IPWSO
International
Prader-Willi Syndrome
Organisation

Children with Prader-Willi syndrome
Aged 3 to 12 years

Medical care: Overview
Medical care: Evaluation

Approved by the Clinical and Scientific Advisory Board of IPWSO
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MEDICAL CARE FOR CHILDREN WITH PRADER-WILLI SYNDROME AGED 3 TO 12 YEARS
An Overview of Medical Problems for Physicians

Prader-Willi syndrome (PWS) is a complex genetic disorder with neurodevelopmental manifestations and many potential medical complications. Genetic testing is available and essential to confirm the diagnosis and to define the genotype, which has further clinical implications, especially for psychiatric symptoms. The earlier the diagnosis is made, the better informed the parents and the treatment team can be so that developmentally appropriate medical and behavioral interventions can be implemented. Although most children are diagnosed as infants, any child with a suggestive early history, especially of hypotonia, excessive weight gain in early childhood, satiety deficit, and poor linear growth should have further evaluation. A single genetic test, DNA methylation analysis, can conclusively make the diagnosis in >99% of cases.

As with any chronic disease, a specialty clinic is beneficial for children with PWS to establish an ongoing working relationship with the parents and a communication hub for clinical consultation with specialists. Some countries are fortunate to have a PWS clinic where children with PWS are seen by specialists on a yearly basis. Visits with the primary clinician should occur every 4-6 months. IPWSO recognizes that access to health services and specialists may vary considerably due to factors that include great distance, poor transportation, limited financial resources, or restricted availability. This document summarizes the main health needs that are recommended in the context of available resources. The reader is directed to the other overview and evaluation guidelines in this series for infants with PWS (up to 3 years of age), children with PWS (3-12 years of age), adolescents with PWS (13 years of age and older), and adults with PWS.

Most Common/Significant Medical Findings in Childhood:

- Children with PWS gradually show increased interest in food and weight gain between 2-6 years of age that is inevitably followed by a strong and uncontrollable, biologically- determined drive to seek and eat food. As a result, they will require calorie restriction and careful monitoring to prevent obesity while maintaining a nutritionally balanced intake with adequate protein and fats. Access to food must be

controlled most often by locking food cabinets, refrigerators and/or freezers or by constant supervision. Psychological FOOD SECURITY (knowing the daily schedule for meals and snacks, the food and portion size that will be served, and the assurance that access to food will be controlled at all other times) will decrease anxiety and behavior around food. Food as gifts, rewards or surprises should be avoided, as it creates expectations that cannot be fulfilled consistently and will result in behavioral problems.

- Hypotonia, decreased muscle mass, and decreased physical activity explain lower calorie needs. Even if weight is normal for height, the fat to lean mass ratio is higher than in typical children.

- Developmental delays are common in walking (average time to walk is 27 months), talking, cognition, motor coordination, and self-help skills and will benefit from early intervention services with physical, speech and language, and occupational therapies. Supportive bracing with ankle-foot orthoses (AFOs) may enable earlier attainment of standing and walking abilities. Developmental dyspraxia (the brain's difficulty translating intent into action, especially integrating complex motor movements used in daily activities) maybe life-long.

- Daily exercise is essential for calorie expenditure, physical and motor development, deep breathing, glycemic control and stress reduction.
- Sensory motor stimulation (swing, spin, jump, swim, vibration, brush, etc.) is essential at any age to manage sensor hunger that results from syndromal hypotonia and sensory processing deficits. This deficiency in sensory motor stimulation during infancy causes a life-long sensory debt.
- Growth hormone deficiency is common.
- Hypothyroidism can be seen in up to 33% of children.
- Central adrenal insufficiency is rare, and in most cases, it is diagnosed in infancy. But children who display the new onset of clinical signs such as decreased appetite, weight loss, orthostatic hypotension with dizziness, and dehydration with salt loss will require evaluation. Also children who fail to thrive under extreme stress of illness or prolonged surgery should be assessed by testing morning serum cortisol levels. If cortisol level is low, a referral to endocrinology for further evaluation is indicated.
- Hypogonadism often includes undescended testicles (80-90%). Treatment with human chorionic gonadotropin (hCG) in early infancy may be successful, but most often, surgery is necessary and recommended before 3 years of age, occurring optimally between 6-12 months of age.

