List of IMDs affecting the ear (n=219)										
Name	**Gene**	**Congenital external ear abnormalities**	**Acquired external ear abnormalities**	**Middle ear involvement**	**Inner ear or retrocochlear involvement**	**Unspecific hearing loss**	**Laboratory investigations**	**Specific treatment**	**OMIM no.**	**IEMbase ID**
DISORDERS OF NITROGEN-CONTAINING COMPOUNDS (n=19)										
Disorders of pyrimidine metabolism										
Dihydroorotate dehydrogenase deficiency	*DHODH*	X		X			Purines and pyrimidines (U, P)		263750; 126064	IEM0002
Disorders of purine metabolism										
Phosphoribosyl pyrophosphate synthetase 1 superactivity	*PRPS1*				X		Enzyme activity	Dietary reduction of meets and fish; Allopurinol 5-10 mg/kg/day; S-adenosylmethionine 30 mg/kg/day	300661	IEM0007
Phosphoribosyl pyrophosphate synthetase 1 deficiency	*PRPS1*				X		Enzyme activity	Dietary reduction of meets and fish; Allopurinol 5-10 mg/kg/day; S-adenosylmethionine 30 mg/kg/day	311850	IEM0007
Disorders of nucleotide metabolism										
Ribonuclease T2 deficiency	*RNASET2*				X		Interferon-α (CSF), Lymphocytes (CSF)		612951	IEM0030
Ectonucleotide pyrophosphatase-phosphodiesterase 1 deficiency	*ENPP1*					X	DNA		208000	IEM0037
Equilibrative nucleoside transporter 3 deficiency	*SLC29A3*				X		Erythrocyte sedimentation rate; IgG (S)		602782	IEM0041
Disorders of glutathione metabolism										
Dipeptidase deficiency	*DPEP1*				X		Leukotrienes (P), Amino acids (P), Acyglycines (U)		179780	IEM1508
Aminoacylase deficiencies										
Aspartoacylase deficiency (Canavan disease)	*ASPA*					X	N-Acetylaspartic acid (U, P, CSF)		271900	IEM0074
Aminoacylase 1 deficiency	*ACY1*				X		Organic acids (U)		609924	IEM0075
Disorders of sulfur amino acid and sulfide metabolism										
Adenosine kinase deficiency	*ADK*				X		SAM/SAH (P), ASAT/ALAT (P), Glucose (S), Amino acids (P), Purines (U), Total/direct bilirubin (S)		614300	IEM0101
Disorders of branched-chain amino acid metabolism										
Mitochondrial short-chain enoyl-CoA hydratase 1 deficiency	*ECHS1*					X	Organic acids (U), 2-Methyl-2,3-dihydroxybutyrate (U), Lactate (P), Pyruvate (P), S-(2-carboxypropyl)-cysteine (U)	Valine restricted diet	616277	IEM0119
17-beta-hydroxysteroid dehydrogenase type 10 deficiency	*HSD17B10*				X		Amino acids (P), Organic acids (U), Acylcarnitines (DBS, P), Lactate (P), Glucose (S)	Protein restricted diet, L-Carnitine	300438	IEM0121
Propionic acidemia due to propionyl-CoA carboxylase subunit alpha deficiency	*PCCA*				X		Acyglycines (U), Amino acids (P), Organic acids (U), Acylcarnitines (P,DBS)	Low protein diet, carnitine	232000	IEM0124
Propionic acidemia due to propionyl-CoA carboxylase subunit beta deficiency	*PCCB*				X		Acyglycines (U), Amino acids (P), Organic acids (U), Acylcarnitines (P,DBS)	Low protein diet, carnitine	232000	IEM0125
Disorders of proline and ornithine metabolism										
Pyrroline-5-carboxylate reductase 1 deficiency	*PYCR1*	X					DNA		612940; 614438	IEM0139
Pyrroline-5-carboxylate reductase 2 deficiency	*PYCR2*	X					DNA		616420	IEM0140
Prolidase deficiency	*PEPD*			X			Amino acids (U)		170100; 613230	IEM0144
Disorders of tryptophan metabolism										
3-hydroxyanthranilic acid 3,4-dioxygenase deficiency	*HAAO*				X		3-Hydroxyanthranilic acid (P)		604521	IEM0163
Disorder of asparagine metabolism										
Asparagine synthetase deficiency	*ASNS*	X					Amino acids (P)		615574	IEM0180
DISORDERS OF VITAMINS, COFACTORS, METALS AND MINERALS (n=12)										
Disorders of lipoic acid and iron-sulfur metabolism										
