Running Head: EVALUATION OF SCBA INFECTION CONTROL PROGRAM

Leading Community Risk Reduction

Evaluation of the SCBA Infection Control Program of the Waterbury Fire Department

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I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

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ABSTRACT

Waterbury firefighters were at risk of exposure to infectious diseases when sharing SCBA. Firefighter compliance with the department SCBA infection control program was evaluated using surveys and monitoring disinfectant supply. This evaluative research project determined: the rate of compliance with SCBA disinfecting procedures; the rate of personal SCBA facepiece usage; factors affecting the rate of compliance; and if the SCBA infection control program required modification. Low compliance rates largely attributable to behavioral preferences revealed an organizational culture that did not prioritize safety. Recommendations included: implementing an improved program with a focused educational presentation, structured follow-up, accountability, and stricter controls, while addressing cultural concerns long-term; appointing a department safety officer; and developing objective evaluative tools to measure compliance in safety programs.

TABLE OF CONTENTS

List of Tables

INTRODUCTION

Infectious diseases can produce effects ranging from mild discomfort to death (Dickerson, 1999). The risk of occupational exposure to an infectious disease is a daily hazard for firefighters. Rescuers may be exposed to pathogens during a variety of activities they perform while carrying out their assigned duties (National Fire Protection Association [NFPA], 2000). In recent years, new urgency has been given to infectious disease due to the rise of acquired immune deficiency syndrome (AIDS), hepatitis, and tuberculosis. The range of diseases that may affect firefighters goes well beyond these three. The 1998 Death and Injury Survey produced by the International Association of Fire Fighters reported that one out of every thirty-two firefighters was exposed to tuberculosis, 5.8% were exposed to hepatitis B, 6.5% were exposed to hepatitis C, 14.6% were exposed to human immunodeficiency virus, and 43.3% were exposed to some other communicable disease (International Association of Fire Fighters [IAFF], 2001).

Because firefighters share self-contained breathing apparatus (SCBA) facepieces and regulators, they are potentially exposed to pathogens. The research problem is that firefighters in Waterbury, CT are at risk of exposure to pathogens when using SCBA, and the effectiveness of the program to protect them from this hazard has not been evaluated. Firefighters may not be performing disinfecting procedures and using personal facepieces to reduce their risk of exposure, thus unnecessarily endangering themselves.

The purpose of this research is to evaluate firefighter compliance with the department SCBA infection control program in an effort to identify and correct deficiencies, and thus improve firefighter safety. This is an evaluative research project. The research questions are:

1. What is the rate of compliance with SCBA disinfecting procedures?
2. What is the rate of personal SCBA facepiece usage?

3. What factors affected the rate of compliance?
4. Should the SCBA infection control program be continued or modified?

BACKGROUND AND SIGNIFICANCE

The Waterbury Fire Department is a career department employing 280 personnel to protect a diverse population of 108,000, residing in a 29 square mile area typical of northeastern mill towns left faltering when industry relocated or closed. The department is organized into six bureaus: administrative services, emergency services, training, dispatch, automotive repair, and fire prevention.

The Bureau of Emergency Services (BES) consists of three shifts, each comprised of a deputy chief, two battalion chiefs, nine engine companies, three truck companies, and one heavy rescue company. Approximately 77 firefighters are assigned to each shift. In addition to suppression services, the BES provides advanced hazardous materials mitigation and technical rescue services. The Bureau of Instruction and Training (BIT) provides instruction and technical support to the BES. Annually, the department responds to over 3,900 non-EMS calls.

In September 2001, the Waterbury Fire Department was awarded an Assistance to Firefighters Grant totaling $306,000 to replace its front-line SCBA with new units featuring integrated personal alert safety system devices and buddy-breathing/rescue options. Additionally, a computer-operated fit-testing device was purchased to ensure an objective, quantifiable fit rating.

To reduce the risk of pathogen exposure during SCBA use, each firefighter was issued a fit-tested, individual facepiece and protective case. Each fire company was issued the SCBA manufacturer recommended disinfectant, Scott Multi-Wash Mini, to disinfect facepieces and regulators to further ensure the safety of firefighters (Scott Health and Safety, 1997).

With the arrival of this equipment, a comprehensive training program began to instruct firefighters in the proper use of the SCBA and disinfectant. This training was developed by the department Bureau of Instruction and Training, and was conducted at a nearby Army Reserve facility. The training consisted of didactic and practical components.

Firefighters first participated in interactive classroom session using SCBA, then were familiarized with the training bulletin (Waterbury Fire Department [WFD], 2003) containing operational information and the SCBA infection control program. The SCBA infection control program includes the provision of individual facepieces and the proper use of Scott Multi-Wash Mini disinfectant. The disinfectant must be used before the use of shared regulators and facepieces, and after use of any facepiece or regulator. Thus a firefighter reporting for duty should disinfect the regulator of his assigned SCBA and then affix his personal facepiece to the regulator. Following the classroom session, participants completed two limited visibility drills to reinforce use of the rescue features. At the conclusion of the drills, each firefighter was coached while disinfecting the SCBA regulator and facepiece to assure proper technique was employed. A copy of the training bulletin was provided to each company.

