

Lab notebook

KBC

4/5/2021

2021-04-05 report

Utility functions

Opposites already manually paired

Bill can explain where these came from better than I can.

```
## Warning: package 'ggVennDiagram' was built under R version 4.0.2
```

```
## Warning: package 'tidyverse' was built under R version 4.0.2
```

```
## -- Attaching packages -----
```

```
## v ggplot2 3.3.2      v purrr  0.3.4
## v tibble  3.0.1      v dplyr  1.0.4
## v tidyr   1.1.1      v stringr 1.4.0
## v readr   1.4.0      v forcats 0.5.1
```

```
## Warning: package 'ggplot2' was built under R version 4.0.2
```

```
## Warning: package 'tidyr' was built under R version 4.0.2
```

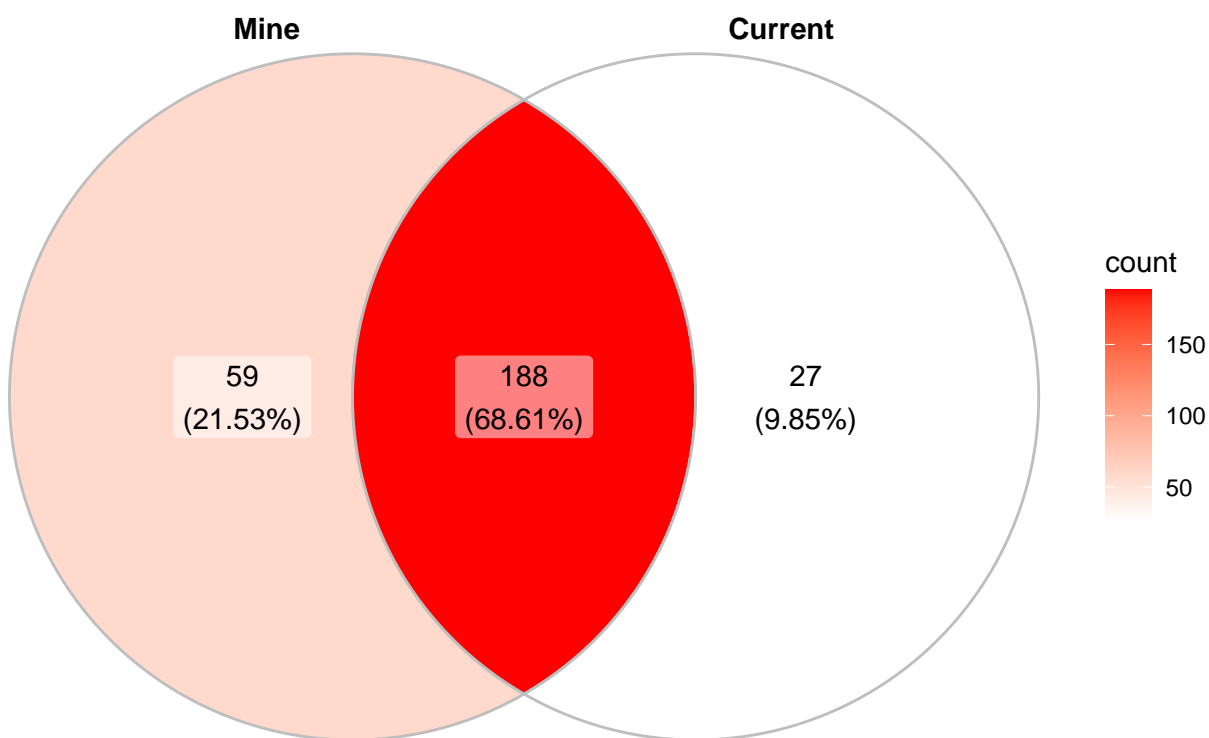
```
## Warning: package 'readr' was built under R version 4.0.2
```

```
## Warning: package 'dplyr' was built under R version 4.0.2
```

```
## Warning: package 'forcats' was built under R version 4.0.2
```

```
## -- Conflicts -----
```

```
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```



