The WORLD Symposium™ is the annual research meeting of the Lysosomal Disease Network. This acronym “WORLD” represents “We’re Organizing Research for Lysosomal Diseases.” This annual meeting is planned by the WORLD Lysosomal Disease Network Steering Organizing Committee. In 2013, the WORLD Symposium was in its third year of being co-organized by the U.S. National Institutes of Health (NIH), with funding from the National Institute of Neurological Disorders and Stroke (NINDS), the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), and the National Institutes of Health’s Office of Rare Disease Research (ORDR), at the National Center for Advancing Translational Sciences (NCATS). From its beginning in 2004, the WORLD Symposium has steadily grown. The graph below shows how meeting registration has increased since 2004. In February 2013 nearly 1,000 total attendees participated in this annual research meeting.

Keys to Understanding the Lysosomal Disease Network

The Annual WORLD Symposium™

What Is It?

By Evelyn S. Redtree, M.S.

The Batten Disease Support and Research Association (BDSRA) was founded in 1987 by parents seeking advocacy, support, and research for a lysosomal disease that has become known as the most common neurodegenerative disease found in children. There are multiple forms of the progressive and fatal disease, which is usually diagnosed between infancy and school age. Each different form results from a different genetic mutation, including those affecting adults, i.e., Kufs disease. The term “Batten disease” originally designated the form known as “juvenile neuronal ceroid lipofuscinosis,” but it has evolved.

Meet Our Patient Advocacy Groups

The LDN considers itself lucky to have dedicated patient advocacy groups as members of the Network. This issue, we present with gratitude . . .

BDSRA Web sites include: http://www.bdsra.org; https://www.facebook.com/bdsra; and https://twitter.com/bdsra

(Continued on Page 3)
The Annual World Symposium
What Is It?

(Continued from Page 1)

Similarly, the total number of submitted research abstracts has shown continuing increase, as shown in the following graph:

![Graph of Annual Abstract Submission to World Symposium 2004 - 2014.]

As usual, for 2014 the World Symposium has applied for AMA PRA Category 1 Credits™. Determination of the number of credits is pending review of the final agenda. Physicians should claim only the credit commensurate with the extent of their participation in the activity. Complete information about 2014 World Symposium CME credits will be provided in the official on-site registration packet.

The World Symposium has an educational structure that maximizes its educational benefits: the first day is focused on basic research on the nature of lysosomal diseases, including the molecular mechanisms involved; the second day is focused on translational research, the bridge between basic research and human medicine; and the third day is focused on clinical research, including clinical trials of new treatments. This day-by-day progression through the three stages of research is a signature feature of the annual World Symposium. In 2014, the World Symposium will meet in San Diego, California from February 11-13 at the Manchester Grand Hyatt hotel. The link to the official registration Web site is available at: www.LysosomalDiseaseNetwork.org. A wealth of meeting information is provided at the registration Web site.

An intensive one-day educational course entitled ‘Lysosomes 101’ is annually offered one day before the World Symposium. Lysosomes 101 presents the current knowledge in this area at the graduate-student level. All interested persons are welcome to register to attend this CME-accredited course. In 2014, Lysosomes 101 is presented on Monday, February 10 from 1:00 - 5:00 p.m. Registration for Lysosomes 101 is separate from registration for the World Symposium. There is an early-bird registration rate in effect through January 9, 2014. The official registration Web site provides complete information.

World Symposium™ 2013: Another Record-Breaker!

By Evelyn S. Redtree, M.S.

The Lysosomal Disease Network’s 2013 World Symposium™ convened in Orlando, Florida from February 13-15. With 955 attendees, this was the largest-ever World Symposium, providing that special combination of lysosomal disease education, intellectual stimulation, research coordination and professional networking not available elsewhere. See pages 6 - 7 for some photographs of World Symposium 2013. For those who were unable to attend, most of the presented abstracts (except for a few late submissions) can be found in the February 2013 issue of Molecular Genetics and Metabolism, Volume 108, Issue 2, pages S1-S102 and 109-148. The World Symposium 2013 included the exciting news that the February 2014 issue of Molecular Genetics and Metabolism will be focused on lysosomes and lysosomal diseases. The plan is to create an entire issue with the highest quality peer-reviewed research articles on lysosomes and lysosomal diseases. The February 2014 issue of Molecular Genetics and Metabolism is included in the official registration packet for World Symposium 2014.
Meet Our Patient Advocacy Groups

(Continued from Page 1)

into a generic name widely applied to the various neuronal ceroid lipofuscinoses.