The initial purchase of disinfectant included 20 cases of six bottles each. One case was issued to each of the 13 fire companies during training. One case was also provided to each of the two battalion chiefs, in order to meet short term needs of companies as supplies were drawn down. The remaining five cases were sent to the quartermaster station for issue as needed. A new order for disinfectant was to be initiated when the quartermaster supply was being drawn down. The initial order was a rough estimate of a one year supply, as the manufacturer lists the product as having a one year shelf life (Scott Health and Safety, 1997).

In May 2004, the Bureau of Instruction and Training was contacted by a line officer concerned that the disinfectant issued to his company displayed a March 2003 expiration date. His concern stemmed from a crew member disclosing that the department medical examination had indicated the crew member had hepatitis C. The line officer stated his company had not used any of the supplied disinfectant up until this disclosure (Name withheld, personal communication, May 24, 2004). Hepatitis C is one of several pathogens that can be communicated from one SCBA user to the next if they share SCBA regulators and/or facepieces without properly disinfecting the equipment (IAFF, n.d.).

The use of SCBA is strictly regulated by the Occupational Safety and Health Administration of the Department of Labor. Specifically, 29 CFR 1910.134 *Respiratory protection* sets out requirements for employers whose workers use SCBA (United States Department of Labor, Occupational Safety and Health Administration [OSHA], 1997). The law requires employers to have a written respiratory protection program that details proper procedures for use, disinfection, care, storage, and maintenance of respirators. Additionally, 29 CFR 1910.134 requires that the employer train employees in the respiratory hazards they will encounter, and requires disinfection of shared and/or emergency respirators before and after each use. Retraining must occur annually, and when inadequacies in employee knowledge are evidenced. Program evaluation including employee consultation is mandated to ensure program effectiveness. As empowered by the Connecticut General Assembly, the Connecticut Occupational Safety and Health Administration applies this law to all public firefighters within the state (Foley & Brodoff, 2002).

OSHA further regulates SCBA cleaning and disinfection via 29 CFR 1910.1030 Occupational Exposure to *Bloodborne pathogens*. The use of shared SCBA regulators and

facepieces raises the possibility of infectious material contacting the skin, eyes, and mucous membranes with infectious material in the course of duty. 29 CFR 1910.1030 requires post use disinfection of equipment, and annual retraining in proper procedures including the limits of the procedures in reducing risk of exposure to bloodborne pathogens and other potentially infectious materials (OSHA, 1991).

In the past, communicable diseases were not monitored. Occurrence rates were unknown. Firefighters were subjected to high risk in the absence of education in proper safety procedures. In the present, a program is in place to limit the risks of disease transmission via SCBA facepieces and regulators. Firefighter compliance with the program has not been evaluated. In the absence of an evaluation of the effectiveness of the existing program, the department is unable to ascertain the risk of harmful disease exposure to which its firefighters are subject, and to correct any gap in compliance. In addition to the health concerns of the firefighters, the department is liable if it has not reasonably provided for the safety of its employees (United States Fire Administration [USFA], 1992). In the future, the department will face increased costs due to medical care and lost work time associated with preventable disease transmission if the existing program is deficient. Contrarily, if the program is effective, the department can benefit from this project by using the SCBA infection control program as a model for other initiatives.

By ensuring that a program to ensure firefighter safety is effective, or modified to be effective, this research project is readily linked to the United States Fire Administration operational objective to “ Reduce the loss of life from fire to firefighters” (National Fire Academy [NFA], 2003a, p. 3).

This research, evaluating the compliance of firefighters with safety procedures, directly relates to key points expressed in Leading Community Risk Reduction (LRCC). Principally, the

executive fire officer must work “to create an organization that has the attitudes and commitment necessary to be successful with a community risk-reduction initiative.” (NFA, 2003b, p. 3-56). By gauging compliance and recommending actions to improve any gaps in performance, this research effort supports the position that: “Change in the community must begin with change inside the organization. The organization is a role model for community risk reduction. The people, policies, and programs must reflect an honest commitment to community risk reduction.” (NFA, 2003b, p. 3-57).

This research project will evaluate firefighter compliance with the department SCBA infection control program. Using the evaluative research method, any performance gaps in compliance will be identified, and corrective actions recommended.

LITERATURE REVIEW

Though recognized as an occupational hazard, infectious disease exposure via shared SCBA respirator and facepiece, receives short shrift in fire service literature. This lack of topic exploration is apparent in two texts commonly used in firefighter recruit training. In *Firefighter’s Handbook*, Wutz (2000, p. 149) states: “An SCBA facepiece must be cleaned after each use or regularly to prevent the spread of communicable diseases. To minimize this problem, many departments issue each individual an SCBA face piece.” A similar economy of words is noted when Noll (1998, p. 105) addresses the topic in *Essentials of Firefighting*, “Breathing apparatus should be cleaned and sanitized immediately after each use….A facepiece that has not been cleaned and sanitized may contain an unpleasant odor and can spread germs to other department members who may wear the mask...”. Such a minimal addressing of a health and safety issue in the texts used to develop the foundation for new firefighters’ knowledge, skills, and abilities was disconcerting.

