Supplemental Table 1: Clinical Features of GSDs					
Condition	**Gene(s)**	**Enzyme(s) or transporter**	**Inheritance**	**Clinical features**	**Other considerations**
GSD 0a	*GYS2*	Hepatic glycogen synthase	AR	Fasting ketotic hypoglycemia. Postprandial hyperglycemia and elevated lactate.[1-3] Short stature and low bone density.[1]	GSD 0a distinguished from other hepatic GSDs by normal liver size.[2]
GSD 0b	*GYS1*	Muscle glycogen synthase	AR	Features include exercise intolerance and hypertrophic cardiomyopathy,[4] sudden death with exercise with no prior exercise intolerance or heart structural abnormalities,[5] and adult-onset myopathy without cardiomyopathy.[6]	Very small number of cases.
GSD I, von Gierke disease	*G6PC1* (GSDIa) and *SLC37A4* (GSD Ib)	G6Pase (GSD Ia) and G6PT (GSD Ib)	AR	Fasting hypoglycaemia, lactic acidosis, high triglycerides, elevated uric acid (tendency for gout), hepatomegaly, HCAs (with chromosome anomalies[7] and may be associated with poor metabolic control[8]) with malignant potential, nephromegaly, renal tubular and glomerular disease, osteoporosis, pulmonary hypertension[9,10], anemia[11], bleeding disorder[12-14]. In GSD Ib, neutropenia, neutrophil dysfunction, and IBD[15].	Blood lactate rises quickly with hypoglycemia. Hypoketotic hypoglycemia.
GSD II, Pompe disease	*GAA*	Acid alpha-glucosidase	AR	Infantile-onset Pompe disease: Lethal without treatment.[16] Hypertrophic cardiomyopathy,[17] hypotonia,[17] motor delay[17], conduction anomalies,[18] cardiorespiratory failure,[16] feeding difficulty,[17] neurological symptoms (such as sensorineural hearing loss, small fiber neuropathy, bulbar weakness, and learning difficulties).[19] Late-onset Pompe disease: presentation at any age without cardiomyopathy in the first year of life.[20,21] Proximal limb girdle weakness and involvement of the diaphragm.[20] Lingual weakness with swallowing difficulty,[22] ptosis, small fiber neuropathy,[23] osteoporosis,[24] and GI dysmotility.[25,26] In some, cardiac hypertrophy later in life and increased risk for arrhythmias.	Variable expressivity of LOPD is being better characterized with addition of GAA activity to some NBS programs.[21]

GSD III (Cori disease; Forbes disease)	*AGL*	Glycogen debranching enzyme	AR	Fasting hypoglycemia with elevated ketones may be seen, hyperlipidemia, hepatomegaly, elevated AST and ALT.[27] HCA in a minority of patients.[27,28] Risk of HCC.[29,30] Hepatic fibrosis and progression to cirrhosis may occur.[29-31] In GSD IIIa: increased CK (normal in some individuals), myopathy. Muscle weakness can be proximal and distal and spares respiratory muscles.[27] Left ventricular hypertrophy, risk of cardiomyopathy, increased risk for arrhythmias.	Hypoglycemia can occur with or without elevated ketones. Cirrhosis causes HCC in GSD III (as opposed to GSD I where HCC develops from adenomas).[32]
GSD IV (Andersen disease)	*GBE1*	Glycogen branching enzyme	AR	Phenotypic variability. GSD IV may be best considered as a clinical continuum in which different patients have varying involvement of hepatic, cardiac, and neurologic features. Historically, subtypes described include classic (progressive) hepatic subtype with hepatosplenomegaly, liver dysfunction and progressive cirrhosis, cardiomyopathy, hypotonia, failure to thrive, and death often by 3 to 5 years of age without liver transplantation. Another subtype, APBD, is an adult-onset neurodegenerative disorder and can present with gait difficulty, progressive neurogenic bladder, autonomic dysfunction, sensory loss, and variable cognitive difficulty, among less common features described in references. [33-35]	Other phenotypes historically described include fatal perinatal neuromuscular subtype, congenital/neonatal neuromuscular subtype, non-progressive hepatic subtype, and childhood/juvenile neuromuscular subtype which are described in cited literature.[33-35]
GSD V (McArdle disease)	*PYGM**	Myophosphorylase	AR	With exercise, quick development of myalgia, fatigue, cramps, tachypnea, and tachycardia.[36] Elevated CK (usually) and propensity to rhabdomyolysis.[36,37] Contractures. Risk of compartment syndrome.[36,37] Often, presentation in first decade but with variability.[37] Fixed muscle weakness in some patients (more common in proximal muscles and more likely with age).[37] Some individuals with episodes of myoglobinuria that can lead to acute kidney failure.[37] Compared to the general population, diabetes, gout, and coronary infarction are more common.[36]	Second-wind phenomenon[38] almost unique to GSD V (also seen in PGM1-CDG), Pre-exercise ingestion of sucrose improves exercise intolerance.[39]

