Features

A GROWING FIRE HAZARD CONCERN IN COMMUNITIES: HOME OXYGEN THERAPY AND CONTINUED SMOKING HABITS

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ABSTRACT

The Safe Home Care Project investigated both qualitatively and quantitatively a range of occupational safety and health hazards, as well as injury and illness prevention practices, among home care aides in Massachusetts. This article reports on a hazard identified by aides during the study's initial focus groups: smoking by home care clients on long-term oxygen therapy. Following the qualitative phase we conducted a cross-sectional survey among 1,249 aides and found that medical oxygen was present in 9 percent of aide visits (314 of aides' 3,484 recent client visits) and that 25 percent of clients on oxygen therapy were described as smokers. Based on our findings, the Board of Health in a local town conducted a pilot study to address fire hazards related to medical oxygen. Medical oxygen combined with smoking or other sources of ignition is a serious fire and explosion hazard that threatens not only workers who visit homes but also communities.

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Home care is one of the fastest-growing industries in the United States: according to Bureau of Labor Statistics data for 2013, personal care aide and home care aide are projected to be the second- and third-fastest growing jobs during the period 2012-2022 [1]. The growth reflects numerous factors: an aging population, advances in medical technologies, health care cost containment, improved infection control, and the desire of most Americans to be cared for at home. Improvements in medical care mean that people may live longer and more independently with chronic diseases than in prior generations. As a result, the demand for home care services is increasing rapidly, and aides may be assisting clients who have complex chronic conditions and ongoing medical therapies [2]. Data from the National Health Interview Survey show that among adults in the United States aged 75 and over, about 11 percent required help with activities of daily living (ADLs) that pertain to moving and caring for one's body, such as eating, dressing, or bathing; and 20 percent required help with instrumental activities of daily living (IADLs) that support an independent life style, such as household chores or shopping tasks [3].

Home care aides provide the support that allows clients to live at home rather than in institutional settings. Home care aides are predominantly female and increasingly immigrant, minority, and older [4]. Despite high demand, aides represent one of the nation's lowest-paid occupational groups, with median annual pay in 2012 of approximately $20,000 [1]. The companionship clause of the Fair Labor Standards Act exempted many home care aides from minimum wage and overtime protection. In September 2013, the U.S. Department of Labor issued the federal rule to extend minimum wage and overtime protection to home care aides—the rule will become effective in January 2015 [4, 5].

The home care setting and home care aides represent a typical changing workplace and workforce in the United States, with considerable regulatory policy challenges: private homes have become workplaces for a significant number of workers, and this trend will continue to increase in the future. Occupational safety and health (OSH) hazards are difficult to evaluate in highly variable private residences. Furthermore, the workforce is geographically dispersed and transient. From the care work perspective, the home is a less organized, less controlled, and more unpredictable care environment than a facility-based care setting such as a hospital or nursing home [4, 6, 7]. Government regulations apply in only a limited way to home care. For example, the 2001 revised Bloodborne Pathogens Standard applies to the home care or home health care agency but does not regulate working conditions in a home. If a worker is employed by an agency, the employer is responsible for non-site-specific requirements of the standard (e.g., exposure control plan, provision of personal protective equipment, engineering controls), but the employer is not responsible for site-specific violations in the home (e.g., housekeeping, maintaining a sanitary worksite, ensuring the use of engineering controls or personal protective equipment (PPE)) [4, 8, 9].

In 2010, the National Institute for Occupational Safety and Health (NIOSH) funded the University of Massachusetts Lowell to investigate both qualitatively and quantitatively a broad range of occupational safety and health hazards among home care aides in Massachusetts. The research effort is known as the Safe Home Care Project—with the formal title of Safety and Health for Home Care Workers in Social Assistance and Healthcare. It builds on the research team's earlier study, Project SHARRP (Safe Home Care and Risk Reduction for Providers, during 2004-2009). Project SHARRP investigated the risk of sharps injuries and other blood exposure in home health care [6, 7]. The project team, in collaboration with the Massachusetts Department of Public Health's Occupational Health Surveillance Program, has partnered with other sector stakeholders, such as home care agencies, labor unions, an industry group, and government agencies. The project seeks to improve safety and health in home care through investigation of the challenges, hazards, and promising practices in delivery of increasingly complex care in homes; identification of effective, preventive interventions; and development and distribution of educational materials for home care workers, agencies, and other beneficiaries.

