Respiratory Protection Programs for Firefighters: A Survey of Practices for the State of Kentucky

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SYNOPSIS

Objective. Firefighters play a crucial role as first responders in a variety of situations that can expose them to respiratory hazards. To ensure their safety and health, fire departments should have a respiratory protection program in place for all firefighters. A survey of Kentucky fire departments was conducted to assess their respiratory protection practices, barriers to program implementation, and medical evaluation programs.

Method. A 21-question survey assessing respiratory practices during the previous 12 months was mailed to all Kentucky fire departments.

Results. A 62% survey response rate was achieved, with 116 of Kentucky's 120 counties returning at least one survey. All respondents indicated they were utilizing some type of respiratory protection, but only 37% indicated they had a written respiratory protection program. Compensation status and department sizes were found to be significant variables ($p < 0.01$) in determining if a fire department had a written respiratory protection program. Lack of funding (48%) and lack of understanding (39%) were cited as the greatest barriers to program implementation. Only 51% indicated they require their firefighters to receive a fit testing of their respirator, and 23% indicated they had a health-care provider who reviewed medical questionnaires or provided medical evaluations.

Conclusion. This survey indicates that many Kentucky fire departments are not meeting the legal and voluntary respiratory protection standards and guidelines, and demonstrates the need for improved education and funding to ensure that firefighters are adequately protected from respiratory hazards. This is particularly applicable to small rural volunteer departments, which had the greatest gap in compliance.

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Firefighters are exposed to a variety of toxic, irritating, and carcinogenic compounds in the by-products of combustion and other chemicals encountered while on the fire scene.¹⁻³ Inhalation of these compounds and hot gases can result in acute and chronic health effects. Damage can occur to the tracheobronchial tree and lungs, resulting in reduced lung capacity and changes in pulmonary function.^{4,5} Long-term effects, such as increased risk of contracting various forms of cancer, are also possible.⁶ In addition to the medical effects, these changes can adversely impact the firefighters' ability to successfully perform their job in the future.⁷

In response to these risks, various standards and regulations have been developed and applied to protect firefighters. The respiratory protection standard of the Occupational Safety and Health Administration (OSHA), located in 29 CFR 1910.134, seeks to reduce occupational diseases caused by the inhalation of contaminated air.⁸ The standard states that in instances such as fire scenes, where exposures cannot be adequately evaluated or controlled with engineering measures, the employer must consider the atmosphere to be immediately dangerous to life and health.

To successfully accomplish their job of fire suppression and rescue, firefighters must quickly respond to ever-changing environments with unknown concentrations of toxic and hazardous materials. This requires the firefighters entering the fire-scene environment to use a self-contained breathing apparatus (SCBA). The OSHA respiratory protection standard requires a worksite-specific written respiratory protection program, initial medical determination of employees' ability to use personal protective equipment, and annual respirator fit testing and training for all personnel utilizing respiratory protection. Users are trained to understand how a respirator works as well as proper use and maintenance. Fit testing ensures that a proper seal is formed and maintained around the user's face during use.

Respirator use places increased stress on the cardiopulmonary and musculoskeletal systems. In firefighters, this occurs due to the increased physiologic demands on the user from the weight of the SCBA system.⁹ This, coupled with the stress, heat, and physical demands of firefighting, can lead to injury or death in firefighters thought to be otherwise healthy. Determining if a respirator user is medically fit to wear a respirator is an important part of a respiratory protection program.¹⁰ The OSHA respiratory protection standard states under section 1910.134(e)(2)(I) that "the employer shall identify a physician or other licensed health care professional to perform medical evaluations using a

medical questionnaire or an initial medical examination that obtains the same information as the medical questionnaire."

Because not all respirator users are required to have a physical, the initial assessment through the questionnaire process helps minimize cost by selecting those who are at higher risk for complications from respirator use. There is strong evidence to support that the stress and physical demands firefighters encounter on the fire scene are directly linked to an increased risk of death from coronary heart disease.¹¹ According to the United States Fire Administration (USFA), from 1990 through 2000, on-duty heart attacks accounted for 44% of deaths for firefighters, as compared with 22% for police and just 15% for all occupational trades.¹² A sound medical evaluation program not only ensures that firefighters can safely perform in a respirator, but also provides secondary benefits such as an opportunity for early detection of risk factors that lead to cardiovascular, pulmonary, or other diseases. This allows the health-care provider to give preventive recommendations and health promotion advice, as well as assist with referral for further evaluation or treatment as needed.

