

Biological Monitoring in the Workplace



**A Special Insert Contributed by the
Health and Safety Committee**



November 1999, 2/1



Biological Monitoring in the Workplace



Introduction

Conservators across all specialty groups work with a variety of potentially harmful chemical substances. They should be interested in knowing 1) what is their possible exposure risk, and 2) what adverse health effects, if any, have resulted from this exposure. The concept of conducting medical monitoring tests to identify signs or symptoms of disease is familiar to all physicians.

However, the goal of anyone working with hazardous materials is to prevent disease from even occurring. To do that, one needs first to establish whether your work materials or practices are resulting in measurable exposure to those hazards. The evaluation of health risk is a multi-faceted process best done by a specialist in the field of occupational hygiene or safety. The process, to be complete, should include repetitive sampling of the workplace ambient air to determine the anticipated inhalation exposure expected from a certain conservation task using particular chemicals. In addition, there are forms of biological monitoring which may be appropriate for a health professional to perform in the context of workplace risk evaluation. Your personal physicians can also conduct biological monitoring tests for occupational exposure, provided they are familiar with the standards specific to the specialized field of occupational medicine.

This Guide is intended to provide the conservator with useful references necessary to begin this process, by:

- discussing how biological monitoring can be used by health professionals as a tool for assessing your exposure to chemicals in the workplace,
- explaining the difference between biological (exposure) and medical (health effects) monitoring,
- listing chemicals for which there are established guidelines or standards for biological monitoring, and
- offering useful references and resources.

Explanation of terms

The health **risk** (or hazard) from a particular chemical is a function of both its **toxicity** and the **exposure dose** actually absorbed by the user.

- *Toxicity* is the capacity of a material to produce injury or harm when the chemical has reached a sufficient concentration (dose) at a certain site in the body.

- *Exposure dose* is the amount of chemical that has been absorbed by the body and could therefore reach that site to do harm.

- The *risk, or hazard*, of working with that chemical is the probability that this dose concentration will occur.

In other words, a carcinogen used inside a properly functioning lab hood could pose far less of a health risk than a low-toxicity alcohol used in closed quarters, with poor ventilation and no skin protection.

Environmental monitoring can be used to determine exposure by looking at the concentration of the chemicals in the work environment. These tests would include airborne (inhalation exposure) samples and surface wipe samples. If the overall dose of a chemical enters the body through routes other than inhalation (i.e., ingestion or dermal) then **biological monitoring** of other media (like urine, exhaled breath, or blood) may be a better determinant of overall dose than air sampling alone. Biological monitoring also produces a pre-clinical measurement of the presence of the chemical, estimating the amount which has proceeded from the external to the internal environment. Finally, **medical monitoring** tests will be used by the physician to measure adverse health effect, or occupational illness, in a particular individual. By the time medical monitoring produces an indication of the chemical, the parameter measured is extent of biological effect, i.e., illness. Biological (exposure dose) monitoring and medical (health effect) monitoring, when assessed together, constitute a **medical surveil-**

lance program, a term which usually applies to a study of health trends in a population of workers, not in an individual. This term is often used in the regulatory standards of the U.S. Occupational Safety and Health Administration (OSHA).

An Important Distinction to Understand

A primary distinction between biological and medical monitoring is that the former is an estimate of dose, the latter is a measure of the effect of that dose. In other words, for medical monitoring to produce an abnormal reading, the chemical must have already had an adverse effect on the person. Biological monitoring, on the other hand, can detect whether you have been measurably exposed to a chemical (hopefully **before** symptoms appear). For example, if conservators request periodic liver function tests because they are working with certain solvents, they will be waiting for a manifestation of the damage, rather than trying to determine if work exposures, as measured through air or exhaled breath samples, may be putting them at risk. Biological monitoring, if conducted according to validated occupational health protocols and within specified time frames, can serve as an invaluable red flag for conservators, particularly those who are working consistently with small amounts of highly hazardous chemicals, or have just been accidentally exposed to an atypically high concentration.

Routes of Exposure

Exposure to toxic substances in the workplace can result from chemicals being inhaled, ingested or being absorbed through the skin (including mucus membranes). Figure 1 presents the pathway by which a chemical substance in the workplace environment can produce toxic effect. By being aware of these routes of exposure, the conservator can both better judge the potential

