International 22q11.2 Foundation

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Glossary:

A dictionary of terms & definitions related to the 22q11.2 syndromes

What does **22q11.2DS** mean?

22q11.2DS stands for **22q11.2 deletion syndrome.**

22	Chromosome 22 (the smallest of the human chromosomes, in every cell of the body)
q	The long arm of the chromosome
11.2	The position on the chromosome – like the GPS coordinates
Deletion	A piece missing from one of the pair of chromosome 22
Syndrome	A collection of features

Old Names of 22q11.2 deletion syndrome:

- Autosomal dominant Opitz G/BBB syndrome
- CATCH22
- Cayler cardiofacial syndrome
- Conotruncal anomaly face syndrome (CTAF)
- Deletion 22q11.2 syndrome
- DiGeorge syndrome
- Sedlackova syndrome
- Shprintzen syndrome
- VCFS
- Velocardiofacial syndrome
- Velo-cardio-facial syndrome

Now that researchers have found the unifying cause, we encourage everyone to use the name **22q11.2 deletion syndrome (22q11.2DS).** In English-speaking communities, abbreviations that are also in use for 22q11.2 deletion syndrome include: 22q, 22qDS, and 22q11DS.

What does **22q11.2DupS** mean?

22q11.2DupS stands for **22q11.2 duplication syndrome.**

22	Chromosome 22 (the smallest of the human chromosomes, in every cell of the body)
q	The long arm of the chromosome
11.2	The position on the chromosome – like the GPS coordinates
Duplication	A piece that is repeated on one of the pair of chromosome 22
Syndrome	A collection of features

Disclaimer: The information in this glossary is provided for educational purposes only. It is not intended to be taken as medical advice. The needs for everyone are different, and not all information is applicable to everyone. If you have questions or concerns, please discuss them with your doctor or healthcare provider.

A

Adenoids – Adenoids are a patch of tissue that sits at the back of the throat behind the nose and the top of the mouth. They are part of the immune system – they trap harmful bacteria and viruses that we breathe in or swallow.

Allergy – Our immune system usually fights off external things that are harmful to the human body. Allergy is a condition in which the immune system reacts to something that is harmless to most people. The **allergen** that triggers the allergic response can be food, animals, medications, plants, or other things in the environment. Depending on the allergen and the individual, different parts of the body may be affected. Mild allergies may not cause a lot of problems, but severe allergic reactions (called **anaphylaxis**) that are not treated right away can lead to death. Allergy is a condition that affects up to about 40% of children with 22q11.2 deletion syndrome and has also been reported in those with 22q11.2 duplication syndrome.

Amniocentesis – Amniocentesis is a test done on pregnant women to check the health and/or genetic status of the fetus. It involves inserting a needle into the uterus to extract a small amount of amniotic fluid, which contains fetal cells and proteins. Families are strongly advised to learn about the risks of this procedure and be prepared for the results before this test.

Anomaly – An anomaly is something that is different from what is expected.

Antibodies – Antibodies (also called **immunoglobulins**) are Y-shaped proteins produced by plasma cells (mature **B cells**) of the immune system. They bind to a variety of targets, including bacteria, viruses, leading to clearance or inactivation. Rarely, antibodies get made to components of our own bodies, a process called **autoimmunity** [See **Autoimmune Disorders**]. The human immune system can make antibodies with a very wide variety of binding sites. Some children with 22q11.2 deletion syndrome experience a gradual decrease in antibody function and numbers. Antibody deficiencies have also been reported in those with 22q11.2 duplication syndrome.

Aorta – The aorta is the largest blood vessel (artery) in the human body. It takes oxygen-rich blood from the heart to the rest of the body. [See "The Heart and Normal Blood Flow" in the Heart Series on the Health Conditions Explained page of our website.]

Aortic Arch Anomalies (AAA) – The **aorta** normally forms a left curved structure (called the "left-sided aortic arch") as it exits the heart. Aortic arch anomalies include diverse malformations that involve the aortic arch and the vessels that branch out from the aortic arch. There may be (1) changes in the way the aortic arch is curved or located (e.g. a right-sided aortic arch); (2) an interruption of the aortic arch; (3) a double aortic arch; and (4) abnormalities of the aortic vessels. AAA may happen on its own or together with other congenital heart diseases. It may lead to no symptoms or cause symptoms in the respiratory system or the esophagus. [For an example of AAA, please see "Interrupted Aortic Arch" in the Heart Series on the Health Conditions Explained page of our website.]

