

# Occupational Medicine Programs for Animal Research Facilities

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## Abstract

Occupational medicine is a key component of a comprehensive occupational health and safety program in support of laboratory animal research and production facilities. The mission of the department is to maximize employee health and productivity utilizing a population health management approach, which includes measurement and analysis of health benefits utilization. The department works in close cooperation with other institutional health and safety professionals to identify potential risks from exposure to physical, chemical, and biological hazards in the workplace. As soon as exposures are identified, the department is responsible for formulating and providing appropriate medical surveillance programs. Occupational medicine is also responsible for targeted delivery of preventive and wellness services; management of injury, disease, and disability; maintenance of medical information; and other clinic services required by the institution. Recommendations are provided for the organization and content of occupational medicine programs for animal research facilities.

**Key Words:** animal; animal research; health promotion; laboratory animals; medical surveillance; occupational health; population health; risk assessment

The core mission of occupational health and safety (OHS<sup>1</sup>) programs is to maximize employee health and productivity through targeted delivery of preventive and wellness services, and active management of injury,

disease, and disability. Ideally, the occupational medicine (OM<sup>1</sup>) element of the overall OHS program encompasses a multifaceted occupational healthcare service that complements the overall program and meets the institution's need for productivity and cost effectiveness. The OM service works within the overall occupational health and safety program to ensure that risks associated with the use of research animals are identified and controlled to an acceptable minimum. Maintenance and enhancement of health, not the treatment of disease, is the key to keeping employees healthy, productive, and at work.

Most institutions have developed effective programs for controlling hazards and minimizing occupational risks of injury and illness in the workplace. Many institutions that maintain an animal care and use program have an environmental health and safety office that employs health professionals with expertise in chemical safety, biological safety, physical hazards, industrial hygiene, health physics, engineering environmental health, fire safety, and occupational toxicology; or they have corresponding technical resources available under other arrangements. The environmental health and safety office generally provides technical consultation, risk assessment, accident reviews, training, emergency response, waste management, record keeping, inspections and audits, and compliance monitoring. The OM service provides clinical and preventive health services and shares risk assessment duties with the other divisions of OHS.

These OHS services assist institutional leaders and managers of the animal care and use activities in establishing health and safety policies and promoting high standards of safety. Services provided by OHS should always be designed in collaboration with the institutional leaders, managers, and employees to ensure that the OHS program not only complies with regulations but also is relevant and practical for the animal care and use program.

The 10 key elements of effective OHS programs include the following: organizational strategy and management support; population health management; information management; hazard, exposure, and health risk assessment; facility design and exposure control; administrative procedures; occupational medicine surveillance; education and training; emergency procedures; and program evaluation. This article focuses on the role of the OM Department in delivering OHS services to employees engaged in the care and use of research animals.

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<sup>1</sup>Abbreviations used in this article: EHS, environmental health and safety; HR, human resources; NIH, National Institutes of Health; OHS, occupational health and safety; OM, occupational medicine; OSHA, Occupational Safety and Health Administration.

## Organizational Strategy and Management Support

A fully integrated health and safety program combines qualified health care professionals with professionals from the Departments of Environmental Health and Safety (EHS<sup>1</sup>), Human Resources (HR<sup>1</sup>), and Risk Management or Loss Control (often part of the Legal Department). The most effective units are centralized to provide guidance across the entire institution, which should be clearly implemented in the form of written policies and procedures. This fully integrated unit must report to a senior level in the organization to achieve the needed visibility for the OHS function. A variety of organizational structures exist in different institutions. Frequently, the OHS unit or program components report to either an HR or EHS Vice-President. Different reporting relationships can work successfully as long as there is strong management support. Regardless of how these programs are structured, the most successful programs demonstrate a high degree of integration, cooperation, and collaboration. Ultimately, this fully integrated program requires the full involvement, active participation, and “ownership” of management and employees. The OHS program is most effective when health and safety are the primary responsibility of the line manager or the principal investigator and when there is an institutional champion who vigorously supports the program.

## Population Health Management

Just as organizations have Chief Financial Officers and Chief Information Officers, the head of the Occupational Medicine Department should serve as the Chief Health Officer for the organization. The focus of the Chief Health Officer, and the Occupational Medicine Department, is on maximizing the health and productivity of the entire workforce. Because it is more effective to prevent than to treat disease, public health interventions such as preventive services and proactive interventions are preferred.

The process of identifying and intervening on high-prevalence medical “intervention targets” is often referred to as population health management. Conducting a Pareto analysis of total health benefit and disability costs is the first step in developing a comprehensive strategy to manage the health of the employee population. Pareto analysis is a method of classifying items, events, or activities according to their relative importance. The analysis method was developed by Vilfredo Pareto (1848-1923), an Italian economist and sociologist. His discovery that 80% of the wealth in Italy was held by only 20% of the population is the genesis of the 80/20 rule. The Pareto Principle states that only a “vital few” factors are responsible for producing most of the noteworthy outcomes. Organizations use this analysis to concentrate more detailed attention on the high value/important items and to decide which subset of problems should be solved first or which problems deserve the

most attention. Usually 80% of a health and welfare benefit or service is used by only 20% of the population (i.e., 20% of the employees use 80% of the sick time taken).

To apply this method to OHS services, health cost data (workers compensation, disability, and health care costs) are collected in a medically confidential manner and analyzed according to the use and cost maldistribution of health costs. These data can be used to identify the important injuries or diseases that affect costs in the population of each business. These collections of high-burden disease represent intervention targets. An intervention target can generally be categorized as one of three types: population, individual, or workplace. Each target represents the opportunity to improve health and reduce costs by pairing a high-cost disease with a successful health intervention to reduce costs.

## Population Intervention Targets

Interventions that take place at the level of the entire workforce are often referred to as population interventions. These interventions are broad and targeted but not particularly intensive. They are proactively focused on primary prevention of disease. Good examples of these types of programs are Wellness and Health Education, which can be made available inexpensively in a variety of media including paper, phone, facsimile, audio, internet, and video. Comprehensive programs often begin with a health risk appraisal. Primary interventions are keyed to the important diseases that have been identified in the workforce but almost always include smoking, exercise, nutrition, depression, stress, prenatal care, and back problems. Programs based in the workplace often include home safety as an extension of workplace-based safety programs.

## Individual Intervention Targets

Individuals who already have disease can be approached through secondary prevention programs. The main purpose of these interventions is to halt or reverse further disease progression. These programs include general information and education on common diseases and pharmaceuticals coupled with active case management by a health professional. The programs are usually available through the employer’s health care coverage. The key is to know which diseases are important in your population to be certain that programs in those areas are delivered to your employees. Good examples of these types of interventions include hypertension, lipid abnormalities, diabetes, and depression management programs.

## Workplace Intervention Targets

Specific work sites where employees experience elevated rates of injury or illness or patterns of injury (e.g., laceration

tions) that occur across the entire worksite are good examples of potential workplace intervention targets. Some additional information involving analysis and review of injury and illness data is required and is often available from an existing Health and Safety Department.

