**Chapter 23
Medical surveillance of emergency response personnel**

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**Introduction**

The dangers faced by today’s emergency response personnel are steadily increasing in complexity, threatening the lives of emergency responders as well as their careers, health, and wellness. To protect their workers and comply with regulatory mandates, response agencies implement medical surveillance (medical monitoring) programs as part of their comprehensive occupational health initiatives.

Several important federal regulations and consensus documents provide guidance on the design and operation of a medical surveillance program. They include but are not limited to OSHA 29 CFR 1910.120 “Hazardous Waste Operations and Emergency Response,” EPA 40 CFR 311 “Worker Protection,” NFPA 1500 “Standard on Fire Department Occupational Safety and Health Program,” and NFPA 1581 “Standard on Fire Department Infection Control Program.” Individual states may also have pertinent medical surveillance directives that emergency response agencies should adhere to in operating their programs. Medical surveillance requirements may vary between firefighters, EMS, and law enforcement. Thus, those responsible for their agencies’ medical surveillance programs should be intimately familiar with the rules and regulations affecting their departments, including the potential variation in requirements for various personnel. The Centers for Disease Control has created a technical assistance website, document, and training materials for emergency responder health monitoring and surveillance at [www.cdc.gov/niosh/topics/erhms](http://www.cdc.gov/niosh/topics/erhms).

Currently, OSHA 29CFR 1910.120 requires employers to implement medical surveillance programs in the following situations.

* For employees who may be exposed to hazardous substances or health hazards at or above permissible limits (PELs) for 30 days or more per year
* In the absence of PELs, for employees working at levels above the published exposure levels for a given substance
* Employees who wear a respirator for 30 days or more per year
* Hazmat employees, defined as personnel who plug, patch, or temporarily control leaks from containers holding hazardous substances
* All employees who are injured as a result of overexposure in an emergency incident involving hazardous substances

The Environmental Protection Agency's (EPA) standard varies slightly from the Occupational Safety and Health Administration's (OSHA) standard in that it includes volunteers who work for government agencies engaged in emergency response, such as firefighters. The EPA standard also applies to employees of state and local governments in states that lack OSHA-approved plans.

Medical surveillance is the process by which the health of an emergency responder is maximized and risks are minimized [1–3]. The process includes the systematic collection, analysis, and evaluation of health data in a defined population to identify patterns or trends suggesting adverse health effects or needs for further investigation or remedial action [2–5]. Medical surveillance is applicable not just to hazardous materials (hazmat) entry team members but firefighters, EMS personnel, responders to large-scale mass casualty incidents (MCIs), and law enforcement officers. Members serving in specialty capacities such as dive teams, SWAT teams, and civil disturbance units may be subject to additional comprehensive medical monitoring programs [1,6,7]. A 2009 report from the World Trade Center Medical Monitoring and Treatment Program (now operated by NIOSH as the World Trade Center Health Program) detailing the evaluation results of more than 20,000 emergency responders and ongoing medical treatment for 2,000 personnel with physical problems and 2,900 with mental health issues, reinforces that every response agency regardless of size should have a defined medical surveillance program to maximize responder health and safety [8]. The goal of the medical surveillance program is to promote [1,6,7]:

* early recognition of hazardous materials exposure-related occupational disease
* early intervention and treatment
* effective management of the occupational disease process
* illness prevention.

The health hazards faced by today’s emergency responders include chemicals such as carcinogens, toxins, irritants, and corrosives, as well as infectious agents and radiation-emitting substances. Psychological stress and temperature extremes are also considered health hazards. OSHA 29 CFR 1910.120 stipulates that the medical surveillance program be comprehensive and address all foreseeable risks [9]. The program should be maintained by the employer and operate under the direction of an occupational medical director who is licensed in the state where the program is operated. This physician may be an employee of the agency or a contractor hired to fulfill this role. The physician must be familiar with occupational medicine, toxicology, and the job-related activities of the personnel he or she is overseeing [7]. Hiring an occupational medicine physician to provide this service is often limited by funding, and operational medical directors are increasingly being asked to fill this role, or departments may contract with comprehensive occupational medicine service providers.

