Comparing Written Programs and Self-Reported Respiratory Protection Practices in Acute Care Hospitals

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INTRODUCTION

Following a study of respiratory protection programs and practices in California acute care hospitals during the 2009 novel H1N1 influenza outbreak (Respirator Evaluation in Acute Care California Hospitals - REACH I), (1) the National Institute for Occupational Safety and Health (NIOSH) supported a similar nationwide assessment of hospitals’ prevention practices for aerosol-transmissible diseases. The Respirator Evaluation in Acute Care Hospitals (REACH II) study was conducted in six states in 2010 and 2011. The overarching goals of REACH II were to 1) describe the extent to which hospitals in the United States had implemented respiratory protection programs for influenza and other aerosol-transmissible diseases, and 2) determine health care workers’ use of respiratory protection for infectious aerosol exposures in representative hospitals.

Results of interviews and program reviews in hospitals in two of these states (15 in Minnesota and 13 in Illinois) have been described by Brosseau et al. (2) Briefly, a total of 363 health care workers and 171 hospital and unit managers representing the highest risk departments (emergency, intensive care, medical/surgery) were interviewed about respiratory program policies and practices. Written programs from each hospital were evaluated for required elements (3) and respirator donning and doffing was observed with 77 health care workers.

The OSHA Respiratory Protection Standard regulates the provision and use of respirators in all U.S. workplaces to protect employees from “harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors.” (4) An employer is required to address 11 key elements that include a written program and policy, designated program administrator, risk assessment and corresponding respirator selection, regular medical evaluation, annual fit-testing, annual training, communication, maintenance and use procedures, recordkeeping, program evaluation, and ensuring respirator availability. (3)

The most serious written program deficiency was the lack of a program administrator in almost all hospitals. Most programs also did not adequately describe medical evaluation, fit-testing, and training; however, respondents indicated receiving these at appropriate intervals. Most health care workers did not have an adequate method for identifying their fit-tested respirator model and size. However, every observed health care worker was able to easily obtain a respirator when asked to demonstrate proper wear (correct model and size were not assessed). In most cases, health care workers were able to properly don and doff the respirator; the most frequent failures...
involved correct strap placement, user seal check performance, and using straps for removal.

In health care settings, respiratory protection plays an important role in preventing the transmission of infectious diseases that are spread by droplet or airborne routes of exposure.\(^5\) Because exposure guidelines and sampling methods are lacking for most infectious diseases, hospitals must rely on published guidelines for selecting the correct respirator for a particular organism. Most relevant to acute care hospitals are guidelines from the Centers for Disease Control and Prevention (CDC) and recommendations from the Health Care Infection Control Practices Advisory Committee (HICPAC).\(^6\)

The California Occupational Safety and Health Administration (Cal OSHA) has incorporated all of these into a single set of respirator and exposure control recommendations for a wide range of infectious organisms in its Aerosol Transmissible Disease Standard.\(^7\)

To examine further the relationship between the written programs and self-reported practices in participating hospitals, we developed a method for scoring each written respiratory protection program for the 11 required program elements. As well, respirator practices scores were developed for each hospital using selected interview responses from managers and health care workers. Program and practices scores were compared among hospitals, between states, and by employee group. We hypothesized that well-written respiratory protection programs meeting most of the OSHA criteria would be associated with a higher fraction of positive interview responses about respirator policies and practices.

**METHODS**

**Data Collection**

Interview and observation tools from the REACH I study were used as a starting point for REACH II instrument design, following a collaborative process involving personnel from the six participating states and NIOSH.\(^1\) Changes to the REACH I interviews included matching interview questions across the three employment categories (department managers, unit managers, and health care workers), expanding the focus from influenza to all types of aerosol-transmissible diseases, and revising the respirator donning and doffing observation tool. Minor changes were made in organization, skip patterns, wording, and response categories. More detailed information about the interview and observation tools can be found in Brosseau et al.\(^2\)

The sampling frame is described in detail in Brosseau et al.\(^3\) Briefly, participating hospitals, selected using random and convenience sampling, included 15 in Minnesota and 13 in Illinois. These were generally representative of all acute care hospitals in each state with more large urban and fewer small rural hospitals than expected.