## Information Management

OHS and OM departments make use of large amounts of information. This information can be general nonconfidential, personal and confidential, institutionally confidential, trade secret, or medically confidential. To deal with this information appropriately, all OM departments should have a written confidentiality policy and require OM employees to sign a confidentiality statement at least annually. In some organizations, activities in the OM department relate to the Health Insurance Portability and Accountability Act of 1996 (PL 104-191 1996). If an organization is a "covered entity" under the regulations promulgated by Health and Human Services, additional requirements for protection of private health information apply. Expert legal counsel should be sought to determine which, if any, requirements apply and, if covered under the Act, which steps are necessary for compliance.

Rapid access to employee-specific exposure information is increasingly important for efficient safety and medical management. OM documents occupational exposures, medical surveillance, work-related injury and illness, and some required safety training. All of this documentation is important for evaluating the OHS program of the institution, promoting health and safety, identifying new occupational risks, ensuring the cost effectiveness of program activities, and achieving regulatory compliance.

The Institute of Medicine has endorsed the development of electronic medical records to improve patient care. Electronic records and on-line access to relevant health and safety information improve the management and performance of occupational health and safety programs. The Institute of Medicine suggests that electronic patient records should serve the following purposes: (1) to support patient care and improve its quality; (2) to enhance the productivity of health care professionals and reduce the administrative costs associated with healthcare delivery and financing; (3) to support clinical and health services research; (4) to accommodate future developments in health care technology, policy, management, and finance; and (5) to have mechanisms in place for ensuring patient data confidentiality at all times (IOM 1997).

In the OM service, electronic records facilitate the exchange of information between departmental staff members of Environmental Health and Safety, Occupational Health, Animal Care and Use, and Research. Some type of electronic record system is especially critical to track and schedule multiple medical surveillance groups. In Table 1 are examples of information elements that can be shared in an OHS information management network. Confidentiality and

limited access to some kinds of information are paramount and must be ensured.

## Federal Requirements and Guidelines for Occupational Healthcare Services

The Occupational Safety and Health Act mandates that employers provide a safe and healthy workplace for their employees. Occupational healthcare services may be required for the institution to meet its responsibilities under the general duty clause of the Act and those specified in health standards promulgated by the Occupational Safety and Health Administration (OSHA<sup>1</sup>). For example, an institution would be required under the OSHA bloodborne pathogens standard (CFR 1910.1030 1998) to offer hepatitis B vaccinations to employees who handle blood, organs, or other tissues from experimental animals and to make available to an employee a confidential medical evaluation immediately after exposure to animal tissues that are contaminated with a blood-borne pathogen. The OSHA standard on occupational exposure to hazardous chemicals in laboratories (CFR 1910.1450 1990) requires medical surveillance when exposure monitoring reveals an exposure routinely above the action level for an OSHA-regulated substance (e.g., a time-weighted average of 0.75 ppm or a short-term exposure level of 2.0 ppm for formaldehyde) (CFR 1910.1048 1987). However, many of the hazards in the animal research setting are not specifically regulated by OSHA. Examples of unregulated hazards include animal allergens and ergonomic concerns. Organizations should develop their own standards, policies, and procedures to address these issues.

*The Public Health Service Policy on Humane Care and Use of Laboratory Animals of 1986*, which was promulgated in response to the Health Research Extension Act of 1985, requires institutions that receive federal funds to provide occupational healthcare services to employees who work in laboratory animal facilities and have substantial animal contact. As described in *Guidelines for Research Involving Recombinant DNA Molecules* (NIH 2001), institutions that receive NIH support for recombinant-DNA research are required to provide occupational healthcare services to employees engaged in animal research involving viable recombinant DNA-containing micro-organisms that need biosafety level 3 or greater containment. It is suggested in the NIH guidelines that for this level of risk, occupational healthcare services include records of agents handled, active investigation of relevant illnesses, and possible maintenance of serial serum samples for monitoring serological changes that may result from employees' work exposures. Institutions that are not legally required to follow the NIH guidelines should be encouraged to adopt the principles of the guidelines for all aspects of work involving recombinant DNA molecules (PL 99-158 1985).

Medical surveillance programs and specific occupational healthcare services are recommended in *Biosafety in*

**Table 1 Occupational health and safety information management network**

Activity	Information provided	Information received
Animal care and use	Job profile Project risk data Training records	List of employees at risk Employment risk agents Exposure and monitoring data Group medical surveillance data Medical surveillance schedules Material safety data sheets Risk assessment data Training schedules
Research	Job profile Project risk data Training records	List of employees at risk Employment risk agents Exposure and monitoring data Group medical surveillance data Medical surveillance schedules Material safety data sheets Risk assessment data Training schedules
Environmental health and safety	Accidents and injury investigation data Employment risk agents Exposure and monitoring data Material safety data sheets Risk assessment data Training schedules OSHA <sup>a</sup> 300 log data	List of employees at risk Hazardous materials purchasing data Group medical surveillance data Job classification and position description Job profile Project risk data Training records Worker compensation data
Occupational health	Health evaluation data to individual employees Group medical surveillance information Medical surveillance schedule Employee fitness for duty Training records Population health management intervention targets	Accident and injury investigation data List of employees at risk Employment risk indicators Exposure and monitoring data Job profile Material safety data sheets OSHA 300 log data Risk assessment data Workers' compensation data Scrambled non-identified health cost data (from outside vendors)
Administration and management	List of employees at risk Hazardous materials purchasing data Job classification and position description Workers' compensation data	Accident and injury investigation data Employment risk indicators Job profile Project risk data OSHA 300 log data

<sup>a</sup>OSHA, Occupational Safety and Health Administration.

*Microbiological and Biomedical Laboratories* (CDC-NIH 1999) for employees engaged in research programs that involve experimentally or naturally infected vertebrate animals. We recommend consulting this authoritative source for details and guidance regarding the application of these recommendations to specific research situations.

### Assessment of Health Risks

Accurate risk assessment is the first critical task to ensure employee health in an animal care facility. It is the basis for

all of the OHS program elements. Exposure to animals, animal products, and zoonotic diseases is a primary focus in these facilities. However, laboratory animal facility employees face occupational risk from the entire spectrum of physical, chemical, and biological agents. Specific exposures to reproductive and carcinogenic hazards may also require additional attention from OHS staff. These hazards are individually reviewed in the NIH *Guidelines* (NIH 2001, and a summary appears in Table 2 (Wald 2002).

