## Occupation and the Environment

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| **Occupational and Environmental Exposures—overview** | Timing, type, and dose of exposure will influence outcomes. First trimester exposures can result in miscarriage or structural anomalies. Later pregnancy exposures may lead to functional impairments, small for gestational age, or preterm delivery. | The same agents may be occupational or environmental exposures. Environmental exposure to an agent is often more common, but involves lower dose than occupational exposures. Very few chemicals in use in industry are adequately tested for reproductive toxicity. Standards or regulatory limits (e.g., TLV, REL, PEL) were developed for normal adult non-pregnant workers, and are usually based on health effects unrelated to pregnancy. | Discuss work exposures with patients:  
- Understand what the exposures are. Material Safety Data Sheets will report chemical content, but are not required to report reproductive hazards.  
- Smell is not a good guide to toxicity; harmful levels of chemicals cannot always be smelled, and some much less hazardous chemicals have an odor.  
- New Jersey Right to Know Hazardous Substance Fact Sheets (URL in Additional Resources Section) specifically list reproductive hazards and ways to reduce exposure for many chemicals, including appropriate personal protective equipment PPE.  
- Toxicants can be brought home by the worker or other family member on work shoes, clothing, and other items. Ask about this source of possible exposure.  

If the patient cannot be removed temporarily from exposure to a reproductive toxicant, consider (PPE):  
- Gloves can prevent dermal absorption, but only if the right material and thickness of glove is used. See [http://www.aps.anl.gov/Safety_and_Training/User_Safety/gloveselection.html](http://www.aps.anl.gov/Safety_and_Training/User_Safety/gloveselection.html) and glove resources in Additional Resources.  
- If splashing is likely, eye goggles should be worn.  
- Respirators should be recommended only after careful evaluation of the patient and exposure.  
  - Respirators may increase breathing resistance. During pregnancy, women typically experience increased oxygen demand and decreased lung capacity. These may make it more difficult for pregnant women to breathe while in a respirator.  
  - Wearing even a properly fitted respirator does not guarantee protection from a reproductive toxicant.  
  - Charcoal or other paper “masks” do not offer protection against many chemicals. |

CDC-Info is available for consultation at 1-800-CDC-INFO.
## Physical agents

### Ionizing radiation
- Recognized reproductive toxicant. Effects include infertility, miscarriage, certain birth defects (depending on timing and dose).
- Healthcare workers:
  - Certain industrial/laboratory workers
  - Flight crew members
- Certain workplace radiation exposures incur a higher level of risk during pregnancy, including caring for patients who have been administered nuclear medicine radioactive materials, especially Iodine-131; portable X-ray machines; and fluoroscopy procedures.
  - Ionizing radiation exposure is well regulated in most U.S. workplaces.
    - The best first step is to talk to the workplace Radiation Safety Officer.
    - If a Radiation Safety Officer is not available, consult with the Ohio Department of Health, Bureau of Radiation Protection at [http://www.odh.ohio.gov/odhPrograms/rp/radprot/radprot1.aspx](http://www.odh.ohio.gov/odhPrograms/rp/radprot/radprot1.aspx)
    - CDC-Info (1-800-CDC-Info) may be able to consult.
  - Flight attendants and pilots are exposed to a different kind of ionizing radiation at levels that may be of concern for some crewmembers during pregnancy. Consult the AFA website ([http://ashsd.afacwa.org/index.cfm?zone=/unionactive/view_article.cfm&HomeID=98723](http://ashsd.afacwa.org/index.cfm?zone=/unionactive/view_article.cfm&HomeID=98723)), or CDC-Info.

### Nonionizing radiation
- Adverse effects are very dependent on source frequency, intensity, and duration.
  - Resonant frequencies (30-300MHz) are considered especially hazardous.
  - Birth defects resulting from local hyperthermia have been demonstrated in animals.
- Certain industries (plastic welding)
- Specific healthcare workers (diathermy operators)
- Radiation from current computer screens is not considered a risk to pregnancy.
  - This kind of radiation exposure is very location-specific and often not uniformly distributed from its source.
  - Information on frequency and intensity are necessary to estimate exposure. Consultation with a Safety Officer or CDC-info is recommended.
  - For many environmental sources, a prudent distance of about 3 feet will significantly reduce exposure.
  - Certain occupational sources can emit much higher levels in a non-uniform distribution.

