

University of Ottawa

GUIDE FOR PREGNANT WOMEN IN LABORATORIES

FOR STAFF, STUDENTS AND VOLUNTEERS



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POLICY FOR PREGNANT WOMEN IN LABORATORIES
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TABLE OF CONTENTS

Objective	3
Definitions	3
Declaration of pregnancy	4
Rights of working pregnant women	5
Responsibilities of employers and employees	5
Potential negative risks	6
Biological risks in laboratory	6
Chemical risks in laboratory	7
Physical risks in laboratory	8
Ionizing radiation	8
Supplemental information	11
Annex I: Biological risks	12
Annex II: Chemical risks	14
Annex III: Physical risks	16
Annex IV: Radioactive risks vs. non-radioactive risks	17

POLICY FOR PREGNANT WOMEN WORKING IN LABORATORIES

Objective

During the nine months (approx) of pregnancy, each activity practiced by the women can have effects, both positive and negative, on the health of the baby she is carrying. The harmful effects of certain actions done during pregnancy are more well known than others: smoking cigarettes, consuming alcohol, eating poorly, etc. However, it is less obvious that repeated exposure to chemicals or low doses of radiation can affect the wellbeing of the future child.

Due to the fact that the biological characteristics of the embryo/foetus are different from those of adults (large number of cells in active phase of division), it is therefore, more than any other period in the circle of life, sensitive to harmful effects of the environment. The University of Ottawa therefore recommends minimizing all actions that could have a negative impact on the embryo/foetus.

With the goal of trying to fulfill this objective, this guide presented by the University of Ottawa is intended to inform workers of the biological, chemical and physical risks that can be encountered when working in the laboratories at the University and to help prevent and diminish the impacts of these risks on their health.

It should be noted that the following recommendations and information for the health of the embryo/foetus are also applicable for the duration of the breast-feeding of the infant, since any dangerous substances present in the mothers' milk can be transmitted to the infant through this way.

Definitions

Risk: Danger that can be associated with a task or activity. The level of risk depends on the properties of the agent used, the dose, the duration, the manner and moment of exposure as well as the personal susceptibility.

Teratogenic: agent that can cause malformations to an embryo or to a foetus as well as the human reproductive system. It can be a chemical substance, a virus, ionizing radiation, etc.

Carcinogen: agent that can cause cancer

Mutagen: Substance or agent that can cause an augmentation in the level of gene changes. These mutations (changes) can lead to cell malformation or cancer development, ex: certain biological and chemical agents as well as exposure to ultraviolet rays or ionizing radiation

Embryotoxic: Agent that is toxic for the embryo

Foetotoxic: Agent that is toxic for the foetus

Declaration of pregnancy

During the first three months of pregnancy, the organs and limbs of the embryo/foetus form; this is the most sensitive period in its development. The University therefore invites every pregnant woman to declare their pregnancy status as soon as possible to maximize the security of the future child.

It is recommended, with the help of the supervisor, to find ways to control the possible risks found in the workplace. When possible, dangerous materials should be moved or replaced by less harmful substitutes. Safety precautions to minimize the risk of exposure to biological, chemical and physical agents should be revised with the supervisor; including the following general precautions:

- Do not smoke, eat, drink or put on make-up in the laboratories
- Never oral pipette
- Wash hands after each manipulation of dangerous substances
- Use the appropriate individual protective equipment:
 - o Disposable gloves (double-up if necessary) resistant to solvents during the manipulation of dangerous substances to avoid all skin contact
 - o A lab coat or other protective clothing when there is possibility of splashing
- Avoid transporting any residues of toxic substances on clothing, shoes, skin, etc. and contaminating other people, ex.: family members, particularly young children

The pregnant worker or the supervisor should then advise the Environmental Health and Safety Office so that an officer may be aware of the situation. By being advised of the pregnancy state of the worker, the officer may review precedents in radiation exposure and can therefore estimate the level of exposure possible during the rest of the pregnancy. If there is presence of radiation in the pregnant workers environment, the worker will be protected for the length of the pregnancy by having to wear a dosimeter at the level of the abdomen. If ever the dosimeter

is lost or improperly stored (stored near a radioactive source), the concerned worker should immediately contact the Environmental Health and Safety officer to replace it.