More puzzling is that *Self-Contained Breathing Apparatus*, a volume dedicated to comprehensively covering the proper use and maintenance of SCBA, states even less, only recommending general guidelines that firefighters be trained in relevant SOPs, and disinfect facepieces after each use (International Fire Service Training Association [IFSTA], 1991). Though this might be dismissed as an older source not reflecting concerns more prominent in recent years, more timely articles such as *The Fundamentals of SCBA Training* (Fulmer & Jirka, 2004) make no mention of infectious disease whatsoever.

This lack of information concerning risk of disease transmission stands in stark contrast to the numerous pages, even chapters, used to address infection control in emergency medical texts. Several list the following as pathogens to which SCBA users may be exposed based on mode of transmission: AIDS/HIV and hepatitis via blood; and chickenpox, German measles, bacterial meningitis, mononucleosis, mumps, tuberculosis, and whooping cough via airborne droplets, saliva, or respiratory secretions (Dickerson, 1999; Walter, Rutledge & Edgar, 2003).

Diseases are caused by pathogens, microorganisms such as bacteria and viruses. An infectious disease is one that spreads from one person to another. It can spread directly through blood-to-blood contact (bloodborne), contact with open wounds or exposed tissues, and contact with mucous membranes of the eyes and mouth. (Limmer and Grill, 2000)

Disagreement concerning which pathogens may be communicated via shared respirator exist. One example lies in the different transmission modes that articles by different concerns consider. Within the definition of “Other Potentially Infectious Materials” in NFPA 1581, 2000 Edition, *Standard on Fire Department Infection Control Program*, saliva, sputum and respiratory secretions are included as transmission modes (NFPA, 2000). Conversely, texts drawing from *Occupational Exposure to Bloodborne Pathogens* (OSHA, 1991), which arose out of concern

over HIV and HBV, generally do not include these as transmission modes unless the named substances are contaminated with blood. This differentiation carries over into emergency medical references, but is largely academic with regard to this research project. Cited texts are in agreement that a risk of exposure to infectious disease is present, and the steps to reduce the risk of exposure are consistent for all named pathogens. As hepatitis C had emerged as a concern within the department, further research was conducted into details about the transmission of this pathogen.

Hepatitis C, a virus also called HCV, is the country's most common blood-borne disease, infecting at least 1 in every 50 people. If a firefighter is a carrier, he can transmit hepatitis C to the firefighters he works with. The Philadelphia Fire Department had an estimated 250 cases of hepatitis C reported in the late 1990's. The true number is unavailable as many firefighters sought care from healthcare providers other than the city physicians. For many, the mode of transmission was believed to be exposures during EMS activities. For most, no definitive exposures were documented (Dittmar, 2000; IAFF, n.d.).

Most hepatitis C infections are chronic, and lead to liver disease, including cirrhosis and liver failure. HCV is spread by contact with the blood of an infected person. This can be percutaneous, meaning blood or other body fluids enter through the skin through an open wound, scrapes, or chapped skin; or mucocutaneous, when blood or other body fluids enter through mucous membranes, such as in the eye, nose, or mouth (IAFF, n.d.). The risk of shared respirators and facepieces is not unlike that presented by sharing razors or toothbrushes in that minor tissue damage such as chapped skin or gum abrasions increases the possibility of transmission. HCV can live on surfaces for up to four days (Centers for Disease Control and Prevention [CDC], 2004). Although the IAFF maintains firefighters are at increased risk of HCV

due to occupational exposure based on limited testing of firefighters in Philadelphia, PA, CDC states that healthcare workers and firefighters are not at greater risk than the general public (Dittmar, 2000).

Research into the severity and occurrence of infectious diseases affecting firefighters elicited a rededication to determine the effectiveness of in place programs to protect firefighters from the scourge of these illnesses, and to correct any program deficiencies.

The principle fire service leadership texts; *The Fire Chief's Handbook*, *Managing Fire and Rescue Services*, and *Management in the Fire Service* restate the requirements of 29 CFR 1910.134 *Respiratory program* in summary. None expound on the nature of the program evaluation mandated in the law (Sturtevant, 2003; Foley & Brodoff, 2002; Carter & Rausch, 1999). Addressing risk management more generally, the need to evaluate program effectiveness in order to identify weakness which can then be improved is clear (Loflin & Sanders, 2002).

Process improvement requires measurement of performance with respect to the required programs, activities, and processes in order to close the gap between existing performance and the desired state (Endicott, 2002). The intention is to determine what is working, what is not, and what has to be modified to make the program more effective. A problem for fire and rescue services is measuring the right activities (Loflin & Sanders, 2002). In this case, the incidence of firefighters contracting infectious diseases, similar to the incidence of fire, would not of itself be a reliable indicator of program effectiveness.

In *Guide to Developing and Managing an Emergency Service Infection Control Program*, the USFA states that periodic reevaluation, besides being an OSHA requirement, ensures that programs remain state-of-the-art relevant to expanding knowledge and legal mandates. Further, only analysis of compliance/quality assurance data can show if SOPS are being followed, or are

too complicated. Though on-scene and in-station observation of work practices is advanced as the most effective means of measurement; analysis of inventory, incident reports, maintenance reports, and risk management reports are other means available. Finally, USFA notes that as noncompliance requires well-documented follow-up, the more verification the better (USFA, 1992).