At each hospital we obtained a copy of the written respiratory protection program and conducted interviews with three hospital managers (directors of infection control, nursing, and employee health), managers of three units most likely to require respirators for aerosol-transmissible diseases (intensive care (adult or pediatric), emergency, and medical/surgical), and five health care workers most likely to require respirators from each of these three units (for a total of 15 health care workers). Our sample included 43 hospital managers, 47 unit managers, and 183 health care workers from Minnesota hospitals and 46 hospital managers, 35 unit managers, and 180 health care workers in Illinois. The most common were nurses (57%), nursing assistants (11%), and physicians, technicians, respiratory therapists, receptionists, and environmental services (~5% each). More details about the interview instruments can be found elsewhere.\(^2\)

**Demographic Data Coding**

To combine hospitals from both states into a single data set, demographic data for Illinois hospitals were re-coded based on the median bed number in Minnesota (small < 90.5 beds; large > = 90.5 beds), which resulted in 1 small and 12 large hospitals. The Minnesota sample had 7 small and 8 large hospitals. Hospitals were also sorted on location (rural vs. urban). Some demographic information for interview participants was also re-coded dichotomously: job type (nurse vs. non-nurse) and union status (in a union vs. not in a union).

**Scoring Written Programs**

An instrument was developed to consistendly score written respiratory protection programs for each of the 11 OSHA respiratory protection program elements (the full instrument is available as an online supplementary file):

1. Written Program
2. Program Administrator
3. Risk Assessment and Respirator Selection
4. Medical Evaluation
5. Communication (how hospitals convey information about selection and use of respirators)
6. Fit-testing
7. Training
8. Respirator Maintenance and Use
9. Recordkeeping
10. Program Evaluation
11. Respirator Availability.

Each element received 2 points if completely met, 1 point if partially met, and 0 points if not met or missing, for a maximum total of 22 points. For example, for a written program to receive the full 2 points for the element “fit-testing” it should include written procedures that ensure annual fit-testing. Specifically, each of following items should be addressed:

1. The fit-test method should be described and appropriate for the selected respirator(s).
   a. Describe the use of qualitative fit-test methods (e.g., Bitrex or saccharin) for respirators with assigned protection factors of 10 or less
   b. Describe the use of quantitative fit-test methods (e.g., controlled negative pressure or ambient...
particle concentration) for all other types of respirators (at a minimum)
c. Mention the OSHA protocol (Appendix C of the OSHA regulation) and include a complete list of fit-test exercises.

2. The program must indicate when a fit-test is required, which must include (at a minimum):
   a. Prior to initial use
   b. At least annually thereafter
   c. If specific changes have occurred (e.g., weight gain, facial scarring, or cosmetic surgery)
   d. Whenever an employee reports that the respirator is unacceptable for whatever reason.

A program would receive a score of 2 if all of these aspects were described in the written program, a 1 if one or more aspects were missing, and a 0 if no fit-testing policies or practices were addressed.

We also developed a model program that addressed all of the criteria necessary for a perfect score, as well as advice to hospitals for implementing a successful respiratory protection program (provided as an online supplementary file).

Scoring Respirator Practices

To obtain a score for self-reported respirator practices, we selected 20 questions from the hospital manager interview relevant to each respirator program element that could be scored dichotomously (true or false). Where possible, matching questions were selected from the unit manager (18 questions) and health care worker (14 questions) interviews. No questions were available on any of these interviews for four program elements: program administrator, communication, maintenance and use, and recordkeeping. Questions were scored as yes (1) = met OSHA standard or CDC guideline requirements or no (0) = did not meet OSHA or CDC requirements. A complete list of questions and correct answers is shown in Table I.

A practice score for each program element was determined by dividing the number of correct answers for that element’s questions by the total number of respondents (Table I). The number of people answering a specific question may not match the number of people interviewed, if a respondent failed to answer a particular question. A question was left unanswered if an employee did not feel capable to respond. A survey question might also be left unanswered if an employee did not have enough time to complete the interview.

Data Analysis

Data were analyzed using SAS version 9.2 (SAS Institute Inc., Cary, NC). Comparisons of means were performed using a student’s t-test. Analysis of variance was used to explore the impact of fixed demographic variables (hospital size (large vs. small), location (rural vs. urban), job type (nurse vs. non-nurse), and union status (in a union vs. not in a union)) on health care worker interview response scores with random variables including state and hospital. Lastly, a comparison was performed to identify any correlation between a hospital’s written respiratory protection program score and the average interview score for a hospital across all employee groups (managers and health care workers).