Pregnant workers Rights

According to the amendments in the Human Rights Code of Ontario, with regards to the discrimination based on pregnancy or breastfeeding as interpreted by the Ontario Commission for Human Rights:

The employers can take into consideration the needs of women during their prenatal and postnatal periods through several ways, without suffering any unjustified prejudice, by:

- Transferring a woman to another work position, or by assigning her to modified functions, in one way or another in a temporary fashion;
- Offering her a flexible work schedule, so that she can attend doctors' appointments, including fertility treatments;
- Authorizing her to take breaks when needed – a general Human Rights principle to not deprive someone because she has special needs; this means that employees that need breaks, for example, for breastfeeding, should normally be able to take those breaks without using normally allocated breaks such as lunch hours, or without having to make up the time with supplemental hours, unless the employer can prove that their breaks are being unjustly used.

Responsibilities of the Employers and the Employees

According to the Human Rights Code of Ontario:

- An employer and an employee are jointly responsible to determine what would be the most appropriate adaptation measures to take into account the needs of the employee, according to the circumstances. The two parties must discuss respectfully and cooperatively the appropriate measures that can be put into place, used, and maintained.
- If a doctor tells a pregnant woman that she does not have to do certain work, it is up to the future mother to clearly explain to her employer the reasons that she can no longer do certain work and the nature of the special needs he will have to take into consideration.
- The employers should accept the special requests concerning the needs of the pregnant worker, unless there are legitimate reasons not to.

- The employer has the right to ask for sufficient information from the employee to help her. The employer may also ask for advice from a specialist to help the employee.
- Once the employer is aware of the needs of a pregnant woman, he or she must take those needs into consideration, unless in doing so he or she would be suffering an unjustified prejudice.
- The employer does not have the right to force the pregnant employee to take an absence from work without pay, to ensure her needs have been met. The rights of the pregnant woman, as an employee, must be kept in the highest regard when taking into consideration her needs as a pregnant woman.

Potential negative risks

An exposure to a dangerous substance can cause effects that can perturb the development of the embryo/foetus before as well as after the birth: abortion, structural anomalies (teratogenic effects), toxicity for the organs, delay of growth and development, reduction of body weight, death, peri or post-natal anomalies, as well as functional anomalies. This also includes the alteration of mental and physical development after the birth of the child, including the pubescent development as well as the future reproductive capabilities of the child.

Biological risks in the laboratory

Biological agents can be viruses, bacteria or parasites such as herpes, Hepatitis A, B or C, HIV, rubella, brucellosis, malaria, etc (see also Annex I). Some of these biological agents are used in the laboratories at the University, while others can be concealed in biological samples, e.g. blood, urine, milk, tissues, etc. For the embryo/foetus to be contaminated by these substances, they must first cross the placental barrier. The permeability of the placenta is variable depending on the period of the pregnancy:

- Before the third month: viruses can cross the placenta
- After the fourth month: germs can cross the placenta
- As of the seventh month: larger parasites can cross the placenta

An infection of the mother can produce three outcomes:

- Infection of the foetus followed by in-utero death or structural anomalies
- Non-apparent infection of the foetus after birth
- No contamination

The biological agents can penetrate the body through airways, through ingestion and through the skin. It is important to remember that not all micro-organisms can enter the body in the same way, e.g. HIV cannot enter the body through breathing (i.e. airways).

Most of the documented accidents are caused by:

- Cuts or scrapes during injections, or defecations, etc.
- Mouth pipetting
- Spills of tubes and flasks
- Contamination by infectious aerosols
- Splashes from using the centrifuge
- Bites or scratches from animals in the laboratories

The best protection against infectious agents is through the use of personal protective equipment, the use of safe work practices such as the use of appropriate fumehoods for certain types of biological agents, knowing the potential risks of each agent used as well as having received the appropriate vaccinations. It is important to disclose that certain types of vaccines such as those against rubella and chickenpox are to be avoided during pregnancy, since they can cause neonatal malformations. For more information on the subject, visit the website of the Recommendations of the Advisory Committee on the Immunization Practices (ACIP).

For more information concerning specific biological agents, consult the Public Health Agency of Canada website: <http://www.phac-aspc.gc.ca/lab-bio/index-eng.php>

Chemical risks in the laboratory

Thousands of chemical products exist, some of which can be dangerous to the health of those who are exposed to them for extended periods of time.

The consequences of the exposure of a pregnant woman to chemical products, such as solvents or metals, depend on the developmental stage of the embryo/foetus:

- During the first three months: risks of structural anomalies (teratogenic effects)
- After the first three months: teratogenic effects, but mostly functional anomalies

Chemical products penetrate the human body through forms such as gasses, dust, aerosols and vapors. They can be inhaled, or absorbed through the mouth and skin. For the embryo/foetus to be exposed, the chemical product would have to travel through the mothers' blood stream and cross the placenta. At the top of the list of most commonly known products to have toxic

effects on the embryo/foetus, are mercury and its derivatives, as well as lead and carbon monoxide.

