

Medical Fitness Evaluation for Respirator Users: Results of a National Survey of Private Sector Employers

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Objective: To provide information on medical evaluation procedures for respirator use in private sector establishments. **Methods:** In 2001, data on respirator use and practices were collected in a survey of private sector establishments. **Results:** Of establishments where respirators were required, 46% did not evaluate employees' medical fitness. Evaluations for fitness increased with establishment size, ranging from 35% in small establishments (1–10 workers) to 95% in large establishments (≥ 1000 workers). Questionnaire with a follow-up examination, as needed, was the most common method of evaluating medical fitness (48%). **Conclusions:** Results suggest that about half of all private sector establishments where respirators are required do not comply with Occupational Safety and Health Administration requirements for medical fitness evaluations. Improved awareness among employers and workers and identification of methods to increase medical evaluation practices, especially among smaller establishments, is needed. (J Occup Environ Med. 2007;49:691–699)

Proper use of respirators can reduce the inhalation of harmful airborne substances and thus reduce or prevent health risks to workers. However, the use of respirators can be physically demanding, especially when they are bulky and heavy (eg, self-contained breathing apparatus [SCBA]), when used in extreme temperature, or if they restrict workers' vision. Adverse health effects associated with respirator use may be greater in individuals with existing respiratory, cardiovascular, psychological, or other medical conditions. Thus, it is important to evaluate medical fitness for respirator use based on an understanding of workplace environmental factors, physical demands of the job, respirator characteristics, and health conditions of the individual.^{1–4} A medical evaluation should be performed before respirator fit testing and before the user is assigned to a task requiring use of a respirator. In this way, workers who cannot safely and effectively use respirators can be identified before being placed in hazardous situations. Medical evaluation methods range in complexity from a self-administered questionnaire to a physician interview and examination, which might include spirometry and possibly even exercise testing.⁵

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The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

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DOI: 10.1097/JOM.0b013e318076b7d1

The Occupational Safety and Health Administration (OSHA) mandates, and the American National Standards Institute (ANSI) recommends, that workers required to wear respirators receive a medical clearance prior to fit testing for respirator

use.^{6,7} In metal/nonmetal mines, the Mine Safety and Health Administration (MSHA) requires the operator to establish a respiratory protection program consistent with the ANSI recommendations when the use of personal respiratory protection is required.^{8,9} In coal mines, the MSHA requires that approved respiratory protection must be made available by employers to all affected underground coal miners (though it is not required to be worn).¹⁰ Details regarding OSHA and MSHA regulations for respirator use are available elsewhere.^{6,8-12}

The revised OSHA respiratory protection standard, in effect since April 8, 1998, requires the employer (in any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required) to identify a physician or other licensed health care professional to perform the evaluation of employees using a self-administered screening questionnaire or an initial medical examination (which elicits the same information as the questionnaire) to determine the employees' ability to use a respirator. A follow-up medical examination is also required if a worker gives a positive response to any of the questions numbered 1 through 8 in section 2, part A of Appendix C (questionnaire) of the OSHA standard.⁶

The OSHA medical evaluation questionnaire includes questions regarding the worker's smoking status; medical conditions like diabetes, allergies, specific lung conditions (eg, asbestosis, emphysema, pneumonia, breathing problems); cardiac conditions; current medications; and any other problems (medical or physical) that interfered with previous use of a respirator. Employees must have a re-evaluation if they exhibit problems with wearing a respirator either during fit testing or in the workplace. OSHA regulations prohibit the assignment of a worker to a task requiring a respirator unless

the worker is physically able to perform the work while wearing a respirator.

This paper presents and discusses selected results from the *Survey of Respirator Use and Practices*, which was developed by the National Institute for Occupational Safety and Health (NIOSH) and the Bureau of Labor Statistics (BLS).¹³

Materials and Methods

Description of Survey

In August 2001, the BLS mailed a standardized survey questionnaire to 40,002 establishments selected from a sampling frame of 174,305 US private sector establishments used in the 1999 BLS *Survey of Occupational Injuries and Illnesses* (SOII).¹⁴ The survey sample included establishments from all parts of the US private sector, with the exception of self-employed individuals and farms with fewer than 11 employees. The final response rate of the survey was 76%.