RESULTS

Written Respiratory Protection Program Evaluation

No written respiratory protection program had all required program elements (Table II). Written program scores ranged from 2–17 out of a possible 22. The average score for Minnesota hospitals was 10.3 (CI: 8.1–12.3) and did not differ significantly from the average Illinois hospital program score of 7.9 (CI: 5.1–10.7) (p = 0.16) (Table III).

Most commonly, hospitals were missing two program elements: communication and program administrator. Seven (47%) Minnesota and eight (62%) Illinois hospitals did not describe how respirator information was conveyed to employees; only two Minnesota hospital programs received full credit for this element. Ten (67%) Minnesota and nine (69%) Illinois programs did not indicate a designated program administrator; only three hospitals (two in Minnesota and one in Illinois) received a full score.

Interview Response Evaluation

Overall, hospital managers were more similar to unit managers in their responses, and both answered correctly (compared to the OSHA standard) significantly more often than health care workers (p < 0.001). For eight program elements, managers more often identified the correct response than health care workers (Table IV). Most respondents (> 82%) answered correctly the questions about medical evaluation, fit-testing and respirator availability, with no differences among employee groups.

Managers were more likely than health care workers to indicate their hospital had a written program and conducted program evaluations (p < 0.001). Hospital managers were more likely than health care workers to say their hospital had conducted a risk assessment (p = 0.006), while unit managers were not significantly different from either group. Unit managers were significantly more likely than health care workers to indicate training met OSHA guidelines (p = 0.024), while hospital managers were not significantly different from either group.

The average overall interview score in Minnesota was significantly lower than in Illinois (p < 0.001) (Table V). Further examination indicates that this is entirely due to differences in health care worker responses between the two states. Minnesota health care worker interview scores were significantly lower than those in Illinois (p < 0.001). When examining interview responses for each program element (data not shown), Illinois health care workers answered correctly significantly more often than those in Minnesota for all program elements except written program.
### TABLE I. Interview Questions Used in Scoring Process by Element and Interview Type

| Program Element, Questions, Responses (underline = correct) | HM | UM | HCW |
|-------------------------------------------------------------|----|----|-----|
| **Written Respiratory Protection Program**                  |    |    |     |
| Does your facility have a written Respiratory Protection Program? | x  | x  | x   |
| _Yes, No, Don’t know_                                       |    |    |     |
| **Respirator Selection**                                    |    |    |     |
| 1. Which guidelines are used to determine which infectious disease exposures require respiratory protection? | x  | x  |     |
| **CDC recommendations, OSHA recommendations, State department of health recommendations, Other (specify), Don’t know** | x  | x  |     |
| 2. Does your facility conduct a risk assessment to determine which employees should be included in the respiratory protection program? | x  | x  |     |
| _Yes, No, Don’t know_                                       |    |    |     |
| 3. What is the minimum level of respiratory protection employees are required to use when in close contact with a patient who has a suspected or confirmed infectious disease requiring airborne precautions (such as tuberculosis)? | x  | x  | x   |
| None, Surgical Mask, N95 filtering facepiece (disposable respirator, Elastomeric half-face N95 respirator, Powered Air Purifying Respirator (PAPR), Other (specify), Don’t know | x  | x  |     |
| 4. What is the minimum level of respiratory protection employees are required to use when performing aerosol-generating procedures with a patient who has a suspected or confirmed infectious disease requiring airborne precautions (such as tuberculosis)? | x  | x  | x   |
| None, Surgical Mask, N95 filtering facepiece (disposable respirator, Elastomeric half-face N95 respirator, Powered Air Purifying Respirator (PAPR), Other (specify), Don’t know | x  | x  |     |
| 5. What is the minimum level of respiratory protection employees are required to use when in close contact with a patient who has seasonal influenza? | x  | x  | x   |
| None, Surgical Mask, N95 filtering facepiece (disposable respirator, Elastomeric half-face N95 respirator, Powered Air Purifying Respirator (PAPR), Other (specify), Don’t know | x  | x  |     |
| 6. What is the minimum level of respiratory protection employees are required to use when performing aerosol-generating procedures with a patient who has seasonal influenza? | x  | x  | x   |
| None, Surgical Mask, N95 filtering facepiece (disposable respirator, Elastomeric half-face N95 respirator, Powered Air Purifying Respirator (PAPR), Other (specify), Don’t know | x  | x  |     |
7. What is the minimum level of respiratory protection employees are required to use when in **close contact** with a patient who has a suspected or confirmed infectious disease requiring **droplet precautions** (for example, pertussis)?