Aortic Root Dilation – The **aorta** is the large blood vessel that brings oxygenated blood from the heart to the rest of the body. An aortic root dilation is due to an increase in the normal diameter of the root (the beginning) of the aorta, which can sometimes prevent the aortic valve from fully closing. This bulging of the root allows some of the blood to flow back into the heart, resulting in reduced blood flow to the rest of the body. Severe cases of aortic root dilation can lead to more serious outcomes, including the formation of small blood clots at the bulge. The clots can flow into the blood stream and block vessels in the brain, causing a stroke. The bulge itself can rupture, and blood can quickly leak out of the aorta. If the dilation becomes very big, it is called an **aneurysm**, and surgery may be needed. People with an aortic root dilation may not have any symptoms, but doctors can discover the problem using X-ray, echocardiogram, or CT scan/MRI for a more detailed study of the structure of the heart and the blood vessels nearby. It is known that children and adults with 22q11.2 deletion syndrome can develop aortic root dilation, whether they have other existing congenital heart diseases or not. Therefore, it is important to get a heart checkup periodically.

Arteries – Arteries carry oxygen-rich blood from the heart to different parts of the body

Aspiration – Aspiration happens when someone breathes in a liquid or solid, which then goes down the airways or even to the lungs. Patients can present with coughing, choking, difficulty breathing and recurrent pneumonias.

Asthma – Asthma is a condition associated with inflammation and narrowing of airways. The symptoms include shortness of breath, chest tightness, coughing, and wheezing. While airway muscles are relaxed in most people, they are sensitive and often inflamed in a person with asthma. When something irritates or triggers asthmatic airways, the muscles tighten even more and the airways fill up with mucous. This makes it difficult to breathe – a situation commonly known as an **asthma attack**. Asthma cannot be cured but can be managed with medications. Scientists don't know why some people get asthma while others don't. Nevertheless, asthma is not infectious, so it cannot be caught from another person. Asthma has been reported in children with 22q11.2 deletion syndrome as well as those with 22q11.2 duplication syndrome.

Atopy – Atopy means having a genetic tendency to develop allergies. It is a common condition in 22q11.2 duplication syndrome. (see **Allergy**)

Atrium – An atrium is an upper chamber of the heart. The human heart has two of them: the right atrium receives oxygen-poor blood from different parts of the body, while the left atrium receives oxygen-rich blood from the lungs. [See "The Heart and Normal Blood Flow" in the Heart Series on the Health Conditions Explained page of our website.]

Attention Deficit Disorder (ADD) / Attention Deficit Hyperactivity Disorder (ADHD) – The official medical term is attention deficit hyperactivity disorder (ADHD). It is a common childhood condition, affecting approximately 10% of all schoolchildren, related to the brain's growth and development. The prevalence of ADHD is much higher (40-50%) among children with 22q11.2 deletion syndrome. Children with ADHD have difficulties paying attention and/or controlling impulsive behavior, or they may be overly active. The condition often lasts into adulthood, where difficulties with "executive functions" such as planning, organization, emotional dysregulation, etc. become more problematic.

Autism Spectrum Disorder (ASD) – Autism Spectrum Disorder (ASD) is a condition in which a person's brain development affects his/her ability to socialize, communicate, and behave. There is a wide range of symptoms, which is the reason for having "spectrum" in the name of the condition. ASD is diagnosed by meeting a minimum number of impairments in the three domains of social interaction, communication, and restricted repetitive and stereotyped patterns of behavior, interests and activities. Signs of ASD are typically obvious by the time a child is 2 years old, and each child with ASD has his/her own set of symptoms and level of severity. Among children confirmed to have 22q11.2 duplication syndrome (22q11.2DupS), perhaps 14-25% have autism spectrum disorder (ASD). Among children with 22q11.2 deletion syndrome (22q11.2DS), ASD estimates range from 10-40%. Many children with 22q11.2DupS or 22q11.2DS have some features of ASD, but do not meet full diagnostic criteria. Further, the true rate of ASD in 22q11.2DupS or 22q11.2DS may not be known because some individuals may not be diagnosed.

Autoimmune Disorders – Our immune system can usually distinguish between foreign entities and our own body. Autoimmune disorders happen when our immune system attack components of our own healthy body by mistake. There are over 100 autoimmune disorders. The overall frequency of autoimmune disease may be as high as 25% in 22q11.2 deletion syndrome.

B

B cells (B Lymphocytes) – B cells are a type of white blood cells in the immune system. The letter "B" comes from the fact that these cells were first discovered in the Bursa of Fabricius of chickens. In humans, B cells mature in the bone marrow. The surface of B cells displays receptors that are basically **antibodies** (also called **immunoglobulins**) tethered to the surface of B cells, and the human genetic make-up allows for many possible types of antibodies. During B cell development, these antibodies are "checked" to make sure they do not accidentally react to components of the healthy human body. Once B cells are ready to function, their surface antibodies survey for proteins and pathogens around them. Unlike T cells, B cells do not need the proteins and pathogens to be broken down for for recognition and response. If the surface antibodies bind successfully to a foreign item, the B cell will generate many copies of itself, so that there are more of the same B cells to bind to the invaders. Some B cells will mature into plasma cells that makes many more of the same antibodies—this time not attached to cell surfaces. These free-flowing antibodies will go around the body to bind to the targets and trigger a response from the immune system to remove them. Some individuals with 22q11.2 deletion syndrome have a deficiency in antibody-mediated immune responses, but scientists are still trying to find out the exact details. B cell deficiencies have also been reported in children with 22q11.2 duplication syndrome.