Establishments were classified into industry categories based on the Standard Industrial Classification (SIC) manual published in 1987.¹⁵ The results of the survey are national estimates based on the survey weighting applied to a selected probability sample. Survey sample weights were assigned for estimating numbers of establishments and numbers of employees. Details of the questionnaire design (including cognitive interviews and field testing), estimating procedures, reliability of estimates, and non-sampling errors are described in *Respirator Usage in Private Sector Firms, 2001*.¹³

According to the instructions, the survey was to be completed by the person responsible for directing and overseeing the use of respirators in each sampled establishment. The survey included questions concerning respirator use and practices (eg, number of workers in each establishment using respirators for required purposes, types of respirators worn, agents the respirators were intended

to protect against, types of fit testing, existence and features of written respiratory protection programs, qualifications of respirator program administrators, and respirator labeling), and three questions that specifically addressed the characteristics of medical evaluation for fitness to wear respirators.¹³

Description of Results Presented in This Report

This report focuses on responses to the three BLS/NIOSH survey questions specifically concerned with medical evaluation of fitness for required respirator use:

1. Does your establishment assess your employees' medical fitness to wear respirators? (*Yes; No, our employees are not assessed; Don't know*).
2. Which method does your establishment use to assess your employees' medical fitness to wear respirators? (*[Check only ONE.] Questionnaire only; Questionnaire with follow-up examination, as needed; Physical examination only; Other; Don't know*).
3. Which of the following typically determine(s) your employees' medical fitness for respirator use? (*[Check ALL that apply.] Nurse(s) employed by contract, direct salary, or fee for service; Physician(s) employed by contract, direct salary, or fee for service; Individual employees' personal physicians; Contract occupational health service; Other; Don't know*).

For a *No* or *Don't know* response to the first of these three questions, the respondent was instructed to skip the remaining two questions.

For this report, we abstracted selected findings relating to medical evaluation of fitness for required respirator use from the report, *Respirator Usage in Private Sector Firms, 2001*.¹³ Additional analyses (not available from the published BLS/NIOSH report) were performed by the BLS by restricting the survey

TABLE 1

Estimated Number and Percent of Establishments With Required Respirator Use Indicating Whether Medical Evaluations Were Performed, by Industry Division¹³

| Industry Division | Yes, Evaluate Fitness | No, Do Not Evaluate Fitness | Don't Know If Evaluate Fitness | Number of Establishments With Required Respirator Use |
|-------------------------------------|-----------------------|-----------------------------|--------------------------------|---|
| Agriculture, forestry, and fishing | 3309 (25) [±205] | 7805 (59) [±470] | 2073 (16) [±434] | 13,186 [±404] |
| Mining | 2246 (64) [±61] | 1068 (31) [±3] | 150 (4) [±1] | 3493 [±45] |
| Construction | 24,142 (38) [±341] | 33,522 (52) [±426] | 4324 (7) [±823] | 64,172 [±417] |
| Manufacturing | 27,172 (56) [±53] | 18,315 (38) [±147] | 1457 (3) [±92] | 48,556 [±88] |
| Transportation and public utilities | 8984 (87) [±386] | 1366 (13) [±211] | — | 10,351 [±372] |
| Wholesale trade | 20,093 (64) [±449] | 10,662 (34) [±416] | 483 (2) [±60] | 31,238 [±431] |
| Retail trade | 4544 (27) [±191] | 11,440 (68) [±499] | 640 (4) [±22] | 16,948 [±396] |
| Finance, insurance, and real estate | 2777 (66) [±2082] | 1230 (29) [±191] | — | 4202 [±1412] |
| Services | 39,081 (44) [±1459] | 45,240 (50) [±857] | 4275 (5) [±411] | 89,629 [±1180] |
| All private industry | 132,346 (47) [±509] | 130,648 (46) [±499] | 13,598 (5) [±434] | 281,776 [±506] |

Data are number (%) [95% CI]. Number and percentages may not sum to totals due to rounding and or data exclusion of non-classifiable responses.

— Data did not meet BLS publication guidelines.

data¹⁶ to those establishments responding *Yes* to assessing their employees' medical fitness to wear respirators. In addition, we calculated 95% confidence intervals for survey estimates using a formula provided by the BLS.