The BDSRA is led by Margie Frazier, Ph.D., its Executive Director. Reach her at: mfrrazier@bdsra.org. The primary focus of the BDSRA is to provide critical services for families and their children diagnosed with a neuronal ceroid lipofuscinosis disease; to foster awareness about these diseases within the scientific, medical, and care-giving communities; to promote and fund research nationally and internationally; and to generate information and networks for diagnosis, medical referral, genetic testing and counseling. The BDSRA also hosts an annual conference for families and medical experts for the purposes of education, networking, and patient and family support. The national office in Columbus, Ohio provides quarterly newsletters, medical equipment exchange services, and programs for sibling support, grandparent support, parent mentoring, and bereavement outreach. Two advisory boards also serve the BDSRA: a medical advisory board and a scientific advisory board. View the Board members roster at: http://www.bdsra.org/about-bdsra/boards/.

Family support groups in Canada, Australia, New Zealand, South Africa, South America, Spain, the United Kingdom and Serbia have been organized through BDSRA efforts. There are eighteen BDSRA chapters in the U.S., Canada, Australia and South Africa which operate to serve families, raise funds and advocate for research. Working with clinicians and scientists, quality genetic-testing centers have been established in the U.S., Canada, Australia and Argentina. Cell and tissue banks and the Batten Disease Registry have been created by the BDSRA to assist in research and genetic-testing studies. The BDSRA has also established Batten disease “Centers of Excellence” in Boston, MA; Columbus, OH; Rochester, NY; Houston, TX; Belgrade, Serbia; and Cordoba, Argentina to aid families and their home treating physicians. The BDSRA has been awarded a 2013 Genzyme Patient Advocacy Leadership (PAL) Award to support its project “Multicultural Clinical Practice Guidelines for Batten Disease.” This project will produce and publish multi-lingual Batten disease clinical practice guidelines for medical professionals in the United States, Serbia, and Argentina. More languages will be added later.

The first research grant from the BDSRA was awarded in 1992. To date more than $6 million in BDSRA research funding has supported significant studies worldwide, with research results published in more than 120 journals and other publications. In January 2013 the BDSRA announced new research grants totaling almost one million dollars for the development of treatments and a cure for Batten disease. These grants were made possible by the BDSRA working in close partnership with more than 20 other organizations around the world. The organizations included Biogen Idec; Batten Disease Support; Noah’s Hope; Blake’s Purpose; Our Promise to Nicholas; and Hope4Bridget. Institutions where the work will be performed include the University of Texas Southwestern Medical Center; Yale University; University of Iowa; University of Medicine and Dentistry of New Jersey; Weizmann Institute of Science in Israel; King’s College London; University Medical Center Hamburg-Eppendorf in Germany; and Lincoln University in New Zealand.

Did You Know?
There are two Lysosomal Disease Network studies in Batten Disease: Protocol #6716 led by Dr. Douglas Ballon at Weill Cornell Medical College in New York City, and Protocol #6717 led by Dr. Jonathan Mink at the University of Rochester in Rochester, New York. To learn more about Dr. Ballon’s study, search for # NCT01035424 on ClinicalTrials.gov; to learn more about Dr. Mink’s study, search for # NCT01873924.