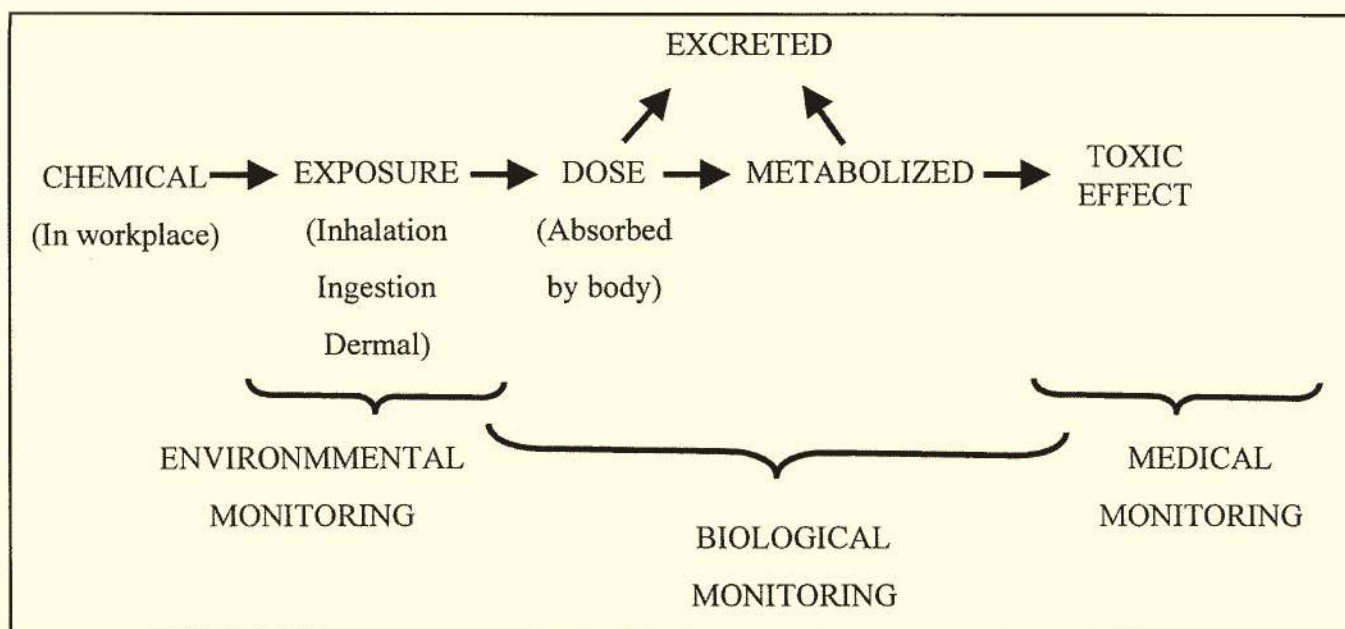


Fig. 1. Exposure pathway for workplace chemicals

for exposure and also better control that exposure. For example, a large number of chemicals including some solids as well as many liquids, can be absorbed through intact skin and into the bloodstream. By being aware of this potential route of exposure, conservators can modify their work habits or even use protective clothing (e.g., impermeable gloves) to prevent this dermal absorption. Also, ingestion of a compound can be direct (e.g., hand to mouth) but is more likely to be indirect (e.g., substance getting onto food or drink in the workplace). The value of frequent washing and restrictions on consumption of food and beverage in the studio or lab should be obvious.

Environmental Monitoring

If inhalation is the only significant route of entry to the body, then the results of ambient air samples taken within the person's "breathing zone" reflect the dose of that chemical to the body. The collection device is placed close to the person's breathing zone, typically on the worker's lapel. The device may be connected to a battery-operated, calibrated sampling pump, which is worn through the work/exposure period, often an 8-hour shift or 15-minute short term exposure period. Validated sampling and analytical methods are followed, such as those published by the

National Institute for Occupational Safety and Health (NIOSH). The sample is analyzed by a qualified laboratory for the concentration of the chemical studied, and the results are compared with established regulatory standards, such as the Permissible Exposure Limits (PELs) promulgated by the OSHA or consensus guidelines, such as the annually-revised Threshold Limit Values (TLVs) of the American Conference of Governmental Industrial Hygienists (ACGIH), or the NIOSH Recommended Exposure Limits (RELs). None of these concentrations should be construed as absolute lines between safe and unsafe exposures, but should be evaluated in the overall exposure assessment. Contacts for these organizations are listed in the reference section of this Guide.

Other techniques for estimating the potential for environmental exposures are occasionally used such as wipe samples to estimate the concentration of a toxic chemical on work surfaces or even on the workers skin. There are, however, only a few validated techniques for collecting and analyzing these types of samples, or standards against which to judge results (such as lead), so these procedures are generally of qualitative, not quantitative, value to the investigator.

Biological Monitoring

If significant exposure can occur through routes of entry other than inhalation, biological monitoring may be warranted. The most widely accepted forms of biological monitoring include exhaled breath, urine, and blood testing. Alterations in these concentrations reflect absorption by all routes of entry, reflect physiological responses unique to the individual, and offer information beyond that provided by air sampling alone.

The reference values most commonly used in this case are guidelines such as the annually revised Biological Exposure Indices (BEIs), published by the ACGIH. BEIs, like the TLVs, RELs and PELs, do not represent a sharp distinction between hazardous and non-hazardous exposures. The ACGIH Documentation of the BEIs states: "Alterations in function or unusual laboratory findings can be viewed as evidence of harm, or they can be viewed as only a marker that exposure has occurred. Interpretation of biological monitoring is complicated by the fact that the concentration of the material measured is not exactly equivalent of the exposure dose. When a chemical is absorbed into the body, excretion of earlier ingestion of that substance may be occurring at the same time." Action on unexpected values should not be based on a single

Table 1. Chemicals with Established BEIs

Chemical	Biological Specimen	Chemical	Biological Specimen
Acetone	Urine	Methanol	Urine
Aniline	Urine or blood	Methemoglobin inducers	Blood
Arsenic	Urine	Methoxyethanol	Urine
Benzene	Urine	Methoxyethyl acetate	Urine
Cadmium	Urine or blood	Methyl chloroform	Exhaled air, urine or blood
Carbon disulfide	Urine	Methylene bis(2-chloroaniline)	Urine
Carbon monoxide	Blood or exhaled air	Methyl ethyl ketone	Urine
Chlorobenzene	Urine	Methyl isobutyl ketone	Urine
Chromium	Urine	Nitrobenzene	Urine or blood
Cobalt	Urine or blood	Organophosphorus cholinesterase inhibitors	Blood
Dimethylacetamide	Urine	Parathion	Urine or blood
Dimethylformamide	Urine	Pentachlorophenol	Urine or blood
Ethoxyethanol	Urine	Perchloroethylene	Exhaled air, urine or blood
Ethoxyethyl acetate	Urine	Phenol	Urine
Ethyl benzene	Urine or exhaled air	Styrene	Urine or blood
Fluorides	Urine	Toluene	Urine or blood
Furfural	Urine	Trichloroethylene	Urine, blood or exhaled air
Hexane	Urine or exhaled air	Vanadium pentoxide	Urine
Lead	Blood	Xylenes	Urine
Mercury	Urine or blood		

isolated measurement but on measurements of multiple sampling.

There are 36 compounds for which BEIs have been established. These 36 compounds are listed in Table 1, along with the biological matrix used for their evaluation. BEIs listed in that table are established by the ACGIH. Additional information on these guidelines can be obtained from that organization (see Resource List at end of this Guide). The BEI values should be used only by a medically-trained individual familiar with their interpretation, and then **only** with the aid of the documentation for BEIs which is also available from the ACGIH.

Critical Factors for Biological Monitoring:

1. The timing of the sample collection is critical, and the protocol guidelines must be followed. This is because different chemicals and their markers take different times to make themselves available for sampling in the same body medium, as characterized by their half-life. The BEI measurements may be intended to represent peak exposures, or to reflect equilibrium levels attained only after steady state has been reached.