Results

Survey-derived estimates are presented by industry division and establishment size for 1) establishments with required respirator use, 2) establishments with required respirator use providing (or not providing) medical evaluations, 3) methods used to evaluate medical fitness for required respirator use, and 4) providers used for medical fitness evaluations.

Establishments With Required Respirator Use

An estimated 3% (3,303,414 ± 6906) of all employees in private sector establishments used respirators for required purposes in the 12 months prior to completion of the survey.¹³ Of all private sector establishments in the United States, an estimated 5% (n = 281,776) used respirators for required (by federal

regulations or by the employer) purposes in the 12 months prior to the completion of the survey.¹³ Industry divisions with the highest percentages of establishments with required respirator use were manufacturing (13%); mining (12%); construction (10%); and agriculture, forestry, and fishing (9%).¹³

Establishments With Required Respirator Use Providing Medical Evaluations

Among establishments with required respirator use, the industry divisions with the highest percentages of establishments providing medical evaluation were transporta-

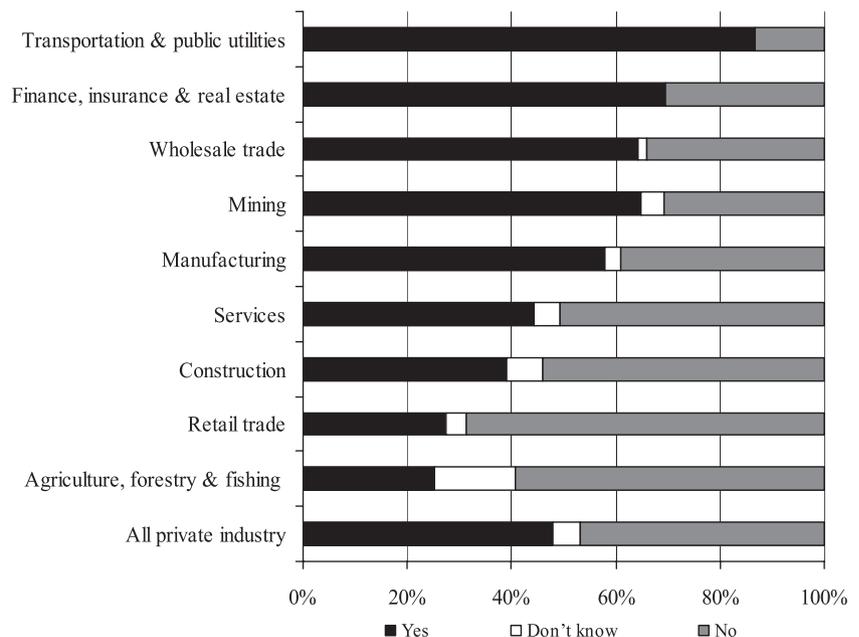


Fig. 1. Percent of establishments with required respirator use indicating whether medical evaluations were done, by industry division.¹³

TABLE 2

Estimated Number and Percent of Establishments With Required Respirator Use Indicating Whether Medical Evaluations Were Performed, by Employment Size Group

| Employment Size Group | Yes, Evaluate Fitness | No, Do Not Evaluate Fitness | Don't Know If Evaluate Fitness | Number of Establishments With Required Respirator Use |
|-----------------------|-----------------------|-----------------------------|--------------------------------|---|
| 1–10 | 42,580 (35) [±1920] | 67,389 (55) [±538] | 9094 (7) [±620] | 122,620 [±1106] |
| 11–49 | 33,551 (40) [±331] | 45,998 (55) [±517] | 3437 (4) [±233] | 83,716 [±427] |
| 50–249 | 29,203 (64) [±127] | 14,342 (32) [±381] | 927 (2) [±59] | 45,291 [±214] |
| 250–999 | 19,007 (87) [±215] | 2579 (12) [±234] | 85 (0.4) [±31] | 21,742 [±215] |
| ≥1000 | 8004 (95) [±171] | 339 (4) [±100] | — | 8406 [±169] |
| All private industry | 132,346 (47) [±509] | 130,648 (46) [±499] | 13,598 (5) [±434] | 281,776 [±506] |

Data are number (%) [95% CI]. Number and percentages may not sum to totals due to rounding and or data exclusion of non-classifiable responses.