### Temperature
- Heat is a known teratogen, although the fetus is protected to some extent by maternal circulation.
- Outdoor workers.
  - Some warehouse and factory workers (includes metal fabrication, glass or plastics manufacture)
- Avoid hot work environments that do not provide for adequate cooling breaks.
- Avoid specific sources of heat to the fetus: very hot/prolonged showers, saunas, hot tubs, diathermy treatments.

### Noise and vibration
- Sound is transmitted through the womb; very loud noise may damage the fetus’s developing ear structures and cause permanent hearing loss.
  - Low frequency noise (less than 100 Hz) may cause maternal changes in EEG pattern, heart rate, and blood pressure.
  - There is very limited evidence that vibration may contribute to reproductive disorders.
- Many occupations may be exposed to noise and/or vibration.
  - Hearing protection should be used by pregnant women exposed to 85 decibels (dB) or more to prevent maternal cardiovascular (heart) and endocrine (hormone) stress, which could harm both mother and fetus.
  - Providing hearing protection to the mother does not decrease the amount of noise transmitted to the fetus. The American Council of Government Industrial Hygienists (ACGIH) recommends that pregnant women should not be exposed to noise at or above 115 dBC, TWA (115 decibels, C weighting, Time-Weighted Average).
  - Segmental vibration can cause circulatory problems in the affected region. Increasing distance between a mother’s abdomen and a source of vibration/noise will help reduce the amount of vibration/noise that reaches the fetus.
| Chemicals | Increased risk for many adverse reproductive outcomes, including fertility problems, chromosomal aberrations, miscarriages, stillbirth, birth defects. | Trichloroethylene, chloroform, benzene, toluene, and other solvents may be in:  
- Petrochemicals  
- Metalworking fluids  
- Drycleaning fluids  
- Paint thinners, mineral spirits  
- Laboratory chemicals  
- Printing inks  
Multiple solvents are often used in commercial products, so effects of a single solvent cannot always be distinguished. | Most organic solvents are associated with some level of increased reproductive risk, including transfer to milk of a breastfeeding mother.  
- Pregnant workers may wish to consider talking to their employers to avoid these duties on a temporary basis during pregnancy and breastfeeding.  
- If avoidance during pregnancy/breastfeeding is not feasible:  
  - Increase ventilation as much as possible.  
  - Avoid eye, skin and respiratory contact. Use appropriate PPE (see PPE options under Overview, above).  
- Avoid optional contact with dry cleaning fluids, degreasers, paints, paint strippers and thinners, household cleaners. |
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| Plastics, epoxies and resins | Increased risk for fertility problems, miscarriages, stillbirth, birth defects. | These chemicals include styrene, methyl methacrylate, epoxy resins, vinyl chloride.  
Workers at potential risk include those in:  
- Plastic manufacturing  
- Beauty/nail salons (FDA has banned methyl methacrylate from nail salons)  
- Healthcare workers, especially orthopedics and dental laboratories  
- Boat building | Pregnant workers may wish to consider talking to their employers to avoid these duties on a temporary basis during pregnancy and breastfeeding.  
- If avoidance during pregnancy/breastfeeding is not feasible:  
  - Avoid directly mixing resins if at all possible. When mixed, the toxic monomers quickly turn into polymers, which are usually much less toxic (Guidance to reduce methyl methacrylate mixing exposures provided in the Resources section below.)  
  - Increase ventilation as much as possible.  
  - Avoid eye, skin and respiratory contact. Use appropriate PPE (see PPE options under Overview, above).  
- Avoid optional contact with dry cleaning fluids, degreasers, paints, paint strippers and thinners, household cleaners. |
| Formaldehyde | May cause Impaired fertility, miscarriage.  
Formaldehyde is a recognized carcinogen. | Healthcare workers, pathology/cytology laboratory personnel, anatomy and mortuary science students, funeral home employees/embalmers, beauticians  
