under OSHA regulations, and thus were not inspected. Among the eight farms selected for OSHA inspection, four responded to the survey (50% response rate) and all of these had previously worked with NYCAMH to prepare for a potential unannounced inspection (Fig. 1). The geographic distribution of the major regions of large dairy farms in NY (western, central, northern, and eastern) were well represented in the survey.

Among 48 uninspected farms, 13 participated, five were too small, five refused, 25 could not be contacted, thus our response rate was 13/43 (30% response rate). Of the 13, 12 had had prior consultation/walkthrough, and/or some worker safety training from NYCAMH (58%), or DOL and other consultants (42%). One surveyed, uninspected farm was excluded because it had not used any of the available educational resources. The total number of eligible farms that were not inspected but were included in the survey is 12. Thus, we report the findings from surveys of 16 farms, four of which underwent OSHA inspections during the summer months.

The inspected and uninspected farms are compared in Table I. The four OSHA inspected farms were larger than the uninspected farms surveyed. Inspected farms reported a higher average herd size, although this difference did not reach statistical significance. Inspected farms reported significantly higher total numbers of hired workers than uninspected farms ($P = 0.04$). The number of hired milkers was also significantly higher among the inspected farms as compared to uninspected farms ($P = 0.03$). In addition, the number of full-time hired workers was higher among inspected farms versus uninspected farms, a difference that approached statistical significance ($P = 0.06$). Respondents were farm owner/managers (60%), or manager/safety officer (40%), 38% female and 2 out of 16 emailed their responses. Survey completion on average took 30 min.

Table II summarizes the resources utilized to assist farmers to prepare for a potential OSHA inspection. Based on the survey responses, all survey participants had used at least one resource for assistance and most (63%) reported using a variety of resources to prepare for the OSHA inspection.

Farm managers were queried about the amount of time needed to assemble the required documentation for OSHA compliance. Half of the respondents spent time creating OSHA 300 logs covering the last 3 years (mean 0.64 hr.), 15 (94%) respondents needed to work on creating a complete chemical inventory with binder of SDS sheets (mean 10.4 hr.), 10 (63%) spent time creating Hazard Communication Written Plans (mean 3.15 hr.), and 10 (63%) spent time creating written safety plans for the other "dairy dozen" topics (mean 6.2 hr.). Farmers reported a mean of 0.69 hr. spent per week updating OSHA documentation (accident logs, chemical inventory, safety plans, training sign-ups), however, many respondents reported not doing this weekly.

Worker Trainings

Most farms conducted training in animal handling (100%), tractor operation (81%), PTO hazard prevention (88%), and skidsteer operation (100%). Manure storage safe management, confined space entry hazards, and horizontal silo safety were conducted on 75% of the farms. Half of the farms had trainings specifically in machine guarding, machinery lockout/tagout, electrical and noise hazards. All farms had trainings conducted in Spanish. The mean number of hours for training per employee was 0.4 for any one topic.

TABLE I. General Descriptors of 16 Dairy Farms Included in the Survey Stratified by Inspection Status

	All (n = 16)		OSHA inspected (n = 4)		Not OSHA inspected (n = 12)		
	Mean	Median	Mean	Median	Mean	Median	*P*-value*
Herd size	1,205	1,100	1,350	1,350	1,156	925	0.27
Milkings per day	2.8	3.0	3.0	3.0	2.8	3.0	0.34
# total hired workers	23.1	22.0	32.8	31.0	19.8	15.5	0.04
# of full-time hired workers	20.4	17.5	30.0	28.5	17.3	13.5	0.06
# of part-time hired workers	2.6	2.0	2.8	2.5	2.6	2.0	0.71
# of hired milkers	10.2	9.0	16.8	15.5	8.0	7.5	0.03
# of hired field workers	9.7	9.0	9.5	9.5	9.8	8.5	0.67

*Wilcoxon rank sum test.