The rate of discovery of chemical agents is much faster than the rate of understanding their properties; the consequences of exposure to many of these agents are therefore unknown. Furthermore, there are often many chemical agents present at one time, and the mix of these chemicals can often result in dangerous consequences. It is therefore recommended to minimize the amount of exposure to chemical agents, as well as when being exposed, to wear the proper personal protective equipment and to use safe work practices.

Before manipulating any new substance, be aware of the dangers associated to exposure with this chemical (see also Annex II). To obtain information on the chemical substances to avoid during pregnancy, visit the Canadian Centre for Occupational Health and Safety web site: http://www.ccohs.ca/products/Supplements/MSDS_FTSS/msdsINTGUIDE.html

Physical risks in the laboratory

The physical risks that can be dangerous to the health of the embryo/foetus (see Annex III) include lifting or transporting heavy objects, the risk of falling or slipping, excessive noise, excessive dust, extreme temperatures and stress; dangers as of the 5th month of pregnancy also include working standing, without the possibility to take breaks by sitting down.

The dangers from ionizing radiation found in the laboratories at the University are also part of the physical risks.

Ionizing radiation

Many types of radiation exist that each person is exposed to on a daily basis. For example, natural radiation from the environment: heat, light, ultraviolet rays, etc.; the average person receives approximately 0.125 rem of radiation per year from the environment or from medical procedures. The radiation that is found in the laboratories of the University is ionizing radiation from different types of particles:

- Alpha:* relatively heavy particles, travelling from 2-8 centimeters in the air and stopped by the skin.
- Beta:* Fast electrons, travelling from 0-10 meters in the air and stopped by the gloves or a few millimeters of flesh.

Gamma and X: Travel a few hundred meters in the air and penetrate through clothing and the body

Neutrons: Travel long distances and penetrate into the body

Irradiation corresponds to the exposure to ionizing radiation. It can come from a sealed or non-sealed source and stops if the person is far enough away from the source. It can be external, for example, on the surface of the body and can cause an external irradiation of the organism. It can live on work surfaces, the human body, etc. and can also cause the suspension of radioactive dust in the air. It can be internal, for example, by accidentally permitting the penetration of radioactive substances into the body; by ingestion, inhalation, through the transcutaneous or direct pathways (scrapes, burns, gashes, etc.) and therefore causes internal irradiation.

Radiation can therefore pass directly through the mother's body and cause damage to the developing embryo/foetus.

Due to the fact that the annual individual radiation dose of workers at the University is lower than 0.1 rem, the Canadian Nuclear Safety Commission considers these workers as members of the public and therefore are not to pass the limit of 0.1 rem.

The effects of ionizing radiation on the embryo/foetus are strongly related to the stage of development of the embryo/foetus. The more well-known effects are malformation and functional deterioration, which can occur during the development of the embryo/foetus, and can cause premature births, low birth weight, as well as an increase in the risk of developing cancer during childhood. The knowledge concerning the possible effects of radiation on the embryo/foetus from the Commission on Radiological Protection (ICRP) can be resumed as follows:

1st to 3rd week: Radiation can lead to the immediate death of the embryo, which normally leads to a unnoticed miscarriage, e.g. late periods. This result only occurs after a very high dose of radiation

After the 3rd week: Malformations or anomalies can occur after severe exposure to radiation estimated at approximately 10 rems. An important exception can be microcephaly (small head size). The risk is approximately 5 chances in 1000 per rem between the 4th and 7th weeks after conception, and a maximum of 9 chances in 1000 per rem between the 8th and 11th weeks.

<i>3rd week to last week:</i>	The chances that the irradiated embryo/foetus develops cancer before the age of 10 greatly increases. The US Nuclear Regulatory Commission (NRC) believes that a maximum of 0.5 rem is sufficient to protect the embryo/foetus.
<i>8th week to 15th week:</i>	The brain is much more sensitive, therefore malformations of the brain can be caused much easier, e.g. mental retardation. The brain, during the two months following this stage, is a little less sensitive. It can be noted that no effects on the development of the brain caused by radiation have been observed in humans after a dose lower than 5 rems.
<i>13th week to 40th week:</i>	Premature birth and delay in growth of child are both possible outcomes.

It is important to understand that the effects caused by ionizing radiation are the same as the effects caused by natural radiation (see also Annex IV).