OBJECTIVE

This article focuses on an unanticipated finding identified by the Safe Home Care Project study: the hazards of medical oxygen in home care when oxygen users are smokers. This fire hazard was first identified in focus groups and then further evaluated in a large-scale survey of home care aides' occupational safety and health experiences, a post-survey evaluation, and a pilot intervention.

BACKGROUND

Home cooking equipment, smoking materials, and heating equipment are leading causes of residential structure fires, injuries, and civilian home fire deaths [10]. Medical oxygen combined with smoking or with any other source of ignition is a serious fire and explosion hazard.

Oxygen therapy is used to prevent or treat hypoxia, the deprivation of adequate oxygen supply to the body [11]. It is prescribed for chronic medical conditions including chronic obstructive pulmonary disease (COPD), late stage heart failure, cystic fibrosis, and sleep-related disorders such as sleep apnea [12]. The most prevalent of these conditions is COPD, also known by other names, such as emphysema or chronic bronchitis; in the United States, approximately 6.3 percent of adults (an estimated 15 million) have physician-diagnosed COPD [13], and almost as many, 12 million, are estimated to have undiagnosed COPD [14].

In 2004, approximately 1.3 million Medicare beneficiaries rented oxygen concentrators, the most common type of home oxygen equipment for this population [15]. Data on non-Medicare procurement of medical oxygen is limited.

However, a very conservative estimate suggests that a total of over 2 million oxygen systems are in use throughout the United States—that is, one out of every 147 residents in the United States has an oxygen concentrator [16, 17].

Recent newspaper and journal articles confirm that burns and fires related to smoking and home oxygen use are a growing problem and a serious public safety threat [18-20]. Data from the National Fire Protection Association (NFPA) show that during the period 2003-2006 hospital emergency rooms treated 1,190 thermal burns per year caused by ignitions associated with home oxygen equipment (in most cases, the fire department was not involved) [16]. In 73 percent of these burns, smoking materials provided the ignition source. The NFPA also estimates oxygen equipment was involved in an average of 182 home fires annually, with 46 civilian deaths and 60 civilian injuries; one in four fires resulted in death [16]. There is no safe way to smoke while using oxygen. Even if oxygen has been shut off, it may have saturated and lingered on hair, clothing, curtains, furniture, and bedding in the area [16].

METHODS

This study was part of the Safe Home Care Project at the University of Massachusetts Lowell (UML), funded by the National Institute for Occupational Safety and Health (NIOSH). The overall study investigated a broad range of OSH hazards and good work practices among home care aides in Massachusetts. The study implements a research-to-practice approach designed in three major phases: 1) pre-survey qualitative phase including12 focus groups and 26 in-depth interviews [4]; 2) cross-sectional survey questionnaire administered among 1,249 home care aides in Massachusetts; and 3) post-survey qualitative phase including feedback on our survey findings as well as focus groups and in-depth interviews to seek further interpretation of our survey findings and home care aides' recommendations for preventive interventions. The focus group, interview, and survey protocols were built on methods developed for a previous study of sharps injuries in home health care [6, 7, 21]. All focus group, interview and survey protocols were approved by the UML Institutional Review Board. Each participant provided signed informed consent.

The study's focus group and survey population included home care aides who were employed by private agencies and personal care attendants (PCAs) who were self-employed and hired directly by home care consumers or their surrogates. In our study, we used the term "home care aide" to include a range of aide job titles, unless otherwise noted. Agency employees included home health aides, personal care homemakers, homemakers, and companions. PCAs were hired and supervised directly by eligible consumers receiving MassHealth (Massachusetts Medicaid administrator) insurance coverage for assistance with ADLs. PCAs are organized by a labor union, and the Massachusetts PCA Quality

Home Care Workforce Council acts as the employer of record in collective bargaining negotiations [22].

In the cross-sectional survey, we invited employees with direct client care job duties at partner agencies and consumer-hired PCAs to complete a questionnaire describing their demographics, workplace characteristics, hazards and injury/illness outcomes, and characteristics of recent client visits. Home care aides received the questionnaire either through an on-site recruitment event (agency employees) or via United States postal mail service (PCAs). PCAs returned the questionnaire by mail; participants at agencies returned the questionnaire either in person at on-site in-service training events in their agencies or through the mail.

