

Ohio Partners for
Birth Defects Prevention

Birth Defects: *Causes and Prevention Strategies Handbook*

Genetic



Maternal Health



Lifestyle



Environment



Acronyms List

Amnio	—	Amniocentesis	ODH	—	Ohio Department of Health
CL/CP	—	Cleft Lip/Cleft Palate	ONTD	—	Open Neural Tube Defect
CMV	—	Cytomegalovirus	OPBDP	—	Ohio Partners for Birth Defects Prevention
CVS	—	Chorionic Villus Sampling	PKU	—	Phenylketonuria
DVT	—	Deep Ven Thrombosis	SIDS	—	Sudden Infant Death Syndrome
FA	—	Folic Acid	STD	—	Sexually Transmitted Diseases
FASD	—	Fetal Alcohol Spectrum Disorder	VZIG	—	Varicella Zoster Immunoglobulin
GC	—	Genetic Counseling	W/D	—	Withdrawal
HBV	—	Hepatitis B Virus			
IUGR	—	Intrauterine Growth Restriction			
LBW	—	Low Birth Weight			
mg	—	Milligram			
MR	—	Mental Retardation			
NTD	—	Neural Tube Defect			
OCCSN	—	Ohio Connections for Children with Special Needs			

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About this handbook

The incidence of birth defects is a serious problem that impacts the health and development of many Ohio babies and their families. Birth defects are the leading cause of infant deaths in Ohio and the United States. Many national initiatives have emerged encouraging states to establish prevention programs to reduce the occurrence of birth defects and to promote early intervention programs to prevent secondary disabilities associated with birth defects in children.

In response to these needs, The Ohio Partners for Birth Defects Prevention (OPBDP) was formed in 2004. The group was established through a partnership agreement between the March of Dimes, Ohio Chapter, and the Ohio Department of Health (ODH). The OPBDP's main objective is to increase the public's awareness about preventable birth defects and what can be done to prevent or reduce the incidence of birth defects in our state. It functions as a subcommittee to the ODH Ohio Connections for Children with Special Needs (OCCSN) Advisory Council. OCCSN is Ohio's newly developing birth defects information system.

The OPBDP is made up of approximately 30 members from around the State of Ohio. When the work group began meeting, it searched for tools to provide an overview and to train members about the known causes of and prevention strategies for birth defects. We discovered that, although information is available on individual birth defects and isolated prevention strategies, there really is not one concise source that summarizes birth defects information in a single manual. That is when we conceived the idea for creating this *Birth Defects Causes and Prevention Strategies Handbook*.

The handbook classifies the causes of birth defects into four major categories: Genetic, Maternal Health, Lifestyle and Environmental. Under each category, known causes are identified. "At-a-glance" overview information about risk factors, possible fetal complications, incidence and prevention strategies are listed across from each known cause.

Although there are literally thousands of identified birth defects, medical science lags far behind in identifying the causes, treatments, cures and

prevention strategies for most of them. The intent of the handbook, therefore, is to provide the user with a general broad-stroke overview of what we know about the causes of birth defects at this moment in time. It is a quick-reference tool that does not mean to provide in-depth information about all birth defects.

Despite the best maternal health, quality prenatal care and preventive steps taken on the part of parents and their health providers, birth defects can still occur. Therefore, it is important to do the best we can with the information we have to assure the highest quality of life through available primary and secondary prevention measures. We recognize the important contributions people with special needs add to our lives. Disability is a natural part of the human experience and people with disabilities who live among us make immeasurable contributions to our society as a whole. This is the philosophy that underlies the activities of our work group and, we feel, enhances our prevention efforts.

The handbook will be available on the ODH Web site under the Genetics and OCCSN Programs. We hope health professionals/providers will find this information useful in their trainings, clinical practice, patient education and counseling. Additionally, we hope educators will be able to use the handbook to educate others and to increase awareness about the known causes of birth defects and prevention strategies. Your efforts to assist us in our mission to increase awareness in the public about this important topic are very much appreciated.