```
## [1] "IN BOTH MINE AND THE CURRENT PAIRS:"

## [1] "abnormal" "normal"
## [1] "absent" "present"
## [1] "active" "inactive"
## [1] "acute" "chronic"
## [1] "adhesive" "non-adhesive"
## [1] "aerobic" "anaerobic"
## [1] "aerobic (for occurrence)" "anaerobic (for occurrence)"
## [1] "aligned with" "misaligned with"
## [1] "aromatic" "non-aromatic"
## [1] "arrhythmic" "rhythmic"
## [1] "asynchronous" "synchronous"
## [1] "back" "front"
## [1] "balanced" "unbalanced"
## [1] "branched" "unbranched"
## [1] "closed" "open"
## [1] "coiled" "uncoiled"
## [1] "colored" "discolored"
## [1] "compatible" "incompatible"
## [1] "complete structure" "incomplete structure"
## [1] "condensed" "decondensed"
## [1] "conspicuous" "inconspicuous"
## [1] "continuous" "discontinuous"
## [1] "contractile" "non-contractile"
```

```

## [1] "coordinated" "uncoordinated"
## [1] "crowded" "uncrowded"
## [1] "damaged" "undamaged"
## [1] "decreased accumulation" "increased accumulation"
## [1] "decreased acidity" "increased acidity"
## [1] "decreased adhesivity" "increased adhesivity"
## [1] "decreased affinity" "increased affinity"
## [1] "decreased age" "increased age"
## [1] "decreased amount" "increased amount"
## [1] "decreased angle to" "increased angle to"
## [1] "decreased anterior-posterior diameter"
## [2] "increased anterior-posterior diameter"
## [1] "decreased area" "increased area"
## [1] "decreased avidity" "increased avidity"
## [1] "decreased behavioural activity" "increased behavioural activity"
## [1] "decreased branchiness" "increased branchiness"
## [1] "decreased cellular motility" "increased cellular motility"
## [1] "decreased circumference" "increased circumference"
## [1] "decreased coiling" "increased coiling"
## [1] "decreased combustibility" "increased combustibility"
## [1] "decreased concentration" "increased concentration"
## [1] "decreased contractility" "increased contractility"
## [1] "decreased coordination" "increased coordination"
## [1] "decreased curvature" "increased curvature"
## [1] "decreased degree of illumination" "increased degree of illumination"
## [1] "decreased depth" "increased depth"
## [1] "decreased diameter" "increased diameter"
## [1] "decreased distance" "increased distance"
## [1] "decreased distribution" "increased distribution"
## [1] "decreased duration" "increased duration"
## [1] "decreased duration of temperature" "increased duration of temperature"
## [1] "decreased efficacy" "increased efficacy"
## [1] "decreased efficiency" "increased efficiency"
## [1] "decreased elasticity" "increased elasticity"
## [1] "decreased elevation" "increased elevation"
## [1] "decreased fatigability" "increased fatigability"
## [1] "decreased fecundity" "increased fecundity"
## [1] "decreased female fertility" "increased female fertility"
## [1] "decreased female receptivity" "increased female receptivity"
## [1] "decreased fertility" "increased fertility"
## [1] "decreased flexibility" "increased flexibility"
## [1] "decreased fluid flow" "increased fluid flow"
## [1] "decreased fluorescence" "increased fluorescence"
## [1] "decreased force" "increased force"
## [1] "decreased fragility" "increased fragility"
## [1] "decreased frequency" "increased frequency"
## [1] "decreased functionality" "increased functionality"
## [1] "decreased height" "increased height"
## [1] "decreased humidity" "increased humidity"
## [1] "decreased intensity" "increased intensity"
## [1] "decreased length" "increased length"
## [1] "decreased life span" "increased life span"
## [1] "decreased magnetism" "increased magnetism"
## [1] "decreased magnitude" "increased magnitude"

```