In discussing techniques available to measure the effectiveness of training programs, Carter and Rausch (1999) identified: tests, self-evaluation by the learner, and observation during simulated and on-the-job application and task performance. Beach (1985) reported that the usefulness of an evaluation technique is generally inversely proportional to its ease of implementation. Advancing well-developed performance measures involving control groups as the most refined method, he discussed limitations of simpler work performance comparisons, notably that it is difficult to isolate the factors which contributed toward observed changes. Much easier to develop and use, questionnaires can only elicit participant responses, not directly measure a sought after behavior change.

The rationale and advantages of various evaluation techniques is interesting and instructive both for the immediacy, and to develop continuing program evaluation. This research project can only be the start of an ongoing process of training and evaluation to achieve compliance with mandated regulations, and to improve firefighter health and safety. To quickly gauge firefighter compliance, simple evaluative tools such as surveys and supply monitoring may be used. In the long-term more advanced measures can be developed and integrated into department operations.

PROCEDURES

Following an extensive literature review to develop a deeper understanding of firefighter occupational exposures to infectious disease, and evaluative techniques; surveys and an inventory of SCBA disinfectant were used to evaluate the rate of compliance with the in-place SCBA infection control program. Surveys were distributed to Waterbury firefighters during annual SCBA fit-testing in June 2004 by the Bureau of Instruction and Training. Only company level personnel were included in the survey. Chief officers were excluded do to their very infrequent use of SCBA.

On reporting to fit-testing, the firefighters were rotated through the survey table positioned at the opposite side of the large room, one at a time. Firefighters were requested to voluntarily complete the surveys anonymously, and to slide the completed surveys into a slot in a large sealed box on the table.

To ensure that survey results were representative of the 230 Waterbury firefighters with a 95 percent confidence level, a sample size of 144 was selected (Krejcie, 1970). Fit-testing and surveying were conducted on each shift and with each fire company in an attempt to avoid unequal representation of any subgroup of firefighters. Surveys were collected until the required 144 completed forms were received. Only three firefighters elected to not complete a form, by submitting a blank form or by not submitting a form.

The survey (Appendix) was developed to allow firefighters to anonymously self-report compliance. Prior to distribution, a draft survey was reviewed by the Bureau of Instruction and Training and by eight firefighters assigned to the headquarters station. Initial survey questions asked for basic demographic information; rank, years of service, and whether they attended the mandatory training that included the infection control program.

The survey and inventory were developed to answer the research questions in the following manner. Research question one, concerning the rate of compliance with SCBA disinfecting procedures, was directly answered by survey questions six, seven, and eight. Respectively, the survey questions covered pre-use regulator disinfection, post-use facepiece disinfection, and post-use regulator disinfection. This research question was objectively addressed by the inventory of disinfectant completed in early June, 2004.

Research question two, concerning the rate of personal SCBA facepiece usage, was directly addressed by survey question four. Research question three sought to identify factors contributing to non-compliance. It was addressed by survey question five regarding personal facepiece usage, and survey question eleven concerning disinfection procedures. Research question four asked if the current program should be continued or modified. A complete review of survey responses and the inventory was necessary to conclusively answer that question.

Survey questions ten and eleven concerning instruction in disinfection procedures pre-use and post-use respectively, were asked to indirectly evaluate if too much information might have been presented in one training session. The disinfection instruction was part of the new SCBA training asked about in survey question one. Additionally, survey question twelve asked respondents to indicate if and how additional SCBA training should be carried out.

Compliance with the SCBA infection control program required the use of Multi-Wash Mini, the SCBA manufacturer recommended disinfectant. One case containing six bottles of this disinfectant had been distributed to each company when the new SCBA were issued in February 2003. To evaluate whether the quantity of Multi-Wash Mini used corresponded to the quantity expected based on the self-reported compliance rate, the department supply of Multi-Wash Mini was inventoried. The inventory was conducted without the knowledge of the line firefighters

during station visits by the Bureau of Instruction and Training for other purposes such as gas detector calibration.

Scott Health and Safety reports that each 16 ounce bottle of Multi-Wash Mini contains sufficient disinfectant for at least 700 sprays (Scott Health and Safety, 1997). This was verified by spraying the contents of two bottles of expired disinfectant until no solution was being drawn into the sprayer. The number of sprays to empty the bottle were counted in each trial.

The survey instrument had several limitations. As it did not directly measure compliance, the survey required truthful responses by participating firefighters. For some respondents, indicating rank and years of service could place them into a small subgroup of personnel and remove the cloak of anonymity. Though minimized by having firefighters complete the survey individually, the influence of peers may have affected responses. Finally, firefighters may view their compliance differently than an objective observer would.

Conducting the inventory of Multi-Wash Mini was limited by the ability of Bureau of Instruction and Training personnel to locate all disinfectant bottles in storage or positioned for use by each of the thirteen fire companies, without asking assistance from the firefighters.