None, Surgical Mask, N95 filtering facepiece (disposable respirator, Elastomeric half-face N95 respirator, Powered Air Purifying Respirator (PAPR), Other (specify), Don’t know

8. What is the minimum level of respiratory protection employees are required to use when performing **aerosol-generating procedures** with a patient who has a suspected or confirmed infectious disease requiring **droplet precautions** (for example, pertussis)?

None, Surgical Mask, N95 filtering facepiece (disposable respirator, Elastomeric half-face N95 respirator, Powered Air Purifying Respirator (PAPR), Other (specify), Don’t know

### Medical Evaluation

| Question                                                                 | None | Surgical Mask | N95 filtering facepiece (disposable respirator, Elastomeric half-face N95 respirator, Powered Air Purifying Respirator (PAPR), Other (specify), Don’t know |
|--------------------------------------------------------------------------|------|---------------|--------------------------------------------------|
| 1. Did you receive medical evaluation and clearance before wearing a respirator? | x    | x             | x                                                  |
| Yes, No, Don’t know                                                      |      |               |                                                  |
| 2. How frequently are you medically evaluated?                           | x    | x             | x                                                  |
| Once at hire only, Once at hire, and then annually; Once at hire, then as required by a physician; No requirements, Other (specify), Don’t know |      |               |                                                  |
| Annually, Just in time, More than annually                              |      |               |                                                  |

### Fit-testing

| Question                                                                 | None | Surgical Mask | N95 filtering facepiece (disposable respirator, Elastomeric half-face N95 respirator, Powered Air Purifying Respirator (PAPR), Other (specify), Don’t know |
|--------------------------------------------------------------------------|------|---------------|--------------------------------------------------|
| 1. What happens if an employee cannot be successfully fit-tested?        | x    |               |                                                  |
| They are put into a Powered Air Purifying respirator, They are reassigned to a lower risk job classification, Other (specify), Don’t know, I haven’t been fit-tested, Given another mask |      |               |                                                  |
| 2. Do employees receive fit-testing before being allowed to wear a respirator? | x    |               |                                                  |
| Yes, No, Don’t know                                                      |      |               |                                                  |
| 3. How often do employees receive fit-testing?                           | x    |               |                                                  |
| Once at hire only, Once at hire, and then annually; Once at hire, then as required by a physician; No requirements, Other (specify), Don’t know, Annually, Just in time, Biannually, More than annually |      |               |                                                  |

*(Continued on next page)*
### TABLE I. Interview Questions Used in Scoring Process by Element and Interview Type (Continued)

| Program Element, Questions, Responses (underline = correct)                                                                 | HM | UM | HCW |
|----------------------------------------------------------------------------------------------------------------------------|----|----|-----|
| **Training**                                                                                                                 |    |    |     |
| 1. How often are employees required to attend respirator training?                                                           | x  | x  | x   |
| Once at hire only, Once at hire, and then annually; Once at hire, then as required by a physician; No requirements, Other (specify), Don’t know, Annually, Just in time, More than annually |    |    |     |
| **Program Evaluation**                                                                                                        |    |    |     |
| 1. Are health care workers formally asked to provide input on respiratory protection policy decisions?                         | x  | x  | x   |
| Yes, No, Don’t know                                                                                                           |    |    |     |
| 2. Are unit managers formally asked to provide input on respiratory protection policy decisions?                                | x  | x  |     |
| Yes, No, Don’t know                                                                                                           |    |    |     |
| 3. Does your facility have a formal mechanism or method to evaluate the effectiveness of the respiratory protection program? | x  |    |     |
| Yes, No, Don’t know                                                                                                           |    |    |     |
| **Availability**                                                                                                              |    |    |     |
| 1. Are respirators located close to the point of use (i.e., rooms with suspected or confirmed seasonal influenza or patients on airborne precautions)? | x  | x  | x   |
| Yes, No, Don’t know                                                                                                           |    |    |     |
| 2. Does your facility have Powered Air Purifying Respirators available when employees need them?                               | x  | x  | X   |
| Yes, No, Don’t know                                                                                                           |    |    |     |