- Premature adrenarche (appearance of pubic or axillary hair before age 8-9 years) is very common; it is not a real puberty. It is related to secretion of hormones from the adrenal glands and does not require treatment. It seldom progresses to early puberty. Commonly, it is associated with hyperinsulinemia that responds to carbohydrate restriction, reducing insulin secretion and resistance.
- Precocious puberty is rare and requires endocrine evaluation for treatment with an antigonadotropin medication until the adolescent years.
- Sleep problems are common and include sleep/wake disturbances and sleep respiratory disorders. Sleep/wake disturbances consist of difficulty sustaining sleep at night and excessive daytime sleepiness. Occasionally, narcolepsy is suspected and requires a multiple sleep latency test (MSLT) to confirm the diagnosis. Sleep studies may reveal sleep apnea (central and/or obstructive). Obstructive sleep apnea may be complicated by overweight/obesity and responds to continuous positive airway pressure (CPAP). Central sleep apnea is managed with bi-level positive airway pressure (BiPAP) and growth hormone supplementation.
- Visual acuity problems, especially myopia, are common and early diagnosis and management with corrective lenses is essential for school performance. Eye gaze disturbance (such as strabismus) will require referral to ophthalmology for patching or surgery.
- Dental caries are common due to reduced salivation. Healthy dentition requires exceptional preventative oral hygiene and ongoing attention by a pediatricdentist.
- Speech articulation problems are common, and speech and language therapy is recommended.
- Hearing problems should be evaluated; sound hypersensitivity occurs in somechildren.
- Pragmatic language or social interaction skills may be delayed and lead to consideration for social communication disorder or autistic spectrum disorder. A referral for evaluation by a speech and language therapist is recommended.
- Some children with PWS are prone to ingestion of toxic substances, eating inedible foods, swallowing objects or inserting objects into body orifices. Anticipatory guidance and prevention strategies will be required.
- Gastrointestinal motility problems occur throughout the gut and include chewing and swallowing problems, esophageal dysmotility, reflux, rumination, and choking. Chronic constipation is common and requires treatment.

- The catastrophic cascade of gastric distention, gastroparesis, gastric necrosis and rupture can occur. A distended stomach can be seen after overeating and with other conditions, such as constipation, dietary change, ingestion of carbonated beverages or gastroenteritis. Symptoms can be subtle until very late in the course. Early signs are foul smelling burps, a change in behavior, refusal to eat, or breathing problems. Since vomiting rarely occurs in persons with PWS, any vomiting, especially if foul smelling or dark in color, is frequently an indication of life threatening intra-abdominal disease, even in the absence of other signs. Emergency medical evaluation should include abdominal scans, and prompt intervention to decompress the stomach using a nasogastric tube can be lifesaving. For an important algorithm on this condition, see https://pwsausa.org/wp-content/uploads/2015/10/PWS-GI-Algorithm- Chart.pdf.
- Respiratory abnormalities include shallow breathing (tidal volumes are small at rest and barely audible by stethoscope), reduced rate of breathing, redundant airway tissue that predisposes to apnea, and reduced sensitivity to CO_2 that typically drives ventilation..
- Cardiovascular issues include reduced heart rate variability, a symptom of underlying autonomic nervous system dysfunction in PWS, which predisposes to cardiovascular disease. There is a decreased response of blood pressure and pulse to exercise. Cardiomegaly occurs with obesity hypoventilation that can affect even young children with morbid obesity.
- Spinal deformities include scoliosis, kyphosis or kyphoscoliosis, and are present in about 40%. Scoliosis identified in childhood can be treated with bracing and may require surgery. Growth hormone is not contraindicated.
- Hip dysplasia is present in about 10%. It may be noted at birth or appear later in infancy as the result of developmental delay and/or hypotonia.
- Osteoporosis or osteopenia may be seen in children, and can be prevented with adequate nutritional intake of calcium/vitamin D, physical activity to stimulate bone turnover, and endocrine therapy if warranted. Lifelong monitoring is required, especially in individuals who are immobilized for any reason.
- Gait abnormalities and foot deformities may require evaluation by physiatry (physical medicine), podiatry, or orthopedics and benefit from orthotics, or physiotherapy. Due to heightened pain tolerance in children with PWS and difficulty localizing the source of pain, any persistent limp or complaint of limb pain should be evaluated, usually with a radiograph.