The effectiveness of a medical surveillance program requires definition of the mission of the program, its components, and operating procedures for surveillance activity before, during, and after an incident. The overarching purpose of medical surveillance is elimination of a responder’s exposure to harmful, disease-causing situations [1,6,7]. Thus, careful attention is paid to identifying potential health hazards as soon as possible and correcting practices that may jeopardize a responder’s health and safety. The components of a medical surveillance program include:

* having dedicated staff to conduct the program
* suitable office space to operate the program
* protocols for individual testing, biological monitoring, exposure monitoring, and determination of job-related risks and exposures
* tracking systems
* compliance with medical information privacy requirements.

Available funding should be sufficient to provide competitive salaries for the staff, necessary office space and technology (including occupational health software programs), and examination equipment. Sufficient time and expertise should be available to allow for regular analysis of ongoing responder clinical data and review of incident reports to identify at-risk practices and recommend prescriptive improvements to reduce harm risks whenever possible.

The medical surveillance program also involves performing medical screening. This screening includes five categories of examination [7]: post offer of employment, baseline, annual or periodic, job termination, and exposure- or injury-specific medical examinations. These government-required exams should be complemented by a medical monitoring program. Each of the surveillance elements is covered in more detail below.

Employers with medical surveillance programs must maintain responders’ health records during the length of their service, and for a minimum of 30 years post resignation or retirement. Responders are entitled to access their records within 15 days of a request [7,9].

Many medical surveillance programs have focused on injury prevention through implementation of rigorous physical conditioning programs, healthy lifestyle reminders, and work performance evaluations. These programs may operate under the oversight of the medical director or other designated physician, athletic trainers, physical therapists, or physician extenders.

**Initial employment examination**

The preemployment physical is performed once a conditional job offer has been made to a candidate and must be completed in compliance with the 1990 Americans with Disabilities Act. The examination typically includes a lengthy questionnaire inquiring about various aspects of the candidate’s past and current health, pertinent family history, and off-duty employment and hobbies. Immunization and vaccination status may also be determined. The physical exam should be conducted by a licensed physician or physician extender. In addition, the following tests may be ordered and their results reviewed with the candidate [2,4,5,7,10].

* Vital signs to include height and weight, blood pressure, pulse, and respirations
* Chest x-ray to determine preexisting abnormalities
* Pulmonary function testing including forced expiratory volume (FEV), forced vital capacity (FVC), and FEV:FVC ratio with the results taking into account the individual’s height, weight, and age
* Vision test for corrected and uncorrected vision along with color blindness and night blindness
* Auditory testing to reflect hearing capacity at various ranges such as 500, 1,000, 2,000, 3,000, 4,000, and 6,000 hertz
* 12-lead ECG and stress testing depending on the age of the candidate and any abnormality seen on the original ECG
* Blood chemistry for liver and kidney abnormality along with glucose and serum electrolytes
* Complete blood count for anemia and other blood dyscrasias
* Urinalysis for evidence of renal disease or signs of infection

Drug testing, pregnancy testing, and more specialized biochemical testing (e.g. red blood cell cholinesterase, heavy metals, tuberculin) or physical exam testing may be required depending on responder duties and agency policy. Response agencies may also conduct fit testing for self-contained breathing apparatus (SCBA), air-purifying respirator (APR), and N95/N100 masks as part of the examination process. Physical capacity screening relevant to the physical demands of the job may also be conducted. Pertinent physical examination along with other test results are recorded on a standardized physical exam form that becomes part of that individual’s written or computerized medical record. The results of the complete examination are then reviewed with the individual along with recommendations for fitness for duty, healthy lifestyle changes, and corrective actions for any specific problems.

Some agencies have implemented the practice of freezing blood specimens. This allows the individual’s original specimen to be compared to a postexposure specimen. However, the storage requirements, legal issues, associated costs, and reliability of results have made this practice controversial and not widely implemented.

**Baseline examination**

The baseline examination is conducted when an individual has been selected to join a specialized team that may put the individual at higher than normal exposure to hazardous situations requiring the use of personal protective equipment (PPE). The examination establishes baseline levels and the presence or absence of work restrictions. If a previous examination has been done within 1 year of the specialty team appointment, the results of the original exam may be used as the baseline, provided it meets the requirements of the specialty assignment. The responder should receive a written report summarizing the findings, identified problems, and recommended corrective actions. The report sent to the employer shall only address fitness for duty and whether there is any medical problem that should preclude the individual from being part of a specialty team; there should be no mention of any specific findings or diagnosis.