TABLE II. Resources Used to Prepare for Potential OSHA Inspections by Surveyed Dairy Farms (n = 16)

OSHA compliance education resources used	# (%) farms
NYCAMH Dairy Safety Program—consultations/walkthrough	10 (63)
NYCAMH Dairy Safety Program—worker trainings	12 (75)
Other NYCAMH services	7 (44)
NEDPA Sponsored Group Training Session	2 (13)
New York Department of Labor On-Site Consultation Service	5 (31)
Independent Consultants, Workers' Compensation Insurance Agents, Upstate Niagara Dairy Coop, Veterinarian	5 (31)
Other—internet research, safety training materials from New Mexico State University, OSHA resources, Farm Bureau, webinars from Ag industry sources	3 (19)
Farms using more than one resource	10 (63)
Farms using only one resource	6 (37)

Financial Costs to the Farm to Prepare for OSHA Inspection

The largest inspection preparation expense entailed physical changes made to the farms in the 6 months prior to OSHA inspection time (Table III). The initial mean cost for physical changes was higher in the farms that were not inspected versus those that were. However, this difference is largely driven by one outlier cost of $148,410 for an uninspected farm that made several large improvements including upgrading their machine shop. The mean cost of physical changes to uninspected farms was $12,998 even with this outlier removed, so removing the outlier does not explain the higher mean cost for physical changes among the uninspected farms. However, median costs for physical changes ($10,715) were higher in the inspected farms compared to uninspected farms ($3,609).

The estimated cost of training workers was substantially less than physical changes, but higher for the inspected farms, as would be expected given the larger number of employees on inspected farms (median $1,842 inspected vs. $833 not inspected). Most farms (73%) did not incur any direct costs for worker trainings, as they received services free from NYCAMH, veterinarians, and a dairy coop, or trainings were done by the farm owners or managers. For the four farms that did pay for training, the average direct cost was $46.86 per employee per training. Office management costs were the least costly item and similar for inspected and not inspected farms.

Total mean cost for preparation for OSHA inspection was $13,863 for inspected farms, $14,536 for uninspected farms (excluding one outlier), and overall, for 15 farms, the mean was $14,357. Median costs, however, were higher for inspected farms ($12,743) compared to uninspected farms

TABLE III. Reported and Expected OSHA Compliance Costs for Surveyed Dairy Farms (n = 15) Stratified by Inspection Status

Costs for inspection preparation	OSHA inspected (n = 4)	Not OSHA inspected (n = 11)[a]	All (n = 15)
Office management costs			
Mean	$280	$433	$392
Median	$200	$107	$107
Range	$0–$719	$0–$1,731	$0–$1,731
Worker trainings			
Mean	$1,911	$1,215[b]	$1,414[b]
Median	$1,842	$833[b]	$890[b]
Range	$468–$3,494	$115–$4,123[b]	$115–$4,123[b]
Physical changes 6 months prior			
Mean	$11,672	$12,998	$12,644
Median	$10,715	$3,609	$6,740
Range	$4,516–$20,743	$200–$58,175	$200–$58,175
Total prep costs			
Mean	$13,863	$14,536	$14,357
Median	$12,743	$5,716	$9,222
Range	$5,011–$24,955	$200–$59,881	$200–$59,881
Expected cost to be OSHA compliant			
Mean	$6,250	$7,700	$7,286
Range	$5,000–$7,500	$2,000–$20,000	$2,000–$20,000
"Do not know" (number, percentage)	2 (50%)	7 (58%)	9 (56%)

[a]One uninspected farm was excluded from this analysis because it has outlying physical changes expense.
[b]One uninspected farm was excluded from worker training-specific statistics due to unknown cost.

TABLE IV. Reported and Expected OSHA Compliance Costs per Employee for Surveyed Dairy Farms (n = 15) Stratified by Inspection Status

Costs for inspection preparation per employee	OSHA inspected (n = 4)	Not OSHA inspected (n = 11)[a]	All (n = 15)
Office management costs			
Mean	$9	$34	$28
Median	$5	$10	$9
Range	$0–$25	$0–$144	$0–$144
Worker training			
Mean	$61	$71[b]	$68[b]
Median	$53	$44[b]	$44[b]
Range	$17–$120	$9–$344[b]	$9–$344[b]
Physical changes six months prior			
Mean	$360	$676	$592
Median	$279	$211	$227
Range	$167–$715	$8–$3,670	$8–$3,670
Total prep costs			
Mean	$430	$775	$683
Median	$337	$301	$313
Range	$186–$861	$8–$3,789	$8–$3,789

[a]One uninspected farm was excluded from this analysis because it has outlying physical changes expense.
[b]One uninspected farm was excluded from worker training-specific statistics due to unknown cost.