Section 18 of the OSHA act encourages states to operate their own state-run OSHA programs, and currently 23 states, including Kentucky, do so. A major component of state-run programs is that, in addition to covering private entities, they must also cover all state and local municipality employees. The Kentucky Occupational Safety and Health Administration has adopted the OSHA standards for respiratory protection; thus, all fire departments in Kentucky that compensate their firefighters must meet the requirements of 29 CFR 1910.134. While the OSHA respiratory protection standard clearly applies to paid firefighters, there is often uncertainty regarding how the standard applies in volunteer fire departments. For the OSHA respiratory protection standard to be in effect, there must be some sort of compensation received for services rendered. Firefighters at departments composed entirely of volunteers do not receive compensation; consequently, they would typically be exempt from the OSHA standard. However, a few states, such as Michigan and New York (but not Kentucky), have enacted special provisions to expand OSHA coverage to volunteer fire departments.

While the OSHA standard may not cover volunteer firefighters in all states, the Environmental Protection Agency (EPA), by authority of 40 CFR 311, incorporates OSHA standards into its own statutes.¹³ This mandate by Congress requires the EPA to cover all firefighters, both volunteer and paid, who respond to

hazardous material (HAZMAT) events in both federal and state-run programs. Therefore, once a fire department begins to respond to HAZMAT incidents, it is automatically under the jurisdiction of both the EPA and OSHA, regardless of its status as a volunteer or paid fire department. In addition, the National Fire Protection Association (NFPA) has developed NFPA 1500: Standard on Fire Department Occupational Safety and Health Program, and NFPA 1404: Standard for Fire Service Respiratory Protection Training, both of which specify the minimum requirements for a fire service respiratory protection program.^{14,15} While NFPA standards are not enforceable by law, they represent the best practice for the health and safety of firefighters and should be followed by all fire departments.

METHODS

The study was designed as a cross-sectional survey of all Kentucky fire departments and used a self-administered, 21-question survey assessing their respiratory practices during the previous 12 months. Survey questions were based on the requirements of the OSHA respiratory protection standard. Although categorical answers were established for each question, an open-ended response was allowed for most questions. Input on the survey design was obtained from local fire department officers, the Kentucky State Fire Commission (KSFC), and faculty members of the University of Kentucky College of Public Health.

One concern with the survey was that fire department officers would view it as a way for government regulatory agencies to target noncompliant departments. To help ease concerns about this issue, the cover letter noted that the survey responses would be used for statewide assessment and academic purposes only. Respondents were also told that no identifying characteristic of any individual fire department or county would be released. Institutional Review Board approval was obtained through the University of Kentucky Office of Research Integrity.

The KSFC attached the initial mail-out to a regularly scheduled statewide mailing sent to all 825 Kentucky fire departments in October 2005. The survey portion of the mailing consisted of a cover letter with contact information explaining the purpose of the study, the 21-question self-survey, and a self-addressed, postage-paid return envelope. Instructions in the survey requested that it be completed by a department officer or respirator program administrator. The return deadline for the initial mail-out was set for December 2, 2005; however, surveys received after that date were still included in the study. Respondents could indicate at the end of

the survey if they would like a thank-you letter to be sent to their county executive or commanding officer in appreciation of their participation. A 30% response rate was obtained for the initial mailing. After surveys were received, they were assigned a tracking number and their information was entered into a Microsoft® Excel spreadsheet format for analysis.

A second mail-out, utilizing the same survey, was sent on January 30, 2006, to the 576 fire departments that did not respond to the initial mail-out. The cutoff date for the follow-up mailing was February 24, 2006, but surveys were not entered into the database for analysis until June 2006. Statistical significance for all comparisons was established by using a Chi-square test, with significance established at $p < 0.05$.

RESULTS

A total of 511 responses were received, for an overall response rate of 62%. Of the 120 counties in Kentucky, there was at least one survey response from each of 116 counties. All of the 511 responses indicated they were utilizing respiratory protection in some fashion. Table 1 shows the overall results of the survey.

