Pregnant pause

Inspector Nikki Sprenger and Bttn. Chief Gerald M. Bates, Tucson Fire Department | *Fire Chief*

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With more than an estimated 6,000 women working as full-time career firefighters and officers in the United States and perhaps 40,000 more in the volunteer, part-time and seasonal sectors, the topic of reproductive safety garners a considerable audience. By the very nature of the job, firefighters are exposed to environmental, chemical, biological and physical hazards in varying amounts and combinations

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By the very nature of the job, firefighters are exposed to environmental, chemical, biological and physical hazards in varying amounts and combinations on a regular basis. A woman who remains in an active firefighting assignment may be putting her unborn child at risk from an exposure to toxic products of combustion.

Policy positions

Although reproductive safety is an important workplace consideration, it hasn't been addressed officially by all of the country's fire service leadership organizations.

For example, the International Association of Fire Chiefs doesn't have an official statement on the subject. Women in the Fire Service, which represents career and volunteer firefighters and rescue personnel in 48 states, does not offer an official policy either, but donates a considerable portion of its Web site to bibliographies on reproductive safety and legal issues.

The International Association of Fire Fighters, which has been involved in scientific and medical research involving the risks associated with pregnancy, recommends “that pregnant firefighters should not participate in fire suppression, hazardous material and EMS operations from the time pregnancy is confirmed and that pregnant firefighter candidates should defer training. Alternative duty should be identified for pregnant firefighters, preserving rank and wages.”

By law, the determining factor in any work status decision is the person's ability to do the job — not the pregnancy itself, or an altruistic desire to protect the firefighter or her fetus. Such a decision should be made in concert with the pregnant firefighter, her physician

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and the department administration.

Many physicians are certainly aware of the risks that exposure to toxins may have on a fetus. They may not, however, be fully aware of the unique physical demands of firefighting and potential for exposure to a variety of toxic chemicals, particularly carbon monoxide, and how those factors may also affect fetal development.

Avenues of exposure

While the presence of certain chemicals at a fire scene depends on the types of fuels that have burned, some toxic gases are common to most fires. These include carbon monoxide, hydrogen cyanide, acrolein, formaldehyde, benzene, acetaldehyde and formic acid. These gases are suspended in smoke, which is primarily made up of oxygen, nitrogen, carbon dioxide, carbon monoxide and carbon particles. The most prevalent of these gases is carbon monoxide.

Firefighters who conduct overhaul operations without SCBA may exceed recommended carbon monoxide exposure limits and suffer adverse health effects. A study published in the *American Industrial Hygienists Association Journal* found that during the overhaul of 26 fires in Phoenix, five presented levels of carbon monoxide in excess of the National Institute for Occupational Safety and Health short-term exposure limit of 200ppm. The stel is a 15-minute exposure limit that should not be exceeded during the workday.

Although the fire service has traditionally focused on the exposure risk to contaminants at a fire scene, diesel exhaust may be a more prevalent source of carbon monoxide on a day-to-day basis. Diesel exhaust from apparatus can fill the engine bays with carbon monoxide and even infiltrate fire station living and sleeping quarters. Effects from the exposure highly depend on how often and how long a person is exposed.

Whereas many industry workers' exposure to diesel exhaust will not usually exceed an 8-hour workday, most firefighters work 24-hour shifts. Contributing to the exposure is the number of apparatus housed in a station, the number of calls run during a shift and the station's design.

Chemical effects

Carbon monoxide gas is a chemical asphyxiant that deprives the body of oxygen. It adheres to hemoglobin in the blood, forming carboxyhemoglobin (COHb) and consequently making the hemoglobin molecule unavailable for the uptake of oxygen.

In fact, 100ppm of carbon monoxide in ambient air is enough to produce 16% carboxyhemoglobin in the bloodstream. According to the International Fire Service Training Association, carboxyhemoglobin amounts in the blood stream between 10% and 20% would cause shortness of breath during physical exertion and tightness across the forehead.

Hemoglobin transports 98% of the body's oxygen. As the amount of oxygen diffused in the blood increases, the partial pressure of oxygen increases. An increase in the partial pressure of oxygen causes oxygen and hemoglobin to bond, and a decrease causes hemoglobin to release oxygen. Because carbon monoxide binds to hemoglobin more avidly, taking up available space, it causes a leftward shift in the oxygen disassociation curve, resulting in decreased oxygen delivery to the tissues.

There is evidence that other fire gases can have an additive effect to carbon monoxide, but there is a general lack of information available about how chemicals react together in a human exposure.

Hydrogen cyanide and carbon dioxide pose the greatest risk of a combined effect. Large concentrations of carbon dioxide decrease the hemoglobin's affinity for oxygen. Hydrogen cyanide is produced by fuels that contain nitrogen, such as plastics, synthetic fibers, nylon, wool and polyurethane foam. The NIOSH STEL for hydrogen cyanide is 4.7 ppm.