^Answers scored as correct are underlined.
TABLE II. Written Program Scores by Hospital and Program Element

|            | MINNESOTA |            | ILLINOIS |            |
|------------|-----------|------------|----------|------------|
|            | 1 2 3 4 5| 6 7 8 9 10| 11 12 13| 14 15      |
| WP         | 2 0 0 2 0| 2 0 0 0 0| 2 1 1 1 1| 2 1 2 2 1|
| PA         | 2 0 0 0 0| 0 1 2 0 0| 1 2 2 1 1| 2 2 2 1 2|
| R          | 2 1 1 1 1| 1 2 2 1 1| 2 2 2 1 2| 1 1 2 2 1|
| C          | 2 0 0 1 1| 1 0 1 1 0| 2 1 1 1 0| 0 0 1 1 0|
| ME         | 2 0 1 1 0| 1 1 2 1 1| 1 1 1 2 1| 1 1 1 2 1|
| FT         | 1 1 1 1 2| 1 1 1 1 0| 1 2 2 1 0| 1 2 2 1 1|
| M          | 2 2 2 2 1| 1 2 2 1 1| 2 2 2 1 1| 0 1 2 2 1|
| T          | 0 1 1 1 0| 1 1 1 1 0| 1 1 1 1 0| 2 0 2 1 1|
| PE         | 1 0 1 0 1| 1 0 2 1 2| 1 1 1 1 2| 1 1 2 1 1|
| Re         | 1 0 0 | 0 0 0 1 2| 1 2 2 0 1| 0 1 2 0 1|
| A          | 1 1 1 2 0| 1 1 1 0 1| 1 1 1 1 1| 2 2 0 1 0|
| Score      | 15 7 7 11| 9 5 12 12| 9 13 13 5| 14 9 12 16|

A WP - Written Program; PA - Program Administrator; R - Risk Assessment/Respirator Selection; C - Communication; ME - Medical Evaluation; FT - Fit-testing; M - Maintenance and Use; T - Training; PE - Program Evaluation; Re - Recordkeeping; A - Availability.

The mixed effects model showed that overall interview scores differed significantly by job title, with nurses scoring significantly higher than non-nurses (p < 0.001). Union status, hospital size (large vs. small), and hospital location (rural vs. urban) were not important factors.

We found no correlation between overall written program scores and overall interview responses scores by hospital (r = -0.086) (Figure 1).

Discussion

In general, hospitals’ written programs did not provide adequate details for most of the respiratory protection program elements while the overall interview scores demonstrated that hospitals were generally following regulatory guidelines. Hospitals with the better written programs did not always have the better survey responses and vice versa. This is most likely due to the lack of a program administrator in most hospital programs. Programs without a designated administrator were most often missing a comprehensive risk assessment and ongoing program evaluation.

Other investigators have found similar results in different workplace settings. In a study of respiratory protection programs in 20 small UK industrial sites, Bell et al. found that fewer than half of sites had considered respiratory risks. (8) Graveling et al. found that the most important factors in a successful respiratory protection program are organizational and management support. (9) Key to these is a program administrator who serves as a single centralized person charged with managing the entirety of the respiratory protection program. Having a trained program administrator has been shown to ensure a comprehensive detailed written respiratory protection program. (10) This is a common problem with many