Accurate risk assessment requires information about the research protocol, a detailed knowledge of institutional chemical inventory, and potential exposure to physical and

**Table 2 Hazard types at work**

Hazard class	Hazard type	Examples
Physical hazards	Human-machine interfaces	Repetitive motion (ergonomics) Lifting Vibration
	Mechanical trauma Physical environment	Needle sticks, lacerations, slips and falls, crush injuries, thermal burns Temperature Pressure Long/rotating shifts
	Energy	Ionizing radiation: X-ray, ultraviolet Nonionizing radiation: infrared, microwave, magnetic fields Lasers Noise Electric shock
Chemical hazards	Solvents	Aliphatics, aromatics, alcohols, ketones, ethers, aldehydes, acetates, peroxides, halogenated compounds
	Metals	Lead, mercury, cadmium
	Gases	Combustion products, irritants, simple and chemical asphyxiants, anesthetic gases
	Dusts	Organic (wood) and inorganic (asbestos/silica)
	Pesticides Epoxy resins and polymer systems	Organochlorine, organophosphate, carbamate Toluene di-isocyanate, phalates
Biological hazards	Bacteria	<i>Bacillus anthrax</i> , <i>Legionella pneumophila</i> , <i>Borrelia burgdorferi</i>
	Viruses	Hepatitis, human immunodeficiency virus, hantavirus
	Mycobacteria	<i>Mycobacterium tuberculosis</i>
	<i>Rickettsia</i> and <i>Chlamydiae</i>	<i>Chlamydia psittaci</i> , <i>Coxiella burnetii</i>
	Fungi	<i>Histoplasma capsulatum</i> , <i>Coccidioides immitis</i>
	Parasites	<i>Echinococcus</i> , <i>Plasmodium</i>
	Prions	Creutzfeldt-Jakob disease
	Envenomations	Arthropod, marine, snake
	Allergens	Enzymes, animals, dusts, insects, latex, plant dusts
	Natural products Novel biologicals	Endotoxins, wood dusts Malignant cells, recombinant organisms

biological agents. Additional investigation is then required to determine the level of exposure and any potential health hazards from that exposure. Workplace interventions in the form of hazard substitution, engineering controls, and personal protective equipment to reduce exposure can then be designed and implemented. Medical monitoring is the final step to ensure the effectiveness of interventions and to monitor for health effects.

Some work activities create greater risks of occupational injury and illness, such as handling of heavy cages (back injuries), direct handling of macaques (B-virus exposure), and removing litter from cages (increased exposure to allergens). This hazard and risk assessment task is the joint function of medical staff, EHS professionals and supervisors, and principle investigators.

Among the aspects of a job that merit consideration are exposure intensity, exposure frequency, the hazards associated with the animal being handled, the hazardous properties of the agents that are used in research, the susceptibility of the individual, and the occupational health history of

previous employees. Ultimately, the determination of risk and the need for healthcare services are matters of professional judgment, especially when the frequency and intensity of exposures to hazards are below the action levels designated by advisory or regulatory organizations. These decisions are most accurately made in the setting of the multidisciplinary OHS unit. Examples of risk assessment variables associated with the care and use of research animals are listed in Table 3.

## Facility Design and Operation

During the design of a new facility or the renovation of an existing one, hazards associated with the care and use of animals should be addressed in a collaborative effort and should involve the investigators who will use the facility, the manager and other principal staff of the institution's animal care and use program, and EHS staff. If possible, all animal care and work should be performed in dedicated

**Table 3 Examples of risk assessment variables associated with animal-related research**

Criterion	Possible classifications	Information services
Exposure intensity	High Medium Low Absent	Job profile, environmental health and safety assessment, employee history
Exposure frequency	≥8 h/wk <8 h/wk No direct contact Never	Job profile, environmental health and safety assessment, employee history
Hazards posed by animals	Severe illness Moderate illness Mild illness Illness unlikely	Institutional veterinarian, medical professional
Hazards posed by materials used in or with animals	Severe illness Moderate illness Mild illness Illness unlikely	Material safety data sheets; CDC-NIH <sup>a</sup> agent summary statements, radiation, chemical, and biological safety committees; environmental health and safety staff
Susceptibility of employee	Direct threat <sup>b</sup> Permanent increase Temporary increase	Medical evaluation, review of personal medical records
Expected incidence or prevalence of disease	High Medium Low Absent	Published reports, industry experience, medical literature
History of occupational illness or injury in the position or workplace	Severe Moderate Mild None	Workers' compensation reports, OSHA <sup>a</sup> 300 log
Regulatory requirements	Required for any contact Professional judgment permitted	Environmental health and safety office, consultants, risk managers, medical professionals

<sup>a</sup>CDC-NIH, Centers for Disease Control-National Institutes of Health; OSHA, Occupational Safety and Health Administration.

<sup>b</sup>Reasonable probability of substantial harm. Public Law 101-336: Americans with Disabilities Act of 1990.

facilities. If this arrangement is not achievable, careful consideration must be given to how animals will be transported into and out of these facilities to minimize risks to personnel, particularly for exposure to animal allergens. Transportation should be limited to designated corridors and routes—preferably ones that have low traffic flow. Filter top cages can reduce allergen contamination of these corridors.

The facility design process is critical in planning for management of risk in the workplace and should also include careful attention to prevention and control of ergonomic hazards in the design of animal facilities (Kerst 2003). Engineering controls that reduce physical stress in repetitive operations and in the lifting and movement of heavy loads by animal care staff are important design objectives. Ergonomic design criteria should be used in the selection of fixed equipment such as animal caging, necropsy tables, sinks, and cage cleaning equipment. Additional attention should be given to engineering controls, including ventilation systems, for control of animal allergen exposures.

## Exposure Control Methods

Exposures to occupational hazards are controlled through the application of engineering controls, work practices, and the use of personal protective equipment in a hierarchical structure. That is, isolation of workers from hazards is first attempted with engineering controls. If engineering controls do not adequately control the exposure potential, work practices are modified to help to minimize exposure potential. Finally, personal protective equipment may be required to provide a barrier between employees and hazards that cannot be controlled otherwise. Medical input is required for the respiratory protection program and may also be needed for glove selection if the employee has medical issues related to glove use.

## Engineering Controls

Engineering controls are a combination of safety equipment and physical features of the facility that help minimize haz-

ardous exposures of personnel and the surrounding environment. Safety equipment provides a barrier between employees and hazards, and physical features can prevent or reduce the potential for release of hazardous agents from the immediate work area. Some engineering controls commonly used in animal care and research are: barriers and airlocks, chemical fume hoods, biological safety cabinets, and isolation cages. Cage cleaning and cage washing can result in high concentrations of particulate contaminants and very high heat loads from the cage washing equipment. Consequently, high ventilation rates are important for providing acceptable environmental conditions for personnel.

## Work Practices

Work practices constitute a critical element in controlling exposures. Employees should understand the hazards associated with the procedures they are performing, recognize the route through which they can be exposed to those hazards, select work practices that minimize exposures, and through training and experience acquire the discipline and skill necessary to sustain proficiency in the conduct of safe practices. All categories of work practices should be considered, and several examples are given in Table 4.

### *Personal Hygiene*

Scrupulous attention to personal hygiene is essential for all personnel who care for and use research animals. Individuals should wash their hands before and after handling ani-

mals and whenever protective gloves are removed. There should be no eating, drinking, smoking, application of cosmetics, handling of contact lenses, or other activities that can increase the risk of ingesting hazardous materials or contaminating mucous membranes in animal care and use areas. In areas of high risks, complete change of clothing may be necessary to limit the potential spread of hazardous biological agents.