2. When interpreting biological monitoring data, the physician must

take into consideration factors that contribute to individual variation in response to the exposure. You and your colleagues will likely have differences in pulmonary function, hemodynamics, body composition, efficacy of excretory organs, and activity of enzyme systems that mediate metabolism of the chemical. Other factors to consider include personal factors (age, sex, pregnancy, medications, state of health), lifestyle choices (smoking, drug use, eating habits, and personal hygiene), and environmental exposures outside the workplace. It is possible to exceed the BEIs and not experience adverse health effects. Your personal or company physician must carefully evaluate your personal profile and integrate all necessary information into the interpretation of biological monitoring results.

3. To assist in the interpretation of biological monitoring, particularly the BEIs, the physician is referred to the ACGIH Documentation of the BEIs which detail specific information on the above variables as they relate to a specific chemical agent, and lists quality control measures to be taken in the sampling, handling, and analysis of specimens.

When is biological monitoring necessary or appropriate?

1. Specific monitoring may be mandated by an OSHA standard (Table 2), or may be recommended by the documentation of a specific BEI.

2. The effectiveness of personal protective equipment (or even personal hygiene, work practices, and engineering controls) in creating a barrier against the hazardous agent can be evaluated through monitoring for the marker of the exposure. For example, airborne concentrations of inorganic arsenic may be undetectable in the breathing zone during handling of treated objects. However, high concentrations in the urine may indicate inadvertent ingestion though lack of gloves and poor hand or face washing practices.

3. Biological monitoring should be used to substantiate air monitoring, or to determine the potential for absorption via the skin and GI tract. It should be conducted when it offers an advantage over the use of air monitoring alone.

When should biological monitoring not be used?

Biological monitoring should not

Table 2. OSHA Standards with Medical Examination or Surveillance Requirements, Title 29 Code of Federal Regulations (CFR) Part 1910

1910.95	Occupational noise exposure
1910.134	Respiratory protection
1910.139	Respiratory protection for M. tuberculosis
1910.1001	Asbestos (and 1926.1101 – Asbestos in Construction Industry)
1910.1003	Select Carcinogens
	4-Nitrobiphenyl
	alpha-Naphthylamine
	Methyl chloromethyl ether
	3,4-Dichlorobenzidine (and its salts)
	bis-Chloromethyl ether
	beta-Naphthylamine
	Benzidine
	4-Aminodiphenyl
	Ethyleneimine
	beta-Propiolactone
	2-Acetylaminofluorene
	4-Dimethylaminoazo-benzene
	N-Nitrosodimethylamine
1910.1017	Vinyl chloride
1910.1018	Inorganic arsenic
1910.1025	Lead
1910.1027	Cadmium
1910.1028	Benzene
1910.1029	Coke oven emissions
1910.1030	Bloodborne pathogens
1910.1043	Cotton dust
1910.1044	1,2-dibromo-3-chloropropane
1910.1045	Acrylonitrile
1910.1047	Ethylene oxide
1910.1048	Formaldehyde
1910.1050	Methylenedianiline
1910.1051	1,3-Butadiene
1910.1052	Methylene chloride
1910.1450	Occupational exposure to hazardous chemicals in laboratories

be used as your personal exposure control method, because it measures dose only after it has occurred and may affect bodily functions in some way. Biological monitoring and medical surveillance are not substitutes for environmental or personal sampling but should be used to complement them.

Medical Monitoring

Medical monitoring is conducted on exposed individual to evaluate any adverse health effects of those exposures. The major purpose is the early detection of disease or conditions for which treatment can prevent further illness. Health surveillance of a population of workers for disease is used to predict effect and can also be a valuable tool in hazard control, by detecting when an initially effective control or work practice has lost effectiveness.

Recommendations for medical monitoring tests are in the purview of the physician, based on reported symptoms and knowledge (provided by the conservator) of chemicals to which the patient is exposed. Be respectful of the fact that physicians receive a standardized medical school education, and that occupational and environmental medicine is considered a specialty requiring further training in epidemiology, toxicology, industrial hygiene, and case management of occupational injuries and illnesses. Physicians specializing in occupational medicine are certified by the American Board of Preventive Medicine. Additional medical resources can be found on the attached listing of **Occupational Health Clinics**, as published by the Association of Occupational and Environmental Clinics

Many OSHA standards now have requirements for medical examinations, focusing on screening of individuals or surveillance of an entire exposed group. These standards are listed in Table 2.

Highlights for Conservators: The OSHA Respiratory Protection Standard

The OSHA Respiratory Protection Standard 29CFR1910.134 requires medical approval prior to use of a respirator for a number of reasons, all re-

lating to fitness-for-duty. For example: can a firefighter stand the physical and physiological strain of wearing a self-contained breathing apparatus? Does the worker have pre-existing medical conditions which can be worsened by the effect of wearing a respirator (claustrophobia, severe asthma or pulmonary disease)? Should the individual be working in a certain chemical exposure setting (even with a respirator, which is not infallible) if they have a compromised immune system, are pregnant, or have other medical conditions for which the PELs or TLVs might not apply?

Periodic (typically, annual) follow-up respirator medical examinations are also useful to review current exposure data and any changes in personal medical history. Abnormal pulmonary function tests or chest x-rays may indicate a compromised or ill-fitting respirator, or a hyper-susceptible individual for whom a respirator should not be approved as the primary control.

Attached is the *Medical Evaluation Questionnaire* (mandatory Appendix C of the OSHA Respiratory Protection Standard), which is to be used by your physician to evaluate and approve your ability to wear a respirator in the course of your duties.

The Value of the Exposure Assessment: Everyone Has a Part to Play

An exposure assessment relies on judgement and contributions from all parties involved. The conservator can provide the industrial hygienist and/or physician with a detailed chemical inventory and Material Safety Data Sheets. This list should include hazards that are known to be inherent to the objects you typically work with, such as white lead in paintings or mold growth on paper and books. The health professionals will also need to understand the routine and non-routine tasks involved, including all tasks and movements that might produce peak exposures, and any existing controls. Understanding your work exposure time frame is critical for a physician to administer clinical tests he/she thinks are useful. For example, if a physician believes that biological monitoring for lead exposure appears

warranted for a paintings conservator, he/she will need to know if the blood tests reflect exposure in the preceding few days, or accumulated exposure that ended months ago. If your physician is not specialized in occupational medicine, provide her/him with copies of the appropriate OSHA standard (see Table 2, and access standard on the Internet or by phone from OSHA), particularly the medical surveillance technical appendices, and the ACGIH references for BEIs.