TABLE III. Summary of Written Program Scores by Element and Two-Sample t-Test

|            | WP | PA | R  | C  | ME | FT | M  | T  | PE | Re | A  | Score |
|------------|----|----|----|----|----|----|----|----|----|----|----|-------|
| Minnesota (N = 15) |    |    |    |    |    |    |    |    |    |    |    |       |
| Mean       | 1.2| 0.5| 1.4| 0.7| 0.9| 1.0| 1.6| 0.7| 0.9| 0.6| 0.8| 10.3 |
| (SD)       | 0.9| 0.7| 0.6| 0.7| 0.5| 0.7| 0.5| 0.5| 0.8| 0.7| 0.6|       |
| Illinois (N = 13) |    |    |    |    |    |    |    |    |    |    |    |       |
| Mean       | 1.2| 0.4| 0.9| 0.4| 0.6| 1.0| 0.8| 0.7| 0.8| 0.8| 0.5| 7.9  |
| (SD)       | 0.8| 0.7| 0.8| 0.5| 0.4| 0.7| 0.8| 0.7| 0.7| 0.8|       |
| Both States Combined (N = 28) |    |    |    |    |    |    |    |    |    |    |    |       |
| Mean       | 1.2| 0.4| 1.2| 0.5| 0.8| 1.0| 1.2| 0.7| 0.9| 0.7| 0.6| 9.2  |
| (SD)       | 0.9| 0.7| 0.7| 0.6| 0.5| 0.5| 0.7| 0.6| 0.8| 0.7| 0.7|       |
| p-value    | 0.89| 0.76| 0.09| 0.24| 0.21| 1.00| 0.00| 0.86| 0.57| 0.55| 0.21| 0.16 |

A WP - Written Program; PA - Program Administrator; R - Risk Assessment/Respirator Selection; C - Communication; ME - Medical Evaluation; FT - Fit-testing; M - Maintenance and Use; T - Training; PE - Program Evaluation; Re - Recordkeeping; A - Availability.
respiratory protection programs. In a 2001 survey of nearly 300,000 private sector establishments, Doney et al. found that 14% of respiratory protection programs did not identify a single program administrator. In those organizations with a program administrator, 42% had not received appropriate training.\(^{(10)}\)

In the model respiratory protection program developed for acute care hospitals we included a description of a program administrator’s responsibilities (see online supplemental file), which include ensuring that:

- A risk assessment is conducted; that the work areas, processes, or tasks requiring respiratory protection are identified; and that appropriate respiratory protection devices are selected for those work areas, processes, or tasks
- The program is fully implemented in all appropriate departments and units
- Employees receive medical surveillance, fit-testing, and training at the time of hire and at appropriate intervals thereafter
- Adequate records are maintained
- Medical evaluation is performed by a physician or other licensed health care professional
- Information regarding medical clearance, fit-testing, and training is communicated to all appropriate departments, managers, and employees
- Only NIOSH-certified respirators are used in accordance with their certification
- Respirators are properly stored and maintained
- The program is evaluated periodically and updated as needed.

There continue to be uncertainty and disagreement about which infectious disease hazards require respiratory protection in health care settings. This may explain the lack of clarity in hospital programs about infectious organisms other than tuberculosis. Graveling et al. found that when respiratory hazards are not recognized or risks are not readily apparent, management support of respiratory protection is often lacking.\(^{(9)}\) With the exception of California, there are no OSHA regulatory requirements specific to respiratory infectious disease exposures. Hospitals have some choice about which CDC and other guidelines to follow, depending on local, state, and hospital accreditation requirements.

In many of the written programs we reviewed, hospitals had not undertaken a formal risk assessment. We expected to find a detailed list of infectious organisms, descriptions of jobs and tasks where exposures might occur, and identification of the specific respirator required for each exposure accompanied by a clear explanation for each selection. We also expected hospitals to select higher levels of respiratory protection for patients and health care workers.

### TABLE IV. Interview Scores by Employment Group for All Hospitals (MN and IL Combined)

|                          | Hospital Managers (N = 88) | Unit Managers (N = 82) | Health care Workers (N = 362) | p-value |
|--------------------------|----------------------------|------------------------|-------------------------------|---------|
| Written Program          | 96%                        | 96%                    | 82%                           | HM = UM > HCW < 0.001 |
| Respirator Selection    | 83%                        | 77%                    | 75%                           | HM > HCW 0.006 |
| Medical Evaluation       | 85%                        | 88%                    | 82%                           | 0.487   |
| Fit-testing              | 92%                        | 91%                    | 87%                           | 0.410   |
| Training                 | 85%                        | 88%                    | 82%                           | UM > HCW 0.024 |
| Program Evaluation       | 41%                        | 39%                    | 16%                           | HM = UM > HCW < 0.001 |
| Availability             | 95%                        | 89%                    | 86%                           | 0.057   |
| Overall Score            | 82%                        | 81%                    | 71%                           | HM = UM > HCW < 0.001 |