Formaldehyde is also present in formalin, and glutaraldehyde may have similar health effects. | Formaldehyde may transfer to the milk of a breastfeeding mother.  
- Pregnant workers may wish to consider talking to their employers to avoid duties with formaldehyde exposure on a temporary basis during pregnancy and breastfeeding.  
- If avoidance during pregnancy/breastfeeding is not feasible:  
  - Increase ventilation as much as possible  
  - Avoid eye, skin and respiratory contact. Use appropriate PPE (see PPE options under Overview, above).  
- The New Jersey Fact Sheet for formaldehyde available at:  
| **Chemotherapy drugs** | May cause miscarriages, stillbirths, or birth defects.  
Many of these drugs are known teratogens and/or carcinogens. | Healthcare workers (pharmacy, nursing, operating room personnel; physicians; cleaning/maintenance workers), veterinary care workers  
Exposure can come from handling, mixing or administering chemotherapy, or from handling cancer patients and their waste products. | • Exposure to these drugs during mixing, administering, or caring for a treated patient can be difficult to control to a level that could be considered safe for a pregnant woman.  
• Pregnant workers may wish to consider talking to their employers to avoid these duties on a temporary basis during pregnancy and breastfeeding.  
• Guidelines for safe handling can be found at NIOSH's Hazardous Drug Alert website, http://www.cdc.gov/niosh/docs/2004-165. |
| **Anesthetic gases** | May cause impaired fertility, miscarriage, low birthweight and/or preterm birth, birth defects. | Healthcare workers in dental offices, hospital, and veterinary operating rooms; Chemical industry workers  
Agents include:  
• Isoflurane  
• Sevoflurane  
• Desflurane  
• Nitrous oxide | • Avoiding exposure to these anesthetic gases while planning to get pregnant or when pregnant is advisable. Pregnant workers may wish to consider talking to their employers to avoid exposure to these gases on a temporary basis during pregnancy.  
• If occupational exposure cannot be avoided, respiratory protection can be evaluated but does not guarantee a safe environment for the fetus. See respirator discussion in Overview above.  
• Scavenger systems can work well, but the systems must be very carefully maintained and monitored to make sure they are working; if they are not working, the developing baby is at risk. See Resources for references on scavenger system maintenance. |
| **Carbon monoxide** | Reduced fetal growth Neurologic damage | Combustion product at increased levels in workplaces including:  
• Parking garages  
• Tollbooths  
• Motor vehicle service facilities  
• Workplaces with tobacco smoke | • Avoiding exposure to CO when pregnant is advisable. Pregnant workers may wish to consider talking to their employers to avoid exposure on a temporary basis during pregnancy.  
• If occupational exposure cannot be avoided, respiratory protection can be evaluated but does not guarantee a safe environment for the fetus. See respirator discussion in Overview above.  
• Increased ventilation may be helpful in some low-exposure situations. |
| Pesticides | Miscarriages, genitourinary defects, neural tube defects, gastroschisis, cognitive deficits | Occupations that may be highly exposed include farm workers, greenhouse workers, florists, fruit/vegetable handlers, veterinarians and veterinary assistants, landscapers, and anyone who performs pest or weed control. In the home, people may be exposed through the use of insect sprays in and around the house, lawn or garden treatments, or the use of flea and tick treatments or preventatives on pets. | - Greenhouse and farm workers must observe re-entry times carefully. - Wear fungicide-impervious gloves when handling cut flowers from a greenhouse or florist. - Veterinary workers and pet owners should avoid skin contact with flea, tick, and mite treatments or preventatives. - Avoid carry-home exposure and use proper PPE. - Wash hands after handling pets wearing flea collars or who have received flea and tick drops. |