To minimize the impacts of radiation, it is recommended to try and maintain a uniform level of minimal radiation exposure rather than be exposed for only two months of high levels of radiation. It is also recommended to limit the amount of time of exposure to radioactive substances and to use adequate personal protective equipment, as well as radiation safety practices such as:

- Working in a safe and clean environment
- Being aware and competent with our own work environment as well as the products that can be found there
- Clearly identify each product
- Increase the working distances with the ionizing source
- Always wear a lab coat and appropriate gloves (double if necessary)
- Always wear protective eyewear when there is risk of splashing
- Use volatile substances in the appropriate fume hood
- Decontaminate the work surface after each radioactive activity
- Control regularly the amount of radiation by using a radiation detector adapted to the element or by using contamination tests by smears
- Use the screens adapted to the substance being used:
 - o ^{32}P : Behind a plexiglass screen
 - o ^{22}Na : Behind a lead screen

- ^{45}Ca : Behind a 3mm plexiglass screen for a dose higher than 1 mCi
- ^{86}Rb : Behind a plexiglass screen
- ^{125}I : Behind a glass screen impregnated with lead

The effects due to strong doses of radiation in humans are pretty evident and easily measurable. However, weak doses have much less evident effects and are not as easily measured. Furthermore, many observations have been made during tests being done with animals, however these observations are much more deductive in nature than certain.

It is therefore much safer for the health and safety of the future child to assume that each dose of radiation can be a potential source of danger, and as such should continue to act in the safest way possible by avoiding unnecessary risks.

Whatever the source of the risk, caution is always the best solution.

For more information concerning radiation and its regulations, consult the Canadian Nuclear Safety Commission website.

Supplemental information

To obtain additional information, please contact The Office of Risk Management at (613)-562-5892.

ANNEX I

BIOLOGICAL RISKS: Main infectious agents

	Sources of contamination	Pathways of contamination	Foetal contamination	Foetal pathology
<i>Viral agents</i>				
Hepatitis B and C	Most biological liquids originating from humans	Parenteral inoculation, exposure to excoriated or mucus skin	5% of transmission by placental transmission, 80-90% of transmission during birth or post-partum	Risk of chronic hepatitis (80-90%)
Herpes simplex virus	Theoretical risks in laboratory (fragile virus)	Direct skin contact, or mucus	Transplacental transmission, rupture of the membranes, direct pathway during birth	Congenital Herpes: embryopathy, premature, foetal hypotrophy
HIV	Professional exposure (approx. 0,3-0,4% risk if come in contact)	Parenteral or cutaneous, mucus or contaminated blood	Vertical transmission. Main risks during birth and breastfeeding	No foetopathy. All newborns are seropositive, 15-25% are contaminated, 1/5 have a severe premature evolution, 4/5 have AIDS by 7 years old
Rubella	Professional eviction in case of seronegativity	Respiratory pathway, inter-human	Transplacental pathway	Embryo or foetopathy depending on the moment of contamination
<i>Bacteria</i>				
Brucellosis	Zoonose from urine, and abortion products	Transcutaneous and airborne	Possible transplacental passage	Contamination very rare
Listeriosis	Laboratories for the bacteriological control of food	Digestive, conjunctival, respiratory, cutaneous	Transplacental passage, 30-40 forms, 105 births per year	Abortions (25% if infection in 1 st trimester). Severe neonatal infections (75% of deaths). Late meningitis after 7 th day of life

	Sources of contamination	Pathways of contamination	Foetal contamination	Foetal pathology
<i>Parasites</i>				
Malaria (plasmodium)	Blood	Scrapes or pricks during smears, thick droplets	Severe maternal effect, death possible. Congenital malaria is rare	Abortion, premature birth, foetal hypotrophy
Toxoplasmosis (toxoplasma)	Ingestion of oocysts (60-80% of adults are immunized)	Dirty hands from soiled litter. Eviction of pregnant women, seronegativity	Transplacental Congenital toxoplasmosis, approx. 30-300 births	Abortion, encephalomyelitis, death. Visceral forms, discrete or non-apparent

It is important to note that the table of biological risks does not contain all the possible infectious agents that can infect the embryo/foetus, but only the most common biological agents.

ANNEX II

CHEMICAL RISKS: Main chemical agents (solvents and metals)