Ferredoxin reductase deficiency	*FDXR*				X		Complexes I - IV activity (muscle), DNA		617717	IEM0203
Frataxin deficiency (Friedreich ataxia)	*FXN*				X		Glucose (S)		229300	IEM0204
Disorders of biotin metabolism										
Biotinidase deficiency	*BTD*				X		Organic acids (U), Acylcarnitines (DBS, P)	Biotin 5-10 mg/day	253260	IEM0227
Disorders of thiamine metabolism										
Thiamine transporter 1 deficiency	*SLC19A2*					X	Lactate (P), Glucose (S)	Thiamine	603941	IEM0229
Disorders of riboflavin metabolism										
Riboflavin transporter 2 deficiency	*SLC52A3*				X		Flavins (B), Organic acids (U), Acylcarnitines (P,DBS)	Riboflavin	211530	IEM0234
Riboflavin transporter 3 deficiency	*SLC52A2*				X		Flavins (B), Organic acids (U), Acylcarnitines (P,DBS)	Riboflavin	614707	IEM0235
Disorders of vitamin D metabolism										
Vitamin D receptor deficiency	*VDR*				X		ALP (P); Calcium (P); Phosphate (P)	Calcitriol, oral calcium, intravenous calcium, cinacalcet	277440	IEM0268
Disorders of copper metabolism										
MEDNIK syndrome	*AP1S1*					X	AST/ALT (P), Copper (S, U), Ceruloplasmin (S), VLCFA (P)		609313	IEM0282
Acetyl-CoA transporter deficiency	*SLC33A1*					X	Copper (S, U), Ceruloplasmin (S)		614482	IEM0283
MEDNIK-like syndrome	*AP1B1*				X		Copper (S), Ceruloplasmin (S), VLCFA (P)		242150	IEM1442
Deficiency of copper chaperone for superoxide dismutase	*CCS*					X	DNA		603864	IEM1443
Disorders of magnesium metabolism										
KCNJ10 deficiency	*KCNJ10*					X	Calcium (P), Magnesium (P), Potassium (P), Aldosterone (P), Renin (P)		600791; 612780	IEM0313
DISORDERS OF CARBOHYDRATES (n=4)										
Disorders of the pentose phosphate pathway and polyol metabolism										
Ribose-5-phosphate isomerase deficiency	*RPIA*					X	Polyols (U, P, CSF)		608611	IEM0328
Disorders of insulin secretion and signaling										
Kabuki syndrome	*KMT2D*	X				X	DNA		147920	IEM1492
Beckwith Wiedemann syndrome	*IGF2;H19;CDKN1C;KCNQ1*		X				Fatty acids and ketones (P, U), Glucose (P)		130650	IEM1513
Glycogen storage diseases										
Alpha-glucosidase deficiency (Pompe disease)	*GAA*				X		ASAT/ALAT (P), CK (P), Glycogen (M)	Avalglucosidase alfa and alglucosidase alfa	232300	IEM0356
MITOCHONDRIAL DISORDERS OF ENERGY METABOLISM (n=67)										
Disorders of pyruvate metabolism										
Pyruvate dehydrogenase kinase isoenzyme 3 superactivity	*PDK3*				X		DNA		300905	IEM0395
Disorders of the Krebs cycle										
Mitochondrial aconitase deficiency	*ACO2*				X		Glucose (P)		614559	IEM0396
ATP-specific succinyl-CoA ligase β subunit deficiency	*SUCLA2*						Organic acids (U), Acylcarnitines (DBS, P), ASAT/ALAT (P), Lactate (P)		612073	IEM0399
GTP-specific succinyl-CoA ligase α subunit deficiency	*SUCLG1*				X		Organic acids (U), Acylcarnitines (DBS, P), ASAT/ALAT (P), Lactate (P)		245400	IEM0400
Disorders of thiamine metabolism										
Alpha-ketoglutarate dehydrogenase deficiency	*OGDH*				X		Fatty acids and ketones (P, U), Glucose (P), Lactate (P)		203740	IEM1137
Disorders of mitochondrial carriers										
Mitochondrial ATP-Mg-phosphate transporter deficiency	*SLC25A24*	X		X	X		DNA		612289	IEM0412
Disorders of complex I assembly										
Acyl-CoA Dehydrogenase 9 deficiency	*ACAD9*					X	Amino acids (P), Organic acids (U), Acylcarnitines (DBS, P), ASAT/ALAT (P), CK (P), Lactate (P), Ammonia (P), Glucose (S)	Riboflavin, sodium pyruvate, beta-blocker, coenzyme Q10	611126	IEM0445
TIMMDC1 deficiency	*TIMMDC1*				X		Lactate (P)		615534	IEM1076
Disorders of complex III subunits										
UQCRFS1 deficiency	*UQCRFS1*				X		DNA		618775	IEM1483
BCS1L deficiency (GRACILE syndrome)	*BCS1L*				X		DNA		603358	IEM0458