| PCBs and PBBs | LBW, stillbirth, cleft palate, possible renal malformations | Production of PCBs was banned in the U.S. in 1977. Workers can be exposed to PCBs in waste management/recycling or when repairing older electrical capacitors. PCB contamination of surface waters is widespread. Consuming fish caught in these waters can cause PCB exposure. | - Small, young fish typically have the lowest PCB and PBB levels. Following fish consumption guides to reduce mercury exposure will also reduce dietary PCB exposure: [http://www.nrdc.org/health/effects/mercury/walletcard.PDF](http://www.nrdc.org/health/effects/mercury/walletcard.PDF). - New Jersey Fact Sheet on PCBs available at: [http://nj.gov/health/eoh/rtkweb/documents/fs/1554.pdf](http://nj.gov/health/eoh/rtkweb/documents/fs/1554.pdf). |
# Metals

## Lead
- Has been linked to abnormal sperm, menstrual disorders, miscarriages, stillbirths, cognitive defects in offspring.
- Many occupations may be exposed, including manufacturing/metal fabrication; recyclers; construction or maintenance; battery, paint, ink, crystal, or ceramics manufacture; law enforcement.
- Potentially exposed hobbies including rifle hunting/target shooting; welding; making stained glass, jewelry, or ceramics.
- Lead paint (particularly peeling or chipping) in older buildings/structures is most common environmental source of exposure.
- Avoid solder, lead pipes, batteries, lead paints and lead-painted surfaces, lead in glazed ceramics, smelter emissions.
- Discuss hobbies with patients. Firing ammunition and some arts/crafts can create potential for lead exposure. Some patients may be unaware of potential for lead exposure. Choosing lead-free products may be possible. Careful washing after engaging in hobby-work will reduce exposure.
- Avoid sanding/refinishing painted surfaces/furniture unless it is known that the paint is lead-free.
- CDC topic page on lead available at: [http://www.cdc.gov/niosh/topics/lead/](http://www.cdc.gov/niosh/topics/lead/).

## Mercury
- Impaired fetal motor development, cognitive defects, deafness, blindness, neurological damage.
- Occupations potentially exposed include gold and silver mining or refining, production of thermometers and gauges, and production of dental amalgam.
- Avoid mercury in thermometers, mirror coating, dyes, and inks.

## Cadmium
- Birth defects, damage to male reproductive system, menstrual disorders.
- Workers in shipyards, construction, aircraft repair, battery or plastics manufacture, welding, and agriculture may be at risk for exposure.
- Cigarette smoke is the most common environmental source of exposure.
- Hobbies involving metalcrafting, jewelry-making or beading, or welding create the potential for exposure to cadmium.
- Current OSHA standards require biological monitoring of workers exposed to more than 0.0025 mg/m3 cadmium. Detailed information is available from OSHA at: [http://www.osha.gov/SLTC/cadmium/index.html](http://www.osha.gov/SLTC/cadmium/index.html).
- Avoid cigarette smoke (primary or second-hand) during pregnancy.
- Similar to lead, some inexpensive metal costume jewelry, jewelry-making products, or beads may contain cadmium. Hobby jewelry-makers should take precautions.

## Cobalt
- May cause damage to the male reproductive system, including reduced sperm count.
- Workers involved in production of steel alloys (or manufacture of products from those alloys) may be at risk.
- Cigarette smoke is the most common environmental source of exposure.
- Avoid cigarette smoke (primary or second-hand) during pregnancy.
| Biological/infectious agents | Infections that can pass to the unborn baby during pregnancy include rubella, cytomegalovirus (CMV), hepatitis B and C, chicken pox (varicella zoster virus), parvovirus B19, herpes, toxoplasmosis, listeria, and certain other infectious diseases. Adverse reproductive outcomes include miscarriage, stillbirth, and birth defects. Other agents (e.g., influenza and pneumonia) can affect a pregnancy by causing more serious illness in pregnant women. | Healthcare workers Healthcare workers Childcare workers Healthcare workers Tattoo artists and body piercers Healthcare workers Laboratory workers |
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| | | | | | |

- Pregnant women who carefully follow infection control guidelines (i.e., standard precautions) are generally at no higher risk of acquiring a harmful infection from a patient than other workers. Exceptions exist for some pregnant women and some infectious agents:
  - See appendix A of the CDC/HICPAC 2007 document
  - See Guidelines for Infection Control in Healthcare Workers, Table 6 (URL in Additional Resources section below).