If an overexposure is indicated, the health professional will need to expand the assessment to evaluate the effectiveness of existing ventilation or work practice controls, and take further action. Instituting a permanent control (i.e., change in chemical, installation of ventilation controls) is the best option. Interim controls would include the use of a respirator and/or other properly selected personal protective equipment. Another interim option would involve "administrative" controls, such as the rotation of staff through the problematic task, with the intent to reduce everyone's average daily exposure to a minimal concentration. Exposure control is not the topic of this Guide; however, the reader should consult the Resources for further direction.

There are many important and useful reasons to justify the expense of determining the exposure risks presented by your conservation tasks, and the most reasonable control plans to reduce these exposures. The most important reason, of course, is to prevent illness in you and your colleagues.

Acknowledgements

The AIC Health and Safety Committee wishes to acknowledge the assistance of Dr. G. Edward Burroughs, Ph.D., CIH, and Kathryn A. Makos, MPH, CIH, in the compilation of this Guide. Dr. Burroughs is a Research Industrial Hygienist with the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, of the U.S. Public Health Service. Ms. Makos is a senior industrial hygienist with the Office of Environmental Management and Safety, Smithsonian Institution.

Resources

American Conference of Governmental Industrial Hygienists. 1330 Kemper Meadow Drive, Cincinnati, OH 45240; 513-742-2020; www.acgih.org.

Association of Occupational and Environmental Clinics; 1010 Vermont Ave., NW #513, Washington DC 20005; 202-347-4976.

National Institute for Occupational Safety and Health (NIOSH); 800-356-4647; www.cdc.gov/niosh

Occupational Safety and Health Administration (OSHA); 200 Constitution Ave NW, Washington DC, 20210; 202-219-8148; www.osha.gov

References

ACGIH. 1998. Documentation of the Threshold Limit Values and Biological Exposure Indices. Cincinnati, Ohio: American Conference of Governmental Industrial Hygienists.

DiNardi, S. R., ed. 1997. The occupational environment - its evaluation and control. Fairfax, Virginia: American Industrial Hygiene Association Press. 262-282.

Ho, M. H. and H. K. Dillon. 1987. Biological monitoring of exposure to chemicals, organic compounds. New York, NY: John Wiley & Sons.

Mulhausen, J. R. and J. Damiano. 1998. A strategy for assessing and managing occupational exposure, 2nd ed. Fairfax, Virginia: American Industrial Hygiene Association Press.

Plog, B.A., ed. 1996. Fundamentals of industrial hygiene, 4th ed. Chicago, IL: National Safety Council.

Clinic Listings in the United States and Canada

ALABAMA

University of Alabama at
Birmingham
930 20th Street South
Birmingham, AL 35294-2042
205-975-2767 FAX 205-975-4377
Timothy J. Key, MD, MPH

ARIZONA

Samaritan Occupational and
Environmental Toxicology Clinic
Department of Medical Toxicology
925 E. McDowell Rd., Second
Floor
Phoenix, AZ 85006
602-239-6690 FAX 602-239-
4138
Kevin Wallace, MD

CALIFORNIA

Occupational & Environmental
Medicine Clinic
University of California at San
Francisco/ SFGH
Building 30, 5th Floor
1001 Potrero Ave.
San Francisco, California 94110
415-206-4320 FAX 415-206-8949
Patricia Quinlan, MPH, CIH
Alt. Contact: Denise Souza, R.N.,
MSN, OHNP, COHN-S

UCSF Occupational Health
Services
University of California at San
Francisco
2186 Geary Boulevard, Suite 103
San Francisco, California 94115
Robert Harrison, MD, MPH
415-885-7580 FAX 415-771-4472
Alt. Contact Leslie Israel, DO,
MPH

Occupational & Environmental
Health Clinic
Employee Health Services
Univ. of California, Davis Medical
Center
Primary Care Building, Suite A
2221 Stockton Blvd.
Sacramento, CA 95817
916-734-8393 FAX 916-734-7510
Appointments: 916-734-8393

Stephen McCurdy, MD, MPH

Occupational and Environmental
Clinic
University of California at Irvine
Center for Occupational and
Environmental Health
19722 MacArthur Blvd.
Irvine, CA 92715
949-824-8641 FAX 949-824-2345
Dean Baker, MD, MPH

COLORADO

Div. of Env. & Occ. Health Sciences
National Jewish Medical Research
Center
1400 Jackson Street
Denver, CO 80206
303-398-1520 FAX 303-398-1452
Appointments: 303-398-1733
Peggy Mroz, MSPH
Alt. Contact
Cecile Rose, MD, MPH

Toxicology Associates
2555 S. Downing Street #260
Denver, CO 80210
303-765-3800 FAX 303-765-3804
Scott Phillips, MD, FACP

CONNECTICUT

Yale University Occ. & Env.
Medicine Program
135 College Street, 3rd Floor
New Haven, CT 06510
203-785-7267 FAX 203-785-7391
Mark R. Cullen, MD
Alt. Contact
Peter M. Rabinowitz, MD, MPH

University of Connecticut
Occupational & Environmental
Medicine Program
263 Farmington Ave.
Farmington, CT 06030
860-679-2893 FAX 860-679-1349
Eileen Storey, MD, MPH

Northwest Connecticut
Occupational Medical Cntr. 333
Kennedy Drive, Suite 202
Torrington, CT 06790
860-482-4552 FAX 860-489-4647
Gregory E. McCarthy, MD

DISTRICT OF COLUMBIA

Div. of Occ. & Env. Medicine
School of Medicine, George
Washington University
2300 K St. NW
Washington, DC 20037
202-994-1734 FAX 202-994-0011
Tee L. Guidotti, MD, MPH
Alt. Contact
Katherine Hunting, PhD, MPH

GEORGIA

Env. and Occ. Medicine
Consultative Clinic
The Emory Clinic
1525 Clifton Road NE, Rm. 404
Atlanta, GA 30322
404-778-5978 FAX 404-727-8744
Howard Frumkin, MD, Dr. PH

