2020 Report

The Iowa Registry for Congenital and Inherited Disorders (IRCID) continues to be a national leader in surveillance of congenital and inherited disorders and serves as a model program for other states. The IRCID conducts active surveillance to identify information about congenital and inherited disorders that occur in Iowa and to Iowa residents.

Since 1983, the IRCID has collected information for nearly 56,000 children with various birth defects. This information is used by health care providers and educators to provide treatment and support services, and by researchers to study risk factors for birth defects and evaluate treatments for birth defects.

The IRCID also conducts surveillance for nine muscular dystrophies – Duchenne, Becker, congenital, distal, Emery-Dreifuss, fascioscapulohumeral, limb-girdle, myotonic, and oculopharyngeal. Additionally, the IRCID has collaborated with the Metropolitan Atlanta Congenital Defects Program to develop approaches to conduct active surveillance for stillbirths, newborn screening disorders, and birth defects that may be related to Zika virus infection. Recently, the IRCID has been collaborating with the Centers for Disease Control and Prevention (CDC) to conduct active statewide surveillance for pregnant women who tested positive for SARS-CoV-2.

The surveillance and research efforts of the IRCID and its partners provide a valuable resource for the state of Iowa. While taking care to preserve the privacy of families affected by these disorders, the IRCID provides important information to state policy makers and public health professionals. We are pleased to perform this important work on behalf of the citizens of Iowa.

Surveillance for Birth Defects

In the United States, the CDC recognizes three surveillance approaches, each rated differently for completeness of ascertainment of pregnancies with a birth defect.

- Vital Record Reporting: Use of birth and fetal death certificates provided by the state's Department of Health (Rating: Poor)
- Passive Reporting: Use of medical reports submitted by staff from hospitals, clinics, or other facilities (Rating: Fair to Good)
- Active Reporting: Use of trained personnel who systematically review records in hospitals, clinics, or other facilities (Rating: Excellent)

The term "defect" refers to abnormal development related to body structure, body function, and metabolism, or an error in body chemistry. Typically, a defect is present at birth (congenital), but a recognizable defect may be diagnosed during pregnancy (prenatal) or following birth (postnatal).

The IRCID has traditionally focused on structural birth defects, which typically involve a body part that is missing or malformed. Examples include heart defects, spina bifida, clubfoot, and cleft lip and palate. Since 2003, the IRCID adopted the recommendations of the National Birth Defects Prevention Network (NBDPN) to focus largely on a core set of major birth defects (see Table 1). Prior to 2003, the IRCID included many 'minor' defects, so this change represents a reduction in the number of defects that the IRCID monitors.

Table 1. Prevalence (per 10,000 live births) for birth defects in Iowa, 2013-2017 deliveries

Birth Defect	Total	Prevalence
Brain/Spinal Cord		
Anencephalus	40	2.0
Encephalocele	22	1.1
Holoprosencephaly	33	1.7
Spina bifida without anencephalus	92	4.7
Eye		
Anophthalmia/microphthalmia	32	1.6
Congenital cataract	82	4.2
Ear		
Anotia/microtia	62	3.2
Heart		
Aortic valve stenosis	47	2.4
Atrial septal defect	534	27.3
Atrioventricular septal defect	95	4.8
Coarctation of aorta	120	6.1
Common truncus	13	0.7
Double outlet right ventricle	42	2.1
Ebstein anomaly	23	1.2
Hypoplastic left heart syndrome	57	2.9
Interrupted aortic arch	10	0.5
Pulmonary valve atresia and stenosis	200	10.2
Single ventricle	8	0.4
Tetralogy of Fallot	72	3.7
Total anomalous pulmonary venous return	19	1.0
Transposition of great arteries	56	2.9
Tricuspid valve atresia and stenosis	46	2.3
Ventricular septal defect	1059	54.1
Oral/Facial		
Choanal atresia	11	0.6
Cleft lip only	80	4.1
Cleft lip with cleft palate	134	6.8
Cleft palate without cleft lip	141	7.2

Table 1. (continued from previous page)

Birth Defect	Total	Prevalence
Gastrointestinal		
Biliary atresia	8	0.4
Esophageal atresia/tracheoesophageal fistula	50	2.6
Hirschsprung's disease (congenital megacolon)	32	1.6
Pyloric stenosis	364	18.6
Rectal and large intestinal atresia/stenosis	68	3.5
Small intestinal atresia and stenosis	73	3.7
Genital/Urinary		
Bladder exstrophy	8	0.4
Cloacal exstrophy	2	0.1
Congenital posterior urethral valves	16	0.8
Hypospadias[*,†]	642	64.1
Renal agenesis/hypoplasia	120	6.1
Muscle/Skeletal		
Clubfoot	353	18.0
Craniosynostosis	112	5.7
Diaphragmatic hernia	58	3.0
Gastroschisis	82	4.2
Limb deficiencies (reduction defects)	110	5.6
Omphalocele	51	2.6
Syndromes/Chromosomes		
Deletion 22q11.2	34	1.7
Down syndrome (Trisomy 21)	291	14.9
Edwards syndrome (Trisomy 18)	66	3.4
Patau syndrome (Trisomy 13)	34	1.7
Turner syndrome[‡]	40	4.2

[*] Includes first, second, and third degree hypospadias.