Bifid Uvula – The **uvula** is the small, bell-shaped piece of flesh hanging at the back of the soft palate (roof of the mouth). A bifid uvula is one that is split into two halves. It may not be easy to see a bifid uvula very well in a newborn baby, but the condition may be more obvious as the uvula grows and develops. Having a bifid uvula may mean that the child has **submucous cleft palate**, which is when the muscles in the roof of the mouth are split. He/she may struggle with feeding, or milk may leak out from the nose. Later, in some cases, speech may be nasal. Since palate problems are very common in babies with 22q11.2DS, it is recommended that they receive a thorough check by a doctor specialized in these conditions. A surgery may be needed to repair the palate to avoid further speech complications.

Blood Vessels – Blood vessels are channels that allow blood to flow through. There are three main types: **arteries** carry oxygen-rich blood from the heart to different parts of the body; **veins** carry oxygen-poor blood back from different parts of the body back to the heart; and **capillaries** are the smallest blood vessels that connect arteries and veins.

C

Cataract – The lenses inside the eyes are normally clear. A cataract is the clouding of the lenses which can reduce vision. This condition has been reported in individuals with 22q11.2DS and 22q11.2DupS.

Chronic Infection – An infection is an illness caused by pathogens such as viruses, bacteria, or yeasts. Usually, the immune system of the human body can battle these pathogens and eliminate them. If the pathogens cannot be cleared from the body for a prolonged period, the person is said to have a chronic infection. This condition is can occur in people with 22q11.2 deletion syndrome as well as those with 22q11.2 duplication syndrome.

Cleft Palate – The **palate** is the roof of the mouth, and it usually separates the mouth from the nose. A cleft palate is a split in the roof of the mouth, leaving an opening between the mouth and the nose, and therefore allowing food or liquids to come through the nose with feeding and air to come through the nose with speech. A cleft palate happens if the two halves of the palate did not fuse together properly before birth. Surgery is necessary to repair the cleft. Cleft palate happens in about 11% of babies with 22q11.2DS, but about 65% of patients with 22q11.2DS have milder but still significant palate problems. [See also: **Submucous Cleft Palate**, **Bifid Uvula**, and **Velopharyngeal Dysfunction**]

Coloboma – A coloboma is a condition in which the eye is missing some tissue at birth. There are different types of colobomas, depending on the exact type of tissue that is missing. A coloboma can result in a loss of vision as well as sensitivity to light. Coloboma has been reported in individuals with 22q11.2DS and 22q11.2DupS.

Compensatory Articulation Disorders – Compensatory articulation disorders consist of abnormal articulation patterns that result from alterations in the structure and/or function of the speech mechanism. These are most often errors in the place of articulation of sounds, such as sounds made in the throat or nose, instead of in the mouth. Examples of compensatory articulation errors include glottal stops as well as pharyngeal fricatives/stops, nasal fricatives, clicks and others. Compensatory articulation is common (~26-56%) in 22q11.2DS and occurs in the presence of cleft palate and/or **velopharyngeal dysfunction**.

Congenital – Congenital means present at birth. Some features in 22q11.2 deletion and duplication syndromes are congenital, while others develop later in life.

Congenital Heart Disease (CHD; also called **congenital heart defects or congenital heart anomaly) –** A congenital heart disease is a defect in the structure of the heart or great vessels that is present at birth. There are many types of heart defects that may involve the interior walls of the heart, the heart valves, or the large blood vessels that lead to and from the heart. CHDs are present in about 75-80% of patients with 22q11.2DS . The percentage of CHDs in 22q11.2DupS is not completely well established, but recent studies reported it as about 20-33%.

Conotruncal Heart Defects – Conotruncal heart defects are a group of congenital anomalies (problems present from birth) involving the cardiac outflow tract, which is the path that allows blood to flow out of the heart to the rest of the body. Conotruncal heart defects that commonly affect babies with 22q11.2 deletion syndrome include tetralogy of Fallot (ToF), pulmonary atresia with ventricular septal defect (an extreme type of ToF), truncus arteriosus and interrupted aortic arch. [See "Tetralogy of Fallot", "Truncus Arteriosus" and "Interrupted Aortic Arch" in the Heart Series of the Health Conditions Explained page of our website.]