Go to: http://clinicaltrials.gov/ct2/search/index

Be sure to e-mail the editor at: LDNed@umn.edu to have your patient advocacy group featured in a future edition of Indications.
Protocol #6703: Longitudinal studies of brain structure and function in MPS disorders

Dr. Elsa G. Shapiro (profiled on page 5) is the principal investigator of Rare Disease Clinical Research Network (RDCRN) Protocol #6703, a prospective research study which is entitled “Longitudinal studies of brain structure and function in MPS disorders.” This is a multi-site research study which also includes the following principal investigators: Paul Harmatz MD at Children’s Hospital & Research Center Oakland; Sumar Shankar MD at Emory University School of Medicine; Heather Lau MD at New York University School of Medicine; Julian Raiman MD at the Hospital for Sick Children in Toronto, Canada; Morton Cowan MD at the University of California, San Francisco; and Lorne Clarke MD at the University of British Columbia, Dept. of Medical Genetics, in Vancouver, British Columbia, Canada.

In the past five years, the investigators have established a large diverse cohort of participants (130 enrolled participants), developed appropriate neuropsychological and neuroimaging measures, quantified medical and treatment history, collected healthy age-matched control subjects, and have begun to delineate the genotypes and phenotypes of each disorder. Their investigative methods have been acknowledged and used by other investigators and pharmaceutical companies carrying out similar research. Additionally, protocol number 6703 investigators are collaborating with another Rare Diseases Clinical Research Network consortium, the Sterol and Isoprenoid Research Consortium (“STAIR”), to assist them with MRI analysis.

The data that have been and will continue to be collected in this study are the first systematic, quantitative, longitudinal examination of both brain and neuropsychological function in MPS I (Hurler, Hurler-Scheie, and Scheie syndromes), attenuated MPS II (Hunter syndrome), and MPS VI (Maroteaux–Lamy syndrome). MPS I, II, and VI have a spectrum of CNS disease ranging from minimal problems to mild learning difficulties to dementia, with varying admixture of brain disease with extrinsic skeletal and connective tissue disease. One of the difficult problems in the field is that because all patients are treated, there is no opportunity to obtain natural history data without treatment. The challenge at this time is to define a natural history with the ‘standard’ treatments, against which new treatments can be measured. Much of the preliminary data collected in this study suggests that none of the current treatments even come close to a ‘cure.’ Problems remain for these patients in medical, cognitive, brain, psychosocial and adaptive domains.

Better understanding of the pathophysiology of the disease through imaging, and of the neurodevelopmental and neurobehavioral outcomes through precise measurement, will allow treatments to be more focused and directed toward the pathology. Furthermore, while cognitive function has been evaluated in some diseases, the impact of the disease and its therapies on quality of life and psychosocial functioning has not previously been studied.

Such research can more accurately inform patients and parents about potential cognitive, behavioral and neurological outcomes; can develop measures of CNS treatment outcomes; and can help clinical researchers develop treatments directed to specific brain structures and function.

This project would not have been possible without the support of the National MPS Society (http://www.mps-society.org/), the Ryan Foundation for Orphan Disease Research (http://ryanfoundation.net/pages/institutions.html), Genzyme Sanofi (http://www.genzyme.com/) and Shire (http://www.shire.com/shireplc/en/home). This research is also supported by the Center for Neurobehavioral Development, the Center for Magnetic Resonance Research, the Minnesota Super Computer Institute, and the Clinical and Translational Science Institute, all at the University of Minnesota.

Publications Arising From This Protocol:


Meet the Principal Investigators

Elsa G. Shapiro, Ph.D. is the co-principal investigator of the Lysosomal Disease Network (along with Dr. Chester B. Whitley) and also is principal investigator or co-principal investigator of several ground-breaking research studies in lysosomal diseases being carried out by the Lysosomal Disease Network. Dr. Shapiro is Professor in the Departments of Pediatrics and Neurology at the University of Minnesota in Minneapolis. She is adjunct faculty member of the Department of Psychology and the Institute of Child Development at the University of Minnesota. Formerly she was Director of Pediatric Neuropsychology in the Department of Pediatrics. She has made major contributions to the study of childhood dementia in chronic diseases affecting the central nervous system. View her University of Minnesota Amplatz Children’s Hospital Web page at: http://www.uofmchildrenshospital.org/Providers/Bio/D_122156.

Selected Publications:


Check Your Knowledge of Lysosomal Diseases

How well do you know the MPS diseases?