Disorders of complex IV subunits										
Cytochrome c oxidase subunit 6A1 deficiency	*COX6A1*					X	DNA		616039	IEM0466
Disorders of complex IV assembly and ancillary proteins										
APOPT1 deficiency	*APOPT1*					X	DNA		220110	IEM0480
CEP89 deficiency	*CEP89*				X		Lactate (P), Amino acids (P)		615470	IEM1150
Cytochrome c oxidase assembly factor 16 deficiency	*COX16*				X		Organic acids (U), Acylcarnitines (DBS, P), Lactate (P), Glucose (P)		618064	IEM1514
Disorders of complex V subunits										
Mitochondrial ATP synthase F0 subunit 6 deficiency	*MT-ATP6*				X		Lactate (P)		516060	IEM0484
Disorders of mitochondrial cytochrome synthesis and incorporation										

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Mitochondrial cytochrome b deficiency	*MT-CYB*				X		Lactate (P), Organic acids (U), Acylcarnitines (P,DBS)		516020	IEM0487
Holocytochrome c synthase deficiency	*HCCS*				X		Lactate (P)		309801	IEM0490
Disorders of mitochondrial DNA depletion, multiple deletion, or intergenomic communication										
Mitochondrial DNA polymerase gamma catalytic subunit deficiency	*POLG*					X	Lactate (P), Organic acids (U), ASAT/ALAT (P)		607459	IEM0491
Mitochondrial DNA polymerase gamma catalytic subunit deficiency	*POLG*					X	Lactate (P), Organic acids (U), ASAT/ALAT (P)		613662	IEM0491
TWINKLE mitochondrial DNA helicase deficiency	*TWNK*					X	DNA		271245; 616138	IEM0495
Mitochondrial ribonucleotide reductase subunit 2 deficiency	*RRM2B*					X	Lactate (P), Amino acids (P)		604712	IEM0497
Topoisomerase 3α deficiency	*TOP3A*				X		DNA		618098	IEM1073
Single-stranded DNA-binding protein 1 deficiency	*SSBP1*					X	DNA		165510	IEM1533
Disorders of mitochondrial transcription and RNA transcript processing										
Mitochondrial RNA import protein deficiency	*PNPT1*					X	Lactate (P)		614932; 614934	IEM0503
Ribonuclease P 5' tRNA processing enzyme deficiency	*TRMT10C*				X		Lactate (P)		616974	IEM0504
Mitochondrial ribosomopathies										
Mitochondrial ribosomal large subunit 3 deficiency	*MRPL3*				X		Lactate (P), Ammonia (P)		614582	IEM0516
Mitochondrial ribosomal small subunit 2 deficiency	*MRPS2*				X		Lactate (P)			IEM0518
Mitochondrial ribosomal RNA 12S deficiency	*MT-RNR1*					X	Lactate (P)		580000	IEM0522
ERAL1 deficiency	*ERAL1*				X		Follicle-stimulating hormone (P), Luteinizing hormone (P), Estradiol (P)		617565	IEM1079
Mitochondrial ribosomal small subunit 7 deficiency	*MRPS7*				X		Lactate (P), Glucose (P)		617872	IEM1156
Mitochondrial ribosomal small subunit 28 deficiency	*MRPS28*				X		Lactate (P), Organic acids (U)		611990	IEM1211
Mitochondrial ribosomal small subunit 39 deficiency	*PTCD3*					X	Lactate (P)		619057	IEM1540
Disorders of mitochondrial translation factors										
RMND1 deficiency	*RMND1*					X	Lactate (P)		614922	IEM0524
Disorders of mitochondrial tRNA										
Mitochondrial tRNA(Cys) deficiency	*MT-TC*				X		Lactate (P)		590020	IEM0534
Mitochondrial tRNA(Gln) deficiency	*MT-TQ*				X		Lactate (P)		590030	IEM0536
Mitochondrial tRNA(His) deficiency	*MT-TH*				X		Lactate (P)		590040	IEM0538
Mitochondrial tRNA(Leu) 1 deficiency	*MT-TL1*					X	Lactate (P)		590050	IEM0540
Mitochondrial tRNA(Lys) deficiency	*MT-TK*					X	Lactate (P)		590060	IEM0542
Mitochondrial tRNA(Ser) 1 deficiency	*MT-TS1*				X		Lactate (P)		590080	IEM0546
Mitochondrial tRNA(Trp) deficiency	*MT-TW*					X	Lactate (P)		590095	IEM0549
Mitochondrial tRNA(Tyr) deficiency	*MT-TY*				X		Lactate (P)		590100	IEM0550
Mitochondrial tRNA(Val) deficiency	*MT-TV*					X	Lactate (P)		590105	IEM0551
Disorders of mitochondrial tRNA incorporation and recycling										