Craniosynostosis – Craniosynotosis is a condition of premature skull fusion. When a baby is born, the skull contains some gaps (called **sutures**), which allow space for the brain to grow. The many sutures between the skull normally close around 10 months to 2 years of age. In a baby who has craniosynostosis, one or more sutures closes too early in the skull, and the brain does not have enough space to grow. The shape of the head may become abnormal with a raised edge, there may be no "soft spot" on the baby's skull, and the baby's head size may not increase normally over time. A possible serious consequence of craniosynostosis is an increased pressure inside the brain, which can lead to headaches, blindness, seizures, and even brain damage. Craniosynostosis has been reported in babies with 22q11.2 deletion syndrome. It is often treated with surgery to separate the sutures when severe.

D

Deletion – In genetics, deletion means a piece of DNA is missing. In individuals with 22q11.2 deletion syndrome, a segment of DNA from one of the two copies of chromosome 22 is missing. There are four main sizes of deletions for this syndrome: The A-D deletion is by far the most common, involving over 40 different genes, and happens in 85 to 90% of patients. The A-B deletion involves a smaller number of genes and accounts for 5 to 10% of patients. The B-D and C-D deletions are much smaller and rarer than the common deletion.

Dental Caries – Dental caries, also known as tooth decay or cavities, are holes in the teeth. The damage usually happens when acid (produced by bacteria) erodes the enamel surface (the hard part that you see) of the teeth. [See "Let's Talk 22q Teeth – Info for Families" in the Dental Series on the Health Conditions Explained page of our website.]

Developmental disabilities – Developmental disabilities are a group of conditions that affect a person's day-to-day functioning. These disabilities are a result of mental or physical problems which are present at birth, and last throughout the person's life. Individuals with 22q11.2 deletion or duplication syndromes have developmental disabilities, but they may vary widely among these individuals.

Diabetes Type 2 – Diabetes Type 2 is a complex long-term condition in which the body struggles to regulate and use glucose properly as a source of energy. As a result, the level of sugar in the blood is too high, which then leads to many possible problems that affect the heart and blood vessels, nerves, kidneys, eyes, skins, immune system etc. There are many possible risk factors, but in general, eating healthily and getting active are lifestyle choices that can prevent or slow down the progression of diabetes. Individuals with 22q11.2 deletion syndrome are more likely to develop type 2 diabetes compared to the general population and develop it at a younger age.

Down Syndrome – Down syndrome is a genetic condition that happens when a person has 3 (instead of 2) copies of chromosome 21. It happens in about 1 in 700 babies. Individuals who are affected have many possible physical and developmental problems, but each person is affected differently.

Duplication – In genetics, duplication means a piece of DNA is repeated, so that there is an extra piece of DNA. In individuals with 22q11.2 duplication syndrome, a segment of DNA from one of the two copies of chromosome 22 is repeated. In most cases, the duplication involves over 40 different genes.

E

Echocardiogram (an "echo") – An echocardiogram is a non-invasive method for studying the size, shape, structure, and function of the heart, the nearby blood vessels exiting the heart, and the blood flow through the heart valves. During the test, the technician ("**sonographer**") puts a hand-held tool ("transducer") with some cool gel on the patient's chest. The ultrasound (high frequency sound waves that humans cannot hear) from the tool generates pictures of the heart valves and chambers, so that the technician can see how well the heart is working.

Enamel (Dental) – Enamel is the hard covering of the tooth. It protects the tooth when people chew, bite, crunch, and grind. It is what you see when you look at a tooth. [See "Let's Talk 22q Teeth – Info for Families" in the Dental Series on the Health Conditions Explained page of our website.]

Esophagus – The esophagus is the muscle tube that brings food from the throat (**pharynx**) to the stomach. [Note: The British spelling of "esophagus" is "oesophagus".]

F

Fatigue – Fatigue is an overall state of being tired or lacking energy. It is common in both children and adult with 22q11.2 deletion syndrome. Although it can be a direct result of the body dealing with known health issues, fatigue can be an early sign of additional problems (such as having low calcium levels or a mental health problem).

Feeding Difficulties – Feeding difficulties happen in newborn babies with 22q11.2 deletion syndrome who fail to consume enough breastmilk or formula to receive the necessary nutrients. The difficulties can have many causes, such as palate issues, swallowing disorders, and gastrointestinal problems. The condition can even be caused when malformed blood vessels compress the airway and the esophagus. Therefore, babies with 22q11.2 deletion syndrome who have feeding difficulties should be assessed by a pediatrician who is familiar with this genetic condition and specializes in feeding.

Flow Cytometry – Flow cytometry is a method of counting cells based on specific characteristics, such as whether the cells are expressing a certain protein on their surface. It is a useful method to check the cell distribution and numbers in individuals who have **immunodeficiencies**.