Following analysis of the preliminary survey results, home care aides and PCAs received by mail a brochure briefly summarizing the findings. Partner agency managers and the union representative received a detailed report as well as the summary brochure. Along with the brochure and/or report, each recipient received a feedback form and postage-paid reply envelope, along with the invitation to comment on the survey findings. Details of the survey methods are reported elsewhere [23].

At the time of submitting this manuscript, the study's post-survey qualitative phase is underway. To date, we have received 85 completed feedback forms from home care aides and managers on our survey findings. We have scheduled eight focus groups and six in-depth interviews during March-April 2014 to seek home care aides', agency supervisors', and union representatives' perspectives on our survey findings.

To better understand the real-world implementation of possible solutions, we conducted a pilot intervention study in a local Board of Health (BOH). In Massachusetts, BOHs are required by state statute to perform duties for protection of public health, control of disease, promotion of sanitary living conditions, and protection of the environment [24].

RESULTS

This section presents findings from our qualitative and quantitative research. Oxygen and smoking was a prevalent theme in our pre-survey focus groups with home care aides; therefore this issue was also assessed in our subsequent cross-sectional survey.

Study Population

Our pre-survey qualitative phase included 12 focus groups involving 99 home care aides and in-depth personal interviews with 26 stakeholders representing home care agency management, labor union leadership, the workers'

compensation industry system, and home care clientele. Details of this first study phase are reported elsewhere [4].

The cross-sectional survey questionnaire was administered among 1,249 home care aides in Massachusetts. The survey response rate among agency-employed aides was 84 percent and among PCAs 30 percent. The details of the main survey findings are reported elsewhere [23].

Oxygen Reports during the Pre-Survey Qualitative Study Phase

Our pre-survey qualitative study findings showed that common OSH hazards among home care aides include back and shoulder pain/injuries, verbal and physical abuse, falls inside and outside the home, bloodborne pathogen exposures, and long-distance driving [4]. In addition, an unexpected hazard emerged: fire safety related to clients on medical oxygen therapy. A particular concern was smoking by home care clients while on oxygen therapy.

When we asked about general hazards and dangerous situations in their home care work, in six out of the 12 focus groups, home care aides cited clients smoking while on oxygen. A focus group participant expressed the following:

> Yeah, when the people like are using the oxygen and they smoke in the house. . . . It's happened sometimes, it's happened. Even when they know they're not supposed to do it. Even when you report it, they still do it and there's nothing you can do about it . . . you can refuse to go into the house . . . we can say I'm not going there because you are smoking and you have the oxygen, but some people they don't care.

In some cases, a client would shut off the oxygen before smoking. In other cases, as illustrated by this quote, a client would remove the cannula from his/her nose and smoke:

> And the worst part is, [the client] takes the oxygen off her nose and puts it on the chair, and lights a cigarette.
> —Home care aide in Safe Home Care Project focus group

Finally, a client would smoke with oxygen still being delivered nasally [4]:

> I have a client that is on oxygen and she smokes while she has it on. She doesn't want to stop, she has had social workers, nurses, everybody you can think of going in there to tell her to stop. I actually see sparks on her nose. So now, when I go in I just tell her, you can't smoke. Some days I'm there an hour and a half, some days two hours. So she has to go two hours without smoking a cigarette . . . she was outside, she drove a scooter and she had her oxygen on her face and she saw a neighbor and she took her oxygen off her face to smoke the cigarette and the neighbor said to her, you don't need to take that off your face. She said yes I do and she said no you don't, you can smoke with it on. So she's been smoking with it on ever since.
> —Home care aide in Safe Home Care Project focus group

Two home care industry representatives (out of 13 industry representatives) described their perspectives in in-depth interviews:

> Yes, [smoking is] very common. You know, if they want to smoke, we can't stop them, but then we would tell them that the aide would have to leave while they're smoking. But then they get upset and then they don't like the aide, and then they don't want the service. And they need the service. . . . the aides are only there for a short amount of time, so then what happens afterwards when the aide leaves, then they'll smoke again with the oxygen.
> —Home Care agency supervisor

> . . . clients are smoking. It's a concern if the client has oxygen in the house, but you see that too. Smoking with oxygen. That's a big problem. We have that in training. The big hazard for the worker, the client, and the whole building.
> —Home care industry representative

Oxygen Reports in the Survey

After the qualitative phase, the topic was further evaluated in the cross-sectional survey. The survey asked specific questions about the most recent five clients visited in the past month and included questions related to oxygen use and smoking during each visit by the client and/or other individuals in the home.