Sincerely,
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**Consultant Groups/Organizations
Represented Include:**

Consumers

Parents

College Students

Children’s Hospitals—Craniofacial
Teams

Easter Seals

Local Public Health Departments

The Ohio State University (OSU)
School of Nursing

School Health Nurses

March of Dimes, Ohio Chapter

Ohio Department of Alcohol and
Drug Addiction Services (ODADAS)

Ohio Department of Education
(DOE)

Ohio Department of Health (ODH)
Programs:

- Bureau for Children
with Medical Handicaps (BCMh)
- Cardiovascular Health
- Child and Family Health Services
(CFHS)
- Help Me Grow (HMG)
- Ohio Connections for Children
with Special Needs (OCCSN)
- Perinatal Smoking Cessation
Program (PSCP)
- Regional Comprehensive Genetic
Services (RCGC)
- Regional Perinatal Center
Programs (RPC)
- Sickle Cell Services
- WIC

Ohio Department of Mental
Retardation/Developmental
Disabilities (ODMR/DD)

Ohio Partners for Birth Defects Prevention

Birth Defects: *Causes and Prevention Strategies*

Birth Defects Associated with
Genetic Causes



General Category of Cause/Hazard	Specific Cause/Risk Factor	Potential Fetal Complications	Incidence/Carrier Frequency	Screening Tools/Prevention Strategies/Interventions Available
Genetic				
	Single-gene disorders	A few examples of single-gene disorders are listed below	The cause of approximately 20% of major malformations	
		Tay sachs	Incidence 1/3,000; Ashkenazi Jewish carrier frequency 1/30	Family history and carrier screening in high-risk ethnic groups
		Hemoglobinopathies, such as: sickle cell and thalassemia	Carrier frequency: 1/12 African Americans; 1/30–1/75 Mediterraneans/ Asians/Hispanics/Middle Easterners	Family history and carrier screening in ethnic group at risk for some hemoglobinopathies Newborn screening for sickling disorders. Early identification allows for timely treatment
		Cystic fibrosis (CF)	Incidence: 1/2,500 Caucasians Carrier frequency: 1/25 Caucasians 1/65 African Americans and 1/46 Hispanics	Family history of CF and carrier screening for high-risk ethnic groups Education and screening for infertility due to congenital bilateral absence of the vas deferens which is highly associated with mutations in CF gene Newborn screening allows early intervention
		Congenital hearing loss	Incidence: about 3/1,000 babies 60% of congenital or prelingual hearing loss is genetic – of these, 10% are related to connexin-26 Connexin-26 makes up 50% of nonsyndromic, recessive, hereditary hearing loss 30% of genetic hearing loss is syndromic	Family history/genetic consultation and genetic testing
	Chromosomal disorders		The cause of approximately 10% of all major malformations	Education on increasing risk with age Family history to rule out translocations
		One example of a chromosomal disorder is Down syndrome	1/800 live births	Education on causes and risks for occurrence Antenatal screening and testing Maternal analyte and ultrasound screening Amniocentesis/chorionic villus sampling