### *Housekeeping*

All animal care areas, including areas in which hazardous materials are used or stored, should be kept neat and clean. Clutter can become contaminated and add to problems of employee exposure, area decontamination, and waste disposal. Work surfaces should be wiped with disinfectant before work begins, immediately after any spill, and at the end of the activity or workday. Floors should be disinfected or decontaminated daily or weekly as appropriate to the potential hazards. Appropriate dust suppression methods should be used routinely. Wet mopping and the use of a high-efficiency particulate air (HEPA)-filtered vacuum cleaner are appropriate for suppressing dust.

### *Personal Protective Equipment*

The use of personal protective equipment is the final measure for controlling exposures to potentially hazardous agents. Personal protective equipment provides a physical barrier to hazardous materials that may otherwise come into

**Table 4 Work practices to reduce hazardous exposures**

Practices to reduce the number of employees at risk of exposure	Restrict access to the work area.
Practices to reduce exposures by direct and indirect contact	Provide warnings of hazards and advice about special requirements. Substitute less-hazardous materials for hazardous materials whenever possible. Wash hands when contaminated and when work activity is completed. Keep hands away from mouth, nose, eyes, and skin. Use appropriate methods to decontaminate equipment, surfaces, and wastes. Decontaminate work surfaces before and after work and after spills of hazardous agents.
Practices to reduce percutaneous exposures	Wear personal protection equipment (gloves, gowns, and eye protection). Do not handle contact lenses where there is potential for contamination. Eliminate the use of sharp objects whenever possible. Use needles with self-storing sheaths or those designed to protect the user. Keep sharp objects in view and limit use to one open needle at a time. Use appropriate gloves to prevent cuts and skin exposure. Select products with puncture-resistant features whenever possible. Use puncture-resistant containers for disposal of sharps.
Practices to reduce exposure by ingestion	Handle animals with care and proper restraint to prevent scratches and bites. Use automatic pipetting aids, never pipette by mouth. Do not eat, drink, smoke, or carry tobacco products in work areas used for the care and use of research animals. Keep hands and contaminated items away from mouth. Protect mouth from splash and splatter hazards.
Practices to reduce exposure by inhalation	Use chemical fume hoods, biological safety cabinets, and other containment equipment to control inhalation hazards. Handle fluids carefully to avoid spills and splashes and the generation of aerosols. Use in-line high-efficiency particulate air (HEPA) filters to protect the vacuum system.

contact with employees' skin, eyes, mucous membranes, and clothing.

Respiratory protection (with a minimum of a dust/mist respirator) should be *mandatory* to control occupational exposures to aerosols and animal allergens, unless engineering controls can be proven to reduce allergen exposure to safe levels. Employees who require respiratory protection should be enrolled in a respiratory program that is in compliance with OSHA standards (CFR 1910.134 1998). Medical approval for a respirator is required and is coordinated through the OM service. The selection and use of proper respiratory protection equipment should be coordinated through the environmental health and safety staff. It is important to note that surgical masks do not provide respiratory protection because they do not form a seal between the mask and the face, and ambient air has direct access to the respiratory tract. Dust/mist respirators may have a similar appearance to surgical masks; however, when used properly, there is an adequate face-to-respirator seal. For employees with primary laboratory animal allergies, a higher level of respiratory protection may be necessary to prevent development of additional allergies to laboratory animals (Goodno and Stave 2002).

Gloves are the most commonly used personal protective clothing. Latex, vinyl, or other appropriate protective gloves should be worn for handling animals or hazardous materials. Powdered latex gloves, which present special hazards because of the increased risk of latex sensitization in susceptible employees, should be minimized or eliminated. The best strategy is one of "rational glove selection" in which gloves are appropriate to the person and task. Consideration should be given to dexterity, glove integrity/disintegration, and permeability. Care should be taken to ensure that the glove material provides an adequate barrier against the expected hazard. For example, nitrile or rubber gloves may be required to protect against some solvents, whereas thick leather gloves provide better protection against animal bites or scratches. Heavy-duty rubber gloves are durable during cleaning and disinfecting and are commonly used for washing cages. Gloves should be long enough to cover the area to be protected, and disposable vinyl or latex examination or surgical gloves should not be reused.

Uniforms, gowns, or laboratory coats are often provided to prevent contamination of animal care personnel by animal urine and feces as well as biological and chemical agents used in the facility. Such garments should not be worn outside the work area. Protective clothing should be selected so that it provides an adequate barrier against the type and extent of exposure expected. For example, cage washing personnel may wear heavy rubber aprons to protect themselves when using strong detergents and cleaning agents. Safety shoes may be advisable for employees engaged in moving cage carts and other heavy equipment. Individuals who clean and disinfect animal rooms may need similar protective clothing. The need to decontaminate and dispose of protective clothing is an important consideration

in the selection process. Reprocessing contaminated laundry can be more expensive than providing disposable gowns.

Face protection is advised if the eyes, nose, or mouth may be exposed through splashes or splatters of potentially hazardous agents. Safety glasses should be considered minimal eye protection and worn only to prevent injury from projectiles, minor splashes, or contact of contaminated hands with eyes. Goggles or face shields may be needed for tasks involving infectious or hazardous liquids if there is a potential for splashing and splattering. Goggles or face shields are especially important when disinfectants and cleaning agents are used under pressure. Surgical masks, which also provide some protection of the mouth from splashes, may protect animals from exposure to human pathogens but, as stated above, are not adequate to protect employees from animal allergens. Although it has been the subject of some controversy, it is generally accepted that contact lenses can be safely worn beneath eye and face protection. However, they should not be considered to be adequate eye protection, and if eye and/or face protection is required, appropriate equipment should be selected as would be chosen if contact lenses were not being used.

## Administrative Procedures

Adequate administrative procedures are vital to the success of an OHS program. Administrative procedures are most effective if developed in collaboration with their users, and if managers and employees know their roles. Approval mechanisms established to authorize research activity should be clear, practical, and well publicized. Researchers and managers must incorporate hazard assessments and health and safety procedures as an integral part of the research plan, and they should be held responsible and accountable for work performed under their supervision. This accountability is especially important where substantial risks for human health effects exist.

Procedures should be developed for conducting a health and safety review of research activities that involve infectious agents, recombinant DNA molecules that are addressed by federal guidelines, hazardous chemicals, radiation and other physical hazards, or the use of animals that present unique hazards. Those procedures should be incorporated into the institutional animal care and use committee program-review process (NIH 2002). Appropriate occupational health professionals should serve on the committee to participate in the review or be otherwise involved in the review process.

## Occupational Healthcare Service Activities

The wide variety of acceptable arrangements for providing occupational healthcare services reflects the variation in institutional needs and resources, including the size of the animal care and use program, the nature of the risks, and access to occupational healthcare services. The services must be provided by groups or individuals that have training

and experience in occupational health. Medical department members may include physicians, nurse practitioners, physician's assistants, and nurses. Larger organizations are likely to have a medical department composed of employees of the institution or company. Smaller organizations may contract in full or in part for these services. Each institution should select or contract for appropriate professional guidance and occupational healthcare services to meet the occupational health needs of its employees.