Mitochondrial cysteinyl-tRNA synthetase deficiency	*CARS2*				X		Lactate (P)		616672	IEM0556
Mitochondrial histidyl-tRNA synthetase deficiency	*HARS2*				X		Lactate (P)		614926	IEM0558
Mitochondrial isoleucyl-tRNA synthetase deficiency	*IARS2*				X		Lactate (P)		616007	IEM0559
Mitochondrial leucyl-tRNA synthetase deficiency	*LARS2*					X	Lactate (P)		615300	IEM0560
Mitochondrial and cytoplasmic lysyl-tRNA synthetase deficiency	*KARS*					X	DNA		613916	IEM0568
Peptidyl-tRNA hydrolase 2 deficiency	*PTRH2*					X	DNA		616263	IEM0571
Disorders of mitochondrial fission										
UGO-1 like protein deficiency	*SLC25A46*					X	Lactate (P), Organic acids (U)		616505	IEM0576
OPA1 deficiency	*OPA1*					X	Lactate (P)		125250	IEM0577
OPA3 deficiency (Costeff syndrome)	*OPA3*					X	Organic acids (U), 3-Methylglutaric acid (U)		258501	IEM0578
Mitofusin 2 deficiency	*MFN2*				X		DNA		609260; 617087	IEM0579
SPATA5 deficiency	*SPATA5*				X		DNA		616577	IEM1380
Disorders of mitochondrial phospholipid metabolism										
SERAC1 deficiency (MEGDEL Syndrome)	*SERAC1*				X		Lactate (P); Organic acids (U); Filipin staining		614739	IEM0582
Phosphatidylserine decarboxylase deficiency	*PISD*				X		DNA		612770	IEM1098
Disorders of mitochondrial protein import										
Mohr-Tranebjaerg syndrome	*TIMM8A*				X		DNA		304700	IEM0586
GFER deficiency	*GFER*				X		Lactate (P), Ferritin (S)		613076	IEM0589
Disorders of mitochondrial protein quality control										
Mitochondrial processing peptidase alpha deficiency	*PMPCA*				X		DNA		213200	IEM0591
CLPP deficiency (Perrault syndrome type 3)	*CLPP*				X		DNA		614129	IEM0595
LONP1 deficiency	*LONP1*					X	DNA		600373	IEM0596
HSPA9 deficiency	*HSPA9*	X					Bone marrow stain; DNA		182170	IEM0597
Other disorders of mitochondrial homeostasis										
CHCHD10 deficiency	*CHCHD10*				X		CK (P)		615911; 615048	IEM1081
DIABLO deficiency	*DIABLO*				X		DNA			IEM1263
Primary CoQ10 deficiencies										
Prenyl diphosphate synthase subunit 1 deficiency	*PDSS1*					X	DNA	CoQ10 supplementation	607429; 607426	IEM0618
Coenzyme Q2 polyprenyltranferase deficiency	*COQ2*					X	Lactate (P), CoQ10 (M, P, WBC)	CoQ10 supplementation	609825; 607426	IEM0620
Coenzyme Q6 monooxygenase deficiency	*COQ6*				X		Lactate (P), CoQ10 (M, P, WBC)	CoQ10 supplementation	614650	IEM0622
Coenzyme Q7 hydroxylase deficiency	*COQ7*				X		Lactate (P), CoQ10 (M, P, WBC)	CoQ10 supplementation	616733	IEM0623
DISORDERS OF LIPIDS (n=22)										
Disorders of fatty acid synthesis and elongation										
Very long-chain fatty acid elongase 1 deficiency	*ELOVL1*				X		DNA		611813	IEM0647
Very long-chain fatty acid elongase 5 deficiency	*ELOVL5*					X	Arachidonic acid (P), Docosahexaenoic acid (S)		615957	IEM0650
Disorders of non-mitochondrial phospholipid metabolism										
Phosphatidylserine synthase 1 superactivity (Lenz-Majewski syndrome)	*PTDSS1*	X			X		DNA		151050	IEM0667
Phosphatidylserine flippase deficiency	*ATP8A2*				X	X	DNA		615268	IEM0668
Phospholipid flippase deficiency	*ATP11A*				X				619810	IEM1937
ABHD12 deficiency (PHARC syndrome)	*ABHD12*				X		DNA		612674	IEM0674
Disorders of non-lysosomal sphingolipid metabolism										
Sphingosine-1-phosphate lyase deficiency	*SGPL1*				X		ACTH (P); Glucose (P); Triglycerides (S); Albumin (U)	Hydrocortisone, kidney transplant	617575	IEM0682
Alkaline ceramidase 3 deficiency	*ACER3*	X					C(18:1)- and C(20:1)-ceramides (P)		617762	IEM1178
Sphingosine-1-phosphate transporter deficiency	*SPNS2*				X		DNA			IEM1546
Disorders of palmitoylation										