General Category of Cause/Hazard	Specific Cause/Risk Factor	Potential Fetal Complications	Incidence/Carrier Frequency	Screening Tools/Prevention Strategies/Interventions Available
	Multifactorial disorders	A few examples of multifactorial disorders are listed below	The cause of approximately 35% of all major malformations	
		Neural tube defects (anencephaly, encephalocele, spina bifida)	<p>1/1,000 – 1/2,500 live births</p> <p>1/33 live births to women with previous affected pregnancy</p>	<p>Reduction in incidence through folic acid (FA) food fortification</p> <p>To help reduce chance of occurrence, multivitamin with 400 mcg (0.4 mg/day) for all women of childbearing age</p> <p>Must be taken prior to conception and throughout first trimester of pregnancy</p> <p>Ultrasound and maternal analyte screening</p> <p>Referral to genetics to rule out a syndrome</p> <p>To help decrease chance of recurrence, increase dose of FA from 0.4mg when using birth control and not planning a pregnancy, to 4 mg daily beginning at least one month prior to conception and continuing through the first trimester</p>
		Congenital heart defects	<p>1/100 live births; higher incidence in babies lost before term</p> <p>Recurrence risk depends on cause and type of heart defect</p>	<p>FA food fortification</p> <p>Multivitamin for every woman of childbearing age</p> <p>Referral to genetics for family history, syndrome and teratogenic identification</p> <p>Risk calculation</p> <p>Folic acid supplementation and early prenatal care for subsequent pregnancies</p>
		Oral-facial clefts	<p>Incidence approximately 1/1,000; varies by ethnic background</p> <p>10–15% of those with cleft lip and/or palate have a related syndrome</p> <p>40–50% with only cleft palate have a syndrome</p> <p>Recurrence risk depends on cause, family history and severity of cleft</p>	<p>FA food fortification; multivitamin for every woman of childbearing age</p> <p>Referral to genetics for family history, syndrome and teratogenic identification, risk calculation</p> <p>Genetic testing available for some of the associated syndromes</p>

Ohio Partners for Birth Defects Prevention

Birth Defects: *Causes and Prevention Strategies*

Birth Defects Associated with
Maternal Health Conditions



General Category of Cause/Hazard	Specific Cause/Risk Factor	Potential Fetal Complications	Incidence/Carrier Frequency	Screening Tools/Prevention Strategies/Interventions Available
Maternal Health				
Maternal conditions	Maternal obesity	High risk of hypertension, preeclampsia, diabetes, open neural tube defects (ONTD), delivering a large infant, child at risk for being overweight and having diabetes		Nutritional counseling Exercise counseling Obese women should diet before conception and switch to maintenance diet of 1,800 calories/day while trying to conceive
	Maternal underweight	Women of average height but below 120 pounds at risk for amenorrhea, infertility and low birth weight (LBW) baby, preterm delivery and anemia		Nutritional/psychological counseling as indicated
	Advanced maternal age	Increased risk of chromosomal abnormalities Increased risk of infertility Increased risk of pregnancy complications	Incidence increases as maternal age increases	Genetic counseling, antenatal screening and testing: amniocentesis (amnio)/choriopic villus sampling (CVS)
Maternal chronic illness	Diabetes mellitus	Increased risk for miscarriage and birth defects such as caudal regression syndrome, neural tube defects (NTD), cardiac defects, microcephaly, hydronephrosis, renal and ureteral defects, duodenal or anorectal atresia	Hb A1C levels higher than 8.4% have a 32% chance of spontaneous abortion and seven times higher risk of several fetal anomalies. Major congenital malformations found in 5–9% of infants born to mothers with unmanaged existing diabetes (a 2–3 fold increased risk)	Referral to maternal fetal medicine specialist. Intensive diabetic management before and during pregnancy reduces risk to fetus and lessens complications of pregnancy. Insulin is medication of choice for diabetics during pregnancy