OM programs for animal facilities should cover all persons whose duties place them near research animals, their derived products, and their tissues. This group of individuals in an animal facility includes animal care personnel, investigators and their technical staff, students and other trainees, volunteers, engineers, housekeepers, security officers, and maintenance personnel, as appropriate. The occupational healthcare services needed for employees vary with the health risk associated with their animal-related research or support activities. Institutions should strive for consistency in the occupational healthcare services provided for employees at comparable risk. However these services are provided, the OM department should have a clear mission statement and an auditable set of program goals and services.

Institutions often do not provide occupational healthcare services for contract employees who participate in an animal care and use program. If the institution does not provide services, there should be contractual obligations by which contractor organizations provide occupational healthcare services to their own employees at a level similar to services supplied to institutional employees. The institution with responsibility for the space where the contract workers work is obliged to communicate to the contractor the hazards and risks present in the worksite and the rules and procedures for the maintenance of a safe environment.

## Occupational Healthcare Service Responsibilities

### Strategic Organization of Medical Resources

A health and productivity model for occupational health consists of three distinct but related medical services: occupational medicine management, centralized health and compliance services, and medical information management. These services are designed to stand alone as well as to add value with increasing synergy when combined on an institution-wide basis.

#### *Occupational Medicine Management*

The comprehensive, integrated service of occupational medicine management is best delivered by a team of experienced occupational health professionals with extensive experience. This service uses comprehensive integrated occupational health information on which to base decisions regarding medical surveillance, resource allocation, benefits

design and administration, and risk management. The institution benefits from opinions of dedicated occupational medicine professionals and the combined expertise of a cadre of experts in occupational health and safety. Smaller institutions may contract for this expertise from an outside occupational medicine provider.

#### *Centralized Health and Compliance Services*

Centralized health and compliance services are best supported by software systems designed to efficiently deliver transaction-based occupational health services that use the latest in telecommunications and expert system applications. These services consist of the following four elements: clinical services, medically related absence (disability) management, compliance services, and health promotion.

**Clinical services.** The department or vendor provides high-quality, courteous, and timely medical evaluations; impairment assessments; medical surveillance examinations; and occupational injury and illness diagnosis and treatment.

**Medically related absence (disability) management.** This service is best provided by dedicated nurse case managers supported by physicians. The case managers support timely return to work and productivity enhancement by (1) identifying barriers to return to work, (2) assisting employees in navigating the healthcare system, (3) supporting and assisting rehabilitation, and (4) facilitating return-to-work and accommodation management. An integrated disability management program covers all disability and workers' compensation lost-time cases, regardless of whether the absence is occupationally related. The most proactive programs address the psychosocial factors that cause prolonged time lost from work and also seek to prevent initial and repeated episodes of disability where appropriate.

**Compliance services.** This service supports institutional safety management and regulatory compliance programs with expert reporting systems to manage OSHA reporting requirements. The data generated and the reports provided should conform to regulatory compliance and workers' compensation reporting requirements as well as provide the necessary information essential to informed decision making and risk management.

**Health promotion.** We consider employee health promotion, education, and wellness services to have a pivotal relationship with institutional health and safety programs. Health promotion programs are integrated into a comprehensive system of prevention designed to support health behavior improvement or maintenance and augment the early identification and management of health risks.

#### *Medical Information Management*

Management of medical information is required to maintain employee medical records and documentation necessary to support service delivery modules. Components of data and information management include ensuring data integrity, data archiving, and medical information privacy. The expense of these systems requires the full utilization and sup-

port of competent information management professionals to yield their return on investment. There should be an emphasis on data accuracy and reliability to support clinical services and regulatory compliance. The Population Health approach facilitates continued measurement through the development and implementation of systems for tracking and reporting information and findings related to population health, health determinants, and the effectiveness of interventions.

## Occupational Healthcare Responsibilities

Effective OM service depends on the OM Department's knowledge of the employee health risks associated with the care and use of research animals at the institution. It also depends on the opportunity to foster genuine collaboration among all program activities of the institution that manage, support, and conduct the animal care and use program. To carry out the mission to preserve and promote health, the medical department should:

1. Develop a detailed knowledge of the occupational hazards of employees and an understanding of the temporal and spatial distribution of those hazards;
2. Understand the medical presentation of all occupational illness and injuries for which employees are at risk;
3. Understand the characteristics of the workforce, the nature of sensitivity or susceptibility factors among members of the workforce, and the way these factors affect the ability of employees to perform their tasks;
4. Participate in the identification of employees at high risk because of animal-related research;
5. Understand how employment may present a direct threat to employees' health, and provide the institution with a judgment on the individuals' ability to perform the job. This judgment may be rendered for existing employees or on a preplacement basis;
6. Communicate potential health hazards to the management team to assist them in making program decisions based on the best available medical knowledge;
7. Communicate the appropriate medical information in the event of an occupational illness or injury in a timely fashion to persons with a need to know, including HR, workers' compensation, health and safety, and supervisory personnel;
8. Manage medical disability and facilitate return to work;
9. Educate employees about early warning signs of occupational illness or injury that should prompt medical action or evaluation;
10. Provide the institution with a considered judgment, based whenever possible on aggregate information, on the status of occupation-related illness and injury among employees;
11. Evaluate the aggregate population health status of em-

ployees and provide the institution with a considered judgment of potential health interventions; and

12. Maintain objectivity in the face of conflicts that occur because of the occurrence of work-related illness or injury.

Healthcare professionals must have appropriate training and experience to establish and maintain an effective healthcare service for employees involved in the care and use of research animals. The information needed to conduct an occupational health program is typically acquired from many sources. It is essential that veterinarians, investigators, and EHS professionals participate in the orientation and continuing training of healthcare providers about zoonoses, exposures, illnesses, and other health risks associated with the care and use of research animals. It may also be necessary to consult infectious disease specialists, allergists, dermatologists, and pulmonologists about aspects of employee health.

The selection of occupational healthcare services is based on knowledge of occupational hazards, the nature of health risks associated with animal care and use activities at the institution, the diversity of employees, the work environment, and the mission of the institution. Services to each employee are based on work activities that place employees at risk for occupational injury or illness. Medical evaluation should be based on the functional demands of the position, the hazards associated with the animal species involved, and the potential experimental hazards.

Occupational healthcare services can include preplacement medical evaluations, periodic health evaluations, episodic health evaluations, analyses of adverse health outcomes, medical management of workers' compensation cases, immunizations, medical record keeping, serum banking, exit evaluations, and nonoccupational health care. The value and relevance of those activities for employees at risk are discussed below. Activities are selected for inclusion in an institution's occupational healthcare service in consultation with environmental health and safety professionals and in discussion with representatives of the research and animal care and use programs. A summary of some of the services required by federal regulation is provided in Table 5.