Both the survey and the inventory sought to measure the rate of compliance versus a 100% compliance rate. The objective of total compliance is essentially mandated by the 29 CFR 1910.134 Respiratory protection (OSHA, 1997).

Definition of Terms

Communicable disease – a disease that may be transmitted from one person to another.

Disinfection – a process of killing pathogens, such as cleaning with special chemicals.

Fit-testing – a process of assuring a facepiece is properly sized and worn by the user.

Infectious disease – a disease caused by pathogens.

Mucous membranes – the thin frail linings of the nose, mouth, eyes, vagina, and rectum.

Pathogen – a microorganism that can spread disease such as a bacteria or a virus.

RESULTS

The results of the survey that relate to training activities and self-reported disinfection practices are displayed in Table 1.

Table 1

Self-Reported Compliance with Disinfection Policies

	Firefighters				Company Officers		
Service Years	4-6	7-10	11-15	>15	7-10	11-15	>15
Respondents	35	35	11	28	16	3	16
Trained							
New SCBA	35	35	11	28	16	3	16
Pre-Use Cleaning	25	26	10	24	14	3	15
Post-Use Cleaning	32	28	11	27	15	3	16
Compliant Disinfection							
Pre-Use Regulator	7	6	2	8	4	1	5
Post-Use Mask	22	19	9	25	11	3	12
Post-Use regulator	27	25	10	25	11	3	12

The survey was completed by 109 firefighters and 35 line officers. All respondents affirmed that they had attended the training on the new SCBA. Training on pre-use SCBA

disinfection was affirmed by 117 respondents. Training on post-use disinfection was reported by 132 respondents.

Though these three training elements were all covered in a single comprehensive training session, 27 respondents 18.7% of the sample, indicated that they had not had pre-use disinfection training. Firefighters with 10 years or less experience were more likely to report that they had not had the disinfection training than were more senior firefighters or officers. In the case of pre-use disinfection training, 72.9% of firefighters reported attending, versus 87% of senior firefighters and 91.4% of officers.

Analysis of the survey results and of the inventory data, displayed in Table 2, provides the following answers to the research questions.

1. What is the rate of compliance with SCBA disinfecting procedures?

Compliant pre-use regulator disinfection was considered to be a respondent indicating that they always (100% of the time) disinfected the SCBA regulator when assigned to a position. Compliant pre-use regulator disinfection was reported by 33 respondents, 22.9 % of the sample. An additional 25 respondents, 17.4% of the sample, reported compliance 80% of the time. The remaining respondents reported compliant behavior as follows: 19.4% sometimes, 16% seldom, and 24% never. As defined on the survey, these descriptors were used to indicate that the respondent demonstrated the described behavior at a given frequency: sometimes, 50% of the time; seldom, 20% of the time; and never, 0% of the time.

Compliant post-use facepiece disinfection was considered to be indicating the use of Multi-Wash Mini to clean the facepiece. Compliant post-use facepiece disinfection was reported by 101 respondents, 70.6% of the respondents. Respondents selected alternative disinfection

means as follows: 24, water; 5, rubbing alcohol; 2, diluted bleach; 8, wrote in soap and water; and 3 selected other, and did not specify an alternative.

Compliant post-use regulator disinfection was considered to be indicating the use of Multi-Wash Mini to clean the regulator. Compliant post-use regulator disinfection was reported by 113 respondents, 78.5% of the sample. Respondents selected alternative disinfection means as follows: 21, water; 5, rubbing alcohol; 2, diluted bleach; and 2, wrote in soap and water.

Survey question 11 solicited reasons personnel do not use Multi-Wash Mini. Only 75 respondents, 55.1% of the sample, opted out of the question by indicating that they always used Multi-Wash Mini. This 55.1% compliance contrasts sharply with the 70.6% and 78.5% of respondents who indicated that they used this disinfectant in post-use disinfection of facepieces and regulators respectively.

All respondents who indicated that they always complied with pre-use regulator disinfection policies also reported compliant post-use behaviors. Thus, 33 respondents, 22.9% of the sample, reported compliance with all SCBA disinfection procedures.

Self-reported compliance was consistently greater among senior firefighters and officers. In the case of post-use mask disinfection, 87.2% of firefighters with more than 10 years reported compliance as did 78.9% of officers with more than 10 years of service. Only 58.6 % of junior firefighters and 68.8% of junior officers reported similar compliance.

The inventory of disinfectant showed that 10 of the 13 fire companies had used two or fewer bottles since they were issued in February 2003. One company had two bottles remaining. Two companies had no disinfectant. The supplies of disinfectant initially provided to the two battalion chiefs and the quartermaster station were intact as issued. In the 15 months between training in February 2003 and conducting the inventory in June 2004, 230 Waterbury firefighters

Table 2

Inventory of Multi-Wash Mini Disinfectant

Bottles	0	1	2	3	4	5	6
Number of Companies	2		1		2	5	3

used 25 bottles of disinfectant. As verified by counting the sprays to empty two bottles, each bottle of Multi-Wash Mini contains adequate disinfectant for approximately 700 sprays. The actual numbers of sprays counted were 735 and 717 respectively. This translates to roughly 117 disinfection procedures, using six sprays each, per bottle. The members of a four person company each disinfecting one item per shift would use a bottle each month. The actual rate of compliant disinfection is far below that which was self-reported. At the nine companies with five or six bottles in supply compliant disinfection could not have been practiced.