ZDHHC9 palmitoyltransferase deficiency	*ZDHHC9*	X					DNA		300799	IEM0687
Porcupine palmitoyltransferase deficiency (Goltz syndrome)	*PORCN*	X				X	DNA		305600	IEM0688
Disorders of phosphoinositide metabolism										
Phosphatidylinositol 3,5-bisphosphate-5-phosphatase deficiency, neuroskeletal phenotype	*FIG4*	X				X	DNA		216340	IEM0690
Myotubularin-related protein 2 regulatory protein deficiency	*SBF2*						DNA		604563	IEM0696
Phosphatidylinositol 3,4,5-trisphosphate 3-phosphatase deficiency	*PTEN*						DNA			IEM0704
Phosphatidylinositol 4,5-bisphosphate phospholipase C β4 deficiency	*PLCB4*	X					DNA		614669	IEM0708
Phosphatidylinositol 4-kinase type 2-alpha deficiency	*PI4K2A*	X					ASAT/ALAT (P); GGT (P); Amino acids (P); Lactate (P,U)		609763	IEM1253
Disorders of cholesterol biosynthesis										
Chondrodysplasia punctata 2, recessive (Conradi-Hünermann syndrome)	*EBP*	X					Sterols (P)		302960	IEM0749
Smith-Lemli-Opitz syndrome	*DHCR7*				X		ASAT/ALAT (P), Lipid panel (S), 7/8-Dehydrocholesterol (P)	Dietary supplementation of cholesterol 25-300 mg/kg/day, +/- bile acids	270400	IEM0753
Geranylgeranyl pyrophosphate synthase deficiency	*GGPS1*				X		CK (P)		606982	IEM1185
Disorders of steroid metabolism										
Cytochrome P450 oxidoreductase deficiency (Antley-Bixler syndrome)	*POR*	X					Steroids (P, U)	Hydrocortisone	201750	IEM0760
Disorders of bilirubin metabolism and biliary transport										
UDP-glucuronosyltransferase A1 deficiency	*UGT1A1*					X	Bilirubin (P)		218800; 606785	IEM0802
ATP8B1 deficiency (Byler disease)	*ATP8B1*				X		Bile acids (S), Chloride (sweat)		211600	IEM0805

Name	Gene	Congenital external ear abnormalities	Acquired external ear abnormalities	Middle ear involvement	Inner ear or retrocochlear involvement	Unspecific hearing loss	Laboratory investigations	Specific treatment	OMIM no.	IEMbase ID
STORAGE DISORDERS (n=26)										
Disorders of autophagy										
EPG5 deficiency (Vici syndrome)	*EPG5*	X			X		DNA		242840	IEM0811
SQSTM1 deficiency	*SQSTM1*					X	DNA		167250	IEM1228
ATG7 deficiency	*ATG7*				X		DNA		619422	IEM1677
Sphingolipidoses										
Acid sphingomyelinase deficiency (Niemann-Pick type A)	*SMPD1*					X	Enzyme activity (WBC)	Phototherapy, plasmapheresis, enzyme-inducing agents, bilirubin-binding agents (calcium phosphate, orlistat), choleretics (ursodeoxycholic acid), heme-oxygenase inhibitors (Tin-protoporphyrin, Zinc-protoporphyrin), liver transplantation	257200; 607616	IEM0834
Beta-galactosylceramidase deficiency (Krabbe disease)	*GALC*					X	Protein (CSF), Lysogalactosylceramide (S)		245200	IEM0839
Krabbe disease-like disorder due to saposin A deficiency	*PSAP*					X	Sulfatides (U), Protein (CSF), Lysosomal enzymes (DBS)		611722	IEM0833
Alpha-galactosidase A deficiency (Fabry disease)	*GLA*				X		Globotriaosylsphingosine, Globotriaosylceramide, Proteins (U)	Agalsidase alfa enzyme replacement	301500	IEM0844
Acid ceramidase deficiency, primary neurologic phenotype (Farber disease)	*ASAH1*					X	DNA		228000	IEM0845
Oligosaccharidoses										
Alpha-neuraminidase deficiency	*NEU1*					X	Enzyme activity (WBC), Oligosaccharides (U)		256550	IEM0848
Alpha-mannosidase B deficiency	*MAN2B1*				X		Oligosaccharides (U); Enzyme assay (DBS, L, F)	Recombinant enzyme replacement therapy (velmanase alfa); HCT	248500	IEM0850
Beta-mannosidase deficiency	*MANBA*					X	Enzyme activity (DBS,WBC), Oligosaccharides (U)		248510	IEM0851
Alpha-N-acetylgalactosaminidase deficiency (Schindler disease type I)	*NAGA*					X	Oligosaccharides (U), Lysosomal enzymes (DBS)		609241	IEM0852