## Identification of Persons at High Risk

Occupational healthcare services should identify employees at risk because of animal-related work and determine who should participate in the various activities provided by the respective service. Categories of employees whose activities should be reviewed are investigators, technicians, animal-facility operators, clerical and other support personnel, students, trainees, visitors, maintenance and housekeeping personnel, engineers, and facility management technicians. The necessary service components vary with the nature and intensity of the risk. Interaction between OM and EHS staff

**Table 5 Federal recommendations for occupational healthcare services for research involving animals and animal research involving recombinant DNA<sup>a</sup>**

Practice	Recommendations
Limiting access	Only persons who have been advised of the potential hazard and who meet any specific entry requirements (e.g., vaccination) may enter the laboratory or animal rooms. Biosafety 3 and 4: Persons who may be at increased risk of acquiring infection, or for who infection may have serious consequences, are not allowed in the animal facility unless special procedures can eliminate the excess risk. The occupational physician should make that assessment.
Collection and storage of serum samples	When appropriate and giving consideration to the agent or animals handled, baseline serum samples shall be collected and stored for animal care and other at-risk personnel. Additional serum specimens may be collected periodically depending on the agent handled and the function of the animal facility. Serum samples should be logged and tracked. A policy regarding length of sample retention should be in place.
Immunization	All personnel receive appropriate immunizations for the agents handled or potentially present. Immunizations are recommended for clearly identified at-risk employees where a safe and effective vaccine or toxoid exists (e.g., vaccines against hepatitis B, yellow fever, rabies, and poliomyelitis, and toxoids against diphtheria and tetanus). Decisions for giving less efficacious vaccines, those associated with high rates of local or systemic reactions or those which produce increasingly severe reactions with repeated use should be carefully considered.
Screening tests	All personnel receive appropriate tests for the agents handled or potentially present. Skin testing with purified protein derivative (PPD) or previously skin-test negative at-risk employees is recommended.
Medical surveillance	An appropriate medical surveillance program must be in place for all facilities. Biosafety level 2 and 3: Any incident involving spills and accidents that result in environmental release or exposure of animals or laboratory workers to organisms containing recombinant DNA shall be reported immediately. Medical evaluation, surveillance, and treatment shall be provided as appropriate and written records maintained. Biosafety level 4: In addition to the requirements of Biosafety 2 and 3, a system shall be established for: (i) reporting laboratory accidents and exposures that are a result of overt exposures to organisms containing recombinant DNA, (ii) employee absenteeism, and (iii) medical surveillance of potential laboratory-associated illnesses. Permanent records shall be prepared and maintained.
Postexposure counseling and prophylaxis	Required for Biosafety level 4, but should be a standard practice at all facilities regardless of biosafety level.

<sup>a</sup>Sources: (1) CDC-NIH [Centers for Disease Control-National Institutes of Health]. 1999. Biosafety in Microbiological and Biomedical Laboratories. 4th ed. Washington DC: GPO. (2) NIH [National Institutes of Health]. 2001. Guidelines for Research Involving Recombinant DNA Molecules.

is necessary to develop workplace exposure information needed for healthcare services. Such interaction constitutes a process for alerting EHS professionals to hazards that may require additional control. This interaction is also important for assessing risks associated with activities related to animal research and helps to establish criteria for selecting employees who will routinely receive healthcare services. New case findings in OM may suggest the need for additional industrial hygiene surveys or hazard control. At the same time, input from industrial hygiene and safety on new hazards or exposure may suggest additional OM services.

This collaboration does not replace the obligation of occupational medical and nursing professionals to “know the workplace.” Occupational health professionals must spend time in the workplace and have a firsthand under-

standing of the workplace, jobs, and potential hazards. Additionally, the worksite visit should be considered as an extension of the clinical evaluation of employees with suspected work-related illness.

### Preplacement Medical Evaluations

The preplacement evaluation serves several functions in the occupational healthcare service. Every employee who could be exposed to potential hazards in the animal care and use program should undergo a preplacement medical evaluation. Although there is sometimes a perception that the purpose of the preplacement process is to identify people who should be excluded from a particular job, this should rarely

be the case. The purpose of the preplacement process is several-fold. The assessment establishes baseline health information on employees before their exposure to the risks associated with animal-related research. It also provides the opportunity to discuss medical conditions that may alter an employee's exposure-risk profile; these conditions could include current conditions (e.g., tuberculosis) and possible future conditions (e.g., pregnancy in women of childbearing age).

Medical conditions that could temporarily alter fitness for duty or require on-site emergency treatment (such as hypoglycemia in diabetics and epileptic seizures) can be noted, and appropriate contingency plans can be made. The pre-placement medical evaluation also presents an opportunity for education about potential hazards in the workplace, the need for accommodation or personal protection, and medical symptoms that should prompt an employee to seek occupational health evaluation between routine visits. Pre-existing conditions that can affect an employee's capability to perform the essential functions of his or her position without risk of substantial harm may be identified. When identified, reasonable accommodations should be considered to permit the person to perform the job. Additional medical services required for specific employment such as immunizations or serum banking would also be performed at this time.

## Medical Surveillance

Scheduled periodic health evaluations are the key component of occupational health programs. They are most useful when carefully designed to obtain information that can be used to verify the success of the occupational health and safety program in reducing occupational illness and injury. The components and frequency of evaluations depend on the nature of potential hazards (Bush 2001b; Harrison 2001; Seward 2001; Wood 2001). Knowledgeable and experienced healthcare professionals should determine the need for and design of periodic health evaluations. The surveillance strategy should be periodically re-evaluated in light of changes in exposure or workforce characteristics, injury, and illness experience, and the availability of new guidance regarding good occupational health practice. Medical surveillance programs are made up of many components that can include history questionnaires, specialized questionnaires (e.g., for exposure to animal allergens [Bush 2001a; Seward 2001]), physical examinations, laboratory tests, and other special tests or procedures. Each medical surveillance program should be specifically tailored to the potential exposures.

Medical surveillance should include both individual assessments and aggregate analysis of the data collected. Aggregate analysis may help to demonstrate the success of the prevention effort and/or may identify previously unrecognized issues that need to be addressed.

## Episodic and Postexposure Health Evaluations

Persistent symptoms, symptoms that indicate the onset of a work-related illness, or the occurrence of a work-related injury should prompt appropriate medical evaluation and care. A physical examination focused on the chief complaint is typically a routine part of an episodic health evaluation. The medical department is often involved in postexposure evaluation, counseling, and prophylaxis. As a general rule, any event that leads to medical evaluation and any loss of work time that is thought to be work related should be reported through the occupational health information system.

## Recognition, Evaluation, Recording, and Followup of Adverse Health Outcomes

The incidence and prevalence of medical symptoms, injuries, or illnesses should be assessed periodically. Several mechanisms are used to recognize adverse health risks and adverse health outcomes. Incident reports are completed when medical symptoms occur as the result of a workplace event or exposure. They should be reviewed by OM to determine whether medical evaluation is needed. Occupational medicine specialists should be involved in the assessments of suspected work-related illnesses because of the need to distinguish between work-related and non-work-related symptoms, which can be challenging. If symptoms or illness are determined to be work related, the incident information should also be reviewed by the environmental health and safety staff to determine whether their involvement is needed.