ILLINOIS

Occupational Medicine Clinic
Cook County Hospital
1900 W. Polk, Rm. 500
Chicago, IL 60612
312-633-5310 FAX 312-633-6442
Rachel Rubin, MD, MPH
Alt. Contact
Ann Naughton, RN, MPH,
COHN

University of Illinois Occ.
Medicine Program
914 S. Wood
M/C 684
Chicago, IL 60612
312-996-7420 FAX 312-413-8485
Daniel Hryhorczuk, MD, MPH

IOWA

Univ. of Iowa, Occupational
Medicine Clinic
Dept. Internal Med.- College of
Medicine
SE 318, GH 200 Hawkins Drive
Iowa City, IA 52242
319-356-8269 FAX 319-356-7147
David Schwartz, MD, MPH

KENTUCKY

Univ. of Kentucky Occ. Medicine
Program
2400 Greatstone Point
Lexington, KY 40504
606-257-5150 FAX 606-257-8982
Terence Collins, MD, MPH

LOUISIANA

Ochsner Center for Occ. Health
1514 Jefferson Highway
New Orleans, LA 70121
504-842-3955 FAX 504-842-3977
Gregg A. Bendrick, MD, MPH
Alt. Contact: Lori Brown

Tulane Centers for Occupational
Health
1415 Tulane Ave., Box HC31
New Orleans, LA 70112
504-736-5333 FAX 504-736-4835
Douglas A. Swift, MD, MSPH

MARYLAND

Johns Hopkins University
Center for Occupational &
Environmental Health
5501 Hopkins Bayview Circle
Baltimore, MD 21224
410-550-2322 FAX 410-550-3355
Edward J. Bernacki, MD, MPH

Occ. Health Project
Univ. Of Maryland School of
Medicine
405 West Redwood Street
Baltimore, MD 21201
410-706-7464 FAX 410-706-4078
Janie Gordon, ScM

MASSACHUSETTS

Center for Occ. and Env. Medicine
Massachusetts Respiratory Hospital
2001 Washington Street
South Braintree, MA 02184
781-848-2600 FAX 781-849-3290
Dianne Plantamura, MSW,
Coordinator
Alt. Contact David Christiani, MD,
MPH, MS

Occupational Health Program
Dept. Family & Community
Medicine
Univ. of Massachusetts

55 Lake Avenue North
Worcester, MA 01655-0309
508-856-2818 FAX 508-856-1680
Glenn Pransky, MD, MOccH

Occupational & Environmental
Health Ctr.
Cambridge Hospital
1493 Cambridge Street
Cambridge, MA 02139
617-498-1580 FAX 617-498-1671
Rose Goldman, MD, MPH

Occupational & Environmental
Medicine
Boston Medical Center
88 E. Newton St., F-5
Boston, MA 02118
617-353-6630 FAX 617-353-6848
Cheryl S. Barbanel, MD, MBA,
MPH

MICHIGAN

Michigan State University
Department of Medicine
117 West Fee
East Lansing, MI 48824-1316
517-353-1846 FAX 517-432-3606
Appointments: 517-353-4941
Kenneth Rosenman, MD

Div. of Occupational and
Environmental Medicine
Wayne State Univ./Dept. of Family
Medicine
4201 St. Antoine, Suite 4-J
Detroit, MI 48201
313-577-1420 FAX 313-577-3070
Appointments/Clinic: 313-745-
4093
Michael Goldstein, MD, OEM
Alt. Contact
Maryjean Schenk, MD, MPH

Occupational Health Program
School of Public Health, Univ. Of
Michigan
1420 Washington Heights
Ann Arbor, MI 48109-2029
734-764-2594 FAX 734-763-8095
David Garabrant, MD, MPH
Alt. Contact
Alfred Franzblau, MD

Center for Occ. and Environmental
Medicine
22255 Greenfield Rd. Suite 440
Southfield, MI 48075

248-559-6663 FAX 248-559-8254
Laura Harbut, EMT, MBA

Occupational Health Service
St. Lawrence Hospital Work and
Health Institute
1210 W. Saginaw
Lansing, MI 48915
517-377-0309 FAX 517-377-0310
R. Michael Kelly, MD, MPH

MINNESOTA

HealthPartners-Regions Hospital
Occ. & Env. Medicine
640 Jackson St.
St. Paul, MN 55101-2595
651-221-3771 FAX 651-221-8848
Paula Geiger
Alt. Contact William H. Lohman,
MD

Columbia Park Medical Group
Occupational Medicine
Department
6401 University Ave., NE #200
Minneapolis, MN 55432
612-572-5710 FAX 612-571-3008
Donald Johnson, MD
Alt. Contact Dorothy Quick

NEW JERSEY

Env. and Occ. Health Clinical
Center
Env. and Occ. Health Sciences
Institute
UMDNJ - Robert Wood Johnson
Medical School
170 Frelinghuysen Rd.
Piscataway, NJ 08854
732-445-0123 FAX 732-445-
0127
Howard Kippen, MD, MPH
Alt. Contact Gail Buckler, RN,
MPH, COHN-S

NEW MEXICO

Presbyterian Occupational
Medicine Clinic
5901 Harper, NE
P.O. Box 26666
Albuquerque, NM 87125-6666
505-823-8450 FAX 505-823-8484
William I. Christensen, MD, MPH

Occupational and Environmental
Medical Clinic

2400 Tucker NE, Rm. 177
Albuquerque, NM 87131-5267
505-272-4087 FAX 505-272-4494
Karen B. Mulloy, DO, MSCH

NEW YORK

Eastern NY Occ. & Env. Health
Center
155 Washington Avenue
Albany, NY 12210
518-436-5511 FAX 518-436-9110
Anne Tencza, BS, RN, COHN-S
Alt. Contact
Eckardt Johanning, MD

Mount Sinai - Irving J. Selikoff
Center for Occupational and
Environmental Medicine
P.O. Box 1058, One Gustave L.
Levy Place
New York, NY 10029
212-241-0176 FAX 212-996-0407
Appointments: 212-987-6043
Stephen Mooser, MPH
Alt. Contact
Stephen Levin, MD

Center for Occupational &
Environmental Medicine
School of Medicine
Health Sciences Center, Level
3-086
University at Stony Brook
Stony Brook, NY 11794
516-444-2196 FAX 516-444-7525
Wajdy Hailoo, MD, MSc, DIH