($5,716). Because the size differences between the inspected and the uninspected farms could account for observed cost difference in Table III between these groups, costs were estimated per employee. Table IV presents Table III costs as costs per employee as a means for adjusting for farm size. Median preparation costs per employee were similar for inspected farms ($337) compared to uninspected farms ($301). These estimates represent the cost of general deterrence, that is, the effect of the threat of an OSHA inspection on dairy farms in 2014.

Survey respondents were asked to recall what they had expected to spend at the beginning of the process in order to be OSHA compliant. Nine respondents (56%) did not know what to expect (Table III). Seven farmers (46%) did respond to this question. Their mean expected cost to prepare for OSHA inspection was $7,286 with a range from $2,000 to $20,000. The costs these farmers expected to incur for preparing for OSHA inspection, that is, $6,250 for two inspected farms, and $7,700 for five farms that were not inspected, were less than reported costs. However, these results are limited by the nine farms that did not provide this information.

TABLE V. Costs of OSHA Inspection to Four Dairy Farms That Were Inspected and Included in the Survey

OSHA inspected farms (n = 4)	Mean ($)	Range ($)
Total preparation costs	13,850	5,010–24,902
Opportunity costs during inspection (management time, lost income)	5,915	1,913–9,320
Penalty cost of OSHA violations (initial)	1,760	0–3,740
Total cost associated with OSHA inspection	21,525	13,700–33,807

Financial Costs to the Farm for OSHA Inspection

For the four farms that were OSHA inspected as well as surveyed in this study, the cost for preparation, opportunity costs, and fees for violations are presented in Table V. The reported cost of preparing for OSHA inspection (about $14,000) exceeded both the opportunity costs (about $6,000) as well as the cost of initial OSHA violation fees (mean of $1,760).

From the OSHA website, we know that the mean violation fee for all eight randomly inspected farms was $4,949 with a range of $0–$18,200 (Table VI). For the inspected farms included in this survey, there was a mean of 1.25 violations per farm at a mean cost of $1,510 per initial violation compared with a mean of two violations and $2,475 per farm for all eight inspected.

Cost of Compliance Versus Overall NY Dairy Farm Production Expenses

For farms that were inspected, the costs of compliance plus penalties (Table V) was compared to the average farm expenses for 112 large herd dairy farms in NY reported by Karszes et al. [2014]. The accrual cost for these farm expenses in 2013 was $5,116,609. This ratio is $21,525/$5, 116,609, that is, 0.0042, or less than 0.05% of farm expenses. For farms that were not inspected, the cost of compliance alone (Table III) was compared to the same estimate for the average cost for these farm expenses in NY. This ratio is $14,536/$5, 116,609, that is, 0.0028. These ratios would be even smaller if farmers paid for these with a multiyear loan, spreading the costs across multiple operating years, or if the ratios were calculated based upon the expected lifetime benefit of the physical changes.

Attitudes and Perspectives of Dairy Farm Owners/Managers Regarding OSHA Inspection

Among all farms surveyed, nine respondents (56%) reported having difficulty understanding, and thus complying

TABLE VI. OSHA Violations, Penalties and Mean Cost per Violation for Eight NY Dairy Farms Inspected Between July 1, 2014 and September 30, 2014