General Category of Cause/Hazard	Specific Cause/ Risk Factor	Potential Fetal Complications	Incidence/Carrier Frequency	Screening Tools/ Prevention Strategies/ Interventions Available
	Hypertension	Increased risk of pre-eclampsia in mother and renal insufficiency and growth retardation in fetus		<p>Review use of medications during pregnancy; aldomet and calcium channel blockers are commonly used during pregnancy</p> <p>Avoid angiotensin converting enzyme (ACE) inhibitors, angiotensin II receptor antagonists and thiazide diuretics because all are associated with congenital defects; educate about the risks and proper birth control in women of childbearing age</p>
	Seizure disorders	NTDs, facial defects, hypoplasia of distal phalanges, hypertelorism	<p>Children of mothers with epilepsy who are receiving anticonvulsant therapy have 4–8% risk of congenital anomalies.</p> <p>As many as 1/200 women have a seizure disorder such as epilepsy.</p>	<p>Preconception counseling regarding optimizing seizure control, Prescription folic acid supplements (1–4 mg/day) and genetic counseling referral. Avoid use of multiple anticonvulsants, if possible. Physician should aim for best single agent for the seizure type at the lowest protective level. If seizure free for more than two years, consider discontinuing or tapering medications. Women should never stop their seizure medications without asking doctor first as seizures themselves might harm the fetus</p>
	Thrombophilia	<p>Examples: Factor V Leiden, Protein C and S deficiencies, antithrombin III deficiency prothrombin 20210, homocystinuria</p> <p>Increased risk for blood clots, pregnancy complications and loss</p>	<p>Women with history of Deep vein thrombosis DVT have 7–12% risk of recurrence during pregnancy</p> <p>e.g. Factor V Leiden approximate 5–7% of caucasians</p>	<p>Women with personal or family history should be offered testing for thrombophilia before pregnancy</p> <p>Women with history of DVT should start on heparin treatment early in pregnancy</p> <p>Women who are on Rx warfarin (Coumadin) should be counseled regarding pregnancy risks</p> <p>Explore alternatives if have possibility of pregnancy</p> <p>If become pregnant on coumadin, should be switched to heparin as warfarin is teratogenic</p> <p>Screen those at risk due to personal or family history of thrombophilia or clot</p> <p>Treatment depends on type of clotting abnormality</p>
	Rh disease	Hydrops		Proper screening and administration of RhoGam during pregnancy

General Category of Cause/Hazard	Specific Cause/Risk Factor	Potential Fetal Complications	Incidence/Carrier Frequency	Screening Tools/Prevention Strategies/Interventions Available
	Maternal Phenylketonuria (PKU)	Mental retardation (MR), microcephaly, congenital heart disease	Among women with PKU on unrestricted diets: Risk of MR = 92% Risk of microcephaly =73% Risk of cardiac defects =12% Risk of PKU in offspring of women w/ PKU =1/120	Women with PKU should consult with their doctor before pregnancy and follow prescribed diet before and during pregnancy Consult with metabolic specialist. Inform of need to remain on diet throughout life and implications for childbearing and available strategies to reduce risk
	Thyroid disease	Untreated hyperthyroidism can cause pregnancy complications for the mother including preeclampsia. Can cause hyperthyroidism in the newborn Untreated hypothyroidism can cause the baby to have long-term neurologic or developmental difficulties including mental retardation	2% of pregnant women have thyroid disorder	Health care provider may recommend testing in pregnant women who have personal histories, family histories, other autoimmune disorders or symptoms of thyroid disease Educate women about symptoms of thyroid disease Thyroid disorders are generally diagnosed with blood tests For those diagnosed with thyroid disorders, blood levels need to be monitored and amount of medication taken needs to be adjusted as pregnancy progresses
	Systemic lupus erythematosus (SLE)	Serologic abnormalities, skin lesions, congenital heart block, fetal death, risk for miscarriage between 15–40%	1/700 Caucasian women have SLE 1/250 African American women have SLE	Close monitoring of lupus-related lab values; serial fetal ultrasound studies to assess growth; assessment of fetal functioning; adjustment of corticosteroid meds to optimize maternal health. Fetal heart rate monitoring to rule out congenital heart block; fetal echocardiogram