The results showed that 9 percent of clients/consumers were on oxygen and of this group, 25 percent of them were reported to be smokers (see Table 1). In homes where the client was on medical oxygen, 19 percent of the aides reported exposure to secondhand smoke on their last visit. (This includes smoking by other individuals in the home.)

Table 1. Clients' Oxygen Use and Smoking Behaviors

	Client visits ($n = 3,484$)	Percent (%)
Clients reported by aides as smokers	422	12
Client on oxygen	314	9
Of clients on oxygen, number/percentage who smoke	77	25
Of clients on oxygen, number/percentage of their aides who were exposed to secondhand smoke during their visit[a]	61	19

[a]Includes secondhand smoke from other smokers in the home.

Post-Survey Feedback

Following analysis of the survey results, a summary brochure of key findings was sent to each survey participant. We invited feedback and included a postage-paid envelope and a single-page anonymous form asking for: 1) safety or health tips for someone new to home care; 2) the most important occupational safety and health concerns for the respondent personally; and 3) other comments and suggestions. Among the 84 participants who provided feedback (7% response rate), one person included the safety tip: *Make sure client does not smoke with oxygen!!!*

More generally, a number of the comments addressed oxygen and smoking, fires, and secondhand smoke (see Table 2).

Table 2. Participant Feedback on Survey Findings

	Theme		
	Oxygen and smoking	Fire	Second-hand smoke
Question: If you could share one or two job safety or health tips for someone just starting out in home care, what advice would you give them? Aides' responses:			
Make sure client does not smoke with oxygen!!!	✔		
Extinguish cooking fire with a lid or by extinguisher foam.		✔	
If a fire alarm goes off and no one [is] rushing out I try to call the [police] and then [let others indoors know] there is a fire.		✔	
Question: In your opinion, what are the most important safety and health concerns for you personally in your home care work? Aides' responses:			
Secondhand cigarette smoke.			✔
I am worried regarding fires. I don't like smoking, as it is hard to breathe in closed areas.	✔		✔
That client . . . wouldn't smoke while getting service.			✔
Keeping the environment clean, no smoking . . . while I am in the house			✔
Can they [the client] get out if there's a fire.		✔	

Pilot Intervention in Local Town

We presented our Safe Home Care Project study findings about medical oxygen and smoking to a local Board of Health and asked if the BOH was interested in taking on this topic as a project to benefit the town. No specific guidelines were established and there were no incentives offered, other than access to the expertise of the Safe Home Care Project team. There was strong interest and with the Board's approval, the BOH agent agreed to manage the pilot project. Over a period of approximately six months, the agent spearheaded a three-faceted approach: 1) she convened a project stakeholder group that included the Fire Chief, Council on Aging (COA), Library, and multi-unit housing managers; 2) she obtained a small state grant that resulted in development of a manual entitled "Protecting Community Members From Tobacco Hazards" [25] (this is a resource manual for fire department, police, other first responders, COA, churches, multi-unit housing managers, service providers and businesses, and other stakeholders (including resources for landlords and condo associations to implement smoke-free policies)); and 3) she established a partnership with a medical school for conducting a two-week population health clerkship in which medical and nursing graduate students explored the problem and conducted outreach to the community. Five students signed up for the internship. Their work included the following: literature review, community talk at the library, resource materials for the BOH website, and interview with the COA that was aired on community cable TV (with periodic re-runs).

Although it was impossible to measure a direct impact of this short intervention study, the obvious benefits were raised awareness (prior to the study, no one other than the fire chief was aware of the potential for medical oxygen and smoking hazards in the community), engagement and development of resource materials for stakeholders, presentation of the topic at regional health networking groups, and education of the next generation of medical professionals (the students participating in the clerkship). This was accomplished at low cost and in a short period of time, which hints of the potential impact if similar efforts became widespread. The intervention study serves as a model for BOHs of other towns.