2. What is the rate of personal face piece usage?

Three respondents had not been issued personal facepieces and thus could not have used them prior to the survey. Of those remaining, 86 respondents, 60.1% of the sample, always used their personal facepiece, and 31 respondents, 22%, used their personal facepiece 80% of the time. Other respondents indicated the following usage of their personal facepieces: 11 sometimes (50% of the time), 5 seldom (20% of the time), and 8 never. Personal mask usage was uniform across rank and years of service. When asked to provide reasons for not using their personal facepiece in question five, 54.9% of respondents opted out of the question by indicating that they always used their personal mask. As three respondents had not been issued personal facepieces, this result closely tracks the 60.1% who reported always using their personal facepiece.

Nineteen respondents indicated that they were fit-tested and were not issued a Comfort Seal mask. These individuals would thus have a mask size other than the spare Comfort Seal masks available within the fire companies. Of these 19 respondents, 17 reported that they always used their personal mask. The remaining two reported using their personal mask 80% of the time.

The self-reported personal facepiece usage does not approach the 100% compliance sought in infection control programs. Additionally, two respondents reported using inappropriately sized facepieces 20% of the time.

3. What factors affected the rate of compliance?

Two survey questions solicited reasons for non-compliance. Question five dealt with personal facepiece usage. Question eleven dealt with compliant disinfection. Each question provided both a list of defined choices and options to write in alternative responses.

Respondents indicated several reasons for not using their personal facepieces. Of the listed choices, 25 respondents indicated that they do not attach their facepiece to the assigned SCBA and end-up using the attached spare facepiece. Forgetting to bring the personal facepiece was chosen by 25 respondents. A preference for using the spare facepieces was indicated by 10 respondents. No respondents indicated that a lost facepiece or installed prescription lens kit was a factor. Respondents wrote in alternative reasons as follows: 11, do not bring their facepiece when assigned to work at other fire stations; 3, were not issued facepieces; and 1, lazy.

In survey question eleven, respondents selected reasons they do not use Multi-Wash Mini for disinfection. Ten respondents selected two choices. All other respondents chose only one. Respondents selected the listed choices as follows: 15, low risk; 14, lazy; 9, prefer soap and

water; 9, busy getting apparatus back into service; 8, it takes too long; 7, not familiar with procedure; 1, wrote in no designated cleaning area; and 8, other reason, none specified.

Of the respondents indicating reasons for non-compliance, only three chose one of the program limitations, not being issued a facepiece. No one reported lost or prescription lens equipped facepieces as a reason. Seven reported being unfamiliar with the procedures. All other respondents whether they selected provided responses or wrote in their own chose behavioral reasons.

4. Should the SCBA infection control program be continued or modified?

Self-reported compliance with disinfection procedures ranged from a low of 22.9% for pre-use regulator disinfection, to a high for post-use regulator disinfection of 78.5%. The inventory of disinfectant revealed that compliant disinfection could not have been practiced in most of the department. Use of personal facepieces more than 80% of the time was reported by 83% of respondents. The majority of reasons given for non-compliance, 93.2%, were behavioral preferences. No data indicated that the department was anywhere near the 100% compliance mandated or sought in infectious disease programs.

Additionally, in response to survey question 12 regarding training in SCBA disinfection that should occur; 72 respondents chose no further training is required, followed by 46, who chose incorporating the training into company level monthly training, and 21 who selected classroom review of procedures and risks with hands-on practice. Two respondents wrote in that the department should conduct in depth annual SCBA training for all incumbent firefighters, and that disinfection procedures should be reviewed in those sessions.

The Waterbury Fire Department has low compliance rates with its SCBA infection control procedures as evidenced by the survey and inventory. The self-reported compliance rates

cannot be reconciled with the large inventory of disinfectant. The reasons for non-compliance are not lack of necessary supplies or equipment, but self-identified behavioral preferences. The overwhelming majority of firefighters additionally indicate that they believe little or no additional SCBA training is necessary. The existing SCBA infection control program has not achieved acceptable levels of compliance and therefore must be modified.

DISCUSSION

The disinfection inventory made it apparent that much of the self-reported compliance was either not truthful or not objective. This brought into question the usefulness of the survey. Beach (1985) had discussed the usefulness of evaluation methods being inversely proportional to their ease of use. This would seem to hold true for the self-reported compliance, certainly if one were trying to prove high rates of compliance. If viewed as a means of identifying and understanding non-compliance the survey may be more useful. With only promised anonymity, many respondents frankly admitted to non-compliant behaviors. These responses alone would have been sufficient to recognize that the SCBA infection control program required modification.