General Category of Cause/Hazard	Specific Cause/Risk Factor	Potential Fetal Complications	Incidence/Carrier Frequency	Screening Tools/Prevention Strategies/Interventions Available
Sexually transmitted Diseases (STDs)	STDs/HIV	Risk of preterm labor and transmitting to fetus		Educate regarding safe sexual practices to avoid exposures Adequate screening, thorough treatment education and treatment of partners HIV-preconception screening/testing, drug treatment and counseling to reduce risk to fetus
	Herpes	Herpes exposure: visual defects, blindness, cerebral defects, cutaneous lesions	1/435 live births	Adequate screening and treatment for woman and her partner
	Syphilis	Syphilis: hearing loss, fetal demise with hydrops if infection is severe; if mild, abnormalities of skin, teeth, bones	1/2000 live births	Screening, early treatment decreases risk to fetus
Maternal infections	Varicella virus	Congenital varicella syndrome (visual defects, cerebral defects, limb defects, cutaneous lesions, extensive scarring) If infection occurs close to delivery, baby may be born with chickenpox and, if not properly treated, 30% chance of death Pneumonia can occur in up to 10% of pregnant women with chickenpox	1/2,000 will develop chickenpox during pregnancy and 1% risk baby will be born with congenital varicella syndrome Incidence of congenital varicella syndrome: 1/62,500 live births	Preconception history should be taken to determine those at risk (did not have chickenpox virus or vaccine as child) If at risk, can check antibody titers If low or nonexistent, can obtain vaccination against chickenpox if not pregnant. Women should wait at least one month after vaccination before becoming pregnant For pregnant at-risk women who are exposed, treat with Varicella Zoster Immunoglobulin VZIG as soon as possible after exposure
	Toxoplasmosis	Visual defects, blindness, cerebral defects, seizures, MR, hearing loss, hepatomegaly, splenomegaly, jaundice, Intrauterine Growth Restriction (IUGR), LBW	1/1,000 to 1/8000 live births	Avoid eating raw/undercooked meat and changing cat litter
	Cytomegalovirus	Chorioretinitis, MR, microcephaly, neurologic dysfunction and hearing loss	1/45 to 1/500 live births	No immunization currently available for CMV. Avoid infection with frequent hand washing. Wear gloves when changing diapers or handling secretions if working with small children or the elderly
	Parvovirus (fifth disease)	Fetal myocarditis, hemolytic anemia, nonimmune hydrops fetalis, and fetal death		No immunization currently available Avoid exposure to children with fifth disease (parvovirus B19)

General Category of Cause/Hazard	Specific Cause/Risk Factor	Potential Fetal Complications	Incidence/Carrier Frequency	Screening Tools/Prevention Strategies/Interventions Available
Maternal infections (continued)	Rubella (German measles)	Congenital rubella syndrome can include eye defects (resulting in vision loss or blindness), hearing loss, heart defects, mental retardation and cerebral palsy Can cause miscarriage and stillbirth	1/100,000 live births (congenital rubella syndrome) 1 in 5 women susceptible About 25% of babies whose mothers contract rubella during first trimester are born with one or more birth defects	All children should be vaccinated and all women should be tested prior to conception and vaccinated if not immune Rubella vaccine (live viruses) should be given at least one month prior to pregnancy
	Hepatitis B	In pregnant women with acute hepatitis B, vertical transmission occurs in up to 10% of neonates when infection occurs in the first trimester and in 80–90% of neonates when acute infection occurs in the third trimester. May also be increased risk for prematurity and low birth weight Chronic infection occurs in about 90% of infected infants. Among persons with chronic hepatitis B virus (HBV) infection, the risk of death from cirrhosis or hepatocellular carcinoma is 15%–25%	1.25 million Americans have chronic hepatitis B infection	Immunize infants and children Hepatitis B screening to check immune status
Mental illness	Depression/anxiety	Withdrawal symptoms can occur in neonates whose mothers are on tricyclic antidepressants near the time of delivery. Rarely, maternal use of benzodiazepines associated with cleft lip/cleft palate (CL/CP) and withdrawal (W/D) syndrome in the newborn	About 10% of pregnant women have depression	Avoid benzodiazepines Lithium, valium, librium, phenytoin, tranxene (tranquilizers) Screening and identification of mental illness before, during pregnancy and in postpartum period
Other known or suspected teratogenic medications	Avoid use of Accutane (acne); Tegison (psoriasis)/chloramphenicol, nitrofurantoin, tetracycline (antibiotics); Thalidomide (anti-nausea); barbiturates; sulfonamides; DES (synthetic hormones); amphetamines (Ritalin)	Increased risk for birth defects		Prevent pregnancy for women who use Accutane or ceasing Accutane use before conception, eliminates harmful exposure Consult with physician regarding use of these medications; preconception counseling with primary care provider, genetic counseling and avoiding use of specific medicines possibly substitute safer medications.