```

## [1] "decreased male fertility" "increased male fertility"
## [1] "decreased male receptivity" "increased male receptivity"
## [1] "decreased mass" "increased mass"
## [1] "decreased mass density" "increased mass density"
## [1] "decreased mobility" "increased mobility"
## [1] "decreased object quality" "increased object quality"
## [1] "decreased occurrence" "increased occurrence"
## [1] "decreased odor" "increased odor"
## [1] "decreased osmolality" "increased osmolality"
## [1] "decreased osmolarity" "increased osmolarity"
## [1] "decreased perimeter" "increased perimeter"
## [1] "decreased permeability" "increased permeability"
## [1] "decreased phosphorylation" "increased phosphorylation"
## [1] "decreased photosensitivity" "increased photosensitivity"
## [1] "decreased pigmentation" "increased pigmentation"
## [1] "decreased porosity" "increased porosity"
## [1] "decreased position" "increased position"
## [1] "decreased pressure" "increased pressure"
## [1] "decreased process quality" "increased process quality"
## [1] "decreased quality" "increased quality"
## [1] "decreased radioactivity" "increased radioactivity"
## [1] "decreased radiopacity" "increased radiopacity"
## [1] "decreased rate" "increased rate"
## [1] "decreased resistance to" "increased resistance to"
## [1] "decreased sensitivity of a process" "increased sensitivity of a process"
## [1] "decreased sensitivity of a process to oxygen"
## [2] "increased sensitivity of a process to oxygen"
## [1] "decreased sensitivity to irradiation"
## [2] "increased sensitivity to irradiation"
## [1] "decreased sensitivity toward" "increased sensitivity toward"
## [1] "decreased size" "increased size"
## [1] "decreased solubility" "increased solubility"
## [1] "decreased speed" "increased speed"
## [1] "decreased stability" "increased stability"
## [1] "decreased strength" "increased strength"
## [1] "decreased susceptibility toward" "increased susceptibility toward"
## [1] "decreased temperature" "increased temperature"
## [1] "decreased tendency" "increased tendency"
## [1] "decreased thickness" "increased thickness"
## [1] "decreased threshold" "increased threshold"
## [1] "decreased tolerance to" "increased tolerance to"
## [1] "decreased tonicity" "increased tonicity"
## [1] "decreased turgor" "increased turgor"
## [1] "decreased variability" "increased variability"
## [1] "decreased variability of color" "increased variability of color"
## [1] "decreased variability of rate" "increased variability of rate"
## [1] "decreased variability of size" "increased variability of size"
## [1] "decreased variability of temperature"
## [2] "increased variability of temperature"
## [1] "decreased velocity" "increased velocity"
## [1] "decreased viscosity" "increased viscosity"
## [1] "decreased volume" "increased volume"
## [1] "decreased waxiness" "increased waxiness"
## [1] "decreased weight" "increased weight"

```