Central NY Occ. Health Clinical
Ctr.
6712 Brooklawn Parkway
Suite 204
Syracuse, NY 13211-2195
315-432-8899 FAX 315-431-9528
Michael B. Lax, MD, MPH

New York University/Bellevue
Hospital
Occupational and Environmental
Medicine Clinic
Bellevue Hospital, Room CD349
462 First Ave.
New York, NY 10016
212-562-4572 FAX 212-562-4574
George Friedman-Jiménez, MD

Finger Lakes Occupational Health
Services
980 Westfall Road, Suite 210

Rochester, NY 14618
716-256-0853 FAX 716-256-2271
Deanna Woodhams, MA

NORTH CAROLINA

Div. of Occ. and Env. Medicine
Duke University Medical Center
Box 3834
Durham, NC 27710
919-286-3232 FAX 919-286-1021
Dennis J. Darcey, MD, MSPH
Alt. Contact
Gary Greenberg, MD, MPH

OHIO

Community Health Partners Occ.
Health Center
The Lorain Clinic for
Occupational Medicine &
Rehabilitation
1800 Livingston Ave.
Lorain, OH 44052
440-233-1068 Fax 440-246-4560
Kathleen Fagan, MD, MPH
Alt. Contact Ann Wise, MD

Center for Occupational Health
Holmes Hospital-Tate Wing
University of Cincinnati College of
Medicine
Eden and Bethesda Ave.
Cincinnati, OH 45267-0458
513-584-1234 FAX 513-584-1010
James Donovan, MD, MS
Alt. Contact Susan Pinney, PhD

OKLAHOMA

University Occupational Health
Services
Div. of Occupational and
Environmental Medicine
Oklahoma Memorial Hospital
900 NE 10th Street, #2400
Oklahoma City, OK 73104
405-271-6177 FAX 405-271-4125
David Paul, MD, MPH

PENNSYLVANIA

Occ. and Environmental Medicine
Program
University of Pittsburgh
3708 Fifth Avenue, Suite 401,
Medical Arts Bldg.
Pittsburgh, PA 15213-3405
412-647-5360 FAX 412-647-1140

Joseph J. Schwerha, MD, MPH

Occupational and Env. Health
Service
Dept. of Comm. & Prev. Med.
MCP- Hahnemann School of
Medicine
2900 Queen Lane
Philadelphia, Pennsylvania 19129
215-991-8464 FAX 215-843-6028
Grace Paranzino, MS, RN, CHES
Alt. Contact
Harriet Rubenstein, JD, MPH

University of Pennsylvania School
of Medicine
Occupational Medicine
Silverstein Pavilion
3400 Spruce Street
Philadelphia, PA 19104-4283
215-349-5708 FAX 215-662-3953
Appt: 215-662-2354
Edward A. Emmett, MD

Center for Occupational and
Environmental Health
Abington Memorial Hospital
2510 Maryland Road, Suite 101
Willow Grove, PA, 19090-1109
215-481-5904 FAX 215-481-5920
Lora S. Regan, MD, MPH

TENNESSEE

Occupational and Environmental
Medicine Clinic
Meharry Medical College
1005 D.B. Todd Boulevard
Nashville, TN 37208
615-327-6736 FAX 615-327-6717
Otis Cosby, MD, MPH
Alt. Contact
Herman Ellis, MD, MPH

TEXAS

Texas Institute of Occupational
Safety & Health
11987 U.S. Highway 271
Tyler, TX 75708-3154
903-877-5900 FAX 903-877-7982
Jeffrey Levin, MD, MSPH

University of Texas Health Services
7000 Fannin, Suite 1620
Houston, TX 77030
713-500-3267 FAX 713-500-3263
Thomas Mackey, RNC, PhD

UTAH

Rocky Mountain Center for
Occupational and Environmental
Health
75 South 2000 East
University of Utah
Salt Lake City, Utah 84112-0512
801-581-3841 FAX 801-581-7224
Appointments: 801-581-5056
Anthony Suruda, MD, MPH
Alt. Contact: Royce Moser, MD,
MPH

WASHINGTON

Occupational & Env. Medicine
Program
Univ. of Wash. Harborview Medical
Center
325 9th Ave. #359739
Seattle, WA 98104-2499
206-731-3005 FAX 206-731-8247
Drew Brodtkin, MD, MPH
Alt. Contact
Scott Barnhart, MD, MPH

WEST VIRGINIA

Div. of Occupational & Env. Health
Dept. of Family & Community
Medicine
Marshall Univ. School of Med.
1600 Medical Center
Huntington, WV 25755
304-691-1178 FAX 304-691-1153
Chris McGuffin, MSCH, MSOSH
Alt. Contact
James Becker, MD

Institute of Occupational & Env.
Health
West Virginia Univ. School of
Medicine
3801 Robert F. Byrd Health
Science Center South
Morgantown, WV 26506-9190
304-293-3693 FAX 304-293-2629
Alan Ducatman, MD, MSc

CANADIAN CLINICS

Alberta

Occupational Medicine Consulta-
tion Clinic
Univ. of Alberta
13-103 Clinical Science Bldg.
Edmonton, Alberta, CD T6G 2G3
780-492-6291 FAX 780-492-0364
Jim Cheng, MD

Manitoba

MFL Occupational Health Centre,
Inc.
102-275 Broadway
Winnipeg, Manitoba, CD R3C
4M6
204-949-0811 FAX 204-956-0848

Ontario

Occupational Health Clinics for
Ontario Workers
15 Gervais Drive, Suite 308
Toronto, ON Canada M3C 1Y8
416-449-0009 FAX 416-449-7772
Andrew King, Executive Director

Occupational Health Clinics for
Ontario Workers
848 Main Street East
Hamilton, ON, Canada L8M 1L9
905-549-2552 FAX 905-549-7993
Chuck Emberson, Executive
Director

Occupational Health Clinics for
Ontario Workers
1780 Regent Street South
Times Square Mall
Sudbury, ON, Canada P3C 3Z8
705-523-2330 FAX 705-522-
8957
Donna Campbell, Executive
Director

Occupational Health Clinics for
Ontario Workers
547 Victoria Ave.
Windsor, ON, Canada N9A 4N1
519-973-4800 FAX 519-973-
1906
Jim Brophy, Executive Director

Completion of this form is a prerequisite for respirator fit testing.