Ohio Partners for Birth Defects Prevention

Birth Defects: *Causes and Prevention Strategies*

Birth Defects Associated with
Lifestyle Exposures



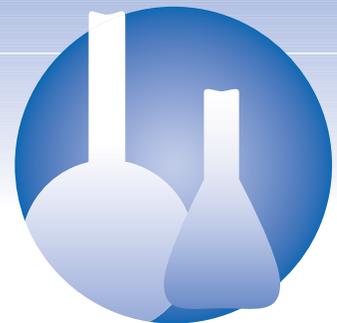
General Category of Cause/Hazard	Specific Cause/Risk Factor	Potential Fetal Complications	Incidence/Carrier Frequency	Screening Tools/Prevention Strategies/Interventions Available
Lifestyle				
	Alcohol	Fetal alcohol spectrum disorder(FASD)—mental retardation, growth retardation, miscarriage, and behavioral disorders, psychosocial-cognitive problems, craniofacial and skeletal anomalies, cardiac defects	The leading non-hereditary cause of mental retardation and birth defects. 1/513 live births	Educating general population about risks of alcohol when consumed in childbearing years, risks before knowing one is pregnant and risks of binge drinking Women should be treated for alcoholism through interventional counseling/treatment programs Women must avoid consuming any alcohol during pregnancy No amount is safe for consumption during pregnancy
	Caffeine	Overdoses of caffeine associated with risk of miscarriage and LBW.		Limit to two cups of coffee per day or the equivalent amount of caffeine in other sources, such as soda
	Domestic violence		Under-diagnosed and incidence escalates during pregnancy	Screen for domestic violence using non-judgmental questions Offer patient materials/referrals to community resources for help
	Hot tubs/overheating (hyperthermia)	Increased risk of congenital anomalies		Avoid hot tubs, spas, and sauna use during pregnancy Avoid extreme environmental temperatures.
	Tobacco <ul style="list-style-type: none"> • Smoking • Second hand smoke 	Infertility, increased risk of miscarriage, prematurity, LBW, placental abruption, perinatal mortality, respiratory distress syndrome, Sudden Infant Death Syndrome (SIDS) and oral clefts	If mother smokes <1 pack/day, risk of LBW is increased by 50%; if mother smokes >1 pack/day, risk increased by 130% If mother quits smoking by 16 weeks, the risks for Low Birth Weight and prematurity are similar to that of non-smoker	Nicotine patches or gum may be helpful before conception (Bupropion/Zyban, Nicoderm nicotine patches may be used during pregnancy) Smoking cessation programs. Behavioral techniques; support groups Family support If mother cannot stop during pregnancy, then encourage mother to lower number of cigarettes smoked to fewer than 10/day because many of the adverse effects are dose related Decrease smoking starting rates in general population
	Illicit drugs			Public awareness and education. Women users need help quitting before pregnancy. Even a single teaching session about how drug use affects the fetus, along with reinforcement at subsequent visits helps When abuse is suspected, refer to a substance abuse treatment program. Periodic urine drug testing may help to encourage abstinence