```

## [1] "decreased wetness" "increased wetness"
## [1] "decreased width" "increased width"
## [1] "decreased width and length" "increased width and length"
## [1] "defasciculated" "fasciculated"
## [1] "degenerate" "non-degenerate"
## [1] "dephosphorylated" "phosphorylated"
## [1] "differentiated" "undifferentiated"
## [1] "discriminate" "indiscriminate"
## [1] "disorganized" "organized"
## [1] "disoriented" "oriented"
## [1] "distributed" "undistributed"
## [1] "down" "up"
## [1] "dry" "wet"
## [1] "edible" "inedible"
## [1] "efficient" "inefficient"
## [1] "elastic" "inelastic"
## [1] "elongated" "shortened"
## [1] "female fertile" "female sterile"
## [1] "female semi-fertile" "female semi-sterile"
## [1] "fertile" "sterile"
## [1] "flexible" "inflexible"
## [1] "fragile" "non-fragile"
## [1] "functional" "non-functional"
## [1] "hard" "soft"
## [1] "high brightness" "low brightness"
## [1] "high saturation" "low saturation"
## [1] "immature" "mature"
## [1] "immobile" "mobile"
## [1] "imperforate" "perforate"
## [1] "impermeable" "permeable"
## [1] "inflated" "uninflated"
## [1] "insensitive toward" "sensitive toward"
## [1] "insoluble in" "soluble in"
## [1] "insufficient" "sufficient"
## [1] "insusceptible toward" "susceptible toward"
## [1] "invariant" "variant"
## [1] "invariant color" "variant color"
## [1] "invariant shape" "variant shape"
## [1] "invariant temperature" "variant temperature"
## [1] "irregular duration" "regular duration"
## [1] "irregular sleep pattern" "regular sleep pattern"
## [1] "irregular spatial pattern" "regular spatial pattern"
## [1] "lumenized" "unlumenized"
## [1] "magnetic" "non-magnetic"
## [1] "male fertile" "male sterile"
## [1] "male semi-fertile" "male semi-sterile"
## [1] "necessary (continuant)" "unnecessary (continuant)"
## [1] "necessary (occurrent)" "unnecessary (occurrent)"
## [1] "negative charge" "positive charge"
## [1] "non-porous" "porous"
## [1] "non-potable" "potable"
## [1] "non-progressive" "progressive"
## [1] "old" "young"
## [1] "opaque" "transparent"

```

```

## [1] "ornamented" "unornamented"
## [1] "pigmented" "unpigmented"
## [1] "responsive to" "unresponsive to"
## [1] "rough" "smooth"
## [1] "serrated" "unserrated"
## [1] "stratified" "unstratified"
## [1] "structured" "unstructured"

## [1] ""

## [1] "IN MINE ONLY:"

## [1] "abaxial to" "axial to"
## [1] "acyclic cyclicity" "cyclic cyclicity"
## [1] "alobate" "lobate"
## [1] "anaplastic" "aplastic"
## [1] "aneuploid" "euploid"
## [1] "asymmetrical" "symmetrical"
## [1] "atonicity" "tonicity"
## [1] "complex" "simple"
## [1] "curved dorsal" "curved ventral"
## [1] "dark blue" "light blue"
## [1] "dark brown" "light brown"
## [1] "dark cyan" "light cyan"
## [1] "dark green" "light green"
## [1] "dark grey" "light grey"
## [1] "dark magenta" "light magenta"
## [1] "dark orange" "light orange"
## [1] "dark phase" "light phase"
## [1] "dark purple" "light purple"
## [1] "dark red" "light red"
## [1] "dark red brown" "light red brown"
## [1] "dark violet" "light violet"
## [1] "dark yellow" "light yellow"
## [1] "dark yellow brown" "light yellow brown"
## [1] "decreased linear velocity" "increased linear velocity"
## [1] "decreased propagation velocity" "increased propagation velocity"
## [1] "decreased proportionality to" "increased proportionality to"
## [1] "decreased spatial extent of a process"
## [2] "increased spatial extent of a process"
## [1] "desaturated blue" "saturated blue"
## [1] "desaturated brown" "saturated brown"
## [1] "desaturated cyan" "saturated cyan"
## [1] "desaturated green" "saturated green"
## [1] "desaturated magenta" "saturated magenta"
## [1] "desaturated orange" "saturated orange"
## [1] "desaturated purple" "saturated purple"
## [1] "desaturated red" "saturated red"
## [1] "desaturated violet" "saturated violet"
## [1] "desaturated yellow" "saturated yellow"
## [1] "disposition" "position"
## [1] "dorsal orientation" "ventral orientation"
## [1] "dorsal to" "ventral to"

```