GSD VI (Hers disease)	*PYGL*	Liver glycogen phosphorylase	AR	Variable.[40] Commonly presents with hepatomegaly and poor growth with broad range of presenting age.[41] Hypoglycemia with ketosis. Elevated liver transaminases, hyperlipidemia, osteoporosis. Liver fibrosis.[42] Cirrhosis described. Recently, large review elucidated that liver biopsy shows increased glycogen in most with liver fibrosis in ~32% and cirrhosis in ~11%.[41]	Hypoglycemia can occur with or without elevated ketones. Although sometimes considered a milder hepatic GSD, severe hypoglycemia and hepatomegaly reported.[40,43]
GSD VII (Tarui disease)	*PFKM*	Muscle phosphofructokinase	AR	Typical form associated with exercise intolerance with contractures and myoglobinuria[44] and at times with hemolytic anemia and hyperuricemia with gout.[44] Atypical phenotypes include a myopathy in infancy with respiratory failure and death by age 2, hemolytic anemia without myopathy, and late-onset fixed weakness.[44]	No second wind phenomenon.[45] Sucrose ingestion before exercise leads to an "out-of-wind phenomenon" with less exercise capacity.[44,46] Akman et al.[44] acknowledged that in the few children with the infantile/early childhood presentation, there was no molecular explanation despite PFK deficiency in setting of severe myopathy. They considered the possibility that there could be different molecular etiologies when considering the rare and severe, infantile presentation.[44]

Hepatic GSD IX	*PHKA2* (GSD IX α2), *PHKB* (GSD IX β), *PHKG2* (GSD IX γ2)	Liver phosphorylase kinase α2 (GSD IX α2), liver and muscle phosphorylase kinase β2 (GSD IX β), and phosphorylase kinase γ2 (hepatic and testis isoform) (GSD IX γ2)	X-linked (GSD IX α2; females can be affected depending on X inactivation), AR (GSD IX β, and GSD IX γ2)	GSD IX α2: Boys usually present in first few years of life with failure to thrive ± hepatomegaly.[47] Ketotic hypoglycemia, when seen, varies in frequency.[40] Variable elevations of transaminases and HLD.[40,47] Liver fibrosis.[42] Variability in presence and severity of fibrosis; cirrhosis described.[47] Mild hypotonia and developmental delay have been described.[40,48] At times, delayed puberty.[40,48] Limited long-term natural history. Adults described as asymptomatic.[40,48] GSD IX β: Rare with varying range of hepatic features.[40] Usually identified due to hepatomegaly.[40,47] Ketotic hypoglycemia and elevated tryglycerides.[47] Muscle features either absent or mild.[40] GSD IX γ2: 25% of GSD IX but typically more severe clinical features.[40,49] Hypoglycemia usually more pronounced. Increased risk for liver fibrosis and cirrhosis[40,47,49] (cirrhosis can develop in first years of life).[40] Liver adenomas have been described.[40]	In hepatic GSD IX, hypoglycemia can occur with or without elevated ketones. GSD IX α2: heterozygous women may be unaffected or have variable severity of symptoms[40,49]; GSD IX β: liver fibrosis occurred in 1 of 3 affected individuals.[47]
Muscle GSD IX	*PHKA1* (GSD IX α1)	Alpha subunit of muscle phosphorylase kinase (GSD IX α1)	X-linked	Variable clinical presentation and age of onset. CK may be elevated. Manifestations include muscle weakness, pain and stiffness with exercise, and atrophy.[50]	Rare and variable.
GSD X	*PGAM2*	Muscle phosphoglycerate mutase	AR	Exercise intolerance with cramps and myalgia/pain[44,50]. Rhabdomyolysis.[50] About half of patients with recurrent myoglobinuria; elevated serum CK between episodes.[44]	Rare.
GSD XI (note that GSD XI is sometimes used for Fanconi-Bickel Syndrome also)	*LDHA*	Lactate dehydrogenase A (skeletal muscle isoform)	AR	Exercise intolerance with cramps and painful stiffness.[50] Rhabdomyolysis and myoglobinuria.[50] Skin lesions described as desquamating erythematosquamous, annular psoriasis-like, annular erythematous plaques, pustular psoriasis-like, and annually recurring acroerythema.[44,51-55] Elevated serum CK during myoglobinuria events may be seen with low serum lactate dehydrogenase concentrations.[44] One individual with apparently isolated skin findings.[54]	Rare. One woman described with uterine stiffness during pregnancy and delivery requiring Cesarean section.[56] There may be apparently isolated skin findings.[54] One child with suspected GSD XI was described as having intellectual disability.[57]