General Category of Cause/Hazard	Specific Cause/Risk Factor	Potential Fetal Complications	Incidence/Carrier Frequency	Screening Tools/Prevention Strategies/Interventions Available
	Cocaine	Increased risk of miscarriage, stroke, prematurity, growth retardation, congenital defects, feeding/sleeping difficulties, jittery/irritability and long-term developmental effects	Approximately 1% of pregnant women use cocaine during pregnancy	Physicians should ask every pregnant woman about drug use. Referral to treatment Women of childbearing age should avoid illicit drugs during periconception period and seek out early prenatal care
	Marijuana	Increased risk of prematurity and jitteriness in the neonate	Most commonly used illicit drug (used by 76% of illicit drug users) Approximately 2.9% of pregnant women use marijuana during pregnancy	Physicians should ask every pregnant woman about drug use Referral to treatment when indicated Women of childbearing age should avoid drugs during periconception period and seek out early prenatal care
	Heroin	May lead to intrauterine growth restriction, miscarriage, prematurity, hyperactivity, seizures and severe neonatal withdrawal		Women who use heroin should be referred to a supervised withdrawal program to be completed before conception Methadone maintenance is an alternative if patient is unable to complete withdrawal before pregnancy
Nutrition	Vitamin/mineral insufficiencies	Diets deficient in milk, whole grains, vegetables and fruits associated with increased risk of LBW babies Strict vegans may have vitamin deficiencies Overdose of Vitamin A and D may be toxic (increased risk for fetal hypercalcemia, growth retardation, hydrocephalus)		Assess risk of nutritional deficiencies (vegan, milk intolerance, calcium or iron deficiency) Before conception women need 1,200 mg of calcium/day Nutrition consultations recommended for all with nutritional deficiencies Avoid overuse of vitamin A ($\leq 5,000$ IU/day) and vitamin D (limit to 400 IU/day)
	Pica	Pica (cravings for dirt/clay/starch) may result in malnourishment/ingestion of toxins and infectious agents		For diagnosis of pica, work up for anemia and psychiatric evaluation and dietary substitutions

Ohio Partners for Birth Defects Prevention

Birth Defects: *Causes and Prevention Strategies*

Birth Defects Associated with
Environmental Exposures



General Category of Cause/Hazard	Specific Cause/Risk Factor	Potential Fetal Complications	Incidence/Carrier Frequency	Screening Tools/Prevention Strategies/Interventions Available
Environment				
Occupational exposures	Drug or chemical exposure in the home or workplace	Timing and type of exposure determines type and severity (e.g., exposure before 17 days of fetal life could be lethal; 17-56 days a toxin can cause a structural anomaly; after 56 days, a functional impairment)	Drug or chemical exposure causes approximately 3–6% of anomalies	Material safety data sheets are legally required from employers to employees
Metal	Lead	Abnormal sperm, menstrual disorders, miscarriages, stillbirths, mental retardation		Avoid solder, lead pipes, batteries, lead paints and lead painted surfaces, lead in glazed ceramics, smelter, emissions.
	Mercury	Impaired fetal motor and mental development, deafness, blindness, neurological damage		Avoid contact with mercury in thermometers, mirror coating, dyes, inks, pesticides, fish from contaminated waters
Solvents	Trichloroethylene, chloroform, benzene, toluene	Heart defects, oral clefts NTDs, miscarriage		Avoid contact with dry cleaning fluids, degreasers, paint strippers and thinners, and other solvents, drug and electronics industries
Plastics	Vinyl chloride	Increased risk for fertility problems, chromosomal aberrations, miscarriages, stillbirth, birth defects		Avoid exposures in plastic manufacturing
Pollutants	Polychlorinated biphenyl, polybrominated biphenyl	LBW, stillbirth, cleft palate, possible renal malformations		Education – decrease pollution, increase funding of studies to identify risks Birth defects surveillance Avoid pesticides, herbicides, carbonless copy paper, rubber, chemicals and electronics industries, fire retardants
Pesticides	Organophosphates			Avoid exposures on farms and in homes and garden insect sprays Wood treatments
Gases	Carbon monoxide	LBW, stillbirth		Avoid exposures to auto exhaust, furnaces, kerosene heaters, cigarette smoke
	Anesthetic gases			Avoid exposures in dental offices, hospital and veterinary operating rooms, chemical industries
Radiation	Radiographs, radioactive materials	Sterility, birth defects		Avoid exposures in medical and dental offices, electronics industries