Foramen Ovale – The foramen ovale is a special hole in the wall between the left and right atria of every human fetus [See **atrium**]. This hole allows blood to bypass the fetal lungs, which cannot work until they are exposed to air. When a newborn takes its first breath, the foramen ovale closes start to close, and within a few months it is sealed completely in about 75% of people. If it remains open, it is called **a patent foramen ovale** (**PFO**; patent means open). For the vast majority of people with a PFO, it is not a problem, and treatment is required only if there is a risk of stroke.

G

Gastroesophageal Reflux – Acid in the stomach is an important tool to digest food. Gastroesophageal reflux (also called acid reflux) happens when stomach acid flows back into the esophagus, which is the muscle tube that brings food from the mouth to the stomach. Stomach acid can irritate the lining of the esophagus, causing a burning feeling in the chest. Gastroesophageal reflux is a common problem in the general population, whether they have 22q differences or not. Treatment is recommended when children have pain, irritability, excessive vomiting/spitting up that leads to poor weight gain, food refusal, swallowing problems, recurrent choking or pneumonias, and interrupted breathing or apnea.

Genetic – A genetic condition is one that is determined by a particular sequence of DNA. Genetic conditions are not always inherited and can arise for the first time when a baby is conceived. For example, most 22q11.2 deletions and some duplications occur "out of the blue" without being inherited from either parent. However, once a person is born with the deletion or duplication, he/she can pass it onto future generations.

Genetics – Genetics is a branch of biology that is concerned with the study of hereditary units called **genes**. It studies how traits are passed through generations, and how variations in genes lead to different health conditions and physical features.

Genetic counseling – Genetic counseling is a process in which trained professionals (usually genetic counselors) advise individuals about genetic conditions that affect them and their families. The counselors can help individuals understand the conditions that affect them and the risk of passing the conditions to future generations. For individuals who have family histories or are at risk of developing certain conditions, the counselors can help them assess the risks and make plans.

Growth Hormone Deficiency – The human body produces factors called growth hormones to direct normal growth and development. Growth hormone deficiency is a condition in which there are not enough growth hormones, leading to reduced growth and short stature. This condition can be diagnosed by an **endocrinologist** and a growth hormone stimulation test.

H

Hypernasal Speech – See **Velopharyngeal Dysfunction**

Hyperthyroidism– Hyperthyroidism means having an overactive **thyroid gland** that produces too much of the hormone **thyroxine**. Symptoms include unintended weight loss as well as an irregular or very fast heart rate. This condition affects a minority of children and adults with 22q11.2 deletion syndrome. Usually, the doctor would use medication to regulate hormone production in the thyroid. However, in some cases, the thyroid gland may need to be removed by surgery or treated with radioactive iodine therapy.

Hypocalcemia – The human body typically maintains a steady level of **calcium** in the blood. Hypocalcemia, a common condition in individuals with 22q11.2 deletion syndrome, happens when the level of the calcium in the blood is too low. This can be due to vitamin D deficiency or when the parathyroid glands are not working [See **Hypoparathyroidism**]. Symptoms include muscle spasms, tingling in fingers and toes, cramps, numbness around the mouth and seizures. Hypocalcemia is usually treated with calcium supplements, vitamin D supplements, and medications that adjust hormone levels. [Note: The British spelling of “hypocalcemia” is “hypocalcaemia”.]

Hypoparathyroidism – Hypoparathyroidism happens when the **parathyroid gland** produces too little **parathyroid hormone (PTH)**, whose job is to regulate the levels of calcium and phosphorus in the body. When there is too little PTH, the calcium level becomes too low, and the patient becomes affected by **hypocalcemia**. Individuals who have hypoparathyroidism may need to take calcium supplements for life. Some of them may need a replacement of PTH as well. Hypoparathyroidism is very common in children with 22q11.2 deletion syndrome.

Hypothyroidism – Hypothyroidism means having an underactive **thyroid gland** that cannot produce enough of certain important hormones. It affects a minority of children and adults with 22q11.2 deletion syndrome. Because the symptoms, such as fatigue and weight gain, may not be obvious, a blood test may be needed to assess thyroid function. The condition can be treated with thyroid hormones.

Hypotonia – Hypotonia means low or decreased muscle tone, or the muscles are "floppy". When a baby with hypotonia is carried, he/she may feel like a rag doll. Hypotonia may be without consequence when it is mild but can have more serious effects when more severe. Among children with 22q11.2 deletion syndrome, hypotonia can be more severe and can affect the throat (the **pharynx**), contributing to a floppy airway and **obstructive sleep apnea**. It can also cause problems in feeding and swallowing.

I

Idiopathic – A condition that is idiopathic arose spontaneously or without known causes. [See **Juvenile Rheumatoid Arthritis** and **Scoliosis**]

Immune – If a person is immune to something, he/she is protected from it.