- Review vaccination history with the patient:
  - Pregnant women should get the inactivated (injected) influenza vaccine, instead of the live attenuated nasal vaccine (LAIV).
  - MMR vaccination is contraindicated during pregnancy. Non-immune health care workers (can be determined by serology) should not work with rubella-infected patients.
  - See immunization recommendations for special HCW conditions, including pregnancy, on Table 3 of:
    - http://www.cdc.gov/mmwr/preview/mmwrhtml/rr6007a1.htm.

- Risks and precautions for CMV can be found at several CDC websites (http://www.cdc.gov/cmv/clinical/index.html, http://www.cdc.gov/cmv/risk/preg-women.html). In 1-4 percent of pregnancies, a mother will develop a primary CMV infection; approximately one-third will pass the infection to their fetus. Most fetal infections (85-90 percent) will resolve prior to birth. These numbers and risks are even lower for seropositive women, but seropositivity to CMV does not necessarily mean immunity.

- Observe safe practices in body modification studios. See: http://www.cdc.gov/niosh/topics/body_art/.

- Guidelines for laboratory workers are intended to prevent laboratory-acquired infection in all personnel when followed correctly. Some exceptions exist.
  - For patient clinical samples, refer to the Guidelines for Safe Work Practices in Human and Animal Medical Diagnostic Laboratories at:

- For laboratory work with concentrated cultures of pathogens, refer to the Biosafety Manual for Biomedical Laboratories at:

For work involving unusual pathogens, emergent infections, or genetically modified pathogens, CDC-Info is available for consultation at 1-800-CDC-INFO.
| Other workplace factors | Shiftwork, atypical work schedules, and long hours of work | Health effects from shiftwork are also relevant to any kind of work during normal sleep time, including irregular shifts and jet lag, as well as long hours of work. Workers may include:  
- Health Care Workers  
- Law Enforcement and Firefighters  
- Cleaning/Building Services  
- Manufacturing Workers  
- Transportation Workers | If feasible, avoid working during normal sleep time during pregnancy.  
Good sleep hygiene is always important, but especially for shiftworkers.  
- General recommendations can be found at [http://www.sleepfoundation.org/article/ask-the-expert/sleep-hygiene](http://www.sleepfoundation.org/article/ask-the-expert/sleep-hygiene).  
- Sleep hygiene tips for shift workers can be found at [http://my.clevelandclinic.org/disorders/sleep_disorders/hic_shift_work_sleep_disorder.aspx](http://my.clevelandclinic.org/disorders/sleep_disorders/hic_shift_work_sleep_disorder.aspx).  
Because the adverse health effects of long or irregular work schedules may be partially due to stress responses, any measures to reduce stress and improve resilience may help (relaxation, exercise, and following a healthful diet). |
| Prolonged standing, ergonomics, and lifting | There is no clear consensus on whether prolonged standing or heavy lifting can cause adverse pregnancy outcomes such as preterm delivery or miscarriage.  
Pregnant women are at higher risk of an injury while lifting due to ergonomic stresses such as altered posture, impaired balance and agility, and an impaired ability to hold objects close to the body due to the abdomen’s changing size.  
Risk of injury can also increase during pregnancy due to hormonal changes that affect ligaments and joints in the spine (to accommodate the growing fetus). | Many occupations may be exposed, including healthcare workers, childcare workers, manufacturing and cleaning workers.  
- Reduce weight of heavy lifting and bulky lifting after first trimester.  
- Advise workers to get off their feet when on breaks.  
- Where feasible, workers should sit periodically during work to avoid standing for long periods of time. |
ADDITIONAL RESOURCES

For specific inquiries:

CDC-Info:  cdcinfo@cdc.gov, phone 800-CDC-INFO (800-232-4636)
8a.m.-8p.m. ET, Monday-Friday, Closed Holidays.
Provides answers to specific questions about occupational reproductive hazards, reproductive health, many other health topics.