- Primary enuresis is common in PWS; it may be related to bladder hypotonia, inability to sense bladder fullness, or significant constipation with rectal distension. Untreated sleep apnea is associated with nocturnal enuresis. If bladder reflux and/or congenital ureteral redundancy is suspected, referral to urology is needed for evaluation and possible surgical correction.
- Skin picking is common but not universal. Mild picking is opportunistic in location (cuticles, fingers, hands, arms, face, scalp, toes, soles of the feet). For many it is caused by the itch of an insect bite; irregularities of finger nails, toe nails, or cuticles; dry skin or callouses. For others it is provoked by idleness or stress. When severe, it can lead to scarring, disfigurement and potentially serious infections. Surgical incisions often become the site of excoriation, which interferes with healing.
- Rectal picking often starts because of constipation, but it is exacerbated by high stress levels. When severe, it can lead to rectal bleeding, fecal incontinence, anemia and misdiagnosis as colitis or inflammatory bowel disease.
- Many of the characteristic behaviors associated with PWS, like hyperphagia, emerge over time during childhood. These include temper tantrums, skin picking, repetitive asking and behavior, evening-up or just-right phenomena, completing a set, collecting and hoarding of preferred items, rigid thinking and difficulty making transitions.
- Learning problems in school are common, especially speech articulation difficulties, arithmetic disorder (dyscalculia), and mild intellectual deficiency. Neuropsychological deficits in executive function, working memory and processing speed are common.
- Abnormal movements are common such as eye fluttering or eye closure when talking, hand to face or finger stereotypies, and/or other mannerisms, such as hair twiddling.
- Behavior problems often interfere with school adjustment. Attention deficit hyperactive disorder (ADHD), inattentive type and other disruptive behaviors are common. Untreated sleep apnea contributes to attention problems. Daytime sleepiness may be associated with behavior problems.
- Social skills deficits are common and often attributable to language processing delay, poor speech intelligibility and/or egocentrism.
- Anxiety is pervasive during childhood and may lead to depression. Psychological interventions to reduce stress and increase coping skills are indicated.
- Psychosis and/or bipolar disorder can arise unexpectedly with stress or as a side

effect of medication treatment with selective serotonin reuptake inhibitors (SSRIs) or some atypical antipsychotics. A gradual increase in goal-directed behavior or intensification of typical behaviors may indicate a mood shift. Impulsive self-injury (cutting, gouging or stabbing) is usually an indication of emotional instability that requires mental health evaluation. A sudden change of behavior or loss of appetite may indicate physical or psychiatric illness requiring emergency evaluation. The development of abnormal mental experiences should be referred for psychiatric evaluation and treatment, such as children who believe their fantasies to be true and act them out, tell lies about peers or caregivers that get them into trouble with the authorities, or display the new onset of confused thinking with loss of function and mood instability.

Additional Issues:

- Children with PWS may not be able to communicate feeling sick. Change in level of alertness or behavior may be the first indicators that the child is ill.
- Temperature regulation is unpredictable (hyperthermia or hypothermia) and there may be a lack of febrile response even with severe infection. Hyperthermia, likely hypothalamic in origin, or fever of unknown origin may occur.
- Pain threshold is high in many children, and they may not be able to locate the site of discomfort. This increases the risk of underappreciating symptoms of serious conditions and overlooking diseases and fractures. In the case of chest or abdominal pain, a radiograph (X- ray) and computerized axial tomography (CAT scan) of the abdomen must be considered early on even if symptoms observed do not appear to warrant great concern.
- Severe obesity in childhood interferes with developmental progression. Medical complications may include type II diabetes, hepatomegaly due to fatty liver, hypertension, lymphedema, obstructive sleep apnea, hypercholesterolemia, skin changes and ulcers, and joint abnormalities.
- Obesity hypoventilation can occur in childhood. It is associated with morbid obesity, dyspnea on minor exertion, obstructive sleep apnea with hypoxemia during sleep, and rising, non- pitting edema of the lower extremities. Respiratory and cardiac insufficiency are late, ominous findings. In severe cases, children are wheelchair bound, confined to a lounge chair, or sit up in bed because they are unable to recline due to respiratory compromise. Inactivity increases the risk of thromboembolism. Tracheostomy complicates and prolongs recovery; many children have decannulated

themselves. Oxygen delivered at greater than 1 liter/minute without positive air pressure can suppress the respiratory drive and worsen hypoxemia due to decreased sensitivity to hypercapnia in PWS. The treatment of choice is exercise and intensive physical rehabilitation to mobilize fluid accumulation, together with a protein sparing diet under the supervision of an experienced dietician.