**Annual or periodic examination**

Depending on the age of the responder and any underlying medical conditions, the physical examination may be repeated annually or less often (but no longer than 2 years) as stipulated in the agency’s medical surveillance program policy. The annual or periodic examination typically repeats the entire baseline testing except for the chest x-ray. An interval history is taken with particular attention paid to any exposure history since the last review or onset of new symptoms. Additional specialized testing may be done depending on the results of the interval history. The responder shall be given a copy of the exam results and any accompanying recommendations. The results of the examination reported to the employer, like the baseline exam, should only address fitness for duty and eligibility for team participation.

**On-scene medical monitoring**

On-scene medical monitoring of persons wearing PPE and/or operating under demanding conditions for extended periods is another critical component of an effective medical surveillance program [1,11,12]. The abbreviated examination completed on scene is usually done by EMS personnel. NFPA 473 “EMS Standards for Competencies for EMS Personnel Responding to Hazardous Materials/WMD Incidents” provides details on how medical monitoring should be conducted. NFPA 1584 “Standard on the Rehabilitation Process for the Members during Emergency Operations and Training Exercises” includes a standard operating procedure for rehabilitation that includes medical monitoring steps and recovery criteria. It should be noted that this standard is mainly consensus based, as the evidence base is poorly developed.

Depending on the incident and work assignment, response personnel may require a rest period spent in the rehabilitation (rehab) area. The amount of time worked before being rested in the rehabilitation area should consider several factors including the nature of the work being done, weather conditions, and level of PPE worn. The rehabilitation area officer should have sufficient personnel, equipment, and supplies assigned to meet the needs of the personnel rotating through rehab. The area should be adequate in size to accommodate large numbers of personnel as needed and located in an environmentally comfortable and convenient location on scene but “away from the action.” Chairs or benches should be available for rest along with access to drinking water. For prolonged events, sports drinks, healthy snacks, and/or light meals (fruit, soup, meal replacement bars, etc.) should be provided along with hand washing and lavatory facilities. Active cooling or rewarming adjuncts must be available when dictated by work or environmental conditions. The 2015 edition of NFPA 1584 will reflect an evidence-based deemphasis on electrolyte replacement [13], will note a daily acceptable caffeine limitation of 400 mg per member, and will recommend against any consumption of energy drinks (not to be confused with sports drinks) by emergency responders. Additionally, it will outline responsibilities pertaining to rehab for the incident commander, company officer, rehab manager, and individual member.

Emergency medical services staff should measure and record vital signs on all personnel reporting to rehab and utilize these, in conjunction with trained observation and locally derived protocols, to assess recovery and readiness to return to duty. Significantly abnormal vital signs (in context of the intensity of activity) or serious complaints must be evaluated in detail and given the necessary medical interventions (including ALS or transportation to a hospital, as indicated). Firefighters or rescuers exposed to smoke should be assessed for carbon monoxide toxicity. Status of personnel assigned to rehab should be tracked by the incident accountability system and final authority for release should be vested in rehab EMS staff.

Medical monitoring is also necessary for personnel assigned to wear PPE (including hazmat suits, confined-space apparel, and dive suits). This practice assures that general fitness criteria are met before they are allowed to don the PPE. Such criteria should be developed as part of the medical surveillance program procedures, and published so that agency personnel are familiar with them. Thresholds should be established for blood pressure, pulse, respirations, temperature, and oxygen saturation. A baseline body weight should also be obtained when possible. Succinct and pertinent health-related questions should be asked of each responder and a brief physical exam conducted, usually consisting of assessing breath sounds, heart sounds, and inspection for skin conditions. The answers to the questions, along with the other vital sign data, should be recorded on a standardized form for each responder. Individuals failing to meet the published criteria should be reevaluated and reexamined after a defined period of time (typically 15–20 minutes) while the individual rests in a quiet environment. If the criteria are still not met, then additional “quiet time” or reassignment to a task not requiring PPE should be considered.