New Jersey Right to Know Hazardous Substance Fact Sheets:  http://web.doh.state.nj.us/rtkhsfs/indexfs.aspx.
Well written workplace safety and health information, including reproductive health, for more than 1600 workplace chemicals (many also in Spanish). Produced by the New Jersey Department of Health in accordance with of the state Right-to-Know law to protect worker health.

General information on occupational and environmental reproductive health:

Review article on occupational reproductive health, including a checklist to evaluate hazards and discussions of clinical strategies.

Environmental exposures: how to counsel preconception and prenatal patients in the clinical setting:
http://www.ajog.org/article/S0002-9378(12)00151-2/abstract
Review article discussing strategies for health care providers to counsel patients on known environmental risks to reproduction.

Preventing Infection During Pregnancy:  http://www.cdc.gov/Features/Pregnancy/
General guidelines for preventing infection during pregnancy (intended for the general public, with PDFs in both English and Spanish).
Resources for Health Care Workers:

Occupational Hazards for Pregnant Nurses:  
Article from the American Journal of Nursing discussing hazardous exposures nurses may encounter, with suggestions on how to deal with these hazards. Written specifically for nurses, by nurses.

Hospital Infection Control Practices Advisory Committee (2007).  
Detailed infection control guidelines for all health care workers. Table 6 gives guidelines for pregnant health care workers.

Hospital Infection Control Practices Advisory Committee (2007).  
Describes airborne precautions for some infectious agents. Guidelines for pregnant health care workers vary by organism and are summarized in Appendix A.

Recommendations for Immunization of Health-Care Personnel:  http://www.cdc.gov/mmwr/preview/mmwrhtml/rr6007a1.htm  
Table 3 summarizes immunization recommendations for special HCW conditions including pregnancy.

Occupational Exposure to Volatile Anaesthetics: Epidemiology and Approaches to Reducing the Problem  
Review article on anesthetic gases and control technology

Controlling Exposures to Nitrous Oxide During Anesthetic Administration:  http://www.cdc.gov/niosh/docs/94-100/  and  
NIOSH references on anesthetic gas scavenger systems.
Includes links to the NIOSH alert (Preventing Occupational Exposure to Antineoplastic and Other Hazardous Drugs in Health Care Settings) and the NIOSH Hazardous Drug List (List of Antineoplastic and Other Hazardous Drugs in Healthcare Settings 2010), along with links to updates and additional information.

Resources for Laboratory Workers:

CDC guidelines for laboratory work with infectious agents. Where special precautions are needed for pregnant lab workers, they are noted in the pathogen-specific guidance pages.

CDC guidelines for working in diagnostic laboratories with clinical specimens. This guide addresses commonly encountered chemicals and other safety concerns of laboratories.

CDC Guidelines for proper use and maintenance of biological safety cabinets (hoods).

Resources for Flight Crews:

Flight crew specific exposures (radiation, circadian disruption) and pregnancy.
**Methyl Methacrylate Control**

Control of Methyl Methacrylate During the Preparation of Orthopedic Bone Cements:  
*Technical article on control of exposure to methacrylate epoxies for surgical bone cement*

**Selection of Personal Protective Equipment (PPE):**

**Quick Selection Guide to Chemical Protective Clothing, 5th ed**  
*Glove guidance document that includes detailed information on chemical resistance, including break through times for specific chemicals against different types of gloves.*

*Glove selection guide (including permeation test data) from Ansell, one of the largest safety glove manufacturers.*

*Web page from the Arbonne National Laboratory discussing how to choose an appropriate glove for the task, including advantages/disadvantages of popular glove materials.*

**Protective Clothing and Ensembles:** [http://www.cdc.gov/niosh/topics/protclothing/](http://www.cdc.gov/niosh/topics/protclothing/)  
*NIOSH topic page addressing PPE. Includes links to specific documents addressing selection of clothing, gloves, eye protection, and respirators.*