- Febrile seizures occur in nearly half of children with PWS and are more likely to occur in the deletion subtype. The lifetime risk of a single seizure is about five times greater than in the typical population.

Medication:

- Many children will have been evaluated for endocrine deficiency before the age of 3 years and may already be receiving growth hormone. For children ages 3-12 years who are being started on growth hormone for the first time, there is concern that the growth hormone may cause adeno-tonsillar hypertrophy and transient edema that could cause or exacerbateobstructive
- sleep apnea. Optimally, sleep studies should be performed prior to starting growth hormone and repeated within 3 months or earlier if clinical signs of airway obstruction occur. If sleep studies cannot be performed, an evaluation by an otolaryngologist or a lateral neck radiograph is recommended for assessment of lymphatic tissue. Serum levels of insulin like growth factor (IGF-1) should be monitored during growth hormone treatment. Also fasting serum glucose should be obtained before and while receiving growth hormone.
- Children diagnosed with hypothyroidism will be receiving thyroxine, and serum levels should be monitored.
- Children previously diagnosed with central adrenal insufficiency may require adjustment of hydrocortisone dose before surgery, anesthesia and during serious or chronicillness.
- When children are treated with oral supplements or daily medications, it is important to avoid the possibility of accidental poisoning or ingestion.
- Due to reduced lean body mass, increased fat mass, and increased sensitivity to drugs of all classes, a low starting dose of medication is suggested, especially antihistamines and psychotropic drugs. Even when starting with a low dose, side effects to medications can occur.
- There are special considerations for surgery. Respiratory suppression can result from the use of standard doses of benzodiazepines or anesthesia during surgery.

Oxygen should be used cautiously because of the decreased response of respiratory drive to CO_2 andthe risk of iatrogenic hypercapnia and CO_2 narcosis. Gastroparesis has occurred following surgery because the gut may not “wake up” as fast as the brain.

General remarks:

This document is designed to address the medical problems typically encountered in children with PWS in an effort to reduce serious complications and improve quality of life. A separate IPWSO document addresses the examination and evaluations performed during regular medical visits.

PWS is due to absence of paternally inherited genetic information on chromosome 15q11.2-q13 due to one of three genetic mechanisms: deletion, maternal uniparental disomy, or imprinting defect. The latter can be associated with familial recurrence risk. It is very strongly recommended that the clinical diagnosis be confirmed through genetic testing. Other conditions can overlap in signs and symptoms with PWS. A DNA methylation analysis confirms the diagnosis in >99% of cases but does not provide the specific genotype. A medical geneticist can order the appropriate genetic testing to determine the specific genotype. IPWSO can be of assistance in identifying sources of testing.

Please also see medical and other information, most of which is written for a lay audience, on the International Prader-Willi Syndrome Organisation (IPWSO) website which includes information about family support organizations in over 100 countries: http://www.ipwso.org.

Sources of detailed information about PWS are:
Pediatrics: www.pediatrics.org/cgi/doi/10.1542/peds.2010-2820
GeneReviews: https://www.ncbi.nlm.nih.gov/books/NBK1330/
PWSA Medical Alert Booklet:
https://pwsa.org/wp-content/uploads/2015/11/newMAbookfinal.pdf

MEDICAL CARE FOR CHILDREN WITH PRADER-WILLI SYNDROME AGED 3 TO 12 YEARS
Evaluation Guidance for Physicians

Prader-Willi syndrome (PWS) is a complex genetic disorder with many neurodevelopmental and behavioral manifestations that emerge across childhood. Many children and their families benefit from early genetic diagnosis and anticipatory guidance throughout the developmental years.

Potential medical and behavioral complications are most effectively treated if identified early in their course. This guide has been prepared to advise physicians caring for children with PWS how to proactively evaluate and clinically identify early signs of problems. Potential complications are detailed in the companion document, An Overview for Physicians Caring for Children with PWS. The examinations and clinical tests listed below are recommended during the annual primary care and/or subspecialty physician visit. Developmental problems, test results, referral to and communication with subspecialists can be discussed with parents during these annual visits.

IPWSO recognizes that access to health services and to specialists may vary considerably, but many countries are developing PWS Multidisciplinary Clinics to facilitate family contact with subspecialists. This document summarizes the main health needs that are recommended in the context of available resources. The reader is directed to the other overview and evaluation guidelines in this series for infants with PWS (up to 3 years of age), children with PWS (3-12 years of age), adolescents with PWS (13 years of age and older), and adults with PWS.