GSD XII	*ALDOA*	Red blood cell fructose-1,6-bisphosphate aldolase A (erythrocyte and muscle isoform)	AR	Rare. Hemolytic anemia, myopathy, rhabdomyolysis.[50] Variable features described include intellectual disability, short stature, dysmorphic facial features.[50,58-63]	Enzyme might be thermolabile, as fever induces rhabdomyolysis/myoglobinuria.[64,65] Hepatosplenomegaly has been reported in affected individual as has seizure or epilepsy.
GSD XIII	*ENO3*	Beta-enolase	AR	Rare. Very few individuals reported.[66-69] Reported features include exercise intolerance, myalgia, rhabdomyolysis, muscle MRI with fatty infiltration.	Nonischemic forearm testing with normal lactate; no benefit of glucose infusion on exercise.[69] Normal baseline CK reported in 2 individuals.
GSD XV	*GYG1*	Glycogenin 1 (muscle isoform)	AR	Rare. Weakness, arrhythmias.[50,70] Phenotype may be predominantly skeletal myopathy or predominantly cardiomyopathy. Severe cardiomyopathy may be present with no skeletal muscle weakness, potentially requiring heart transplantation.[71] Conversely, late-onset skeletal myopathy may present without an apparent cardiomyopathy.[72] A report of 7 individuals described 4 with symmetric proximal and distal weakness and variable symptoms of hip and shoulder girdle, lower legs, and hands; 2 with isolated proximal muscle weakness; and 1 with only hand and finger sequelae.[73] A series of 5 affected individuals (4 families) with limb girdle weakness revealed concomitant ischemic cardiomyopathy and bradycardia in one and only mild changes in cardiac evaluation in the other patients felt to be compatible with age.[74] Another series of 9 patients from 5 families showed myopathy with no apparent heart disease (except for 2 patients at age 58 and 76 who had cardiac anomalies in the setting of coronary artery disease).[75] Individuals with predominantly skeletal myopathy have been described as progressive early-onset limb-girdle weakness,[75] mildly progressive late-onset limb-girdle weakness,[74] and late-onset distal or scapuloperoneal involvement.[75]	

PGM1-CDG (formerly GSD XIV)	*PGM1*	Phosphoglucomutase 1	AR	Two main phenotypes: primary myopathic and multisystem. The multisystem phenotype includes variable features of congenital malformations, muscle and heart involvement, hepatic features, endocrine anomalies, and hematologic anomalies,[76] hypoglycemia, growth retardation, and dilated cardiomyopathy.[77]	Two cases of malignant hyperthermia and rhabdomyolysis after general anesthesia and two patients with hypogonadotropic hypogonadism[77]; second wind phenomenon (thought to be pathognomonic for GSD V) reported in PGM-CDG[78].
FBS (also called GSD XI), Fanconi-Bickel Syndrome	*SLC2A2*	GLUT2	AR	Intolerance and postprandial elevations of glucose and galactose, fasting hypoglycemia, hepatomegaly, proximal tubular nephropathy, glucosuria, short stature, accumulation of glycogen in liver and kidneys.[79]	Rarely, cataracts.[79]
PGK deficiency	*PGK1*	Phosphoglycerate kinase	X-linked	May manifest with nonspherocytic hemolytic anemia, myopathy with rhabdomyolysis, and neurologic features, including intellectual disability (anemia, myopathy, and neurologic features appear to present in different combinations).[80,81] Lower enzyme activity may lead to involvement of multiple systems and susceptibility to rhabdomyolysis.[82]	Parkinsonism, with response to levodopa reported.[81,83-86] Retinitis pigmentosa[81,87] PGK deficiency may have peripheral nervous system disease and a phenotype resembling Charcot-Marie-Tooth disease.[81]

Supplemental Table 1. This table describes some clinical features that have been described in GSDs but is not comprehensive. In a given disease, some manifestations are more common than others, and individuals present differently. *An autosomal dominant GSD has been described in individuals with a monoallelic *PYGM* missense variant.[88] Individuals with this GSD were described with adult-onset muscle weakness in the absence of exercise intolerance; notable differences between this novel GSD and GSD V were also described with histologic and functional characterization.[88] ALT, alanine transaminase; APBD, adult polyglucosan body disease; AR, autosomal recessive; AST, aspartate transferase; CK, creatine kinase; FBS, Fanconi–Bickel syndrome; GAA, acid alpha-glucosidase; GSD, glycogen storage disease; HCA, hepatocellular adenoma; HCC, hepatocellular carcinoma; IBD, inflammatory bowel disease; IOPD, NBS, newborn screening; PFK, phosphofructokinase; PGK1, phosphoglycerate kinase deficiency; PGM1-CDG, phosphoglucomutase 1 deficiency, a congenital disorder of glycosylation.