Alpha-L-fucosidase deficiency	*FUCA1*					X	Enzyme activity (DBS,WBC), Fucose (U)	Bone marrow transplant	230000	IEM0853
Mucolipidoses										
UDP-N-acetylglucosamine-1-phosphotransferase subunit alpha/beta deficiency	*GNPTAB*			X			Oligosaccharide (U), Glycosaminoglycans, Enzyme activity (S)		252500	IEM0855
UDP-N-acetylglucosamine-1-phosphotransferase subunit gamma deficiency (Pseudo-Hurler)	*GNPTG*			X			Oligosaccharide (U), Glycosaminoglycans, Enzyme activity (S)		252605	IEM0856
Mucopolysaccharidoses										
Alpha-iduronidase deficiency (Hurler syndrome)	*IDUA*			X		X	Total GAGs (U), Dermatan sulfate (U), Heparan sulfate (U), Enzyme activity (WBC)	Hematopoietic cell transplantation (HCT), enzyme replacement therapy (laronidase)	607014; 607015; 607016	IEM0858
Iduronate 2-sulfatase deficiency (Hunter disease)	*IDS*			X		X	Total GAGs (U), Dermatan sulfate (U), Heparan sulfate (U), Enzyme activity (WBC)	Enzyme replacement therapy (idursulfase)	309900	IEM0859
Heparan N-sulfatase deficiency (Sanfilippo A disease)	*SGSH*					X	Mucopolysaccharides (U); Enzyme assay (DBS, L, F)	Clinical trial with intracerebroventricular infusion of chimeric fusion of recombinant enzyme +IGF2	252900	IEM0860
N-acetylglucosaminidase deficiency (Sanfilippo B disease)	*NAGLU*					X	Mucopolysaccharides (U); Enzyme assay (DBS, S, F)	Clinical trial with intracerebral adenovirus associated viral vector containing human NAGLU cDNA	252920	IEM0861
Heparan-alpha-glucosaminide N-acetyltransferase deficiency (Sanfilippo syndrome type C)	*HGSNAT*					X	Mucopolysaccharides (U); Enzyme assay (DBS, L, F)		252930	IEM0862
N-acetylglucosamine 6-sulfatase deficiency (Sanfilippo D disease)	*GNS*					X	Mucopolysaccharides (U); Enzyme assay (DBS, L, F)		252940	IEM0863
N-acetylgalactosamine 6-sulfatase deficiency (Morquio A disease)	*GALNS*					X	Total GAGs (U), Keratan sulfate (U), Enzyme activity (WBC)	Elosulfase	253000	IEM0864
Beta-galactosidase deficiency, GM1 gangliosidosis phenotype	*GLB1*					X	Oligosaccharides (U), Lysosomal enzymes (DBS)	In trial gene therapy (NCT03952637)	253010	IEM0835
N-acetylgalactosamine 4-sulfatase deficiency (MPS6)	*ARSB*			X			Total GAGs (U), Dermatan sulfate (U), Enzyme activity (WBC)	Enzyme replacement therapy (galsulfase)	253200	IEM0866
N-acetylgalactosamine 4-sulfatase deficiency (MPS6)	*ARSB*					X	Total GAGs (U), Dermatan sulfate (U), Enzyme activity (WBC)	Enzyme replacement therapy (galsulfase)	253200	IEM0866
Arylsulfatase G deficiency (Usher syndrome)	*ARSG*				X		DNA		618144	IEM1060
DISORDERS OF PEROXISOMES (n=22)										
Disorders of plasmalogen synthesis										
Peroxisomal targeting signal 2 receptor deficiency	*PEX7*					X	Plasmalogens (RBC)		215100	IEM0878
Glycerone 3-phosphate acyltransferase deficiency	*GNPAT*				X		Plasmalogens (RBC)		602744	IEM0879
Alkylglycerone 3-phosphate synthase deficiency	*AGPS*				X		Plasmalogens (RBC)		600121	IEM0880
Fatty Acyl-CoA reductase 1deficiency	*FAR1*	X					Plasmalogens (RBC)		616154	IEM0881
Disorders of peroxisomal β-oxidation										
X-linked adrenoleukodystrophy and adrenomyeloneuropathy	*ABCD1*				X		VLCFA (P)	HCT at early stages of cerebral X-ALD; HSC gene therapy with lentiviral vector	300100	IEM0883
Peroxisomal straight-chain acyl-CoA oxidase deficiency	*ACOX1*				X		VLCFA (P), Plasmalogens (P)		264470	IEM0884
D-bifunctional protein deficiency (Pseudo-Zellweger syndrome, severe)	*HSD17B4*				X		VLCFA (P), Plasmalogens (P), Organic acids (U)		261515	IEM0885
Phytanoyl-CoA hydroxylase deficiency (Refsum disease)	*PHYH*					X	Pipecolic acid (P, U), Phytanic acid (S, U), Protein (CSF)	Phytanic acid restriction	266500	IEM0888