According to Tucson Fire Department Capt. Ray Sayre, a lead instructor for Tucson's Metropolitan Medical Response System, hydrogen cyanide prevents cells from being able to use available oxygen by binding with cytochrome oxidase, the cellular enzyme responsible for allowing oxygen molecules to enter the cell.

In small doses, hydrogen cyanide is detoxified by a naturally occurring enzyme in the body called sodium thiosulfate. Larger doses overwhelm the body's reserve of this enzyme and produce systemic effects such as an increase in pulse rate. The effects of hydrogen cyanide are directly additive to those of carbon monoxide, compounding the problem by exacerbating the cells' inability to use what oxygen is available.

Finally, because firefighting is a strenuous activity that produces carbon dioxide, a firefighter's rate of breathing increases. That increased respiration will increase the uptake of carbon monoxide and hydrogen cyanide.

The effects of these chemical compounds on adults naturally lead to questions about how they may affect a developing fetus.

Oxygen delivery to the tissues is vital to the normal development of the fetus, especially in the first trimester, when vital organs and limbs are forming. Although the mother may be asymptomatic following a small exposure to carbon monoxide, the developing fetus has a greater risk due to three factors:

1. The fetal oxygen disassociation curve normally lies further to the left than that of an adult, resulting in less oxygen delivery to the tissues.
2. Carbon monoxide is eliminated from the fetal blood much slower than the maternal blood.
3. Fetal hemoglobin has a greater affinity for carbon monoxide than adult hemoglobin.

It's important to note that the danger is considerable even when the mother doesn't present clinical symptoms because there's a lag in the time of carbon monoxide uptake and elimination between mother and fetus. With a small exposure, carbon monoxide in the mother's blood can fall to undetectable levels before the fetus reaches peak levels over 24 hours.

Risk reduction

There is a reasonable argument that a pregnant firefighter could be exposed to levels of carbon monoxide that are detrimental to her fetus. The presence of diesel exhaust in apparatus bays and the products of combustion in the overhaul phase of a fire present two avenues of carbon monoxide exposure. The risks posed by each can be reduced by several means.

For example, the use of negative-pressure exhaust fans, triggered when the bay doors close, will help expel exhaust from the trucks, as will the use of ventilation systems that provide fresh air to the bay itself. Without detection and monitoring devices, however, it's difficult to determine to what extent fumes and carbon monoxide are eliminated. Placing detection devices in sleeping quarters and adding weather stripping to all doors leading from the bay to the living areas can further protect firefighters from exposure.

The placement of weight sets or workout equipment in apparatus bays is another factor that can contribute to carbon monoxide exposure. Respiration and circulation can be increased by exercise and elevated body temperature, proportionately increasing the formation of carboxyhemoglobin. Firefighters who work out in the apparatus bays might have an increased risk for exposure that is dependent on the carbon monoxide level and can be compounded by the effects of physical exertion.

Away from the station, peak carbon monoxide concentrations measured in fires exceed 15,000ppm, but firefighters wearing SCBA are not exposed to these concentrations. During overhaul, when firefighters are less likely to wear respiratory protection, carbon monoxide levels can reach and exceed the stel of 200ppm.

Pregnant firefighters operating in the overhaul phase can put their fetus at risk if the proper protective equipment is not worn. In a 2001 study published in the *Journal of Occupational and Environmental Medicine*, the authors concur that using positive-pressure SCBA during overhaul can reduce a firefighter's amount of contaminant exposure by 10,000-fold. The same study noted that the use of a cartridge respirator by itself, which offers no protection from carbon monoxide, was less effective in the reduction of contaminants.

To lessen the risk of a carbon monoxide poisoning to the fetus, a pregnant firefighter should:

- Wear full turnouts and SCBA while working in and around an overhaul atmosphere.
- Consider alternative locations to perform physical-fitness activities if workout equipment is housed in the apparatus bay.

Administrative concerns

An employer's ability to ensure the protection of the pregnant firefighter and her fetus is limited. The 1978 Pregnancy Discrimination Act forbids sex-specific fetal-protection policies, and in 1991, the U.S. Supreme Court ruled that an employer can't determine if a work environment is too hazardous for a pregnant worker and change her work status solely on the basis of her pregnancy. This is a decision that must be left to the pregnant employee and her physician. An employer can only intervene when a firefighter's pregnancy interferes with her ability to do her job.

A related administrative issue facing an employer is how a pregnant employee's work status is determined once she and her physician conclude that she should not continue working in hazardous duty. Departments have developed several ways of managing this issue, including non-hazardous work assignments, accrued leave and work trades. In addition, the 1993 Family and Medical Leave Act requires an employer to grant job-protected unpaid leave to eligible employees for up to 12 weeks per 12-month period for serious health conditions resulting from the pregnancy and/or the birth of a child.