```

## [1] "dystonicity" "tonicity"
## [1] "glutinous"   "non-glutinous"
## [1] "ictal"       "non-ictal"
## [1] "immobile relative to" "mobile relative to"
## [1] "nonpolar polarity" "polar polarity"
## [1] "obsolete backcross fertile" "obsolete backcross sterile"
## [1] "obsolete decreased action potential" "obsolete increased action potential"
## [1] "obsolete decreased consumption" "obsolete increased consumption"
## [1] "obsolete decreased percentage" "obsolete increased percentage"
## [1] "obsolete decreased relaxation" "obsolete increased relaxation"
## [1] "obsolete f1 fertile" "obsolete f1 sterile"
## [1] "obsolete f2 fertile" "obsolete f2 sterile"
## [1] "obsolete high" "obsolete low"
## [1] "obsolete high enzyme function value" "obsolete low enzyme function value"
## [1] "obsolete high percentage" "obsolete low percentage"
## [1] "obsolete high yield" "obsolete low yield"
## [1] "obsolete intercross fertile" "obsolete intercross sterile"
## [1] "obsolete negative regulation" "obsolete positive regulation"
## [1] "splayed dorsal" "splayed ventral"

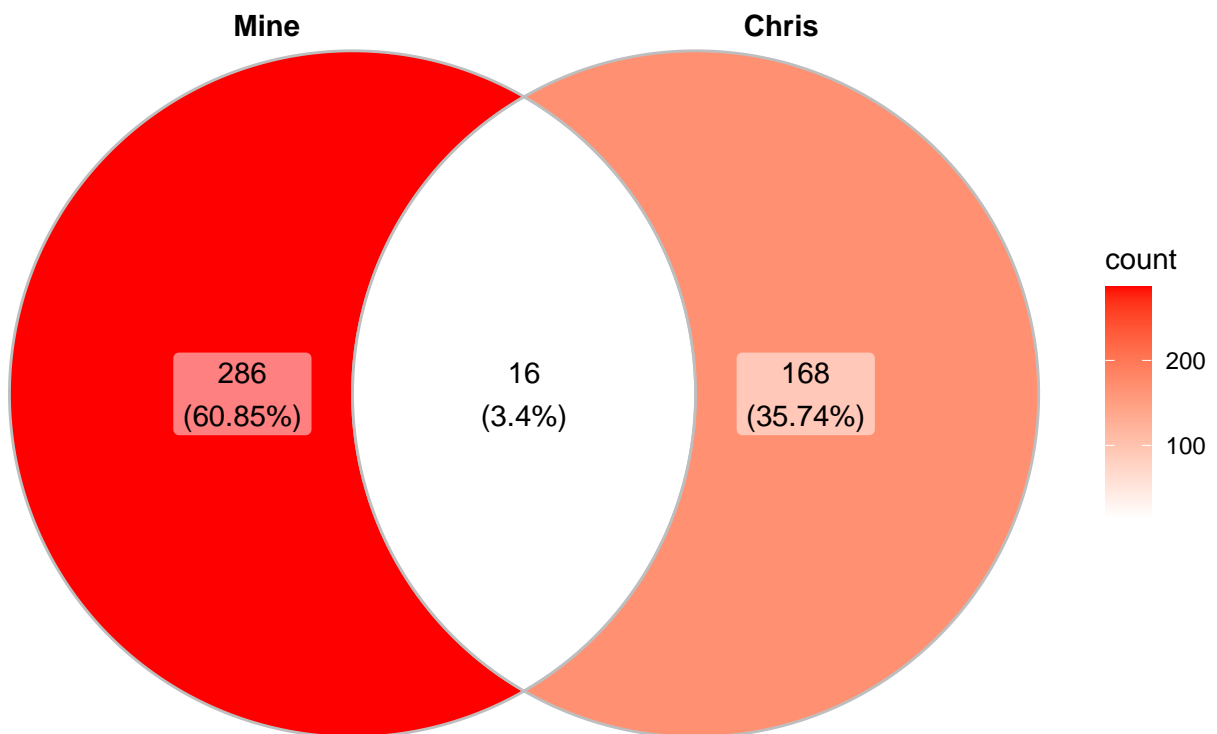
## [1] ""