Careful developmental and medical history, with emphasis on the following:

- Progression of developmental milestones in preschool children: Gross motor, fine motor, speech, cognition and skills of social relating. Consider a referral to special needs preschool, if needed.
- Academic progress in school for children 6-12 years: Determine the results of psychological testing and whether learning disorders have been diagnosed and accommodated. Review the individual educational plan to assure that issues related to PWS have been noted and addressed in the classroom.
- Food history:

  - Diet: Inquire about the current calorie count, dietary plan, and food selection. Consider a referral to a PWS-knowledgeable dietician for calorie control and nutrient supplementation, if needed.
  - Food environments: Assess access to food across environments such as home (extent of food control and supervision), school (potential for double meals, use of food for behavioral reinforcement in the classroom), transport to school, and community (opportunities for food access and adequacy of supervision).
  - Evaluate food related behaviors and develop a plan for managing them.
- Typical behavior problems in PWS: Assess the frequency and severity of temper tantrums, repetitive asking/behavior, cognitive rigidity, difficulty with transitions, collecting/hoarding. Inquire about preventive strategies, the management of behavior across settings, and thelevel of caregiver stress.
- Physical activity: Ascertain the type and duration of exercise per day. Determine if activities are family based, peer involved (such as Special Olympics), and whether there is a plan to limit sedentary activities like screen time (computer and television).
- Sleep/wake history: Assess for snoring, sleep apnea, restless sleep, daytime sleepiness, and/or night wandering. Consider referral to pulmonary or sleep medicine.
- Identify unusual movements or habits (rapid eye blinking, body rocking, tics, stereotypies).
- Inquire about seizures or spells of unresponsiveness. Febrile seizures are especially common among children with deletion genotype. Consider a referral to pediatric neurology.
- Vision: Assess acuity (impairment is common) and eye gaze coordination (strabismus is common). Consider referral to ophthalmology for full evaluation and recommendations.
- Hearing: Assess for deficit or hypersensitivity. Consider referral to otology/audiology.
- Oral hygiene: Evaluate dentition, palate. Dental inspection and cleaning is recommended 2 times per year.
- GI review of systems:
  - Oral competence: Bite, chew, tongue movements, and swallow. Screen for symptoms of dysphagia (difficulty swallowing) and micro-aspiration (recurrent pneumonia, difficult- to-manage asthma). Consider a referral to a speech and

language therapist for evaluation. Consider ordering a cookie swallow and assessment of esophageal motility. Implement Pace and Chase (see Attachments).

- Gastroesophageal reflux disorder (GERD), rumination (commonly due to abnormal esophageal motility).
- Rate of eating: For gorging and/or choking, Implement Pace and Chase (see Attachments).
- Bowel pattern and consistency: Bristol stool chart (see Attachments) – 'make snakes'. Consider referral to gastroenterology for management of constipation.

- Inquire about urinary incontinence. Children may not perceive bladder fullness, and emptying may be incomplete. Bed wetting is common and occurs with sleep apnea. Daytime wetting also occurs and can be related to constipation.
- Assess balance, stance, gait, and gross motor coordination. Determine the degree of assistance required to safely ascend/descend steps. Consider a referral to physiatry or physiotherapy for evaluation and intervention (orthotics).
- Assess fine motor coordination: Determine whether the child can don/doff clothing, or manage toileting hygiene. Referral to occupational therapy may be needed.
- Screen for hip dysplasia and scoliosis. Once the patient can sit stably, obtain seated spine and supine pelvis radiographs at the same time. Refer to orthopedics for abnormal findings.
- Skin picking: Assess location, periodicity and severity of skin picks. Prevention techniques include use of insect repellent to prevent bites; use of emollients for dry skin; use of a pumice stone for callouses on feet; and keeping fingernails, toenails and cuticles trimmed. Consider barrier methods (gloves, topical antibiotic ointment). Consider referral to occupational therapy for a sensory diet and a sensory stimulation program. Consider the use of N-acetyl cysteine to decrease picking behavior.
- Medications and doses: Update the medication list. Assess for potential drug interactions, side effects, and discontinue medications that are no longer necessary. Always inquire about the use of over the counter medicinal agents. Medications prescribed "as needed" are likely to be over used.