DISCUSSION

The results showed that fire safety around clients who smoke while on oxygen therapy was a concern for home care aides. Among their clients, medical oxygen therapy frequently coexisted with smoking, creating an environment with a heightened risk of fire. Aides reported on recent client visits: of clients who were on oxygen, almost 25 percent smoked, and the aides were exposed to secondhand smoke in 19 percent of the visits to clients on oxygen. Secondhand smoke in itself is a well-characterized health hazard and classified by the International Agency

for Research on Cancer (IARC) as carcinogenic to humans (Group 1) [26]. Long-term oxygen therapy is most commonly prescribed for patients who have later-stage chronic obstructive pulmonary disease, a serious lung disease which makes it difficult to breathe and causes long-term disability [27]. Roughly 10 percent of adults in the United States aged 65 and older have physician-diagnosed COPD [14]. Smoking is the dominant cause of COPD [28], and long-term exposure to other lung irritants—such as air pollution, chemical fumes, or dust—also may contribute [27]. COPD is now the third leading cause of death in the United States [27]. Oxygen therapy increases survival for COPD patients and offers other benefits as well, including improved exercise capacity, lung mechanics, and mental state [29, 30]. Because smoking is typically the root cause of COPD, and given the difficulty of smoking cessation, it is reasonable to expect—and our data show—that many clients receiving oxygen therapy are current smokers.

Oxygen Therapy and Fire Hazards

Oxygen is one of three elements necessary for fire: heat (or ignition source), fuel, and oxygen. Adding oxygen makes any existing fire burn hotter and faster, and fuels in the vicinity can ignite at lower temperatures than usual [16]. With medical oxygen in use, the area around the client can become enriched with oxygen. When an ignition source is added, hair, oils on the skin, clothing, furniture, hair spray, cosmetics, skin lubricants, hand sanitizers, and other materials ignite and burn readily in the oxygen-rich environment (Figure 1). User manuals for virtually all oxygen concentrators warn that no smoking or open flames should be allowed around the system due to serious fire hazards. Most also warn against the use of oils, petroleum products, or grease.

Despite the warnings, smoking in the presence of oxygen equipment is common. There are compelling statistics and estimates on fires, burns, deaths, and property damage involving home medical oxygen [16, 20]. The NFPA extrapolation of information in the Consumer Product Safety Commission's National Electronic Injury Surveillance System (CPSC NEISS) database for 2003-2006 (a probability sample of emergency rooms) suggests that 1,190 burns

Smoking → COPD → long-term oxygen therapy
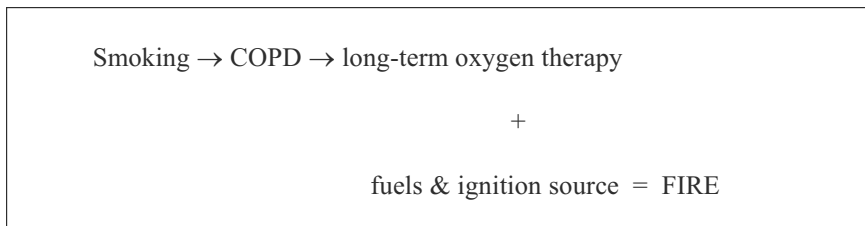
+

fuels & ignition source = FIRE

Figure 1. Oxygen therapy and fire hazards.

occur annually that are related to medical oxygen use [16]. Smoking materials provided the ignition source in 73 percent of these burns, with the next largest sources being stove or oven (10%) and candles (9%). In the vast majority of actual emergency room cases examined (87% or more), the fire department was never called [16].

The NFPA also analyzed home fires based on national fire experience statistics from the U.S. Fire Administration's (USFA) National Fire Incident Reporting System (NFIRS) and NFPA's annual survey of U.S. fire departments (2002-2005) and derived estimates pertaining to fires in which oxygen administration equipment was involved. Their analysis suggests that during 2002-2005, oxygen administration equipment was involved in an average of 182 home fires reported to local fire departments annually, resulting in an estimated 46 civilian deaths and 60 civilian injuries per year. That is, a civilian was killed in one of every four oxygen fires, and a civilian was injured in every one of three incidents [16].

As this article was being written, the local news station reported two fires in Massachusetts caused by smoking in the presence of home oxygen. In the first fire, three people were injured, one seriously, and six people were displaced. Later that day, a second fire injured one person and displaced eleven people [31].

Where Do Solutions Lie?