Written respiratory protection program

When asked if they had a written respiratory protection plan, 37% of all respondents indicated they had a written program in place. Firefighter compensation and size of department were found to be significant variables (Table 2). Twenty-five percent of the volunteer-only departments reported they had a written program, as compared with 76% of the combination departments (have both paid and volunteer) and 92% of the paid-only departments. As expected, because volunteer departments are found more often in rural areas, response area was also significant, with only 26% of the rural departments reporting a written program in place, as compared with 48% of all categories grouped together. Of the large departments (31 members or more), 69% had a program in place, as compared with 33% of the medium-sized departments (21–30 members) and 21% of the small departments (1–20 members).

Medical evaluations

Of all reporting fire departments, 23% reported that they had a health-care provider who reviews medical questionnaires and/or provides medical evaluations. Fire departments that reported having a written respiratory protection program were significantly more likely (48% vs. 8%, $p < 0.01$) to perform medical evaluations of their firefighters than departments without a written

Table 1. Fire department respiratory protection practices survey results

	Number	Percent		Number	Percent
Size of fire department			Organizations utilized by fire departments for respiratory protection training		
Small (1–20 members)	201/511	39	In-house staff	422/489	86
Medium (21–30 members)	177/511	35	Other	60/489	12
Large (>30 members)	133/511	26	Local university	16/489	3
Description of response area			Contracted out to safety and health company	9/489	2
Rural (mostly farmland with occasional residential home)	286/510	56	Local hospital or clinic	9/489	2
Urban (mostly commercial)	41/510	8	Public health department	3/489	1
Suburban (mostly residential homes)	242/510	47	Firefighters receive fit testing for their respirator or SCBA		
Industrial	27/510	5	Yes	260/506	51
Other	3/510	1	No	246/506	49
Compensation of firefighters			Frequency of fit testing		
Volunteer only	403/511	79	Annually	133/285	47
Paid only	39/511	8	As needed	118/285	41
Combination of paid and volunteer	69/511	14	Every six months	27/285	9
Types of respiratory protection utilized			Other	11/285	4
Self-contained breathing apparatus (SCBA)	511/511	100	Organizations utilized by fire departments for fit testing		
Air-purifying respirators	24/511	5	In-house staff	232/295	79
Power air-purifying respirators	9/511	2	Contracted out to safety and health company	23/295	8
Air-line respirators	14/511	3	Other	22/295	7
Written respiratory protection program status			Local hospital or clinic	11/295	4
Have written respiratory protection program	190/508	37	Local university	7/295	2
Do not have written respiratory protection program	318/508	63	Public health department	3/295	1
Greatest barriers to implementing a written respiratory protection program			Type of fit testing utilized		
No funding available	152/318	48	Qualitative (irritant smoke, banana oil)	128/308	42
Lack of understanding	123/318	39	Quantitative (Porta-count)	69/308	22
Not required to have a program	96/318	30	I don't know	112/308	36
Not enough time	75/318	24	Individuals who are medically unqualified for entry are allowed to perform other duties at the scene		
Other or no answer	34/318	11	Yes	320/494	65
Firefighters must pass physical before working in respirator			No	174/494	35
Yes	121/502	24	Has a health-care provider that reviews medical questionnaires and/or provides medical evaluations		
No	381/502	76	Yes	115/496	23
Fire department has physical fitness requirements other than those required by a respiratory program			No	381/496	77
Yes	63/506	12	Functions performed other than firefighting		
No	443/506	88	Search and rescue	406/489	83
Frequency of respiratory protection training			HAZMAT	379/489	78
As needed	196/486	40	First responder/EMT/paramedic	373/489	76
Every six months	95/486	20	Water rescue	120/489	25
Annually	167/486	34	Diving	29/489	6
Other	33/486	7	Other	31/489	6
			HAZMAT training response level		
			Awareness (initial eight-hour class)	199/377	53
			Operations (initial 24-hour class)	142/377	38
			Technician (initial 40-hour class)	48/377	13

HAZMAT = hazardous materials

EMT = emergency medical technician

Table 2. Written respiratory protection plan by department type

	Presence of a written plan		p-value
	Number	Percent	
Size of department			<0.05
Small (1–20 members)	40/194	21	
Medium (21–30 members)	55/170	32	
Large (>30 members)	90/130	69	
Compensation status			<0.05
Volunteer only	50/399	25	
Mixed	52/68	76	
Paid only	35/38	92	

program. Compensation of a department's firefighters was also a significant indicator of whether it has a health-care provider review medical questionnaires. Paid-only departments had the highest level of compliance, with 79% reporting that their firefighters received a review by a health-care provider, as compared with 58% of the combination (paid, volunteer, and part-time paid) and just 13% of the volunteer-only departments ($p<0.01$).