Chemical agents	Pathway of contamination	Possible effects for the foetus
Acetylsalicylic acid (Aspirin)	Respiratory pathway (vapor), digestive, intramuscular, intravenous	Delay in foetal development, delay and prolonged birthing process, Bleeding risk for child, Risk of premature closure of arterial canal
Arsenic compounds	Respiratory pathway, digestive, cutaneous	Foetotoxic effect: augmentation of malformation of brain, eyes, bones and sometimes the kidneys and gonads
Cadmium	Respiratory pathway, digestive	Carcinogen
Methyl chloride	Respiratory pathway	At high concentrations: cardiac malformation Mutagenic effects
Coumafene	Respiratory pathway, digestive	Teratogenic effects: osteoarticular malformation Delay in mental development, ophtalmological anomalies
Lithium	Respiratory pathway, cutaneous	Possible teratogenic effects
Mercury (and derivatives)	Respiratory pathway, cutaneous, digestive	Mutagenic, Possible foetotoxic effects
Carbon monoxide	Respiratory pathway	Delay in foetal growth, attacks the central nervous system and peripheral nervous systems, malformations
Nickel (monoxide)	Respiratory pathway, digestive	Foetotoxic effects: weight reduction of the foetus, increase in frequency of resorptions and death, weak mutagenic effects, carcinogen
Lead (and derivatives)	Respiratory pathway, digestive	Carcinogen, morphological and neurological effects, weak mutagenic and teratogenic effects, increase in spontaneous abortions and stillborns, delay in natal and post-natal growth
Carbon disulfide	Respiratory pathway, digestive	Delay in development

Chemical agents	Pathway of contamination	Possible effects for the foetus
Toluene (methylbenzene)	Respiratory pathway, cutaneous, digestive	Embryo-lethal and foetotoxic: decrease in birth weight, delay in ossification, minor skeletal anomalies
Xylene	Respiratory pathway, digestive, cutaneous	Increase in spontaneous abortions and stillborns

It is important to note that the table of chemical risks does not contain all the possible chemical agents that can affect the embryo/foetus, but only the most common chemical agents.

ANNEX III

PHYSICAL RISKS: Main physical risks

Factors	Threshold limit	Possible effects on foetus
Alcohol	Risk becomes greater in function of the quantity consumed. Moderate to no consumption is recommended.	Structural and anatomical anomalies, delay of uterine growth, functional anomalies, miscarriage
Noise	Exposure to 85 db(A) for more than 8 hours	Studies in progress: Alterations of audition at birth, premature auditory loss, increased tinnitus
Lifting heavy loads	10 to 15 kg lifted from 10 to 15 times per day <i>In the presence of other constraints or personal conditions, supplementary conditions are imposed</i>	Spontaneous abortion, increase in risk of premature births, premature contractions
Upright work station	No precise number of hours, maximum between 6 to 8 hours with breaks in between	Spontaneous abortion, premature birth and premature contractions, low birth weight, placental infarction
Tobacco	Tobacco acts to delay. Recommendation: stop smoking or no smoking	Acceleration of heart rate of foetus (type of asphyxia), increase in stillborn, abortions, bleeding, and placental abnormalities, low birth weight, development of certain cancers, During breastfeeding: neurological troubles
Vibrations	No nocivity threshold, but it is recommended to not operate the following vehicles: <ul style="list-style-type: none"> - Long distance bus - Electric crane - Forklift - Heavy farming equipment - Transport truck - Helicopter - Concrete truck 	Premature birth Stillborn

It is important to note that the table of physical risks does not contain all the possible dangers that can affect the embryo/foetus, but only the most common physical risks.

ANNEX IV

RADIOACTIVE RISKS VERSUS NON-RADIOACTIVE RISKS

Effects of the radioactive risk factors during pregnancy

Effects	Risks from natural radiation	Risk factors	Excess of risk factors
Children with cancer			
Death of the children with cancer	1.4 per thousand	Dose of 1 rem of radiation received before birth	0.6 per thousand
Anomalies			
Small head size	40 per thousand	Dose of 1 rad of radiation received between 4-7 weeks after conception	5 per thousand
Small head size	40 per thousand	Dose of 1 rad of radiation received between 8-11 weeks after conception	9 per thousand
Mental retardation	40 per thousand	Dose of 1 rad of radiation received between 8-15 weeks after conception	4 per thousand

Effects of the non-radioactive risk factors during pregnancy

Effects	Natural risks	Occupation	Excess of risk factors
Stillborns or spontaneous abortion	200 per thousand	Working in a high risk environment	90 per thousand
Alcohol consumption			
Foetal alcohol syndrome	1-2 per thousand	2-4 glasses per day	100 per thousand
Foetal alcohol syndrome	1-2 per thousand	More than 4 glasses per day	200 per thousand
Foetal alcohol syndrome	1-2 per thousand	Chronic alcoholic (more than 10 glasses per day)	350 per thousand
Infant mortality (soon after birth)	23 per thousand	Chronic alcoholic (more than 10 glasses per day)	170 per thousand
Smoking			
Infant mortality	23 per thousand	Less than 1 pack per day	5 per thousand
Infant mortality	23 per thousand	1 pack per day or more	10 per thousand