By Elsa G. Shapiro, Ph.D., Evelyn S. Redtree, M.S. and Brenda Diethelm-Okita, M.P.A.

What are the mucopolysaccharidosis diseases?

The mucopolysaccharidosis diseases, often called MPS diseases, are a group of inherited metabolic diseases caused by the absence or malfunctioning of certain enzymes needed to break down molecules called glycosaminoglycans. These are long chains of sugar carbohydrates in each of the cells that help build bone, cartilage, tendons, corneas, skin, and connective tissue. Glycosaminoglycans (formerly called mucopolysaccharides) are also present in the fluid that lubricates joints.

People with a mucopolysaccharidosis either do not produce enough of one (or more) of the 11 enzymes required to break down these sugar chains into proteins and simpler molecules, or they produce enzymes that do not work properly. Glycosaminoglycans are normally disassembled into smaller components by intracellular organelles called lysosomes. When this process does not occur normally, glycosaminoglycans accumulate in harmful amounts in the body’s cells, blood, and tissues. The result is permanent progressive cellular damage that affects the individual’s appearance, physical abilities, organ and system functioning, and, in some cases, mental development.

Who is at risk?

It is estimated that one in every 25,000 babies born in the United States will have some form of the mucopolysaccharidoses. They are autosomal recessive disorders, meaning that only individuals inheriting the defective gene from both parents are affected. (The exception is MPS II, or Hunter syndrome, an X-linked disorder, in which the mother alone passes along the defective gene to a son, via one of her X chromosomes). When both parents have the defective gene, each pregnancy carries with it a one in four chance that the child will be...
An Incomparable Opportunity . . .

WORLD Symposium annually provides that special combination of lysosomal disease education, intellectual stimulation, research coordination and professional networking not available elsewhere. Here are some of the sights and activities enjoyed by the 955 participants at WORLD Symposium 2013 in Orlando, Florida. If you did not make it to the 2013 meeting, we sincerely hope to see you at WORLD Symposium 2014 in San Diego, California, USA!

Brett Billmeyer and Mary Pruitt of LAL Solace enjoyed a highly successful public educational outreach experience in the exhibition hall. Visit the LAL Solace Web site at: http://www.lalsolace.org/

Barbara Wedehase, MSW, CGC, Executive Director of the National MPS Society (left) and Dr. Patricia Dickson of Los Angeles Biomedical Research Institute at Harbor-UCLA Medical Center, a Principal Investigator in the LDN, share the joy of friendship and the inspiration of their common purpose. Visit the National MPS Society Web site at: http://www.mpssociety.org/

The poster sessions were exciting venues for education, idea exchange, and intensive research networking.
Dr. Elsa Shapiro (seated, right) with five colleagues who are members of her LDN research team at the University of Minnesota. Standing row, left: Kathleen Delaney, Dr. Kelly E. King, Brianna Yund, Victor W. Kovac. Seated, left: Dr. Richard S. Ziegler.

The MLD Foundation (advocate for metachromatic leukodystrophy) provided public education in the exhibit hall. Here, Teryn Suhr of the MLD Foundation (right) shares her knowledge with Jill Wood, Treasurer of Jonah’s Just Begun (advocate for Sanfilippo syndrome). Visit the MLD Foundation’s Web site at: http://mldfoundation.org/ and visit Jonah’s Just Begun at: http://www.jonahsjustbegun.org/

Dr. Chester B. Whitley, Principal Investigator of the Lysosomal Disease Network, addresses attendees at the WORLD Symposium 2013.

Dawn Saterdalen (left) takes advantage of the opportunity to learn about the Newborn Screening Translational Research Network, a project of the American College of Medical Genetics & Genomics. Irina Smotrich (center) and Amy Hoffman (right) provided valuable information about this critical aspect of lysosomal disease treatment. Learn more at: https://www.nbstrn.org/

Attendees expand their knowledge during “Lysosomes 101,” the accredited continuing medical education course which convenes one day prior to WORLD Symposium, and presents graduate-level education about lysosome biology, lysosomal diseases, pharmacotherapy, and highly instructive case studies.