— Data did not meet BLS publication guidelines.

tion and public utilities (87%); finance, insurance, and real estate (66%); wholesale trade (64%); and mining (64%). Agriculture, forestry, and fishing (16%) had the highest frequency of establishments with *Don't know* responses (Table 1 and Fig. 1).

The percent of respirator-using establishments that evaluated medical fitness generally increased as the size of the establishment increased, ranging from 35% of establishments employing 1 to 10 workers to 95% of establishments employing 1000 workers or more (Table 2 and Fig. 2).

Establishments With Required Respirator Use Not Providing Medical Evaluations

Nearly half (46%) of all establishments requiring respirator use did not evaluate employees' medical fitness to wear respirators (Table 1 and Fig. 1). Among establishments requiring respirator use, the highest percent of establishments with no medical evaluation of workers was in retail trade (68%), followed by agriculture, forestry, and fishing (59%), construction (52%), and services (50%) (Table 1 and Fig. 1). The percent of *Don't know* responses for medical evaluations of fitness for respirator use was inversely related to the size of establishments ranging from less than 1% in larger establishments to 7% in smaller establishments (Table 2 and Fig. 2).

Among the establishments requiring air-purifying respirators, a similar percentage (47%; $n = 126,152$; 95% CI = ± 500) did not undertake evaluations, whereas a much smaller percentage of establishments requiring air-supplied respirators (26%; $n = 12,383$; 95% CI = ± 245) did not undertake evaluations.¹³

Methods Used to Evaluate Medical Fitness for Required Respirator Use

Among all private sector establishments that required respirator use and provided medical fitness evaluations, the most commonly used eval-

uation methods were questionnaire with follow-up examination, as needed (48%) and physical examination only (31%) (Table 3). Questionnaire with follow-up examination, as needed was the most commonly used method of medical evaluation in each industry division except for services, where physical examination only was the most commonly used method (Table 3).

The method of evaluating medical fitness also varied by size of establishment. Among the smallest sized establishments (1–10 employees), the most commonly used method was physical examination only (46%), followed by questionnaire

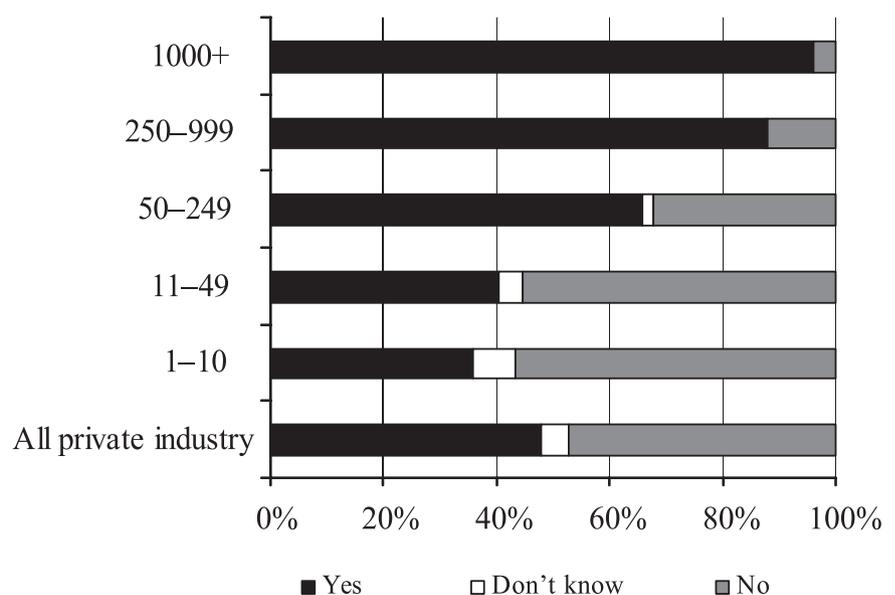


Fig. 2. Percent of establishments with required respirator use indicating whether medical evaluations were done, by employment size group.¹³

with follow-up examination, as needed (27%). Among all other employment size groups the most commonly used method was questionnaire with follow-up examination, as needed, followed by physical examination only. The percentage using the questionnaire with follow-up examination, as needed method trended upward with size of establishment, from 27% of establishments with 1 to 10 employees to 80% of establishments with 1000 or more employees (Table 4).