Appendix C to Sec. 1910.134

OSHA Respirator Medical Evaluation Questionnaire (Mandatory)

Editor's Note: This questionnaire can also be found on OSHA's website:
http://www.osha-slc.gov/OshStd_data/1910_0134_APP_C.html

To the employer: Answers to questions in Section 1, and to question 9 in Section 2 of Part A, do not require a medical examination.

To the employee: Can you read (circle one): Yes/No

Your employer must allow you to answer this questionnaire during normal working hours, or at a time and place that is convenient to you. To maintain your confidentiality, your employer or supervisor must not look at or review your answers, and your employer must tell you how to deliver or send this questionnaire to the health care professional who will review it.

Part A. Section 1. (Mandatory) The following information must be provided by every employee who has been selected to use any type of respirator (please print).

1. Today's date: _____
2. Your name: _____
3. Your age (to nearest year): _____
4. Sex (circle one): Male/Female
5. Your height: _____ ft. _____ in.
6. Your weight: _____ lbs.
7. Your job title: _____
8. A phone number where you can be reached by the health care professional who reviews this questionnaire (include the Area Code): _____
9. The best time to phone you at this number: _____
10. Has your employer told you how to contact the health care professional who will review this questionnaire (circle one): Yes/No
11. Check the type of respirator you will use (you can check more than one category):
 - a. _____ N, R, or P disposable respirator (filter-mask, non-cartridge type only).
 - b. _____ Other type (for example, half- or full-facepiece type, powered-air purifying, supplied-air, self-contained breathing apparatus).
12. Have you worn a respirator (circle one): Yes/No
If "yes," what type(s): _____

Part A. Section 2. (Mandatory) Questions 1 through 9 below must be answered by every employee who has been selected to use any type of respirator (please circle "yes" or "no").

1. Do you currently smoke tobacco, or have you smoked tobacco in the last month: Yes/No
2. Have you ever had any of the following conditions?
 - a. Seizures (fits): Yes/No
 - b. Diabetes (sugar disease): Yes/No
 - c. Allergic reactions that interfere with your breathing: Yes/No

d. Claustrophobia (fear of closed-in places): Yes/No

e. Trouble smelling odors: Yes/No

3. Have you ever had any of the following pulmonary or lung problems?

a. Asbestosis: Yes/No

b. Asthma: Yes/No

c. Chronic bronchitis: Yes/No

d. Emphysema: Yes/No

e. Pneumonia: Yes/No

f. Tuberculosis: Yes/No

g. Silicosis: Yes/No

h. Pneumothorax (collapsed lung): Yes/No

i. Lung cancer: Yes/No

j. Broken ribs: Yes/No

k. Any chest injuries or surgeries: Yes/No

l. Any other lung problem that you've been told about: Yes/No

4. Do you currently have any of the following symptoms of pulmonary or lung illness?

a. Shortness of breath: Yes/No

b. Shortness of breath when walking fast on level ground or walking up a slight hill or incline: Yes/No

c. Shortness of breath when walking with other people at an ordinary pace on level ground: Yes/No

d. Have to stop for breath when walking at your own pace on level ground: Yes/No

e. Shortness of breath when washing or dressing yourself: Yes/No

f. Shortness of breath that interferes with your job: Yes/No

g. Coughing that produces phlegm (thick sputum): Yes/No

h. Coughing that wakes you early in the morning: Yes/No

i. Coughing that occurs mostly when you are lying down: Yes/No

j. Coughing up blood in the last month: Yes/No

k. Wheezing: Yes/No

l. Wheezing that interferes with your job: Yes/No

m. Chest pain when you breathe deeply: Yes/No

n. Any other symptoms that you think may be related to lung problems: Yes/No

5. Have you ever had any of the following cardiovascular or heart problems?

a. Heart attack: Yes/No

b. Stroke: Yes/No

c. Angina: Yes/No

d. Heart failure: Yes/No

e. Swelling in your legs or feet (not caused by walking): Yes/No

f. Heart arrhythmia (heart beating irregularly): Yes/No

g. High blood pressure: Yes/No

h. Any other heart problem that you've been told about: Yes/No

6. Have you ever had any of the following cardiovascular or heart symptoms?

a. Frequent pain or tightness in your chest: Yes/No

b. Pain or tightness in your chest during physical activity: Yes/No

c. Pain or tightness in your chest that interferes with your job: Yes/No

d. In the past two years, have you noticed your heart skipping or missing a beat: Yes/No

e. Heartburn or indigestion that is not related to eating: Yes/ No

f. Any other symptoms that you think may be related to heart or circulation problems: Yes/No

7. Do you currently take medication for any of the following problems?

a. Breathing or lung problems: Yes/No

b. Heart trouble: Yes/No

c. Blood pressure: Yes/No

d. Seizures (fits): Yes/No

8. If you've used a respirator, have you ever had any of the following problems? (If you've never used a respirator, check the following space and go to question 9:)

- a. Eye irritation: Yes/No
- b. Skin allergies or rashes: Yes/No
- c. Anxiety: Yes/No
- d. General weakness or fatigue: Yes/No
- e. Any other problem that interferes with your use of a respirator: Yes/No

9. Would you like to talk to the health care professional who will review this questionnaire about your answers to this questionnaire: Yes/No

Questions 10 to 15 below must be answered by every employee who has been selected to use either a full-facepiece respirator or a self-contained breathing apparatus (SCBA). For employees who have been selected to use other types of respirators, answering these questions is voluntary.