Photo Credits, all photos, pages 2, 6 and 7: Dr. Victor Bloomfield
In 1960 de Duve was awarded the Francqui Prize for Biological and Medical Sciences, a prestigious Belgian scholarly and scientific prize. He was awarded the shared Nobel Prize for Physiology or Medicine in 1974, together with Albert Claude and George E. Palade, for describing the structure and function of organelles (lysosomes and peroxisomes) in biological cells. Dr. de Duve’s later years were mostly devoted to origin-of-life studies, which he elucidated in numerous books.¹ This important work has greatly contributed to the emerging consensus in evolutionary biology that the endosymbiotic theory is correct: that mitochondria, chloroplasts, and perhaps other organelles of eukaryotic cells originated as prokaryote endosymbionts, which after engulfment lived cooperatively inside eukaryotic cells.


To learn more about Dr. de Duve, the following three Web sites offer a wealth of introductory information:
2) http://www.nobelprize.org/mediaplayer/index.php?id=726
3) http://www.vega.org.uk/video/programme/126

Selected de Duve Publications:


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Selected de Duve Publications (Continued):


Ed Wraith, World-Leading Lysosomal Disease Researcher and Physician

It is with great sadness that we acknowledge the passing of our dear colleague. Professor James Edmond (Ed) Wraith died on April 10, 2013 at his home in the United Kingdom. An inspiration to many physicians and researchers, and a pioneer in the field of lysosomal diseases, Dr. Wraith was a beloved physician, researcher, and teacher. He served at Royal Manchester Children's Hospital, Central Manchester University Hospitals NHS Foundation Trust, St. Mary's Hospital, Manchester, and the University of Manchester. The Director of Willink Biochemical Genetics Unit at Royal Manchester Children's Hospital, he was also lead clinician for the nationally-commissioned Lysosomal Storage Disease Service, and an international authority on mucopolysaccharidosis diseases. Dr. Wraith published over 200 peer-reviewed articles. His contributions, presence, and voice are sorely missed in the fight against lysosomal diseases, especially by his many colleagues and the patients for whom he cared.

A memorial for Ed Wraith will be held on April 5, 2014, at The Point, Lancashire County Cricket Club, in Manchester, UK. The "Ed Wraith Memorial Meeting on Lysosomal Diseases" has been planned as a half-day lysosomal disease conference, memorial and dinner, themed around Professor Wraith's life and work. The meeting has been designed to be accessible to all who knew him, including clinicians, scientists, care providers, support groups, charities and affected families. Dr. Brian Bigger of the University of Manchester Institute of Human Development, a member of the organizing committee, urges everyone to book now for the best rates. There is a link to a downloadable .pdf document which provides complete event information at: http://www.mpssociety.org.uk/news-events/professor-ed-wraith-memorial-meeting/.

Sylvester Sanfilippo, Researcher and Physician Who First Characterized MPS III

We also sadly acknowledge the passing of our dear colleague Sylvester J. Sanfilippo, M.D. at the age of 87 on May 2, 2013. Dr. Sanfilippo first described the mucopolysaccharide storage disease which bears his name. A native of Rochester, New York, he graduated from the University of Rochester in 1947, then moved to Salt Lake City to pursue postgraduate studies. There he completed a M.S. in Biochemistry, and his medical degree in 1955. He underwent pediatric training at the University of Minnesota, interrupted by a two-year stint as a pediatrician in the U.S. Navy.

In 1960 Dr. Sanfilippo was awarded a postdoctoral research fellowship and began a comprehensive study of children with mucopolysaccharide storage disease at the University of Minnesota. His investigative method combined the chemical measurement and identification of urinary acid mucopolysaccharides with a thorough clinical evaluation of each patient. Using this method, Dr. Sanfilippo identified and characterized a previously unknown inborn error of mucopolysaccharide metabolism. In addition to his work as a researcher, he also was a beloved practicing pediatrician in Richfield, MN for 26 years, retiring in 1988. We workers in the field of MPS diseases owe Dr. Sanfilippo a debt of gratitude for his research insight and his pioneering work.