Following completion of the work assignment (and decontamination if hazardous materials are present), responders are then given a postentry examination. The new data are compared with the original information recorded on the preentry exam. Substantive changes in vital signs or general well-being should be treated in accordance with department protocols prior to or while the individual is in the rehabilitation area for an assigned period of time. Attention by the examiner to signs of stress in each responder is also important. This may be particularly important for incidents associated with marked horror, multiple injuries, deaths including to responders, or extended operations. When appropriate, provisions for specially trained personnel such as department chaplain or professional counselor at the rehab area should be in place.

It is important that responders have adequate rest periods. The practice used by some emergency response teams is to provide rest periods that are 2–2.5 times the work period (i.e. for every 30 minutes of work in PPE, personnel would rest for 60–90 minutes before being given another work assignment including redonning PPE). The NFPA 1584 document also provides guidance on rest–work period ratios based either on number of SCBA bottles used or time worked intensely without SCBA [12].

In some situations such as prolonged urban search and rescue operations, team members receive their preentry screening when mobilizing out of their base camp at the beginning of each shift rather than at the work site. Depending on the assignment and continuing wellness during the work period, their postentry examination may be performed upon return to the base camp at the end of shift. During the shift, personnel use work–rest cycles determined by environmental conditions, physical activity, and the need for PPE; medical screening is generally not performed unless deemed necessary by on-scene medical providers.

In large-scale incidents involving multiple agencies, one rehabilitation area may be established for all, or each agency may establish its own. Emergency response agencies should familiarize themselves with each other’s rehabilitation practices, operating designs and medical monitoring. Familiarity will help to ensure continuity, shared staffing when needed, and completion of needed documentation on response personnel.

Following termination of an incident, the completed medical monitoring documentation for each responder should be reviewed by qualified personnel in the medical surveillance program. An immediate review by the EMS branch director and/or safety officer should be followed within 24 hours by a review by the medical surveillance program medical director or his/her designee. This review will determine whether an exposure-specific examination is needed. The completed medical monitoring forms should be included with the incident record or entered into each responder’s medical record file, depending on applicable regulations and agency policy.

**Exposure-specific examination**

Any time an exposure occurs, the affected responder should have a medical evaluation to determine the potential or actual presence of injury or disease. The medical surveillance program guidance should clearly specify when, how, and by whom an exposure exam should be conducted. The reporting process and response to a biohazard or blood-borne pathogens exposure are different from the response to a chemical agent exposure. Program guidance should clearly identify the steps for each situation. If the responder needs to be seen in the emergency department for acute assessment, management of the exposure, or postexposure prophylaxis, then the individual should be directed at discharge to follow up with the medical surveillance program staff. Depending on the agent involved, specialized testing may be required along with designated follow-up visits. Referrals to specialists (pulmonologists, cardiologists, etc.) should be coordinated by the medical surveillance program staff. The employer may only be informed of a condition that requires follow-up and/or treatment and whether the individual meets fitness-for-duty requirements. Appropriate worker compensation paperwork should also be completed by the medical surveillance staff in conjunction with the employee and risk management coordinator.

**Termination or exit exam**

The medical surveillance program guidance should outline when a termination or exit exam is to be conducted. The OSHA mandates that an exam be performed upon job transfer, team exit, or resignation, termination, or retirement from the department. The exit exam updates the history and physical exam and repeats all baseline lab studies. Any significant exposures since the last exam are also reviewed and specialized testing initiated if appropriate. The responder should receive a complete written summary of the findings. The employer is told of any medical problem that would preclude return/rehire or the likelihood of temporary or permanent disability.

**Conclusion**

Medical monitoring of emergency personnel has taken on greater importance because of increasing dangers experienced by law enforcement, fire, and EMS personnel. The primary purpose of medical surveillance is to preserve the physical and mental health of each member throughout his or her service to the community. Each agency should have a well-developed medical surveillance program, compliant with federal, state, and local requirements. The program should be led by a highly qualified medical director, complemented by a sufficient number and type of staff members to facilitate day-to-day operations of the program and meet the emergency needs of department personnel. Specific program procedures should be available to address 24-hour accessibility to qualified personnel, examination procedures, performance criteria, and documentation. These practices should be documented in writing for responders, and should be consistently employed and revised as needed.

**References**

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