That behavioral preferences rather than program limitations constituted 93.2% of the reasons given for non-compliance, and that half of respondents indicated no additional training was needed indicate that the problem with the SCBA infection control program is one of organizational culture. USFA addressed non-compliance with infection controls in 1992:

> If noncompliance is due to unclear and/or inadequate SOPS, revisions will be required. Noncompliance on the part of one or more individuals may require supervisory intervention (counseling, training, and possibly formal disciplinary action). Noncompliance by larger numbers of responders may indicate a need for reviewing the

> department's training program or even the organizational culture affecting member attitudes. (p. 84)

The organizational culture revealed within the survey responses does not attribute much importance to safety. SCBA disinfection is conducted at the company level. Line officers are responsible for ensuring that company equipment is properly disinfected. In the 10 companies with four or more bottles of disinfectant, compliant disinfection was clearly not occurring. Reporting on safety programs Kreis (2002) stated:

> For a safety program to be truly effective, all members must be self-disciplined in following departmental safety policies and procedures. That being said *all* officers must adopt a zero tolerance policy for safety violations.
>
> If you think about it, the problem with violating safety policies is that 99.9% of the time we get away with it, and no one gets hurt. (p. 28)

In Waterbury, neither the firefighters nor their supervisors were taking responsibility for their own safety or that of those around them.

Schamadan (2002) and USFA (1992) both reported on the difficulty in achieving compliance with infection control programs being that the perils cannot be readily seen or felt. Often firefighters regard the risks as being either exaggerated or part of the job. Both advocated constant vigilance implemented in the form of a comprehensive program of protection, monitoring, education, and training. The number of respondents indicating that disinfection procedures were not carried out because of the low risk, time involvement, or their laziness, indicates that they do not appreciate the risk of occupational exposure to infectious disease.

A lack of education in the serious nature of the risks of occupational exposures to infectious diseases throughout the department may be a factor in the non-compliance with the

SCBA infection control program. Disinfection as covered in the class, training bulletin (WFD, 2003), and recruit firefighter texts (Wutz, 2000; Noll, 1998) is a skill. Little background information concerning the risks the procedures were meant to protect firefighters from was provided. As Waterbury firefighters do not provide EMS, they may not be as conscious of these risks as those who would have been exposed to the in depth coverage given to the risks of infectious disease in emergency medical texts (Dickerson, 1999; Walter, Rutledge & Edgar, 2003). Additionally, annual department bloodborne pathogen training only addressed rescue related exposures and did not attempt to extend into other occupational exposures (Valerioti, personal communication, August 11, 2004).

Education and training are the most effective means available to limit the risk of contracting an infectious disease (IAFF, 2001). The education and training must extend to the chief officers if management is to give infection control the proper priority (USFA, 1992). As to the format of the training, continuing training and in-service training programs are necessary for fire fighters because unused skills and knowledge fade. The perception that one is being forced to relearn something is a difficult obstacle to overcome with this subject matter, however. The challenge is to gain willing cooperation with drills. (Carter and Rausch, 1999)

Survey responses indicating that 18.7% of respondents didn't recall that pre-use disinfection procedures had been covered in the comprehensive SCBA training program suggest too much information may have been presented in a short time. Carter and Rausch (1999) reported on "the volume of explanation", how lapses of attention, personal biases, misunderstandings, and false impressions of concept clarity can reduce the material effectively reaching the student to far less than what was presented. More focused training programs covering only details of the SCBA infection control program may achieve better results.

Non-compliance with SCBA infection control measures is widespread throughout the Waterbury Fire Department. The non-compliance is a sign of the department culture which places little importance on safety. The department has the equipment and supplies to carry out an effective infection control program. To be successful, this comprehensive program must use more objective evaluation tools to gauge its effectiveness. It will require increased education on infectious disease hazards as part of a cultural change which must take place throughout the department. As Kreis (2002) stated, “Safety must be elevated to one of the department’s most important programs. To be effective, this must be the priority at the top of the organization and be extended through every rank.” (p. 30)

The awareness of the scale of non-compliance with disinfection procedures should serve as a wake up call to the department. It must be assumed that the departmental culture’s low regard for safety carries over into other areas and is unnecessarily exposing firefighters to reducible risks. By seizing on this call for a top down rededication to safety, the department can meaningfully improve the health and safety of its workforce.

RECOMMENDATIONS

The following recommendations were drawn from the research and analysis conducted during this project.

The department must modify the existing SCBA infection control program to educate firefighters about the occupational exposure risks they face when they do not comply with safety procedures. Disinfection cannot simply be presented as a skill with no context.

The SCBA infection control program should be presented as an interactive class during which skills are practiced and proficiency demonstrated. The presentation should strictly focus on the infection control program and not cover operational aspects of SCBA.

Bloodborne pathogen and infectious disease training annually conducted within the department should also address occupational exposures outside the context of rescue, including the use of shared SCBA facepieces and regulators.

The department should reduce the availability of spare facepieces on apparatus in order to compel the use of personal facepieces. One or two spares should be available for incidental use on each apparatus.

Publishers of fire service training texts must include information concerning the risk of occupational exposures to infectious diseases when presenting disinfection procedures. Failure to do so leaves the skill absent meaningful context for doing it properly.

To achieve long term success in improving safety, the department must change its culture to emphasize firefighter health and safety. Part of this is to hold firefighters and supervisors accountable for observed non-compliance.