(Continued on Page 10)
Selected Sylvester Sanfilippo Publications:


Calendron Upcoming Events

Lysosomal Disease Network’s tenth annual WORLDSymposium™, February 11 - 13, 2014 in San Diego, California, USA. For a link to the official meeting registration page, visit: http://www.LysosomalDiseaseNetwork.org/.


13th International Symposium on MPS & Related Diseases, August 13 - 17, 2014 in Costa do Sauipe, Bahia State, Brazil. For more information, visit: http://www.mps2014.com/new/.

American Society of Human Genetics 64th Annual Meeting, October 18 - 22, 2014 in San Diego, California, USA. For more information, visit: http://www.ashg.org/2014meeting/.

Check Your Knowledge of Lysosomal Diseases

(Continued from Page 5)

Lysosomal Disease Network e-mail readers may recall that the Network held a contest prior to WORLDSymposium™ 2013, asking you to give us your best guess of what the final number of registrants for WORLDSymposium 2013 would be. The prize for the closest estimate was $100. Additionally, a $100 prize was to be given to the entrant who demonstrated the mathematical basis for their estimate.

The Lysosomal Disease Network is pleased to announce the winner of both contests. The winner is Rafael J. Tamargo, first author of “Expression of GALT Modulates Glucocerebrosidase Enzyme Activity,” and a co-author of “The use of primary myotubes and fibroblasts for the evaluation of pharmacological chaperone therapy in Pompe disease.” (See Molecular Genetics and Metabolism, Volume 108, Issue 2, February 2013, pages S89 and S98). His estimate was 946, the closest number to 955, the official total. Tamargo arrived at his estimate by using the same registrant-percentage-increase which occurred at WORLDSymposium 2012 — 35% — as the basis for his calculation. The Lysosomal Disease Network thanks everyone who participated in the pre-meeting contest and survey. Your survey responses are appreciated!

What are the signs and symptoms?

The mucopolysaccharidoses share many clinical features, but have varying degrees of severity. These features may not be apparent at birth. The clinical features gradually become worse as storage of glycosaminoglycans affects bone, skeletal structure, connective tissues, and organs. Neurological complications (affecting the central and peripheral nervous
Depending on the type and severity of mucopolysaccharidosis involved, affected individuals may have normal intellect or may demonstrate a spectrum of CNS disease ranging from mild learning difficulties to increasing severity over the period of early development, resulting in dementia. Some types of mucopolysaccharidosis are associated with behavioral disorders or emotional problems. Many individuals have hearing loss. This might be conductive hearing loss (involving the middle ear structures), or sensorineural hearing loss (involving the sensory cells of the inner ear, and/or the brain’s hearing-nerve pathways, and/or the brain’s sound-processing neurons), or a combination of both. Communicating hydrocephalus, in which the fluid in the compartments of the brain increases with increasing pressure, is common in some of the mucopolysaccharidoses. Corneal clouding from intracellular storage of glycosaminoglycans, retinal degeneration and glaucoma also may affect the patient’s vision. Coarse facial features, enlarged tongue, short stature, skeletal dysplasia, enlarged liver and spleen, and hernias are common physical symptoms. Short fingers and claw-like hands, progressively-worsening joint stiffness, and carpal tunnel syndrome can restrict hand mobility and function. Recurring respiratory infections are common, as are obstructive airway disease and obstructive sleep apnea. Many affected individuals also have heart disease, often involving enlarged or diseased heart valves.

What are the different types of the mucopolysaccharidoses?

Seven distinct clinical types and numerous subtypes of the mucopolysaccharidoses have been identified. Although each mucopolysaccharidosis differs clinically, most patients generally experience a period of normal development followed by a decline in physical and/or mental function.

MPS type I has historically been divided into three broad groups based on severity of symptoms: Hurler syndrome, Hurler-Scheie syndrome, and Scheie syndrome (listed in decreasing order of severity). MPS I is now viewed as a continuous spectrum of disease, with the most-severely affected individuals on one end, the less-severely affected on the other end, and a wide range of different severities in between. All individuals with MPS I have an absence of, or insufficient levels of, the enzyme alpha-L-iduronidase, as the result of inheriting a defective gene from both of their parents.