Providers Used for Medical Fitness Evaluations

Overall, physician(s) employed by contract, direct salary, or fee for service was the most commonly reported provider used to evaluate medical fitness (49% of all establishments with required respirator use). This was true for each industry division, except for the mining and wholesale trade divisions, where contract occupational health service was the most commonly used provider for medical fitness evalu-

ations (51% and 55%, respectively) (Table 5). In the smallest establishments (1–10 employees), individual employees' personal physician was a commonly used provider for evaluating medical fitness (30%) (Table 6).

Discussion

Respirators are used to prevent adverse health effects due to hazardous exposures, but problems can arise if respirators are not used appropriately, especially if the us-

TABLE 3

Estimated Number and Percent of Establishments With Required Respirator Use Evaluating Medical Fitness, by Method of Evaluation and Industry Division

| Industry Division | Methods of Evaluation | | | | | Establishments Evaluating Employees' Medical Fitness |
|-------------------------------------|------------------------------|---------------------|---------------------|--------------------|-----------------|--|
| | Questionnaire With Follow-Up | Physical Exam Only | Questionnaire Only | Other | Don't Know | |
| Agriculture, forestry, and fishing | 1141 (34) [±137] | 584 (18) [±271] | 746 (23) [±171] | 837 (25) [±297] | — | 3309 [±205] |
| Mining | 1203 (54) [±71] | 569 (25) [±72] | 168 (7) [±3] | 305 (14) [±26] | — | 2246 [±61] |
| Construction | 13,791 (50) [±320] | 6341 (26) [±383] | 1589 (7) [±382] | 1414 (6) [±227] | 1006 (4) [±685] | 24,142 [±341] |
| Manufacturing | 17,765 (65) [±51] | 5074 (19) [±45] | 916 (3) [±60] | 3259 (12) [±65] | 102 (0.4) [±52] | 27,172 [±53] |
| Transportation and public utilities | 4045 (45) [±158] | 3406 (38) [±882] | 400 (4) [±104] | 1132 (13) [±170] | — | 8984 [±386] |
| Wholesale trade | 12,446 (62) [±462] | 5663 (28) [±476] | 514 (3) [±35] | 1470 (7) [±393] | — | 20,093 [±449] |
| Retail trade | 2428 (53) [±164] | 1406 (31) [±256] | 456 (10) [±168] | 253 (6) [±23] | — | 4544 [±191] |
| Finance, insurance, and real estate | — | — | — | 161 (6) [±104] | — | 2777 [±2082] |
| Services | 7457 (19) [±239] | 17,476 (45) [±3475] | 9597 (25) [±2185] | 3853 (10) [±821] | 230 (1) [±71] | 39,081 [±1459] |
| All private industry | 62,893 (48) [±229] | 40,520 (31) [±944] | 14,388 (11) [±1219] | 12,683 (10) [±278] | 1339 (1) [±415] | 132,346 [±509] |

Data are number (%) [95% CI]. Number and percentages may not sum to totals due to rounding and or data exclusion of non-classifiable responses.

— Data did not meet BLS publication guidelines.

TABLE 4

Estimated Number and Percent of Establishments With Required Respirator Use Evaluating Medical Fitness, by Method of Evaluation and Employment Size Group