Farms inspected	Number of initial violations	Initial penalty ($)	Mean cost per violation ($)	Violation list
#1 (surveyed)	0	0.00	0.00	
#2 (surveyed)	1	1,700.00	1,700.00	(i) Lack of eyewash station
#3 (surveyed)	3	3,740.00	1,246.67	(i) Drill press not anchored; (ii) shop lamp not covered; (iii) grain bin ladder bottom rung too high
#4 (surveyed)	1	1,600.00	1,600.00	(i) Unguarded hole in plywood floor
#5 (not surveyed)	1	2,000.00	2,000.00	(i) Lack of guarding on equipment
#6 (not surveyed)	2	5,355.00	2,677.50	(i) Exposure to electrical panel; (ii) lack of footboard on shop platform
#7 (not surveyed)	2	7,000.00	3,500.00	(i) Exposure to falls; (ii) electrical hazard exposures
#8 (not surveyed)	6	18,200.00	3,033.33	(i) Exposure to falls; (ii) lack of PPE and eyewash station; (iii) confined Space entry without safety plan; (iv) exposure to electrical hazards; (v) lack of equipment guarding; (vi) lack of HazComm written plan/chemical inventory/worker training
Mean per farm	2	4,949.38	2,474.69	

with, specific OSHA regulations, most often with bunker silo regulations which were described as "impractical," "unrealistic," and "difficult." The lack of clarity regarding bunker silo regulations, e.g., design standards, fall protection, and height requirements, left respondents with sometimes conflicting answers from consultants about improving bunker silo-related safety. Two farmers reported that meeting the requirements for manure storage was difficult because not only did they not know what was expected by OSHA but also old facilities are expensive to upgrade.

Three farmers, one whose farm was inspected, expressed concern about how familiar OSHA inspectors are with agricultural operations. They feared that inspectors may not understand work practices and hazard exposures on dairy farms because they are not familiar with agricultural operations. Of the 16 violations cited to date (Table VI), two were specific to agriculture.

Farmers were asked if they observed any changes in worker behavior after safety trainings. Nine (56%) reported affirmatively. Specific changes in worker behavior reported were workers asking to replace PPE when necessary, increased use of protective glasses and ear plugs, improved skidsteer operation, increased attention to hazards, and increased reporting of unsafe conditions or equipment.

Benefits to the Farm

Farmers were asked if there were any benefits to the farm after preparing for OSHA inspection. Nearly all the responses (94%) were affirmative (the one exception was a farmer who said it was "hard to know but it does increase safety awareness"). The benefits the respondents identified included greater awareness of safety hazards, more communication about safety, more signage, and a greater understanding of the inspection process which also served as a reminder to do things safely. So the inspection served as a catalyst for change. As one farmer put it; "it was a good push for the farm to correct the issues they were already aware of." Another farmer stated; "before we were a fairly safe farm; now we are neater and more buttoned up." One farm increased their profits as a result of fixing the electrical problems in the barn, thus increasing milk production, which led the farmer to comment that "the repairs paid for themselves." This is one example where preparing for inspection saved the farmer money.

Farmers were then asked in retrospect, whether the pre-inspection process was worthwhile. Again most farmers responded affirmatively, citing increased worker safety and safety awareness. One farmer felt that the OSHA LEP inspections "catalyzed our industry to provide us education on OSHA's requirements, safety issues, and led to increased training resources for employee training." Negative responses from three farmers included complaints about burdensome paperwork, bureaucratic processes, regulations that are too strict, too costly to implement or subject to the OSHA's inspector's interpretation. When asked to quantify how much the pre-inspection process led to safety improvement on the farm, most farmers reported "some," three reported "a lot," and two reported "a little."

Lastly, farmers were asked whether they thought farms should be inspected by OSHA. Four farmers (25%) reported affirmatively, five were equivocal or did not know, and six said no. One emphatic "no" came from a farmer whose farm was inspected. He felt strongly that it was ridiculous that once the inspection was finished, he did not learn what the violations were right away but "once they do (tell you about the violations), you only have 14 days to correct them." Equivocal responses included two other farms that were inspected: OSHA inspections should be "based on accidents, not random selection of farms, and should not be a surprise." Another farmer felt that OSHA inspectors do not have enough familiarity with farming and their processes to "open a truly valuable dialogue on farm safety issues." One farmer felt that there are "too many variables on each farm. Each farm is different and farmers do not make enough money to implement OSHA regulations." Another commented that because of "OSHA's lack of familiarity with farming," farms should not be inspected by OSHA. Finally, one farmer opined that "inspectors are coming from a different industry standard, which creates lack of clarity about interpretation," but that "once there is more clarity, farms should be inspected."