In the quality control world, a model called the 1-10-100 rule states that at each stage where a problem is not fixed, the cost of addressing it at the subsequent stage increases ten-fold [32]. Cost is not just monetary, but also includes the complexity of solutions and the potential for harm. Applying the model to the problem of long-term oxygen therapy and smoking (Figure 2) suggests that this problem could be addressed at six stages.

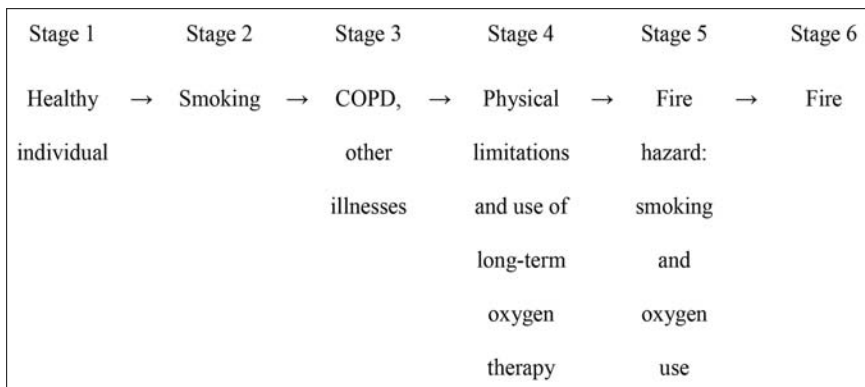| Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6
Healthy individual	→	Smoking	→	COPD, other illnesses	→	Physical limitations and use of long-term oxygen therapy	→	Fire hazard: smoking and oxygen use	→	Fire

Figure 2. Stages leading to oxygen fires.

Guided by the industrial hygiene hierarchy of hazard controls, we see that the most effective protections are the upstream ones (Table 3).

The typical approach for addressing oxygen fire hazards has been counseling and education of patients and families; that is, administrative controls. Information provided focuses on fire safety tips, such as: do not smoke, check for working smoke detectors, avoid using petroleum products, avoid open flames, keep 10 feet away from ignition sources, and use signage to alert residents and visitors to use of medical oxygen and its associated fire hazards. Another form of administrative control is evident in the accreditation program of home health providers by the Joint Commission (accreditor of health care organizations and programs in the United States). As part of accreditation, health care providers are surveyed for compliance with the Joint Commission's *National Patient Safety Goal number 15.02.01 (Identify risks associated with home oxygen therapy, such as home fires),* in which home health providers must assess and promote the safe use of oxygen among patients [33]. This goal was introduced in 2008 in response to reports of patients injured or killed in home fires related to oxygen

Table 3. Oxygen and Smoking-Related Fire Prevention from the Perspective of the Industrial Hygiene Hierarchy of Hazard

Type of control	Examples (and Intervention Stage)	Level of protection
Elimination of the hazard	Prevent need for medical oxygen via population-based interventions and public policies: Smoking prevention (Stage 1) Smoking cessation (Stage 2) Smoking bans (Stages 1-2)	Most protective
Substitution	(not applicable)	↑
Engineering controls	Oxygen equipment features that prevent ignition and/or spread of a fire (Stages 4-6) Residential sprinkler systems (Stage 6)	
Administrative controls	Education on safe use of oxygen (Stages 4-5) Use and reinforce use of safe personal practices (Stages 4-5) Check potential sources of spark (Stage 5) Check smoke detector (Stage 6)	↓ Least protective
Personal protective equipment	(not applicable)	

use. The Joint Commission focus is on patient safety, rather than occupational safety and health. Accreditation of home care agencies that provide support solely for ADLs (versus medical care) is rare, but raising the standards for home health services delivered under Medicare will ultimately benefit the home care industry as a whole. However, the drawback of administrative controls is their reliance on long-term individual behavior change, which is known to be difficult to bring about.

Because most long-term medical oxygen therapy results from smoking and COPD, the most effective interventions will be those that prevent, reduce, and eliminate smoking: passing smoke-free laws, taxing tobacco, changing social norms regarding smoking through hard-hitting anti-tobacco campaigns and elimination of advertising and promotional cues to smoke, and providing access to smoking cessation programs and clinical care that incudes cessation medication [34]. Ideally, reinforcements should be provided so that not smoking is the preferred option. For example, smoking ban policies (in homes, workplaces, and towns) have been shown to protect nonsmokers from secondhand smoke, and are also associated with smoking reduction and cessation [35]. Within the health care community, adoption of COPD chronic care models oriented toward health promotion and prevention of disease complications can ensure that COPD patients' health conditions remain stable as long as possible, delaying the need for oxygen therapy [36].