To provide for the safety of department personnel, employers should:

- Provide exhaust fans and ventilation systems in apparatus bays, and consider the installation of carbon monoxide monitors in apparatus bays, living areas and sleeping quarters.
- Require all personnel to wear full turnouts and SCBA while working in and around overhaul areas.
- Consider relocating workout equipment to an area of the station other than the apparatus bay.

To ensure that pregnant firefighters and their doctors are able to make informed decisions regarding the continuation of a hazardous duty assignment, employers should:

- Enlist the help of the department's physician to research the hazards associated with firefighting and how they may affect a pregnancy.
- Develop and distribute comprehensive information packets to the pregnant firefighter and her physician upon departmental notification of the condition.
- Develop policies requiring the department's physician to be informed of a pregnant firefighters' progress and condition. These updates should be submitted in writing by the woman's personal physician.

As more women choose firefighting as a profession, the fire service must remain current in acknowledging and addressing issues surrounding pregnancy, including how effects of the job may affect the mother and fetus. Fire officers will continue to be challenged with developing policies regarding pregnancy and hazardous duty that address the safety of these firefighters, their co-workers, the public and the unborn child.

Fire Inspector Nikki Sprenger, who has two children of her own, has been with the Tucson (Ariz.) Fire Department for eight years.

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Bryn Bailer, media consultant for the Tucson Fire Department, also contributed to this article.

Pregnancy, work environment and the law

There is legal precedent to guide employers' response to pregnant female workers involved in potentially hazardous work environments.

Between 1979 and 1983, eight employees of battery manufacturer Johnson Control Inc. became pregnant while maintaining blood lead levels exceeding the Occupational Safety and Health Administration safety standard. The company announced a policy barring all women — except those whose infertility had been medically documented — from certain jobs in which exposure to toxic agents or radiation could potentially harm fetal development.

The United Automobile Workers challenged that policy as gender discrimination under Title VII of the 1964 Civil Rights Act.

In its landmark decision in *Automobile Workers v. Johnson Controls Inc.*, 499 US 187 (1991), the U.S. Supreme Court declared such fetal-protection policies unconstitutional — thus guaranteeing women the right to equal employment opportunities without regard to childbearing capacity.
— Bryn Bailer

Survey of fire department policies shows similarities

Fire departments have various approaches to dealing with pregnant personnel. Here are excerpts from several agencies' official policies.

Austin (Texas) Fire Department: “When a firefighter finds out she is pregnant, she should inform her officer and is given an alternative light-duty assignment for the duration of her pregnancy. The job of firefighting is a hazardous job and is not conducive to being pregnant.”

Phoenix Fire Department: “The primary determination of duty assignments of pregnant members will be safety. Upon notification by a physician that a member is pregnant, the member must contact the Fire Department Personnel Officer and indicate

verbally and by written memorandum the expected date of delivery. The Personnel Officer will notify the department physician, who will consult with the member and her physician to determine a time frame when the member will be reassigned to an alternate duty position."

Sterling Heights (Mich.) Fire Department: "Any Fire Department employee, upon being informed by her physician that she is pregnant, shall immediately notify the Fire Chief of her status and expected delivery date. The Fire Chief will schedule a conference with the pregnant member and her union representative to advise her of her options for duty status ... and to outline the chemical and non-chemical effects of firefighting and pregnancy outcome. After the employee has been informed of the hazards of firefighting effects on pregnancy, she will be asked to choose a course of action on duty status that is acceptable to her and her physician."

Tucson Fire Department: "The Tucson Fire Department recognizes pregnancy as a normal occurrence in a woman's life and therefore establishes this policy to implement the provision of temporary alternate non-hazardous duty assignments for pregnant female employees until the employee takes medical or other approved leave.

"When an employee is diagnosed as pregnant by a physician, she will immediately notify her immediate supervisor and the personnel officer.... Employees assigned to a combat position shall request a letter from their attending physician addressing the employee's ability to continue in their present assignment. The personnel officer will provide the employee with a packet of information for her attending physician that includes a description of job duties, responsibilities and conditions.

"The employee is responsible, with advice from her physician, to determine how long she will continue in her assigned position. Temporary reassignments to alternate non-hazardous duty within a classification will be granted upon written request to the Fire Chief by the employee. All alternate non-hazardous assignments shall be based upon Department needs and physical limitations determined by the member's attending physician....

"Discrimination on the basis of pregnancy, childbirth or related medical conditions constitutes unlawful sex discrimination and will not be tolerated."

For more information

The following resources may be helpful:

- "A Handbook on Women in Firefighting," Federal Emergency Management Agency/U.S. Fire Administration
- "Reproductive Safety/Maternity Issues" packet, Women in the Fire Service
- "The Effects of Workplace Hazards on Female Reproductive Health," U.S. Department of Health and Human Services, National Institute for Occupational Safety & Health
- "The Effects of Workplace Hazards on Male Reproductive Health," U.S. Department of Health and Human Services, National Institute for Occupational Safety & Health

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