DISCUSSION

This evaluation of 16 dairy farms (4 OSHA inspected, 12 not inspected) addressed important questions regarding farm level financial costs and overall farmer perceptions and attitudes related to the recently implemented OSHA inspections of dairy farms. The potential for being inspected by OSHA motivated positive changes related to physical hazard reduction and increased safety awareness on dairy farms. In addition, the OSHA work group promotional campaign, along with the free services and worker trainings they provided, also contributed to the changes we observed. To our knowledge, this is the first study to address the effect of OSHA inspections of dairy farms in the United States.

This study revealed a wide range of expected and actual costs related to preparing for an OSHA random inspection. However, the initial investment in preparing for OSHA inspection appears to be higher than the costs of violations. Historically, the OSHA penalty fees for violations have been low in other sectors [Pettus, 1982: Michaels, 2012] and currently are subject to reduction if the farmer addresses the violation within 14 days of notification. As a function of total production costs, preparation for inspection equated to less than 1% of milk production costs.

Would higher OSHA fines induce more changes? The Cochrane review of whether inspections are effective in improving workers' health and safety [Mischke et al., 2013] concluded that the "effect of fines and penalties is uncertain" whereas "first inspections, follow-up inspections, complaint, and accident inspections resulted in higher compliance rates." That review includes all sectors, thus it is not specific to agriculture. Because this case study is limited by the small number of inspected farms to date, future rounds of OSHA inspections need to be evaluated to see if higher fines promote more safety changes and whether these are effective long term.

With the one cost outlier for physical changes included, the uninspected farms reported spending substantially more on physical changes on the farm related to inspection preparation. One example stands out, e.g., where electrical upgrades prompted by the threat of OSHA inspection led to a positive return on investment leading the farmer to conclude that the repairs had more than paid for themselves. The variation in cost estimates, as demonstrated by the wide ranges in Tables III and IV, may reflect the diversity of farms included, poor recall of exact costs, or inflated estimates driven by negative perspectives of the OSHA inspection process. Another possibility is that the threat of OSHA inspection may have a broad impact on physical changes on the farm, worker trainings, and managerial attention to safety, which prompts farmers to go beyond focusing on compliance with each OSHA regulation ("detect and correct the Dairy Dozen"). This broader "behavioral shock" effect of OSHA inspections, as opposed to the "detection/correction model," has been noted in other sectors [Mendeloff and Gray, 2005].

These preparation costs need to be perceived in the broader context of potential risks and costs of farm injury and fatalities, because they (and the OSHA inspection) are intended to reduce such costs. The cost of farm injury, illness, and fatality pose a large financial burden on farmers as shown by Leigh et al. [2001], including significant lost work days, costing more than $7.77 billion (inflation adjusted to 2015 dollars). A study of farm injuries in Ontario found hospitalization costs of nonfatal injuries ranged from $1,142 to $93,139 (inflation adjusted to 2015 dollars) [Hartling et al., 1997]. Such estimates do not include the considerable emotional and social impacts of farm injury have also been documented by Robertson et al. [2006]. Although the risk of farm injury is perceived to be small, farmers perceive the costs of prevention to be high. This risk paradox underlies the common observation of more attention being paid to product prices and business costs, rather than to injury prevention as a cost of doing business [Murphy, 2003].

The findings of this evaluation may have been different based on at least two factors. During the time these dairy farms were preparing for potential OSHA inspections, the price of milk was high in NY. That price advantage gave the farmers more opportunity to invest in safety improvements. It is also important to note that NY farms had access to many free services and materials provided through NYCAMH. With ongoing threats to National Institute of Occupational

Safety and Health funding, it is possible that these services could be terminated in the future, therefore, increasing the expense to farms for safety upgrades, trainings, and materials. If farmers had to pay for these services and materials, fewer likely would have participated in the trainings, resulting in a lower level of deterrence from the threat of OSHA inspection, higher penalties paid by farms, and higher levels of injury.