Immunodeficiencies – Our immune system normally fights off things that are foreign (e.g. viruses, bacteria, fungi, etc.). Immunodeficiencies (or immune deficiencies) happen when the immune system is weakened. The patient may have too many infections, infections that are difficult to cure [see **Chronic Infections**], unusually severe infections, or infections with unusual organisms. Many individuals with 22q11.2 deletion syndrome are immunodeficient. The condition has also been reported in those with 22q11.2 duplication syndrome.

Immunoglobulins – [See **Antibodies**]

J

Juvenile Rheumatoid Arthritis (JRA, or Juvenile Idiopathic Arthritis, JIA) – JRA is a form of arthritis in children. It causes joints to be inflamed and stiff, and any joint can be affected. In severe cases, JRA can limit the movement of the joints. JIA is thought to occur in 2% of children with 22q11.2 deletion syndrome.

K

L

Larynx – The larynx is also called a voice box. It sits at the front part of the throat and plays an important role in sound production.

M

Motor Speech Disorders – Motor speech disorders include impairments in planning, sequencing, reproducing speech, and/or moving the structures needed to form speech. Types of motor speech disorders include dysarthria and apraxia. Children with **dysarthria** may exhibit weakness, paralysis, or incoordination of the musculature responsible for respiration, phonation, articulation, and resonation. **Apraxia** of speech includes difficulties in planning and executing oral speech movements. Some features of apraxia include groping, searching, or effortful volitional oral movements, difficulty sequencing or transitioning from one sound to another, difficulty imitating speech, inconsistency in articulation with repeated productions of the same utterance, errors in vowels as well as consonants, and abnormalities of prosody, including rate, rhythm, intonation and stress patterns. Motor speech disorders are often seen in 22q with prevalence estimates from 32-86%.

N

Nasopharyngeal Reflux – Nasopharyngeal reflux is the abnormal movement of swallowed food back up into the throat and nose areas. It is a common problem in children with 22q11.2 deletion syndrome. Problems with muscles, nerves, breathing, and hormone levels are possible contributing factors, but the exact medical cause may or may not be known. The condition tends to improve over time, but a small number of patients may need an esophagus surgery to prevent the reflux.

Neuropsychiatric Disorders – Neuropsychiatric disorders are a broad group of symptoms that may be associated with a medical condition such as 22q11.2DS. It is important to ensure that these symptoms did not result from medical causes such as thyroid dysfunction or low vitamin levels. Neuropsychiatric disorders that are often seen in adults with 22q11.2 deletion syndrome include (but are not limited to) **schizophrenia**, **anxiety**, and **depression**. Some children with the syndrome have **attention deficit hyperactivity disorder**, **mood disorders**, and **autism spectrum disorder**. Similar neuropsychiatric disorders are also seen in individuals with 22q11.2 duplication syndrome.

Nonverbal Learning Disability (NLD) – Nonverbal learning disability refers to a pattern of test results and behaviors found among up to 70% of children with 22q11.2 syndromes. Individuals with NLD display higher verbal than nonverbal IQ scores, difficulty learning math skills, fine motor delays such as poor writing and drawing, attention problems, and deficient social skills.

O

Obligatory Articulation Disorders (Passive Articulation Errors) – Obligatory articulation disorders are articulation errors which cannot be avoided and are made because of abnormal structure such as **cleft palate** and **velopharyngeal dysfunction**. These may include nasal emission of air, reduced pressure on consonants, nasal sounding speech sounds (such as /m/ or /n/ for /p/ and /b/: example: “maymee”/baby). This type of speech disorder is common in 22q11.2DS and occurs as a result of cleft palate or **velopharyngeal dysfunction**.

P

Phenotypic Variability – In medical genetics, phenotypic variability (also known as **variable expressivity**) happens when people with the same genetic makeup show different clinical features. Individuals (even those in the same biological family) who have the exact 22q deletion can have very different symptoms and severities. This happens for all the standard 22q11.2 deletions and 22q11.2 duplications.

Phonological/Developmental Speech Sound Disorder – A phonological/developmental speech sound disorder is one in which a child is following a typical pattern of speech development but demonstrating errors that should have disappeared earlier. Phonological disorders are predictable, rule-based errors that may affect more than one sound. Phonological/developmental speech sound disorders are present in ~50% of children with 22q11.2DS.

Platelets (Thrombocytes) – Platelets are colorless, disc-shaped blood cells that help form blood clots, which slow down bleeding and help wounds heal. [See **Thrombocytopenia**]

Polyhydramnios – When a baby is inside the uterus, he/she is surrounded by amniotic fluid. Polyhydramnios is the condition in which too much amniotic fluid is present. In severe cases of polyhydramnios, the pregnant mother may have shortness of breath, swelling, and contractions, and the position of the baby may be affected. This condition can cause complications for both the mother and the baby during the birth process. Polyhydramnios can happen while a fetus with 22q11.2 deletion is developing in the uterus.