Relevant body examination, including:

- Height, weight, and head circumference. Chart on appropriate growth curves for children with or without growth hormone (see Links at end of article). Calculate body mass index (BMI, kg/m2); BMI goal is <50%. Assess growth velocity; aim for mid-parental height if receiving growth hormone therapy.
- Vital signs: obtain blood pressure and pulse (seated and standing).
- Assess the quality of interpersonal interaction (alertness, ability to engage and sustain eye contact, and ability to establish rapport).
- Assess quality of communication (ability to express wants and needs, verbally and nonverbally).
- Assess speech clarity and fluency (speech articulation problems and intelligibility; ability to repeat words and phrases for clarity; stuttering or repetition of words and/or phrases; and coordination of tongue movement to produce sounds). Consider referral for further speech and language therapist evaluation.
- Mouth – inspect teeth for signs of reflux, bruxism, decay; look for tonsillar prominence.
- Heart auscultation – evaluate for cardiac insufficiency.
- Lung auscultation – evaluate for irregular ventilation/atelectasis.
- Abdominal exam – palpate liver edge for hepatomegaly (fatty liver), abdominal tenderness, or evidence of constipation.
- Back and hip inspection for scoliosis, kyphosis; examine hips for dysplasia or other joint abnormalities. Physical examination may lack diagnostic specificity.
- Leg edema can be seen in overweight/obese children and requires evaluation by the cardiologist or lymphedema specialist. Ulcers may occur, usually as a result of skin excoriation, and may become infected, requiring antibiotic therapy or specialized wound care. Leg edema (bilateral, non-pitting) can be seen with morbid obesity and is a sign of obesity hypoventilation; this requires immediate care but can be reversible with weight loss and exercise. Unilateral edema and redness may be a sign of venous thrombosis, which is increased among individuals with PWS, and this requires standard evaluation and treatment.
- Gait, feet, and foot position – orthotics or special shoes are needed often for severe pes planus (flat footedness).
- Skin examination – examine for signs of skin picking, such as open sores and infections; look for yeast, fungal or bacterial infection in the skin folds of

overweight/obese children.

- Look for signs of premature adrenarche (appearance of pubic or underarm hair in girls less than 8 or boys less than 9 years of age).
- Anogenital examination – Inspect anus for evidence of rectal picking. Genital examination is abnormal in PWS due to hypogonadism. Boys are born frequently with micropenis and hypoplastic scrotum. If cryptorchid, refer for urological or surgical evaluation. Girls with PWS are born with clitoral and labial hypoplasia. Perform examination by inspection for girls >7 years.
- Monitor abdominal circumference for children receiving atypical neuroleptics or for children who have a history of bloating and abdominal distension to establish a baseline.

Blood tests (yearly):

- Glycosylated hemoglobin (Hemoglobin A1c) and fasting blood glucose (recommend as fasting blood test at 8am).
- Blood lipids, cholesterol, and liver enzymes (recommend as fasting blood test at 8am).
- Thyroid stimulation hormone (TSH) and free thyroid hormone (T4); free triiodothyronine (T3) if possible to obtain.
- Vitamin D (25-hydroxyvitamin D3), calcium, phosphorous.
- Hemoglobin and hematocrit; white blood cell count and platelets.
- Serum electrolytes (sodium-Na+, potassium-K+, chloride-Cl-, and bicarbonate-HCO3-) (Hyponatremia may suggest excess fluid intake or a side effect from psychotropic medications or mood stabilizing anticonvulsants).
- Blood urea nitrogen (BUN or urea) and creatinine (Cr); BUN:Cr ratio may be elevated in PWS due to low muscle mass.
- Insulin growth factor-1 (IGF-1) if possible, especially for those treated with growth hormone to confirm appropriate dose and compliance.

Recommended Clinical Diagnostic Tests:

- Polysomnography prior to and 3 months following the start of growth hormone, or sooner if clinical signs of airway obstruction become evident. If sleep studies are not available, a radiograph (X-ray) of the lateral neck can be performed to evaluate the size of adenoids and tonsils if obstructive sleep apnea (OSA) is suspected. If present,

refer to an otolaryngologist for examination.