10. Have you ever lost vision in either eye (temporarily or permanently): Yes/No

11. Do you currently have any of the following vision problems?

- a. Wear contact lenses: Yes/No
- b. Wear glasses: Yes/No
- c. Color blind: Yes/No
- d. Any other eye or vision problem: Yes/No

12. Have you ever had an injury to your ears, including a broken ear drum: Yes/No

13. Do you currently have any of the following hearing problems?

- a. Difficulty hearing: Yes/No
- b. Wear a hearing aid: Yes/No
- c. Any other hearing or ear problem: Yes/No

14. Have you ever had a back injury: Yes/No

15. Do you currently have any of the following musculoskeletal problems?

- a. Weakness in any of your arms, hands, legs, or feet: Yes/No
- b. Back pain: Yes/No
- c. Difficulty fully moving your arms and legs: Yes/No
- d. Pain or stiffness when you lean forward or backward at the waist: Yes/No
- e. Difficulty fully moving your head up or down: Yes/No
- f. Difficulty fully moving your head side to side: Yes/No
- g. Difficulty bending at your knees: Yes/No
- h. Difficulty squatting to the ground: Yes/No
- i. Climbing a flight of stairs or a ladder carrying more than 25 lbs: Yes/No
- j. Any other muscle or skeletal problem that interferes with using a respirator: Yes/No

Part B Any of the following questions, and other questions not listed, may be added to the questionnaire at the discretion of the health care professional who will review the questionnaire.

1. In your present job, are you working at high altitudes (over 5,000 feet) or in a place that has lower than normal amounts of oxygen: Yes/No

If "yes," do you have feelings of dizziness, shortness of breath, pounding in your chest, or other symptoms when you're working under these conditions: Yes/No

2. At work or at home, have you ever been exposed to hazardous solvents, hazardous airborne chemicals (e.g., gases, fumes, or dust), or have you come into skin contact with hazardous chemicals: Yes/No

If "yes," name the chemicals if you know them:

3. Have you ever worked with any of the materials, or under any of the conditions, listed below:

- a. Asbestos: Yes/No
- b. Silica (e.g., in sandblasting): Yes/No
- c. Tungsten/cobalt (e.g., grinding or welding this material): Yes/No
- d. Beryllium: Yes/No

- e. Aluminum: Yes/No
- f. Coal (for example, mining): Yes/No
- g. Iron: Yes/No
- h. Tin: Yes/No
- i. Dusty environments: Yes/No
- j. Any other hazardous exposures: Yes/No
If "yes," describe these exposures:

4. List any second jobs or side businesses you have:

5. List your previous occupations:

6. List your current and previous hobbies:

7. Have you been in the military services? Yes/No

If "yes," were you exposed to biological or chemical agents (either in training or combat): Yes/No

8. Have you ever worked on a HAZMAT team? Yes/No

9. Other than medications for breathing and lung problems, heart trouble, blood pressure, and seizures mentioned earlier in this questionnaire, are you taking any other medications for any reason (including over-the-counter medications): Yes/No

If "yes," name the medications if you know them:

10. Will you be using any of the following items with your respirator(s)?

- a. HEPA Filters: Yes/No
- b. Canisters (for example, gas masks): Yes/No
- c. Cartridges: Yes/No

11. How often are you expected to use the respirator(s) (circle "yes" or "no" for all answers that apply to you)?:

- a. Escape only (no rescue): Yes/No
- b. Emergency rescue only: Yes/No
- c. Less than 5 hours per week: Yes/No
- d. Less than 2 hours per day: Yes/No
- e. 2 to 4 hours per day: Yes/No
- f. Over 4 hours per day: Yes/No

12. During the period you are using the respirator(s), is your work effort:

a. Light (less than 200 kcal per hour): Yes/No

If "yes," how long does this period last during the average shift: _____ hrs. _____ mins.

Examples of a light work effort are sitting while writing, typing, drafting, or performing light assembly work; or standing while operating a drill press (1-3 lbs.) or controlling machines.

b. Moderate (200 to 350 kcal per hour): Yes/No

If "yes," how long does this period last during the average shift: _____ hrs. _____ mins.

Examples of moderate work effort are sitting while nailing or filing; driving a truck or bus in urban traffic; standing while drilling, nailing, performing assembly work, or transferring a moderate load (about 35 lbs.) at trunk level; walking on a level surface about 2 mph or down a 5-degree grade about 3 mph; or pushing a wheelbarrow with a heavy load (about 100 lbs.) on a level surface.

c. Heavy (above 350 kcal per hour): Yes/No

If "yes," how long does this period last during the average shift: _____ hrs. _____ mins.

Examples of heavy work are lifting a heavy load (about 50 lbs.) from the floor to your waist or shoulder; working on a loading dock; shoveling; standing while bricklaying or chipping castings; walking up an 8-degree grade about 2 mph; climbing stairs with a heavy load (about 50 lbs.).

13. Will you be wearing protective clothing and/or equipment (other than the respirator) when you're using your respirator: Yes/No

If "yes," describe this protective clothing and/or equipment:

14. Will you be working under hot conditions (temperature exceeding 77 deg. F): Yes/No

15. Will you be working under humid conditions: Yes/No

16. Describe the work you'll be doing while you're using your respirator(s):

17. Describe any special or hazardous conditions you might encounter when you're using your respirator(s) (for example, confined spaces, life-threatening gases):

18. Provide the following information, if you know it, for each toxic substance that you'll be exposed to when you're using your respirator(s):

Name of the first toxic substance: _____

Estimated maximum exposure level per shift: _____

Duration of exposure per shift: _____

Name of the second toxic substance: _____

Estimated maximum exposure level per shift: _____

Duration of exposure per shift: _____

Name of the third toxic substance: _____

Estimated maximum exposure level per shift: _____

Duration of exposure per shift: _____

The name of any other toxic substances that you'll be exposed to while using your respirator: _____

19. Describe any special responsibilities you'll have while using your respirator(s) that may affect the safety and well-being of others (for example, rescue, security):

20. Is patient approved to wear a respirator? (yes) _____ (no) _____

If yes, when does approval expire? (date for re-exam) _____

Physician or Licensed Health Professional Signature and Date:

[63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998]

DON'T MISS

The Health and Safety Luncheon Lecture

**“Ergonomics Injuries
in Conservation”**

at the

28th AIC Annual Meeting

Saturday, June 10, 2000

featuring

Guest Speaker Michael McCann, Ph.D., CIH

Dr. McCann is the Director of Ergonomics and Safety at the Center to Protect Workers' Rights in Washington, D.C. His lecture will focus on ergonomics issues in conservation, such as risk factors for overuse injuries, types of injuries, and prevention.

The AIC Annual Meeting will be held at the Adams Mark Hotel, which is just a short distance from downtown Philadelphia. For more information about the AIC Annual Meeting, call (202) 452-9545 or send an e-mail to: infoaic@aol.com.

MARK YOUR CALENDARS NOW!