| Employment Size Group | Method of Evaluation | | | | | Establishments Evaluating Employees' Medical Fitness |
|-----------------------|------------------------------|---------------------|---------------------|--------------------|-----------------|--|
| | Questionnaire With Follow-Up | Physical Exam Only | Questionnaire Only | Other | Don't Know | |
| 1–10 | 11,511 (27) [±791] | 19,650 (46) [±3144] | 7474 (18) [±2707] | 2906 (7) [±378] | 1039 (2) [±660] | 42,580 [±1920] |
| 11–49 | 14,963 (45) [±230] | 10,252 (31) [±487] | 5013 (15) [±402] | 2745 (8) [±160] | — | 33,551 [±331] |
| 50–249 | 17,367 (59) [±126] | 6413 (22) [±144] | 1456 (5) [±97] | 3755 (13) [±110] | 213 (1) [±75] | 29,203 [±127] |
| 250–999 | 12,653 (67) [±151] | 3025 (16) [±228] | 306 (2) [±41] | 3000 (16) [±467] | 23 (0) [±10] | 19,007 [±215] |
| ≥1000 | 6400 (80) [±168] | 1180 (15) [±282] | 139 (2) [±53] | 277 (3) [±20] | — | 8004 [±171] |
| All private industry | 62,893 (48) [±229] | 40,520 (31) [±944] | 14,388 (11) [±1219] | 12,683 (10) [±278] | 1339 (1) [±415] | 132,346 [±509] |

Data are number (%) [95% CI]. Number and percentages may not sum to totals due to rounding and or data exclusion of non-classifiable responses.

— Data did not meet BLS publication guidelines.

TABLE 5
Number and Percent of Establishments Evaluating Medical Fitness for Required Respirator Use, by Industry Division and the Provider who Evaluated Medical Fitness

| Industry Division | Provider Used by Establishments | | | | | | Establishments Evaluating Employees' Medical Fitness |
|-------------------------------------|---|--------------------------------------|--|---|--------------------|-----------------|--|
| | Physician Employed by Contract, Direct Salary, or Fee for Service | Contract Occupational Health Service | Individual Physicians' Personal Physicians | Nurse Employed by Contract, Direct Salary, or Fee for Service | Other | Don't Know | |
| Agriculture, forestry, and fishing | 1174 (35) [±216] | 734 (22) [±156] | 643 (19) [±359] | — | 787 (24) [±125] | — | 3309 [±205] |
| Mining | 773 (34) [±42] | 1144 (51) [±73] | 116 (5) [±6] | 70 (3) [±3] | 297 (13) [±67] | — | 2246 [±61] |
| Construction | 12,681 (53) [±337] | 8913 (37) [±307] | 3764 (16) [±569] | 1974 (8) [±462] | 1348 (6) [±253] | 1119 (5) [±592] | 24,142 [±341] |
| Manufacturing | 15,066 (55) [±46] | 10,284 (38) [±53] | 1736 (6) [±175] | 2608 (10) [±26] | 1181 (4) [±45] | 433 (2) [±66] | 27,172 [±53] |
| Transportation and public utilities | 5957 (66) [±464] | 2851 (32) [±199] | 424 (5) [±84] | 424 (5) [±32] | 565 (6) [±175] | — | 8984 [±386] |
| Wholesale trade | 9549 (48) [±446] | 11,087 (55) [±501] | 921 (5) [±31] | 2390 (12) [±573] | 693 (3) [±518] | — | 20,093 [±449] |
| Retail trade | 2769 (61) [±255] | 534 (12) [±31] | 497 (11) [±102] | — | 486 (11) [±1171] | 225 (5) [±59] | 4544 [±191] |
| Finance, insurance, and real estate | 222 (8) [±81] | — | — | — | — | — | 2777 [±2082] |
| Services | 15,709 (40) [±1225] | 3282 (8) [±211] | 11,048 (29) [±2388] | 2282 (6) [±62] | 9727 (25) [±1798] | 1459 (4) [±973] | 39,081 [±1459] |
| All private industry | 63,900 (49) [±377] | 38,925 (29) [±211] | 21,609 (16) [±1300] | 10,067 (8) [±154] | 15,086 (11) [±985] | 3409 (3) [±520] | 132,346 [±509] |

Data are number (%) [95% CI]. Numbers and percents may not sum to totals due to rounding and/or data exclusion of non-classifiable responses, and because respondents were instructed to indicate all provider types that applied.

— Data did not meet BLS publication guidelines.

er's vulnerability is enhanced by an underlying health condition. Medical evaluation of workers is intended to prevent adverse health effects associated with improper respirator use. Evidence from various studies indicates that a respirator user's health condition (eg, pulmonary, cardiac, psychological, and dermal irritation), can adversely impact the worker's ability to safely and effectively wear respiratory protection, and the importance of medical evaluation for respirator use is emphasized by OSHA regulations and other recommendations.¹⁻⁵ Despite this, results of the BLS/NIOSH survey suggest that only about half of establishments with required respirator use evaluated their employees' medical fitness for respirator use.