Ptosis – Ptosis refers to a droopy eyelid, and happens in about 4% of children with 22q11.2 deletion syndrome. The eyelid may droop a little or droop enough to affect vision if it blocks light entering the pupil. Most ptosis occurs as people age, but some infants are born with this condition. Ptosis can be corrected by surgery to lift the eyelid.

Q

R

S

Scoliosis – Scoliosis happens when the spine (backbone) curves sideways, and often the cause is unknown. Mild scoliosis may not lead to a lot of issues and can be monitored. Severe scoliosis can lead to problems with breathing, back pains, and an uneven appearance. Some patients with scoliosis need to wear braces to prevent the backbone from curving more, while other people may need surgery to correct it. The prevalence of scoliosis is about 48% in 22q11.2 deletion syndrome. The curve pattern resembles adolescent idiopathic scoliosis (the routine type of scoliosis) in most patients, and treatment is similar. Children with 22q11.2DS should be evaluated with physical exam of the spine at their annual physical and referred to orthopedics if a curve is detected. Curves of the spine can begin as early as age 5 years.

Seizure – Electrical pulses are a normal part of brain cell activities that contribute to how people think and behave. A seizure happens when there is a sudden uncontrolled surge of electrical activity in the brain, and can affect the patient's behavior, movements, feelings, and even consciousness. There are multiple causes of seizures, with a wide range of severity. Some patients need medications or even surgeries to manage the seizures while others do not.

Speech Intelligibility – Speech intelligibility refers to how well someone's speech is understood. Those closest to a child with poor speech intelligibility may understand their speech best. The listener's knowledge of context (what the child is speaking about) can often aid speech intelligibility.

Strabismus – Strabismus refers to misaligned eyes and can be the result of various causes. In this condition, the eyes are not aligned properly and are looking in different directions at the same time. If untreated, the brain can learn to ignore the image from one eye, leaving that eye with permanently-reduced vision due to amblyopia. Treatment options for strabismus include eyeglasses, prism lenses, vision therapy, and eye surgery. Strabismus happens in about 18% of children with 22q11.2 deletion syndrome.

Stridor – Stridor is a high-pitched sound heard with breathing that results from turbulent air flow when the airway is partially blocked or narrowed. About 20% of children with 22q11.2 deletion syndrome have airway anomalies which can lead to stridor. In rare cases, malformed blood vessels (vascular ring) compressing the airway can also lead to this type of noisy breathing. Any patient with stridor should get medical attention.

Submucous Cleft Palate – The palate is the roof of the mouth, and it usually separates the mouth from the nose. A **cleft palate** happens if the tissues there did not fuse together properly before birth, leaving an opening between the mouth and the nose. In a submucous cleft palate, there is a split of the muscles that make the palate work normally, but the mucous membrane covering the palate is intact. The child with a submucous cleft palate may have difficulty swallowing, reflux of liquids or foods out of the nose, a nasal speaking voice, and chronic ear infections. Since palate problems are very common in babies with 22q11.2DS, it is recommended that they receive a thorough check by a doctor specialized in these conditions. A surgery may be needed to repair the palate to avoid further complications.

T

T cell (T lymphocytes) – T cells are a type of white blood cells in the immune system. They come from the **bone marrow** but mature in the **thymus** (which is why they are called T cells). On the surface of the T cells are **T cell receptors (TCRs)**, and there are thousands of different TCRs. TCRs checks the broken-down proteins that **antigen presenting cells (APCs)** show them. If the broken-down proteins come from harmful sources, the T cells will trigger a response from the immune system to remove the offender. The exact way of accomplishing this action depends on the subtype of T cells. About 80% of babies with 22q11.2 deletion syndrome have T cell levels that are too low. The level gradually increases as they develop, but the T-cells that patients eventually end up with may not function as well or live as long. Problems with T cells are also related to **autoimmune disorders** and **allergies** in patients with 22q11.2DS. It is strongly recommended that babies with T cell problems be assessed by an immunologist to determine the precautions they need regarding the administration of live vaccines, the use of blood products, and the need for **thymus** transplants.

Tetralogy of Fallot – Tetralogy of Fallot (TOF) is a congenital heart disease that occurs in approximately 20 to 45% of individuals with a 22q11.2 deletion, while 10 – 15% of patients with TOF have a 22q11.2 deletion. TOF is characterized by 4 features: (1) a hole in the wall between the left and right lower pumping chambers (**ventricles**); (2) a narrowing of the pulmonary valve which regulates the blood flow from the heart to the lungs; (3) an **aorta** that incorrectly gets blood from 2 lower heart chambers instead of just 1; and (4) a thickening of the muscle of the wall of the lower right chamber. In babies with TOF, blood that exits the heart and goes to the rest of the body does not carry enough oxygen, which leads to a bluish-purple color to the skin (**cyanosis**). Surgery at a very young age is usually required and performed very successfully. [See "Tetralogy of Fallot" in the Heart Series on the Health Conditions Explained page of our website.]