While citing particular OSHA standards has been shown to reduce injury types specifically related to those hazards [Mendeloff and Gray, 2005], some OSHA LEP regulations may need to be clarified or better specified in order to reduce injury due to agricultural hazards. The most often cited problematic regulation pertains to bunker silo hazards. There are no specific regulations for fall prevention while working on a full bunker silo, but there are best practice guidelines which include various forms of added railings or hitch points. Most bunker designs do not include these features and to add them would be an additional expense to the farms. While OSHA recommended adding railings to bunker silos, none of the farms surveyed had made this change. It is possible that this lack of action may be attributable to not knowing what is acceptable to avoid a penalty. If OSHA regulations were clear on what they deemed to be a safety violation, it would then be clear what type of safety design to invest in. A workable engineering solution for preventing these fall hazards is still needed.

This sort of confusion over standards may have led to farmer concerns about the efficiency, utility, and timeliness of OSHA inspections, as well as the presumed lack of knowledge of agricultural operations. It may be for this reason that only 25% of farmers surveyed felt that OSHA should be conducting inspections of dairy farms.

In addition to the costs considered in this study, inspections may negatively affect the value of production on inspected farms. Many farming activities are highly time and weather sensitive, such as plowing, haying, and harvest, where even a day's delay can significantly decrease the value of a crop if it is not planted on time, does not have time to dry after cutting, or the quality is otherwise affected. Such negative effects are more likely in the late spring, summer months, and into fall when most time and weather sensitive activities occur. The potential for such costs associated with OSHA inspections could be reduced if the inspections were timed in the off season.

Limitations

This study is limited by a small sample size because, to date, OSHA has only randomly inspected eight NY farms in the first year of the LEP. This study includes four of these farms (50%). The four randomly inspected farms were larger than the uninspected farms surveyed, thus comparability may be questioned. The small sample size also limits generalization; yet, it does reflect half of the farms that have been inspected, and thus, in fact, provides a perspective on the very first cohort of inspected farms. Conducting this survey was time consuming and often required several contacts in order to reach someone and interview the individual who knew the most about costs. Another potential limitation is that while all farms included in this study actively prepared in some way for OSHA inspection, the majority (68%) of farms surveyed utilized NYCAMH services. Thus only select farmers were included in this study. Lastly the perspectives of farm workers were not included but should be in future studies.

CONCLUSION

The overall impact of OSHA LEP on farms was positive leading to physical changes on the farm and worker trainings, although the farmers' perspectives about OSHA inspection were mixed. The cost of compliance appears to be a small proportion of production costs. Clarifications and engineering solutions are needed to make specific OSHA safety concerns more applicable to dairy farms.

AUTHORS' CONTRIBUTIONS

Anne M. Gadomski conceptualized the project and co-directed its implementation, obtained IRB approval, coordinated and critically reviewed all analyses, drafted the initial manuscript, and approved the final manuscript as submitted. Marybeth Vargha conceptualized the project and co-directed its implementation, supervised the survey, performed the analysis, and constructed the tables. She critically reviewed and revised the manuscript, and approved the final manuscript as submitted. Nancy Tallman participated in study design and interpretation of results. She critically reviewed and revised the manuscript and approved the final manuscript as submitted. Melissa B. Scribani participated in study design, performed analysis, and interpreted results. She critically reviewed and revised the manuscript and approved the final manuscript as submitted. Timothy Kelsey provided economic consultation, performed a portion of the analysis, critically reviewed and revised the manuscript, and approved the final manuscript as submitted.

ACKNOWLEDGMENTS

Funding for this study was provided by the National Institute for Occupational Safety and Health (2U54OH007542) through the Northeast Center for Occupational Health and Safety: Agriculture, Forestry and

Fishing. The contents of this manuscript are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH.

Ethics Review and Approval: Institutional Review Board (IRB) of the Mary Imogene Bassett Hospital approved this study via expedited review on 12/9/14. A waiver of written informed consent was granted. Participants provided verbal consent at the time of the interview.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article at the publisher's web-site.

Disclosure statement: Authors declare that they do not have any competing interests/conflicts of interest.

Institution at which the work was performed: New York Center for Agricultural Medicine and Health and Bassett Research Institute.