An acute or chronic cough can have an adverse impact on effective use of a respirator.⁴ A single cough can potentially break the face seal of a tight-fitting respirator mask, thus compromising respiratory protection. Cough that raises phlegm has the added complication that the respirator user may have the urge to remove the respirator to expectorate, rather than swallow the phlegm. The BLS/NIOSH survey¹³ indicates that 96% of establishments with required respirator use rely on tight-fitting respirators for which cough should be considered a contraindication.¹⁷

The type of respirator used has relevance to the medical evaluation of workers. Different types of respirators variously influence breathing resistance, dead space volume within the respirator, and the weight of the respirator, each of which present additional burdens on the worker.² Dead space (ie, the volume of air contained within the respirator mask) is medically important because the wearer must re-breathe exhaled air within the dead space, leading to potential dyspnea among some users with underlying lung or neuromuscular diseases. Among respirator types, full facepiece non-powered air purifying respirators, full-facepiece powered air purifying

TABLE 6

Number and Percent of Establishments Evaluating Medical Fitness for Required Respirator Use, by Employment Size Group and Provider who Evaluated Medical Fitness

| Employment Size Group | Provider Used by Establishments to Evaluate Medical Fitness | | | | Establishments Evaluating Employees' Medical Fitness | | |
|-----------------------|--|--------------------------------------|--|---|--|-----------------|----------------|
| | Physician(s) Employed by Contract, Direct Salary, or Fee for Service | Contract Occupational Health Service | Individual Physicians' Personal Physicians | Nurse Employed by Contract, Direct Salary, or Fee for Service | | Other | Don't Know |
| 1-10 | 16,847 (40) [±1523] | 5603 (13) [±426] | 12,862 (30) [±2935] | 713 (2) [±368] | 7361 (17) [±2863] | 1338 (3) [±777] | 42,580 [±1920] |
| 11-49 | 15,614 (47) [±393] | 11,384 (34) [±227] | 3266 (10) [±299] | 1521 (5) [±233] | 2671 (8) [±204] | 1864 (6) [±522] | 33,551 [±331] |
| 50-249 | 13,958 (48) [±107] | 13,727 (48) [±155] | 1687 (6) [±99] | 1917 (7) [±53] | 2050 (7) [±96] | 193 (1) [±48] | 29,203 [±127] |
| 250-999 | 11,443 (60) [±162] | 5547 (29) [±161] | 3184 (17) [±848] | 2683 (14) [±101] | 2546 (13) [±685] | — | 19,007 [±215] |
| ≥1000 | 6037 (75) [±196] | 2663 (33) [±282] | 608 (8) [±212] | 3234 (40) [±186] | 458 (6) [±39] | — | 8004 [±171] |
| All private industry | 63,900 (49) [±377] | 38,925 (29) [±211] | 21,609 (16) [±1300] | 10,067 (8) [±154] | 15,086 (11) [±985] | 3409 (3) [±520] | 132,346 [±509] |

Data are number (%) [95% CI]. Number and percents may not sum to totals due to rounding and or data exclusion of non-classifiable responses, and because respondents were instructed to indicate all provider types that applied.

— Data did not meet BLS publication guidelines.

respirators, full-facepiece airline respirators, and SCBAs (worn in about 61,000, 18,000, 20,000 and 22,000 private sector establishments, respectively¹³) have the largest dead space.

The weight of the respirator also needs to be considered when evaluating medical fitness for respirator use. Depending on the workload, even a healthy worker can fatigue quickly when using respiratory protection.^{18,19} For example, SCBAs (weighing from 23–35 pounds) are used by firefighters typically wearing heavy protective clothing (10–25 pounds) and working at maximal exercise levels under life-threatening conditions with the added heat stress caused by intense ambient temperature. Together, these factors could substantially increase cardiac output. In these cases, workers need to be evaluated for medical fitness to rule out existing cardiac conditions, which may manifest under heavy stress. The medical evaluation could include exercise stress testing with electrocardiogram monitoring for respirator users with existing cardiovascular risk factors or whenever highly stressful conditions are expected.²