Thrombocytopenia – Thrombocytopenia is a condition in which there are too few **platelets** in the blood. Platelets are blood components that help blood clot and stop bleeding, so having too few of them can increase the risk of bleeding. Thrombocytopenia may get better on its own or may require treatment. Some individuals with 22q11.2 deletions have immune thrombocytopenia, in which the body's immune system mistakenly destroy platelets. In these cases, doctors may prescribe medications to improve the platelet count. This problem occurs in about 4% of children with 22q11.2 deletion syndrome.

Thymic Hypoplasia (Hypoplastic Thymus) – Thymic hypoplasia means that the **thymus** is not fully developed. As the schoolhouse required for **T cell** development and education, this leads to low T cell counts and **immunodeficiencies**. About 80% of babies with 22q11.2 deletion syndrome have this condition.

Thymus – The thymus is a small organ that is part of the immune system. It is located at a spot that is in front of and above your heart, between your lungs. The thymus is the place for the maturation and specialization of **T cells**, which play essential roles in the immune response against foreign pathogens such as viruses and bacteria. Babies with severe **immunodeficiencies** that result in very low T cell counts may require a thymus transplant.

Trachea – The trachea, commonly known as the windpipe, is a tube that connects the larynx (voice box) to the lungs. It brings oxygen-rich air to the lungs and carries oxygen-poor air back up. The trachea is split into two bronchi, which go onto the left and right lungs.

U

V

Veins – Veins are blood vessels that carry oxygen-poor blood from different parts of the body to the heart.

Velocardiofacial Syndrome (VCFS) – Velocardiofacial syndrome is one of the old names of 22q11.2 deletion syndrome. "Velo" comes from the Latin word "velum", which means the palate; "cardia" means the heart; and "facies", which means the face. The term velocardiofacial syndrome was coined by Dr. Robert Shprintzen in 1978.

Velopharyngeal Dysfunction (VPD; Velopharyngeal Incompetence (VPI); Velopharyngeal Insufficiency (VPI)) – During normal speech, the soft palate (the back part of the roof of the mouth) closes against the back of the throat, so that air cannot come out through the nose. Velopharyngeal dysfunction happens when the back of the palate and the throat cannot close the space that connects the mouth and the nose during speech and swallowing. This can lead to nasal emission of air during speech production, hypernasal speech, weak pressure on consonants, speech sound disorders, and difficulty swallowing. VPD can happen as a result of any or all of the following: anatomical (structural) and/or physiological (functional) abnormalities, motor disorders, mislearning. VPD occurs in about 70% of patients with 22q11.2 deletion syndrome. Although speech therapy is essential to the treatment of articulation errors in 22q11.2DS, velopharyngeal surgery is necessary to treat velopharyngeal dysfunction.

Velum – Velum is Latin for the palate, which is the roof of the mouth. It separates the mouth and the nose.

Ventricles – Ventricles are lower pumping chambers of the heart. The right ventricle pumps oxygen-poor blood towards the lungs, while the left ventricle pumps oxygen-rich blood towards the rest of the body. [See "The Heart and Normal Blood Flow" and "Ventricular Septal Defect" in the Heart series on the Health Conditions Explained page of our website.]

Ventricular Septal Defect (VSD) – A ventricular septal defect is a hole in the heart wall separating the two lower chambers of the heart (ventricles). Of all patients with **conoventricular VSD**, 5% have 22q11.2 deletion syndrome (22q11.2DS). (Conoventricular VSD is a type of VSD where the hole is in the upper portion of the septum just before the pulmonary valve and aortic valve.) 10 to 50% of children with 22q11.2DS are born with conoventricular VSD. [See "Ventricular Septal Defect" in the Heart Series on the Health Conditions Explained page of our website.]

Vertebrae – The vertebrae are the 33 small bones that stack up to make up your backbone (also called spine). In the middle of the vertebrae is a tunnel which houses the spinal cord and nerves. Most of the vertebrae can move around to allow for a range of motion. The vertebrae in the cervical spine (neck) frequently have a congenital abnormality of shape or formation. The congenital abnormalities may in some cases place the patient at an increased risk of injury because of potential instability of the cervical spine. X-ray examination of the cervical spine, including flexion and extension views of the lateral cervical spine, should be considered as a screening exam in all patients with 22q deletion syndrome regardless of symptoms. [See **Scoliosis**]

W

X

Y

Z

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