An avenue complementary to smoking prevention and cessation is applying the Prevention through Design model, in which occupational safety and health needs are addressed in the design process to prevent or minimize the work-related hazards and risks associated with the construction, manufacture, use, maintenance, and disposal of facilities, materials, and equipment [37]. As the largest supplier of oxygen concentrators, Medicare is well-positioned to foster development of inherently safer equipment by mandating that Medicare funds be used solely for equipment meeting defined performance criteria. Existing national and international consensus codes and standards for both home medical oxygen and industrial oxygen systems offer relevant guidance for improved home oxygen equipment. For example, ISO 8359:1996/AMD 1:2012 (Oxygen concentrators for medical use—safety requirements) requires a thermal fuse (or fire break) located close to the nasal cannula in oxygen concentrators to prevent the spread of fire from the cannula to the oxygen concentrator [38]. Another standards body, the International Electrotechnical Commission (IEC), charged with revising its standards on oxygen concentrators, infers that most instructions for medical device use, including the warnings, are never read. IEC standards are therefore based on the expectation that devices designed for home use must be intrinsically safe [38].

Residential sprinkler systems can also play a role in preventing or slowing the growth of fires and allowing for a safe escape. Many state and local building codes now require residential sprinkler systems. In addition to saving lives,

sprinklers can also protect property from destruction, and in many situations this means that residents will also have a place to live and enough resources to continue living their lives as they did before [39]. Even with sprinklers, the NFPA study [40] suggests that oxygen-fueled fires can progress so quickly that sprinklers may still be inadequate for preventing fatalities, particularly to a home care client in poor health. While sprinklers can be one facet of protection against oxygen fires, true solutions are further upstream.

Our pilot intervention suggests that immediate public health actions can take place at the community level, even in the absence of significant financial resources. In addition to the obvious stakeholders (fire department, health department, council on aging), we also engaged the next generation of medical providers and residential building owners/managers, who can implement protective actions and policies that will yield long-lasting protection against medical oxygen fires. Raising awareness about long-term oxygen therapy and smoking at the community level and within public health networks will provide further impetus for change.

Workplace Practice and Policy Considerations to Address Broader OSH Concerns in Home Care Work Environments

Only recently has the U.S. health care industry started paying more attention to the direct link between patient safety and worker safety [4, 41, 42]; earlier, patient safety was the main focus and less importance was given to health care workers' safety. The Safe Home Care Project findings show that client safety and worker safety are inseparable in home care: home hazards—like home oxygen units—become home care workers' safety risks [4]. Home care agency supervisors interviewed by the Safe Home Care Project explained that before admitting a new client as a case, an initial client evaluation is carried out by a case manager or authorized agency clinician—this baseline home evaluation emerged as one of the most potent safety intervention points by providing the basis for development of a care plan and specifying needed changes in the home environment [4]. The Safe Home Care Project study findings also emphasized the importance of teaching safety to aides in both new employee orientations and annual in-service trainings. Finally, when considering the critical client-worker safety link, it is essential to identify ways to provide safety training and information to home care clients.

CONCLUSIONS

Although oxygen therapy coupled with continuing smoking behavior is a relatively unrecognized hazard in the OSH community, the practice is receiving more widespread attention in mainstream media (newspapers, television) due to

the catastrophic impacts. Medical oxygen combined with smoking or with any other source of ignition is a serious fire and explosion hazard that threatens not only workers who visit homes but also communities. Key leverage points for improving OSH around home medical oxygen are: 1) societal policies and actions that prevent or minimize smoking; 2) engineering design interventions that address occupational safety and health in the design process to prevent or minimize the work-related hazards related to oxygen therapy; 3) home care agency's new client baseline evaluation by a case manager or other clinician; 4) new employee orientations and in-service trainings for home care aides; and 5) education and information campaigns for home care clients. The Centers for Medicare and Medicaid Services can be a key actor, as the largest provider of home oxygen systems.

The increasing prevalence of home as a work environment poses a challenge for existing OSH regulatory models that were designed for traditional workplaces and with management as a responsible party. Health and safety policies must take into consideration that residences are workplaces for today's workforce.

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