Survey results indicated that about 46% of all small establishments (1–10 workers) relied on the presumably more expensive physical examination only method. A study conducted by Pappas et al⁴ shows that a self-administered questionnaire was effective in identifying workers requiring medical evaluation. The results of the study indicated that the questionnaire successfully identified workers who required work restrictions while using respirators, but was only modestly sensitive in detecting specific medical conditions like asthma, other chronic lung conditions, and heart conditions as compared with detection by physician evaluation.⁴ Questionnaire-based evaluations should be linked to physician evaluations, especially for those workers who have difficulties with respirator use or for workers with any underlying

ing medical condition.⁵ This will help protect worker health.

Of all establishments with required respirator use, 73% had 49 or fewer workers.¹³ Less than 40% of establishments employing 49 or fewer workers with required respirator use evaluated medical fitness of employees for respirator use.

The BLS/NIOSH survey results indicate that the smaller the establishment, the less likely a worker required to use a respirator will receive a medical evaluation. Possible deterrents to completing a medical evaluation among employees of smaller establishments are more frequent use and presumably greater expense of the physical examination only method instead of the questionnaire with a follow-up examination, as needed method, and a greater reliance on personal physicians. In contrast, questionnaire with a follow-up examination, as needed was the most common method of evaluating medical fitness in the larger establishments and the evaluations were most often provided by physicians or nurses employed or paid for by the employer.

These findings raise concerns that medical fitness is generally not adequately evaluated in the smaller establishments. Small businesses often lack the expertise of the occupational health and safety professionals for identifying and preventing specific hazards.²⁰ Many employers, especially those with smaller establishments, may be unfamiliar, or may choose not to comply, with OSHA's requirements for medical fitness evaluation related to respirator use.

Several limitations apply to the findings from the BLS/NIOSH *Survey of Respirator Use and Practices*. First, the findings of the survey apply only to private sector establishments. Public sector establishments (approximately 20 million workers in 2001²¹), self-employed, and agriculture establishments with less than 11 workers (approximately 1.3 million workers in 2001²¹) were not included

in the surveyed population. Second, the data are limited by the knowledge and expertise of the person filling out the mailed questionnaire. Although the instructions stated that the person most familiar with respiratory protection should complete the questionnaire, this may not have always happened. Third, in spite of the cognitive and field testing of the questionnaire prior to mailing of the survey, even knowledgeable persons might have misinterpreted the written questions. For instance, in response to the first question, "Does your establishment assess your employee's medical fitness to wear respirators?", respondents may have answered *No* if their establishment did not do the evaluations (ie, if evaluations were performed by a private physician) and then skipped the other two questions as directed by the survey questionnaire. A small percentage of the respondents answered *Don't know*, possibly because they did not understand evaluation procedures used at their establishment or the question itself.

Findings of the BLS/NIOSH survey suggest that a large number of employers do not follow the OSHA requirements for medical evaluation procedures for fitness to use respirators. From October 2004 through September 2005, the OSHA issued about 4300 citations relating to respiratory protection, ranking this as the 4th most violated OSHA standard in 2005.²² Survey results indicate that the mining industry had a high percentage of establishments (12%) that were required to wear respirators.^{12,13} Of these, an estimated 31% didn't assess medical fitness for respirator use.

Recommendations

More employers need to ensure that employees' medical fitness is evaluated before respirator use, as required by regulations. Both employers and employees should be informed and educated about the importance of medical evaluation for

respirator use and the potential health risks associated with lack of medical evaluations. Future research should focus on understanding the barriers to providing medical evaluations for respirator use (eg, cost; time away from work; lack of awareness of the requirements, especially in smaller establishments; and access to health care providers).²³ Efforts should be made to improve awareness of and encourage employers in smaller establishments to consider using the questionnaire with follow-up examination, as needed method of medical evaluation.

Acknowledgment

The authors thank John Steelnack of the OSHA for providing technical review and the following NIOSH staff who provided critical review of this manuscript: Michael D. Attfield, Jacek Mazurek, and Robert M. Castellan. Special appreciation is expressed to William McCarthy and Kelley Frampton of the BLS for the subsequent data analysis.

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