- Polysomnography is also used to evaluate for the presence of obstructive and/or central sleep apnea. Multiple Sleep Latency Test (MSLT) is recommended if there is concern for narcolepsy.
- Radiograph (X-ray) of the back, if scoliosis suspected. The radiologist might be asked to comment on the amount of stool in the colon as an incidental finding.
- Radiograph (X-ray) and/or ultrasound of the hips if dysplasia suspected.
- Bone age (determined by a radiograph of the left hand) is compared to chronological age to determine how fast the skeleton is growing, usually with growth hormone treatment and in the case of premature adrenarche.
- Dual energy X-ray absorptiometry (DXA) is used to measure bone mineral density (for signs of osteoporosis or osteopenia) and to assess body composition (by determining fat mass), if possible to obtain.
- Among children who have had a poor physiological stress response to illness, cortisol testing can be considered before scheduled surgery. Prior to extensive surgeries anesthesiologists should be alerted to the potential for central adrenal insufficiency in PWS.
- Children who have evidence of premature puberty, which is rare, should be referred to an endocrinologist for evaluation and treatment.

Recommended Clinical Consultations:

- Endocrinology: to assess pituitary/hypothalamic function, specifically growth hormone, thyroid and central adrenal insufficiency.
- Medical genetics: to confirm that the correct up-to-date genetic testing has been accomplished and for genetic counseling of recurrence risks for the family.
- Dietician (or equal, assuming knowledge of PWS): to determine adequate calorie and nutritional requirements at least yearly or maybe every 4-6 months if necessary.
- Physiotherapy: to assess joints, muscles and to recommend appropriate motor activities.
- Occupational therapy: to determine sensory needs and a sensory diet for sensory motor stimulation and to evaluate and accommodate for dyspraxia (the brain's difficulty translating intent into motor movements, especially integrating complex motor actions used in daily activities).
- Speech and language therapy: to evaluate oral dyspraxia (difficulty coordinating

movement of the tongue, lips, and pharynx) necessary for articulation and bite-chew-swallow functions; and to evaluate and remediate pragmatic language deficits.

- Pediatric psychology or applied behavioral analyst: to evaluate out-of-control behaviors and prescribe a behavior plan using environmental management strategies or contingent behavioral techniques or programs.
- Pediatric psychiatry: to evaluate difficult to control behavior problems, emergent changes in mood or thinking processes, or use of psychotropic medications.
- Social services: to help the family with resources for support in the present, and to begin planning for needs in the future, such as residential care. Encourage the family to educate and advocate with relatives, school personnel, and community helpers.

Please Note:

Some other conditions can overlap in signs and symptoms with PWS. It is optimal to assure that the diagnosis is correct through genetic testing. DNA methylation analysis can conclusively make the diagnosis in >99% of cases. Further testing by a medical geneticist is necessary to determine the molecular class (genotype). IPWSO can be of assistance in identifying sources of testing.

Sources of detailed information about PWS diagnosis, symptoms, evaluation, and management: Pediatrics: www.pediatrics.org/cgi/doi/10.1542/peds.2010-2820; Gene Reviews: https://www.ncbi.nlm.nih.gov/books/NBK1330/ and PWSA Medical Alert Booklet:
https://www.pwsausa.org/wp-content/uploads/2015/11/newMAbookfinal.pdf

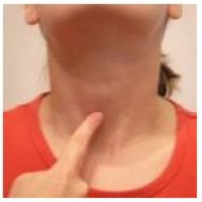
Links:

Butler et al. Growth Charts for Non-growth Hormone Treated Prader-Willi Syndrome. Pediatrics. 2015;135(1):e126-e135.
https://www.pwsausa.org/wp-content/uploads/2017/01/Ht-wt-GH-treated-boys-3-18y-2016.pdf
https://www.pwsausa.org/wp-content/uploads/2017/01/Ht-wt-GH-treated-girls-3-18y-2016.pdf
https://www.pwsausa.org/wp-content/uploads/2017/01/BMI-GH-treated-boys-3-18y-2016.pdf

https://www.pwsausa.org/wp-content/uploads/2017/01/BMI-GH-treated-girls-3-18y-2016.pdf
https://www.pwsausa.org/wp-content/uploads/2017/01/HC-GH-treated-boys-2016.pdf
https://www.pwsausa.org/wp-content/uploads/2017/01/HC-GH-treated-girls-2016.pdf

Attachments: Bristol Stool Chart; Pace & Chase

Why is "Pace and Chase" important?



Sometimes when I eat, food gets stuck in my throat and I don't feel it.

I take a drink after two bites so that all the food goes to my belly. This is called "Pace and Chase."

Staff reminds me to take drinks. They care about me and want me to be safe.

I ask for water when my first drink is empty.

When I am done eating, I drink my "flush" to make sure there is no food in my throat.