[†] Prevalence per 10,000 male live births.

[‡] Prevalence per 10,000 female live births.

Birth Defect Research

Approximately 1 in 33 newborns is affected by a major birth defect in the United States. Major birth defects come with personal and monetary costs, both for the families of these children and for society. Nearly 20% of all infant deaths are caused by major birth defects. Hospitalizations associated with major birth defects are longer than hospitalizations for other conditions and account for nearly $9 billion annually for infants under one-year of age born with major birth defects.

Because the causes of up to 70% of major birth defects that occur are unknown, research is a critical part of any strategy to prevent these defects. As such, in 1996 the United States Congress directed the CDC to establish regional "centers of excellence" in birth defect research and prevention. Further interest in fostering collaboration among state birth defect programs led to the formation of the National Birth Defects Prevention Network in 1998.

National Birth Defects Prevention Network (NBDPN)

The NBDPN is a nationwide association of birth defect programs and individuals. The IRCID is an active member of the NBDPN and participates in many NBDPN projects. For example, the NBDPN provides a set of guidelines to help birth defect surveillance programs around the country organize their work in a consistent manner. The NBDPN also provides educational materials to birth defect abstractors, as well as informational resources to promote Birth Defects Prevention Month each January. Another goal of the NBDPN is to encourage scientific collaboration among birth defect surveillance programs. The IRCID has participated in several of these collaborations.

Iowa Center for Birth Defects Research and Prevention (CBDRP)

The Iowa CBDRP was one of eight centers established by the CDC to study genetic and environmental (broadly defined as non-inherited) risk factors for birth defects and continues as one of seven currently funded centers. Iowa CBDRP investigators have participated in local (statewide) projects, as well as in the National Birth Defects Prevention Study (NBDPS). The Iowa CBDRP is currently participating in the Birth Defects Study To Evaluate Pregnancy exposureS (BD-STEPS).

The NBDPS was a population-based study that investigated risk factors for over 30 birth defects. Partnering with the Iowa CBDRP, the IRCID identified children with NBDPS-eligible birth defects and secured permission from mothers to share information with researchers. Mothers with a pregnancy affected by one of these birth defects and those with an unaffected pregnancy were interviewed about their health, diet, and lifestyle during their pregnancies. Biological specimens were requested from each family to study genetic factors. Over 43,000 interviews were completed nationwide, and specimens were collected from more than 25,000 families.

Over 300 research projects are underway nationwide as part of the NBDPS. Some projects examine risk factors, such as maternal nutrition. Others examine gene and environment interaction effects. Still others examine maternal behavior during pregnancy. The projects performed by Iowa investigators have the potential to positively impact the lives of Iowans. These projects examine the relationships between birth defects and agricultural chemicals, cigarette smoking, alcohol consumption, diet, obesity, medications, and compounds in drinking water, as well as genetic risk factors and their interactions with these exposures.

2020 NBDPS Publications Using IRCID Data (Names in bold designate Iowa investigators)

Carmichael SL, Ma C, Witte JS, Yang W, Rasmussen SA, Brunelli L, Nestoridi E, Shaw GM, Feldkamp ML, National Birth Defects Prevention Study. (2020) Congenital diaphragmatic hernia and maternal dietary nutrient pathways and diet quality. Birth Defects Res 112:1475-1483.

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Zaganjor I, Luben TJ, Desrosiers TA, Keil AP, Engel LS, Michalski AM, Carmichael SL, Nembhard WN, Shaw GM, Reefhuis J, Yazdy MM, Langlois PH, Feldkamp ML, **Romitti PA**, Olshan AF, The National Birth Defects Prevention Study. (2020) Maternal exposure to disinfection by-products and risk of hypospadias in the National Birth Defects Prevention Study (2000-2005). Int J Environ Res Public Health 17:9564.

Surveillance for Microcephaly and Other Birth Defects Related to Zika Virus Exposure

Congenital microcephaly (MC) is a serious birth defect characterized by an abnormally small head size in affected infants compared to infants of the same sex and gestational age. A dramatic increase in MC in infants in Brazil was linked to pregnant women infected with Zika virus. This virus is transmitted most commonly through the bite of infected mosquitoes. Unlike its often mild presentation in infected adults, Zika virus exposure poses a serious risk to an unborn fetus. With the potentially devastating effects of fetal exposure to Zika virus, more timely surveillance is needed for monitoring birth defects that may be related to Zika virus exposure among pregnant women. To advance statewide surveillance of MC and other birth defects that may be related to Zika virus exposure among pregnant women, the IRCID created a rapid response team comprised of experienced surveillance professionals. Our team is partnered with the Center for Acute Disease Epidemiology at the Iowa Department of Public Health, and the State Hygienic Laboratory of Iowa. Along with rapid surveillance, our team participated in national projects led by the CDC for effective translation of our surveillance data into public health action.