MPS type II (Hunter syndrome) results from absent or insufficient iduronate-2-sulfatase (I2S) enzyme. Hunter syndrome presents as either a severe form (absent enzyme) or a mild form (insufficient enzyme). The severe form demonstrates cognitive and behavioral disturbances, with progressive neurodegeneration and mental impairment. The mild form does not demonstrate those effects, but otherwise shares the same physical effects as the severe form, resulting from the accumulation of glycosaminoglycans (GAG).

MPS type III (Sanfilippo syndrome) results from any of four different defective genes, each responsible for production of a different lysosomal enzyme. Based upon the affected gene, types are identified as A, B, C or D. After an initial symptom-free interval, patients present with a slowing of development and/or behavioral problems and sleep disturbances, followed by progressive cognitive impairment, neurodegeneration, dementia, and progressive motor disease. Progressive severe behavioral problems and sleep disturbances, concurrent with normal strength and physical mobility, present a great challenge for care-givers. In the late phase of the illness, patients become increasingly immobile and unresponsive, with dysphagia and seizures. The life-span of an affected child does not usually extend beyond late teens to early twenties.

MPS type IV (Morquio syndrome) is caused by either of two defective genes, resulting in type A or type B, respectively. Generally, signs and symptoms of the two types are indistinguishable. Morquio syndrome has a variable spectrum of severe somatic signs and symptoms, but little or no cognitive impairment. Its systems) include compression of nerves resulting in pain and impaired motor function.
presentation is similar to MPS I, II and VI, and includes severe short stature and vertebral abnormalities. With an estimated incidence of 1:200,000–300,000, it is one of the rarest MPS diseases.

MPS type VI (Maroteaux–Lamy syndrome) is caused by a deficiency of N-acetylgalactosamine 4-sulfatase enzyme, also known as arylsulfatase B, or ASB. Like Morquio syndrome, Maroteaux–Lamy syndrome has a variable spectrum of severe somatic signs and symptoms, with little or no cognitive impairment. There is considerable heterogeneity in the presentation and progression of the disease, but the majority of MPS VI affected individuals will ultimately succumb to the primary and secondary effects of GAG storage on the pulmonary, musculoskeletal and cardiovascular systems.

MPS type VII (Sly syndrome) results from a deficiency of β-glucuronidase enzyme. Like MPS I, II and VI, it presents as either a severe or a mild form. The severity of MPS VII varies widely, but is progressive and affects most tissues and organs. Severe cases of MPS VII are characterized by hydrops fetalis. Features of MPS VII include macrocephaly, hydrocephalus and coarse facial features. Like other MPS conditions these become more pronounced with age. Like MPS IV, Sly syndrome has an estimated incidence of 1:200,000–300,000, making it one of the rarest MPS diseases.

Treatments for MPS diseases vary by type and severity with hematopoietic cell transplantation and enzyme replacement therapy – either alone or in combination – being common. As for MPS I, II and VI, enzyme replacement therapy for MPS IV may be available soon. World-wide, ongoing medical research continues to search for more effective treatments for the MPS diseases, including the possibility of gene therapies.

Learn More . . .

National Organization for Rare Disorders, Inc. (NORD) http://www.rarediseases.org/rare-disease-information/rare-diseases/byID/282/viewAbstract

*Pediatrics* (a medical journal) Article: Recognition and Diagnosis of Mucopolysaccharidosis II (Hunter Syndrome). http://pediatrics.aappublications.org/content/121/2/e377.full


National Center for Biotechnology Information (NCBI), part of the National Institutes of Health (NIH); from its 'Bookshelf' section: http://www.ncbi.nlm.nih.gov/books/NBK1214/

The Sanfilippo Children’s Research Foundation http://www.alifeforelisa.org/Sanfilippo

The Swedish Information Centre for Rare Diseases http://www.socialstyrelsen.se/rarediseases/sanfilipposyndrome