Appendices

References

Birth Defects in Michigan: An Approach to Prevention and Intervention; Michigan Department of Community Health, Lansing, MI., 1999-2001

Brundage, Stephanie C., M.D., Ph.D., Preconception Health Care, American Family Pediatrician, June 15, 2002, pp 2,507-2,514

eMedicine – features up-to-date, searchable, peer-reviewed medical journals and online physician reference textbook: <http://www.emedicine.com/>

Gene Tests – a listing of laboratories providing DNA testing and summaries about selected genetic conditions: <http://www.genetests.org/>

OMIM— Online Mendelian Inheritance in Man— a description of single-gene disorders: <http://www.ncbi.nlm.nih.gov/omim>

Preconception Care: Science, Practice, Challenges and Opportunities: Maternal and Child Health Journal, Volume 10 (5s), September 2006 ISSN: 1,092-7,875

REPROTOX: On-line teratogen information system for professionals. Need to subscribe <http://www.reprotox.org>

REPROTOX® , an information system developed by the Reproductive Toxicology Center for its members. REPROTOX contains summaries on the effects of medications, chemicals, infections, and physical agents on pregnancy, reproduction, and development. The REPROTOX® system was developed as an adjunct information source for clinicians, scientists, and government agencies. Patients should consult their health care providers rather than relying on REPROTOX® summaries.

Helpful Resources and Web sites

Fetal Alcohol Spectrum Disorder Resources:

<http://www.notasingledrop.org>; <http://www.fasdpn.org>; <http://www.childstudy.org>; <http://www.nofas.org>

Genetic Alliance: <http://www.geneticalliance.org> — for more information on national support and advocacy groups

Gene Tests: <http://www.genetests.org> — provides:

Gene Reviews: Online publication of expert-authored disease reviews

Laboratory Directory: International directory of genetic testing laboratories

Clinic Directory: International directory of genetic and prenatal diagnosis clinics

Educational materials

National Birth Defects Prevention Network (NBDPN) at Centers for Disease Control and Prevention (CDC): <http://www.nbdpn.org> or <http://www.cdc.gov> — for more information on genomics and birth defects.

National Council on Folic Acid (NCFA): <http://www.folicacidinfo.org> — for more information on folic acid

March of Dimes : <http://www.marchofdimes.com> — for information on preconception care, pregnancy care and birth defects

National Organization of Rare Disorders (NORD): <http://www.rarediseases.org> — for information on specific rare disorders

National Society of Genetic Counselors (NSGC): <http://www.nsgc.org> — to learn more about genetic counseling and to locate a genetic counselor near you

Ohio Connections for Children with Special Needs (OCCSN): <http://www.odh.ohio.gov/ODHPrograms> — for information about Ohio's birth defects information system

Ohio Regional Comprehensive Genetic Centers:

<http://www.odh.ohio.gov/ODHPrograms/GENSERV/genserv1.htm> — for information on where to go for genetic evaluation, counseling services and educational outreach in Ohio

Online Mendelian Inheritance in Man (OMIM): <http://www.ncbi.nlm.nih.gov/omim> — a description of single-gene disorders

Organization of Teratology Information Specialists (OTIS):

on-line or phone assistance regarding teratogens for medical professionals or patients

<http://otispregnancy.org>

phone: 866-626-6847

Smoke Free Families Program: <http://www.smokefreefamilies.org> — for more information on the effects of smoking on pregnancy and how to quit smoking

Teratogens: <http://www.kumc.edu/gec/support/teratogen.html> — for links to teratogen information



**Ohio Department
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