In many organizations, employees may prepare "near-miss reports" when equipment malfunction or performance error almost results in an accident or substantial exposure. Near-miss reports are usually kept by the EHS staff but should also be reviewed by healthcare providers.

## Medical Management of Injuries and Illness

Whenever possible, OM departments should direct the management and treatment of workers compensation cases. Management by the occupational healthcare service is an effective way to reduce incidence, severity, and costs of occupational injuries and illnesses. This service can provide monitoring of an employee's ability to return to work that is closer than that of an outside provider unfamiliar with the work setting. OM can facilitate early return to work in a modified duty status and can then monitor the employee status with the treating physician until a permanent and stationary status is reached. Some employees will have permanent work restrictions that may require accommodation. OM works with human resources and line management to determine whether the employee can be accommodated in

his or her current position or whether other work is available.

Integrated disability management is a relatively new concept in which OM manages both work- and non-work-related injuries and illnesses. Case management and return-to-work/fitness for duty examinations allow for review of injuries and illnesses that are either work related or personal. The occupational healthcare service can facilitate an appropriate and safe return to the worksite no matter what the original cause of the medical disability.

## Immunization

Immunization programs are an accepted method of protecting people from some infectious diseases. The decision to provide immunization to an employee should be made because of a defined, recognized risk at the time of preplacement, periodic, or episodic health evaluations. Guidance for administration of specific vaccines and toxoids such as for hepatitis B, rabies, and tetanus is provided by the Public Health Service Advisory Committee on Immunization practices (IPAC 2002).

It may also be appropriate to consider vaccination for other agents or organisms with which scientists work. In addition, some employees may benefit from hepatitis A vaccine or malaria prophylaxis if their work requires travel to endemic regions. The OM department should provide or assist with access to travel medicine advice. General immunizations such as influenza may be offered to high-risk employees, or to the general employee population, in an effort to reduce morbidity and time lost from work.

## Medical Record Keeping

It is the responsibility of the employer to maintain medical records related to an employee's participation in healthcare service activity. For employers that delegate this responsibility to a contract medical service, there should be a provision for transfer of records if the contractual arrangement terminates.

Aggregation of occupational health data is commonly overlooked. Many workers receive preplacement and periodic health evaluations, but their results are seldom analyzed in the aggregate for informational purposes. The information derived from aggregate data can be of great use in guiding program decisions. Occupational physicians understand how and why information should be aggregated and analyzed. Data should be analyzed for the three general categories of intervention targets discussed above.

## Serum Banking

Serum banking is the collection and frozen storage of serum samples obtained from employees who may be at risk for

occupationally acquired infection. Typically, the purpose of the program is to give the institution the ability to compare serum obtained after an acute illness or exposure with serum obtained before the illness or exposure began. Serum banking should be conducted only when there is a clear reason for obtaining the specimens and there is a plan to analyze the data as part of a risk-assessment strategy. The CDC and NIH (CDC-NIH 1999) recommend serum banking and serological surveillance when a substantial risk of occupational illness is associated with an agent under study and methods are available to measure immunological response to the agent (see Table 5).

Many important issues should be considered in advance of instituting a serum banking program, including chain of custody, confidentiality, identification and handling of samples, retention, potential deterioration of sample quality over time, and cost. The program should include informed consent of employees and should allow them to decline to participate. The collection and storage of employee serum should not be performed in the absence of a functioning occupational health and safety program.

## Exit Evaluations

An exit evaluation is a medical evaluation performed when an employee terminates employment or changes jobs so that he or she is no longer exposed to a specific hazard. Its purpose is to determine the employee's health status when exposure to potential hazards ceases. Such an evaluation has potential value for medical and legal reasons. It provides a benefit to the employee because it is an opportunity to address previously unrecognized or unresolved work-related health issues. The organization benefits by receiving confirmation either that no health concerns exist or that they have been addressed appropriately. Because it is often difficult to have employees evaluated after they leave an employer, exit examinations should be part of the human resources checklist for employment termination.

## Nonoccupational Health Care

Many companies have found that there is a role for nonoccupational health care to maximize employee productivity. Routine primary care and/or low cost episodic care such as blood pressure monitoring, blood drawing, allergy shots, and simple urgent care allows employees to stay at work while receiving needed medical attention.

Some employers choose to use the occupational healthcare service for general health promotion such as blood-pressure measurement, cholesterol screening, and education about healthy lifestyles. Programs should be targeted to population needs. Primary prevention programs can usually be offered at a low cost per employee and can provide

long-term cost savings. Improved health status, morale, productivity, and possibly short-term cost savings may also be seen.

## Education and Training

Occupational health and safety objectives of an institution can be achieved only if employees know the hazards associated with their work activities; understand how the hazards are controlled through institutional policies, engineering controls, work practices, and personal protective equipment; and have sufficient skills to execute safe work practices proficiently. All of those conditions require a multifaceted education and training effort that addresses the full range of health and safety issues related to the care and use of research animals. OM has an important role in training in the areas of human health effects of exposures, medical surveillance programs requirements, and rational informed consent for immunizations and medical testing. These OM components fit within a larger OHS training program. Approaches for providing an education and training effort depend on the size, resources, animal species, research activities, staff experience, and technical expertise of the institution. However, successful programs have three common attributes:

1. The occupational health and safety goals of the institution and how they will be achieved, including precise guidance on regulatory-compliance strategies, are clearly communicated to all employees.
2. Employees are fully apprised of all relevant hazards and control strategies pertaining to their general work assignments.
3. Supervisors and principle investigators in the animal care and research groups are responsible and accountable for ensuring that their employees have acquired the necessary training, skills, and attitudes to work safely.

Training is a continuous process. An effective education and training program requires resources, administrative record keeping, and a mechanism for monitoring its efficiency, in addition to the interactive mentoring efforts of key employees who provide relevant health and safety information. Record keeping is an essential aspect of an education and training program. No program can succeed without knowledge of who needs what training and when such training has been provided. Training records are also required to satisfy specific requirements of federal and state environmental health and safety regulations. A computer-based system should facilitate such an approach.

A wide variety of mechanisms exist for evaluating the success of the education and training program. Among these mechanisms are record audits, site inspections, personnel reviews, injury and illness records, regulatory-compliance citations, and periodic questionnaires. The approach should

be carefully designed and applied to provide information useful for both institution officials and employees.

## Emergency Procedures

Every institution must have an emergency response plan. Emergency situations will occur, and they require a rapid, coordinated response to minimize harm to personnel and facilities. A rapid and appropriate response is not possible without an institutionally adopted written and tested plan.

An emergency response plan provides a structure for effective response by defining employee responsibilities, interactions between responding personnel, the sequence of response procedures, and availability of emergency equipment. The complexity of the plan will be dictated by the diversity of emergencies that are considered possible and the institutional capacity and ability to respond to emergencies with on-site personnel. EHS personnel should be readily available to coordinate response efforts, and all off-site emergency responders should be well educated in the unique hazards and situations that may occur. All on-site employees should know their roles in responding to emergency situations.