Training and fit testing of respirator users

Only 51% of all respondents indicated they require their firefighters to receive a fit test for their respirator. Fire departments with a written program had a significantly higher percentage of firefighters that were fit tested (73%) than those without a written program (39%, $p<0.01$). No significant difference was found between the type of fit testing used (qualitative or quantitative) and whether the department had a written program. Of the departments with a written program, 15% did not know what type of fit testing they conducted, and 26% of departments with programs reported they did not require fit testing for their firefighters. Table 1 indicates that departments are relying heavily on in-house resources to provide training and fit testing of firefighters.

Barriers to implementing a written respiratory protection program

Survey respondents who indicated that they had no written respiratory protection program were asked to identify the greatest barriers to implementing a written program. Respondents were asked to indicate all answers that applied to them and were given an "other" response option as well. The Figure shows the results of this question. Lack of funding was the number one reason (48%) for not implementing a written respiratory protection program, followed by a

Figure. Barriers to implementing a written respiratory protection program (n=318)

lack of understanding (39%), not required to have a program (30%), and not enough time (24%).

DISCUSSION

A number of factors may explain why the paid and combination fire departments have a higher percentage of compliance with the written respiratory protection program requirement. First, paid and combination departments are typically larger and urban, with access to more funding and better resources, while volunteer-only departments are more likely rural with fewer resources. In addition, any firefighters who are compensated are required by law to meet the OSHA respiratory protection requirements, while volunteer-only departments may not have to do so. Volunteer departments spend most on-duty time either responding, training, or maintaining equipment, while paid firefighters have more opportunity for on-duty time devoted to administration and medical fitness activities.

In regard to training and fit testing, fire departments indicated they are heavily dependent on internal resources. For larger departments with the available human resources and administrative support staff, this is probably an effective solution. The data gathered in this study indicate that very few fire departments are currently utilizing their local health departments, hospitals, and clinics for training and/or fit testing. For small rural departments, partnering with local health officials could be convenient and cost-effective. Several fire departments noted they were receiving their respiratory protection training from the Kentucky State Fire School, Kentucky Community and Technical College System, and/or State Fire Commission. These respondents were all placed in the "other" group; however, some survey respondents could have also indicated these training sources as training they received from their local university. Either way, responses indicate that Kentucky fire departments are receiving training from state training agencies.

Somewhat troubling is evidence that slightly less than half of the departments that reported having a written program in place are performing medical evaluations. Similarly, 27% of the departments with a written program reported they did not require fit testing for their firefighters. There are several reasons that these findings could be inaccurate. Some departments may have incorrectly reported the status of their respiratory programs, including the specifics of their practices. However, even among departments with written programs, a number still have deficiencies resulting in less effective protection for their firefighters.

Regarding the barriers to implementing a program,

it was interesting to see that 94% of the departments without a program in place were all-volunteer departments; however, the greatest barriers to implementation were funding and lack of understanding. Only 30% had not implemented a program because they were not required to do so. This suggests that volunteer department officers appreciate the health and safety benefits of a program. The information shown in the Figure is valuable for assisting training agencies in understanding where to focus assistance efforts, particularly as rural departments are tasked more heavily in regard to homeland security and HAZMAT incidents.