Acyl-CoA-binding domain-containing protein 5 deficiency	*ACBD5*	X					VLCFA (P), Pipecolic acid (P)		616618	IEM1191
Disorders of peroxisomal biogenesis										
Peroxin 1 deficiency (Zellweger)	*PEX1*				X		VLCFA (P), Pipecolic acid (P)		234580; 214100; 601539	IEM0889
Peroxin 2 deficiency (Zellweger)	*PEX2*				X		VLCFA (P), Pipecolic acid (P)		614866; 614867	IEM0890
Peroxin 3 deficiency (Zellweger)	*PEX3*				X		VLCFA (P), Pipecolic acid (P)		617370; 614882	IEM0891
Peroxin 5 deficiency (Zellweger)	*PEX5*				X		Plasmalogens (RBC)		214110	IEM0882
Peroxin 6 deficiency (Zellweger)	*PEX6*				X		VLCFA (P), Pipecolic acid (P)		614862; 614863; 616617	IEM0893
Peroxin 10 deficiency (Zellweger)	*PEX10*				X		VLCFA (P), Pipecolic acid (P)		614870; 614871	IEM0894
Peroxin 14B deficiency (Zellweger)	*PEX11B*				X		VLCFA (P), Pipecolic acid (P)		614920	IEM0895
Peroxin 12 deficiency (Zellweger)	*PEX12*				X		VLCFA (P), Pipecolic acid (P)		614859; 266510	IEM0896
Peroxin 13 deficiency (Zellweger)	*PEX13*				X		VLCFA (P), Pipecolic acid (P)		614883; 614885	IEM0897
Peroxin 14 deficiency (Zellweger)	*PEX14*				X		VLCFA (P), Pipecolic acid (P)		614887	IEM0898
Peroxin 16 deficiency (Zellweger)	*PEX16*				X		VLCFA (P), Pipecolic acid (P)		614876; 614877	IEM0899
Peroxin 19 deficiency (Zellweger)	*PEX19*				X		VLCFA (P), Pipecolic acid (P)		614886	IEM0900
Peroxin 26 deficiency (Zellweger)	*PEX26*				X		VLCFA (P), Pipecolic acid (P)		614872; 614873	IEM0901
CONGENITAL DISORDERS OF GLYCOSYLATION (n=28)										
Disorders of N-linked glycosylation										
ALG11-CDG	*ALG11*				X		Sialotransferrins (S), Factor XI (B), Antithrombin III (P)		613661	IEM0916
RFT1-CDG	*RFT1*				X		Sialotransferins (S), ASAT/ALAT (P), coagulation factors (P)		612015	IEM0917
ALG12-CDG	*ALG12*				X		ASAT/ALAT (P), Glucose (S), Lipid panel (S), Sialotransferrins (S), IGF BP3 ,		607143	IEM0920
MGAT2-CDG	*MGAT2*	X				X	ASAT/ALAT (P), CK (P), Sialotransferrins (S), Factor IX and XII (B), Antithrombin III (P)		212066	IEM0931
DDOST-CDG	*DDOST*			X			Sialotransferrins (S), Factor XI (B), Antithrombin III (P), Proteins C and S (S)		614507; 602202	IEM1192
SSR3-CDG	*SSR3*				X		DNA		606213	IEM1548
Disorders of O-mannosylation										
POMK-CDG	*POMK*				X		CK (P), DNA		616094; 615249	IEM0938
Disorders of O-xylosylation and glycosaminoglycan synthesis										
XYLT2-CDG	*XYLT2*					X	DNA		605822	IEM0946
CHSY1-CDG	*CHSY1*				X		DNA		605282	IEM0953
CHST3-CDG	*CHST3*					X	DNA		143095	IEM0954
HS6ST1-CDG	*HS6ST1*	X			X		Gonadotropins (P), Testosterone (P)		614880	IEM1042
Sulfate transporter deficiency	*SLC26A2*	X	X				DNA		222600	IEM0960
Golgi-resident phosphoadenosine phosphate phosphatase deficiency	*IMPAD1*						DNA		614078	IEM0962
Disorders of O-fucosylation										
B3GALTL-CDG	*B3GLCT*					X	Sialotransferrins (S)		261540	IEM0970
Disorders of glycosylphosphatidylinositol biosynthesis										

Name	Gene	Congenital external ear abnormalities	Acquired external ear abnormalities	Middle ear involvement	Inner ear or retrocochlear involvement	Unspecific hearing loss	Laboratory investigations	Specific treatment	OMIM no.	IEMbase ID
PIGL-CDG	*PIGL*					X	ALP (P), GPI-anchored proteins (WBC, F)		280000	IEM0975
PIGV-CDG	*PIGV*				X		ALP (P), GPI-anchored proteins (WBC, F)		239300	IEM0978
PGAP2-CDG	*PGAP2*				X		ALP (P), GPI-anchored proteins (WBC, F)		614207	IEM0986
PIGB-CDG	*PIGB*					X	ALP (P), GPI-anchored proteins (WBC, F)		604122	IEM1092
PIGY-CDG	*PIGY*	X					Sialotransferins (S), ALP (P)		239300	IEM1198
Disorders of glycolipid glycosylation										
ST3GAL5-CDG (Amish infantile epilepsy)	*ST3GAL5*				X		GM3 (P)		609056	IEM0987