The planning process should follow a logical progression that begins with identification of the types of emergency situations that are most likely to occur. That information is used to determine who should respond to each identified situation. Equipment requirements should be determined by those who will respond to emergencies. After adoption of the written plan by the institution, it is important to conduct training—and particularly to perform drills—to test its efficacy.

The emergency response team for an animal facility should either include or have rapid access to health and safety, veterinary, and animal care personnel. Hazards related to the animal care and use program should be known to ensure that adequate equipment and training are available. All personnel involved in emergency response should know the limitations of their training and equipment and not perform activities for which they have not been trained. Typically, the hierarchy for response will be to protect personnel, then animals, and finally the animal care facility and surrounding buildings.

Medical personnel should have specific information on the unique hazards related to emergency response procedures in the animal facility. They will need to be prepared to support the potential exposures and injuries related to emergency responses. All injuries managed by medical personnel should be included in the system for reporting work-related injuries and illnesses.

## Program Evaluation

Evaluation of the adequacy of a healthcare service should focus on whether the healthcare providers meet legal re-

quirements and ethical guidelines, accomplish the mission of the occupational health program, and deliver the appropriate components of the service. OM services can be audited to determine whether they are fulfilling the mission described in their statement of mission, goals, and services. Examples of some auditable tasks include, but are not limited to, the following:

- Policies and procedures manual;
- Identification of health intervention targets through the use of population health management and communication to management of health interventions to improve health and productivity;
- Appropriate information management tools;
- Medical record keeping and medical confidentiality policy;
- Knowledge of federal and state regulations requiring health services to employees in animal care facilities;
- Tours of the facility by healthcare providers who are knowledgeable about the workplace-hazard profile.
- OM departmental staff participation in the health risk assessment of employees;
- Healthcare service awareness of the occupational health profiles of employees as reflected in the workers' compensation claims experience, the OSHA 300 log, first-aid reports, and incident reports;
- Healthcare service awareness of the hazard control strategies and equipment in use in the facility;
- Appropriate clinical healthcare activities including pre-placement exams, medical surveillance activities, post-exposure evaluation and counseling, medical disability management, immunization, other required screening tests, serum banking, and nonoccupational services;
- Healthcare service requests for consultation from the environmental health and safety staff in the case of health alterations or occupational disease or injury;
- Healthcare service participation in the development of activities of the occupational health and safety program;
- Healthcare service provision of information to the institution about the occurrence of work-related illnesses and injuries;
- Healthcare service participation in medically related training for human health hazards; and
- Health care service participation in emergency planning and drills.

## Conclusion

To understand the role of occupational medicine for employees engaged in the care and use of research animals, it is necessary to appreciate that each facility has a unique combination of potential exposures to physical, chemical, and biological hazards. Medical programs not only should be tailored to the risks employees will encounter on the job but also should focus on the long-range goal of maximizing employee health and productivity.

## References

- Bush RK. 2001a. Assessment and treatment of laboratory animal allergy. *ILAR J* 42:55-64.
- Bush RD. 2001b. Mechanism and epidemiology of laboratory animal allergy. *ILAR J* 42:4-11.
- CDC-NIH [Centers for Disease Control-National Institutes of Health]. 1999. *Biosafety in Microbiological and Biomedical Laboratories*. 4th ed. Washington DC: GPO.
- CFR [Code of Federal Regulations]. December 4, 1987. Title 29 Part 1910.1048. Occupational Safety and Health Administration. Occupational exposure to formaldehyde. Fed Reg 52:46169-46171.
- CFR [Code of Federal Regulations]. January 31, 1990. Title 29 Part 1910.1450. Occupational Safety and Health Administration. Occupational exposure to hazardous chemicals in laboratories. Fed Reg 55: 3300-3335.
- CFR [Code of Federal Regulations]. January 8, 1998. Title 29 Part 1910.134. Occupational Safety and Health Administration. Respiratory Protection Standard. Fed Reg 63:1152-1300.
- CFR [Code of Federal Regulations]. September 9, 1998. Title 29 Part 1910.1030. Occupational Safety and Health Administration. Blood-borne-pathogens standard. Fed Reg 63:48250-48252.
- Goodno KL, Stave GM. 2002. Primary and secondary allergies to laboratory animals. *J Occup Environ Med* (In Press).
- Harrison DJ. 2001. Controlling exposure to laboratory animal allergens. *ILAR J* 42:17-36.
- IOM [Institute of Medicine]. 1997. *Computer-based Medical Record*. Rev ed. Washington DC: National Academy Press.
- IPAC [Public Health Service Advisory Committee on Immunization Practices]. 2002. *MMWR* February 8, 2002/51(RR02): 1-36.
- Kerst J. 2003. An ergonomics process for the care and use of research animals. *ILAR J* 44:3-12.
- NIH [National Institutes of Health]. 2001. *Guidelines for Research Involving Recombinant DNA Molecules*. Effective June 24, 1994, Published in Federal Register [FR], July 5, 1994 (59 FR 34496) Amendment Effective July 28, 1994, FR, August 5, 1994 (59 FR 40170). Amendment Effective April 17, 1995, FR, April 27, 1995 (60 FR 20726). Amendment Effective December 14, 1995, FR, January 19, 1995 (61 FR 1482). Amendment Effective March 1, 1996, FR, March 12, 1996 (61 FR 10004). Amendment Effective January 23, 1997 FR, January 31, 1997 (62 FR 4782). Amendment Effective September 30, 1997, FR, October 14, 1997 (62 FR 53335). Amendment Effective October 20, 1997, FR, October 29, 1997 (62 FR 56196). Amendment Effective October 22, 1997, FR, October 31, 1997 (62 FR 59032). Amendment Effective February 4, 1998, FR, February 17, 1998 (63 FR 8052). Amendment Effective April 30, 1998, FR, May 11, 1998 (63 FR 26018). Amendment Effective April 29, 1999, FR, May 11, 1999 (64 FR 25361). Amendment Effective October 2, 2000, FR, October 10, 2000 (65 FR 60328). Amendment Effective December 28, 2000, FR, January 5, 2001 (66 FR 1146).
- NIH [National Institutes of Health Office of Laboratory Animal Welfare]. 2002. *IACUC (Institutional Animal Care and Use Committee) Guide*. 2nd ed.
- PL [Public Law] 99-158. 1985. *Health Research Extension Act of 1985*. Health Service Policy on Humane Care and Use of Laboratory Animals.
- PL [Public Law] 101-336. 1990. *The Americans with Disabilities Act of 1990*.
- PL [Public Law] 104-191. 1996. *Health Insurance Portability and Accountability Act (HIPAA)*.
- Seward JP. 2001. Medical surveillance of allergy in laboratory animal handlers. *ILAR J* 42:47-54.
- Wald PH. *Industrial poisoning: Information and control*. 2002. In: Goldfrank F, Flomenbaum N, Lewin N, Howland MA, Hoffman R, Nelson L. *Goldfrank's Toxicologic Emergencies*. 7th ed. Stamford: Appleton and Lange.
- Wood RA. 2001. Laboratory animal allergens. *ILAR J* 42:12-16.