When asked if their fire department had physical fitness requirements other than those required by a respiratory program, 12% of the respondents said that they did. When this number was broken down by the department compensation type, it was found that 46% of the paid departments had requirements, as compared with 39% of the combination departments (paid, volunteer, and part-time paid), and 5% of the volunteer only. This is an important finding, because according to the USFA, of the 19 total firefighter deaths in Kentucky from 2001 to 2005, 89% were volunteer firefighters, with stress and overexertion causing 58% of the deaths.¹⁶

Of the 36% of respondents at the operations or technician level of training with a HAZMAT team, only 60% had a written respiratory protection program, and less than half (44%) had a health-care provider that provided medical evaluations as required by OSHA. This is worrisome, because firefighters responding to HAZMAT scenes can have exposures that may not manifest until years or decades later. HAZMAT responders may also wear physically demanding protective equipment for long periods over several days, and may be at increased cardiovascular risk even when compared with other firefighters. Fire departments that choose to operate a HAZMAT team at the operations or technician level must make a large investment in training and equipment. However, the department should also realize that the cost of maintaining the team over the long term includes annual fit testing and medical surveillance.

Limitations

The most significant limitation regarding the data collected in this survey is that all information was self-reported by the respondents. Department officers completing the survey could have incorrectly completed the survey for a variety of reasons. They may not have fully understood their department's program or the terminology used in the survey, or they may have been reluctant to report potential shortcomings. While

the response rate was only 62%, the data were likely representative of the state based on the geographic distribution of responders and the fact that a significant majority of the larger departments responded to the survey. Because the survey includes these larger departments, the percentage of firefighters covered by the survey is greater than the percentage of departments responding.

In 2001, the National Institute of Occupational Safety and Health (NIOSH) conducted a survey of private-sector establishments that use respirators. The data from the NIOSH survey can be used as a comparison with data gathered by the Kentucky survey described here. NIOSH found that 35% of the establishments that required respirator use had established a written respiratory program adopted by management, as compared with the 37% of fire departments with written respiratory programs, as found in this survey.¹⁷ With regard to training, NIOSH found that 59% of the establishments that required respirators provided training to workers, as compared with 51% of fire departments found in this survey. For assessment of the employees' medical fitness, NIOSH found that 47% that required respirators performed an assessment, as compared with 23% found in this survey. It is important to note that the NIOSH survey provides estimates on the number and percent of private-sector establishments that use respirators, but did not collect data on public-sector fire departments.

RECOMMENDATIONS

While the majority of Kentucky's larger, paid departments are meeting the requirements for respiratory protection programs, there is a large gap between them and the smaller, rural volunteer departments. Public safety and health officials should work to improve firefighter safety by increasing the number of Kentucky fire departments that have written respiratory protection programs, conduct fit testing, and perform medical evaluations of their firefighters. Efforts to improve the respiratory protection and overall health of firefighters in Kentucky should focus on the following areas:

- Developing partnerships between fire departments and local health departments and/or the local hospital and clinic. These partnerships should focus on providing training, fit testing, and medical evaluations to firefighters.
- Improving the knowledge and skills of small rural fire department officers in understanding what is required to establish a proper respiratory protection program.
- Improving funding for health and safety programs in smaller, rural fire departments.
- Increasing the number of fire departments that have physical fitness requirements and providing the tools and knowledge to firefighters to achieve these fitness goals (i.e., provide physical fitness facilities and/or health promotion programs for fire departments).

CONCLUSION

As fire departments improve their response resources by purchasing new and improved equipment, they should also be improving their human resources. This can be accomplished through increased training, development of in-house trainers, and general improvement in the departments' safety and health programs. It was worrisome to see that only 4% of the volunteer departments that responded to this survey had physical fitness requirements. To help prevent cardiac-related fatalities, both on and off the fire scenes, departments should have a sound respiratory protection and medical surveillance program in place. This would improve respiratory protection and have the added benefit of helping to identify firefighters at increased risk of sudden cardiac death.

Regardless of the absolute legal applicability of the OSHA regulations and NFPA standards, they are important, basic recommendations that should guide operations of all fire departments. With the increased concern for homeland security and HAZMAT response, firefighters are being asked to know more and do more. They are often the first responders at a fire, HAZMAT incident, or disaster and may be the first receivers of contaminated patients. Volunteer firefighters should not have inferior safety protection compared with that of paid departments. A sound respiratory protection program is an important piece of the overall preparedness plan for operating an effective fire department capable of responding to community needs in emergency situations.

The authors gratefully acknowledge the support provided by the Kentucky State Fire Commission and the commitment by Kentucky's fire department officers to improve firefighter safety and health.

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