Disorders of monosaccharide synthesis and interconversion										
N-acetylneuraminate pyruvate lyase deficiency	*NPL*				X		Sialic acid, free (U)		611412	IEM1212
Disorders of nucleotide-sugar synthesis										
GMPPA-CDG	*GMPPA*				X		Sialotransferrins (S)		615510	IEM1006
Disorders of vesicular trafficking										
Conserved oligomeric Golgi complex subunit 1 deficiency (COG1-CDG)	*COG1*			X			Sialotransferrins (S)		611209	IEM1013
Conserved oligomeric Golgi complex subunit 5 deficiency (COG5-CDG)	*COG5*					X	Sialotransferins (S)		613612	IEM1015
TRAPPC12 deficiency	*TRAPPC12*					X	DNA		617669	IEM1412
SCYL1-binding protein deficiency	*GORAB*	X					DNA		231070	IEM1418
AP4E1deficiency	*AP4E1*	X					DNA		607244	IEM1235
Carpenter syndrome	*RAB23*					X	DNA		201000	IEM1436
METABOLISM OF HETEROCYCLIC COMPOUNDS (n=13)										
Disorders of non-mitochondrial tRNA processing and aminoacyl-tRNA synthetases										
Galloway-Mowat syndrome, YRDC type	*YRDC*				X		DNA		612276	IEM1293
Galloway-Mowat syndrome, GON7 type	*GON7*				X		DNA		617436	IEM1294
Pseudouridine synthase 3 deficiency	*PUS3*				X		DNA		617051	IEM1299
Histidyl-tRNA synthetase 1 deficiency	*HARS1*					X	DNA		614504	IEM1308
Isoleucyl-tRNA synthetase 1 deficiency	*IARS1*				X		DNA	Isoleucine supplementation and protein fortification	617093	IEM1309
Mitochondrial and cytoplasmic lysyl-tRNA synthetase deficiency	*KARS1*					X	DNA		613641; 613916	IEM1311
Disorders of ribosomal biogenesis										
Treacher Collins syndrome type 1	*TCOF1*			X			DNA		154500	IEM1322
Treacher Collins syndrome type 2	*POLR1D*			X			DNA		613717	IEM1323
Treacher Collins syndrome type 4	*POLR1B*	X	X	X			DNA		618939	IEM1325
Acrofacial dysostosis, Cincinnati type	*POLR1A*			X			DNA		616462	IEM1326
Diamond-Blackfan anemia type 14	*TSR2*					X	Reticulocytes (B)	Corticosteroids, red blood cell transfusion, hematopoietic stem cell transplantation (HSCT) - bone marrow transplant	300946	IEM1355
Diamond-Blackfan anemia type 15	*RPS28*					X	Reticulocytes (B)	Corticosteroids, red blood cell transfusion, hematopoietic stem cell transplantation (HSCT) - bone marrow transplant	606164	IEM1356
Cytosolic small ribosomal subunit 23 deficiency	*RPS23*	X					Glucose (P)		617412	IEM1366
MISCELLANEOUS (n=6)										
Disorders of organelle interplay										
Arthrogryposis-renal dysfunction-cholestasis syndrome type 1	*VPS33B*				X		DNA		208085	IEM1381
Hypomyelinating leukodystrophy type 12	*VPS11*					X	Monohexosylceramides (U), Tetrahexosylceramides (U), Sulfatide (U)		616683	IEM1227
Disorders of choline neurotransmission										
BAP31 deficiency	*BCAP31*					X	DNA		300475	IEM1398
Disorders of the synaptic vesicle cycle										
TBC1D24 deficiency	*TBC1D24*					X	DNA		614617; 616044	IEM1453
Miscellaneous										
X-Linked hypophosphatemia	*PHEX*				X		Alkaline phosphatase (P), Phosphate (P)	Burosumab, phosphate supplements, calcitriol	307800	IEM1495
Maternally Inherited Deafness and Diabetes (Ballinger-Wallace Syndrome)	*MT-TL1, MT-TE, MT-TK*				X		Glucose (P)		520000	IEM1504
Abbreviations										
ALAT: alanine aminotransferase										
ALP: alkaline phosphatase										
ASAT: aspartate aminotransferase										
CK: creatine kinase										
CoQ10: cofactor Q10										
CSF: cerebrospinal fluid										
DBS: dried blood spot										
GAGs: glycosaminoglycans										
P: plasma										
S: serum										
SAH: S-adenosyl-homocysteine										
SAM: S-adenosyl-methionine										
U: urine										
VLCFA: very-long chain fatty acids										
WBC: white blood cells										