The fire chief must appoint a department safety officer. This position has been vacant since the previous chief retired in July 2003. Lacking an assigned safety officer, the duties typically assigned to that position have fallen haphazardly to others. This vacancy is symbolic of the low priority assigned to safety by management. The lack of an outcry from firefighters is there willing complicity.

The department needs to develop objective measures to evaluate the effectiveness of the SCBA infection control program and other safety programs. Compliance with safety procedures cannot be accurately assessed via surveys.

Any progress towards improving the department culture to raise the priority given to safety will improve the health and safety of firefighters. This improvement would not be in one operational area, but throughout operations, if the culture truly changed to value the firefighter.

Additional research is needed into the best practices for infection control programs in non-medical workplaces and into evaluative tools to measure the effectiveness of these programs.

Currently, the department has an interim fire chief scheduled to remain in office until December 2004. The new chief should set a high standard for safe operations and hold the department to it as the incremental process of changing the department culture continues.

Follow-up evaluation should take the form of continued inventory of the disinfectant, inspection of SCBA at fire scenes concurrent with accountability system checks, and observation of field disinfection practices by supervisors throughout the department.

Future researchers should avoid the use of surveys to prove positives when evaluating compliance with safety programs. Surveys should be considered useful for gaining insight into negatives such as non-compliant behavior. Surveys should be viewed as qualitative instruments, and the results verified by more objective means.

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APPENDIX

Survey

Completing this survey is voluntary. Doing so will assist the Bureau of Instruction and Training in improving firefighter safety. Additionally, group results may be used in an Applied Research Project for the National Fire Academy.

Do not put your name on this survey. Individual responses are to be kept anonymous and confidential. Your cooperation is appreciated.

Rank: Firefighter (**109**) Line Officer (**35**)

Service Years 4-6 (**35**) 7-10 (**51**) 10-15 (**14**) >15 (**44**)

1. I received training on the Scott AirPak 50 with buddy-breathing option.
   Yes (**144**) No (**0**)

2. I was fit-tested with the computer-aided fit-tester, and issued a personal facepiece.
   Yes (**141**) No (**3**) (If no, skip to Question # 6.)

3. I was issued a Comfort Seal size facepiece. Yes (**122**) No (**19**)

For the following question, please use the following criteria to classify your behavior:
Never 0% Seldom 20% Sometimes 50% Usually 80% Always 100%

4. When SCBA is required, I use my personal mask:
   Never (**8**) Seldom (**5**) Sometimes (**11**) Usually (**31**) Always (**86**)

5. Reasons I do not use my issued facepiece. (Select all that apply.):
   Not applicable. I always use my personal facepiece. (**79**)
   I lost my facepiece. (**0**)
   I forget to bring my personal facepiece when I work at different fire stations. (**21**)
   I do not swap my facepiece onto the regulator, and end up using the spare. (**25**)
   I have a lens kit permanently mounted in my facepiece. (**0**)
   I prefer to use the spare facepieces on the apparatus. (**10**)
   OTHER. (Specify): **(23)**_____

For the following question, please use the following criteria to classify your behavior:
Never 0% Seldom 20% Sometimes 50% Usually 80% Always 100%

6. When I am assigned to a position/change SCBA, I disinfect the regulator during the initial SCBA check:
   Never (**35**) Seldom (**23**) Sometimes (**28**) Usually (**25**) Always (**33**)

(continued on back)

7. Following the use of SCBA, I use the following method to clean the facepiece:
   Water Rinse (**24**) Multi-Wash Mini (**101**) Diluted Bleach (**2**) Rubbing Alcohol (**5**)
   OTHER. (Specify): **(11)** I do not clean the facepiece after use. (**0**)

8. Following the use of SCBA, I use the following method to clean the regulator:
   Water Rinse (**21**) Multi-Wash Mini (**113**) Diluted Bleach (**2**) Rubbing Alcohol (**5**)
   OTHER. (Specify): **(2)** I do not clean the regulator after use. (**0**)

9. I was instructed in the pre-use SCBA disinfection procedures of the department.
   YES (**117**) NO (**23**)

10. I was instructed in the post-use SCBA disinfection procedures of the department.
    YES (**132**) NO (**9**)

11. Reasons I do not use Multi-Wash Mini to disinfect facepieces and regulators are:
    Not applicable. I always use Multi-Wash Mini to disinfect facepieces and regulators. (**75**)
    It takes too long. (**3**)
    I prefer another method of cleaning. (Specify.): **(7)**
    It is not worth the time due to the low risk of infection. (**12**)
    I am busy returning the apparatus to service. (**9**)
    I am too lazy. (**14**)
    I am unfamiliar with the procedure. (**7**)
    Other. (Specify): **(9)**

12. I believe the following training procedures concerning SCBA cleaning and risks would be helpful:
    A review of SCBA cleaning procedures and risks in the monthly in-service training. (**46**)
    A review of SCBA cleaning procedures and risks in a formal classroom setting. (**4**)
    A review and practice of SCBA cleaning procedures, and a review of the risks. (**7**)
    Other.(Specify): **(2)**
    No further training is required. (**82**)

Please place the completed survey through the slot in the sealed box on this table.

Thank you for your time.