2020 Zika Virus Publication Using IRCID Data (Names in bold designate Iowa investigators)

Smoots AN, Olson S, Cragan J, Delaney A, Roth N, Godfred-Cato S, Jones A, Nahabedian JF, Fornoff J, Sandidge T, Yazdy M, Higgins C, Olney R, Eckert V, Forkner A, Fox D, Stolz A, Crawford K, Cho S, Knapp M, Ahmed M, Lake-Burger H, Elmore A, Langlois P, Breidenbach R, Nance A, Denson L, Caton L, Forestieri N, Bergman K, Humphries B, Leedom V, Tran T, Johnston J, Valencia-Prado M, Pérez-González S, **Romitti P**, **Fall C**, Bryan J, Barton J, Arias W, St John K, Mann S, Kimura J, Orantes L, Martin B, de Wilde L, Ellis E, Song Z, Akosa A, Goodroe C, Ellington S, Tong V, Gilboa S, Moore C, Honein M. (2020) Population-based surveillance for birth defects potentially related to Zika virus infection – 22 states and territories, January 2016-June 2017. MMWR Morb Mortal Wkly Rep 69:67-71.

Surveillance for Muscular Dystrophy

Muscular dystrophies (MDs) are a group of genetic progressive muscle diseases affecting an estimated 33 per 100,000 individuals and are characterized by worsening muscle weakness. Historically, types of MDs were diagnosed by known changes in muscle and clinical presentation; presently, diagnosis is determined largely by genetic analysis. Ages at symptom onset of MDs can range from birth through late adulthood. In children, Duchenne is the most common childhood MD, followed by the congenital MDs. In adults, myotonic dystrophy is the most common MD, followed by facioscapulohumeral MD.

Muscular Dystrophy Surveillance Tracking and Research Network (MD STARnet)

The MD STAR*net* is a surveillance program currently active in seven states (Florida, Iowa, New York, North Carolina, South Carolina, Utah, Virginia) and funded by the CDC. The goals of the MD STAR*net* are to define and describe the MD population in the United States, define and describe healthcare needs and outcomes for individuals living with MD, and collect information to guide MD care, treatment, and policy. On behalf of the MD STAR*net*, the IRCID is conducting surveillance of Iowans who are diagnosed with one of eight MDs and meet residence, diagnostic, and treatment period criteria (Table 2). This surveillance consists of identification and ongoing medical chart review. In the current phase, we will identify individuals who have at least one eligible MD diagnostic code (International Classification of Disease [ICD], ICD-9, ICD-10).

Table 2. Number of individuals identified with a muscular dystrophy among Iowa residents

Phase of Surveillance/Muscular Dystrophy	Total
Phase I*	
Duchenne or Becker	140
Phase II†	
Becker	52
Congenital	24
Distal	5
Duchenne	105
Emery-Dreifuss	12
Facioscapulohumeral	81
Limb-Girdle	66
Myotonic	253
Oculopharyngeal	17
Phases III and IV	
Becker‡	<5
Congenital^	41
Distal^	8
Duchenne‡	61
Emery-Dreifuss^	18
Facioscapulohumeral^	131
Limb-Girdle^	143
Myotonic^	437
Oculopharyngeal§	37

*Resident individual with MD diagnosis born on or after January 1, 1982 through December 31, 2011 who lived in Arizona, Colorado, Georgia, Hawaii, Iowa, or western New York.

†Resident individual with MD diagnosis and health encounter from January 1, 2007 through December 31, 2011 who lived in Arizona, Colorado, Iowa, or western New York.

‡Phase III: Resident individual with MD diagnosis born on or after January 1, 2000 and health encounter from January 1, 2000 through December 31, 2015 who lived in Colorado, Iowa, western New York, North Carolina, South Carolina, or Utah.
Phase IV: Resident individual with MD diagnosis born on or after January 1, 2000 and health encounter from January 1, 2000 through December 31, 2020 who lived in Florida, Iowa, western New York, North Carolina, South Carolina, Utah, or Virginia.

^Phase III: Resident individual with MD diagnosis since January 1, 2008 and health encounter from January 1, 2008 through December 31, 2016 who lived in Colorado, Iowa, western New York, North Carolina, South Carolina, or Utah.
Phase IV: Resident individual with MD diagnosis and health encounter from January 1, 2008 through December 31, 2020 who lived in Florida, Iowa, western New York, North Carolina, South Carolina, Utah, or Virginia.

§Phase III: Resident individual with MD diagnosis and health encounter from January 1, 2006 through December 31, 2016 who lived in Colorado, Iowa, western New York, North Carolina, South Carolina, or Utah.

2020 MD STAR*net* Publication Using IRCID Data (Names in bold designate Iowa investigators)

James KA, Gralla J, Ridall LA, Do TN, Czaja AS, Mourani PM, Ciafaloni E, Cunniff C, Donnelly J, Oleszek J, Pandya S, Price E, Yang ML, Auerbach SR. (2020) Left ventricular dysfunction in Duchenne muscular dystrophy. Cardiol Young 30:171-176.

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