### TABLE V. Average Interview Response Score by Employment Group and State

| Site                       | N    | Mean (%) | 95% CI | p-value   |
|----------------------------|------|----------|--------|-----------|
| MN All Respondents         | 267  | 70.5     | 68.1   | 73.0      | <.0001    |
| IL All Respondents         | 255  | 79.9     | 78.3   | 81.6      | 0.3       |
| MN Hospital Managers       | 42   | 82.8     | 78.7   | 86.9      | 0.3       |
| IL Hospital Managers       | 46   | 85.5     | 82.1   | 88.9      | 0.3       |
| MN Unit Managers           | 47   | 79.2     | 75.0   | 83.3      | 0.3       |
| IL Unit Managers           | 35   | 82.1     | 78.4   | 85.8      | < 0.0001  |
| MN Health Care Workers     | 178  | 65.4     | 62.2   | 68.5      | 0.3       |
| IL Health Care Workers     | 174  | 78.0     | 75.9   | 80.0      | < 0.0001  |
higher exposures (e.g., aerosol-generating procedures such as intubation or bronchoscopy).

While five of the 28 written programs did not describe any risk assessment/respirator selection strategy, of the 23 that did about half (11) were primarily focused on tuberculosis. Written programs that received a full score of 2 for the risk assessment/respirator selection program element most often mentioned varicella, SARS, and pandemic influenza in addition to tuberculosis. No program addressed the full range of infectious diseases for which the California OSHA Aerosol Transmissible Disease standard and the CDC/HICPAC guidelines currently require the use of a respirator:

- Aerosolizable spore-containing powder, e.g., Anthrax
- Avian influenza
- Varicella disease (chickenpox, shingles)
- Measles (rubeola)
- Monkeypox
- Novel or unknown pathogens
- Severe acute respiratory syndrome (SARS)
- Smallpox (variola)
- Tuberculosis (TB).

One-third (10 of 28) of written programs did not discuss how the program would be periodically evaluated. Only 40% of hospital managers and 16% of health care workers said their hospital conducted periodic evaluation of the respiratory protection. Again, having a trained designated program administrator would ensure that evaluation takes place on a regular basis and that the program is updated based on the results. A well-conducted program evaluation would include:

- Reviewing the risk assessment to ensure all potentially exposed employees are included in the program and use the proper level of respiratory protection
- Consulting with employees who use respirators and their supervisors
- Random and periodic observations of employee respiratory protection practices, availability, signage, and training content and delivery
- A review of records (training, medical evaluation, and fit-testing) to ensure they are properly maintained and that information is being communicated appropriately.

In contrast to the written program scores, interview scores indicated that respirator practices often met OSHA regulatory requirements for medical surveillance, fit-testing, and training, although managers consistently scored higher than health care workers. Thus, it appears that hospital and unit managers are aware of and following the OSHA respiratory protection regulation, even if the hospital’s program does not adequately reflect this. Again, the lack of a single centralized program administrator may explain this finding.

LIMITATIONS

Several limitations should be noted. The interview questions were not developed with the intention of scoring a hospital’s program; thus, many questions did not have a single right or wrong answer. Recruitment was a significant hurdle in both states and random sampling proved difficult to sustain. In Illinois a convenience sample resulted in a greater fraction of large urban hospitals than expected. Initial data analysis plans did not include a comparison of hospital programs with interview responses. This resulted in an uneven distribution of interview questions with some program elements having no relevant questions.

Our data collection procedures allowed respondents to review the questionnaire during the interview, which may have led to social desirability bias, i.e., selection of the “right” rather than the most representative response.

Lastly, program scoring was originally developed for the purposes of reporting results to each hospital. A better approach might have been to divide each program element into a series of yes/no questions (as is outlined in the evaluation tool) and score each element as a percentage of correct out of total questions. We did not undertake this type of scoring, however, because it is unlikely that it would change the outcome for a comparison of program and interview scores.

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**SUPPLEMENTAL MATERIAL**

Supplemental data for this article can be accessed at tandfonline.com/uoeh. AIHA and ACGIH members may also access supplementary material at http://oeh.tandfonline.com/.

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