## [1] "IN THE CURRENT PAIRS ONLY:"

## [1] "anterodistal orientation" "anterodorsal orientation"
## [1] "auxotrophic" "prototrophic"
## [1] "behavioural active" "behavioural inactive"
## [1] "biconcave" "biconvex"
## [1] "concave" "convex"
## [1] "concave 3-D shape" "convex 3-D shape"
## [1] "distal orientation" "dorsal orientation"
## [1] "distal to" "dorsal to"
## [1] "east" "west"
## [1] "fused with" "unfused from"
## [1] "has extra parts of type" "has fewer parts of type"
## [1] "hydrophilic" "hydrophobic"
## [1] "hydrophilicity" "hydrophobicity"
## [1] "hyperelliptic" "hypoelliptic"
## [1] "hyperplastic" "hypoplastic"
## [1] "hyperresponsive to" "hyporesponsive to"
## [1] "hypertrophic" "hypotrophic"
## [1] "hypertrophic growth" "hypotrophic growth"
## [1] "increased virulence" "reduced virulence"
## [1] "large (value)" "small (value)"
## [1] "north" "south"
## [1] "paedomorphic growth" "peramorphic growth"
## [1] "photoinsensitive" "photosensitive"
## [1] "posterodistal orientation" "posterodorsal orientation"
## [1] "recurrent" "sporadic"
## [1] "relative large (value)" "relative small (value)"
## [1] "resistance to" "susceptibility toward"

```

Comparison to Chris et al.'s stuff



```
## [1] "Mine:"
```

```
## # A tibble: 302 x 2
##   term01      term02
##   <chr>      <chr>
## 1 HP:0030469 HP:0008275
## 2 HP:0100737 HP:0100736
## 3 HP:0025090 HP:0025129
## 4 HP:0031199 HP:0031197
## 5 HP:0011790 HP:0011791
## 6 HP:0012388 HP:0004469
## 7 HP:0100282 HP:0100281
## 8 HP:0012451 HP:0012450
## 9 HP:0032675 HP:0032676
## 10 HP:0011880 HP:0005520
## # ... with 292 more rows
```

```
## [1] "Chris's:"
```

```
## # A tibble: 184 x 2
##   term01      term02
##   <chr>      <chr>
## 1 HP:0000098 HP:0004322
```



```
## 2 HP:0000103 HP:0011037
## 3 HP:0000154 HP:0000160
## 4 HP:0000158 HP:0000171
## 5 HP:0000188 HP:0011341
## 6 HP:0000239 HP:0005486
## 7 HP:0000253 HP:0004481
## 8 HP:0000274 HP:0100729
## 9 HP:0000275 HP:0000283
## 10 HP:0000276 HP:0011219
## # ... with 174 more rows
```

OK, we know the intersection/complements, so let's see what Chris's opposites look like, exactly.

```
## Warning: package 'ontologyIndex' was built under R version 4.0.2
```

```
## [1] "FOUND BY BOTH ME AND CHRIS:"
```

```
## [1] "Decreased activity of mitochondrial respiratory chain      Increased activity of mitochondrial r
## [1] "Decreased circulating ACTH level      Increased circulating ACTH level"
## [1] "Decreased circulating antibody level      Increased circulating antibody level"
## [1] "Decreased HDL cholesterol concentration      Increased HDL cholesterol concentration"
## [1] "Decreased inflammatory response      Increased inflammatory response"
## [1] "Decreased lymphocyte apoptosis      Increased lymphocyte apoptosis"
## [1] "Decreased mean platelet volume      Increased mean platelet volume"
## [1] "Decreased mitochondrial number      Increased mitochondrial number"
## [1] "Decreased pineal volume      Increased pineal volume"
## [1] "Decreased size of nasopharyngeal adenoids      Increased size of nasopharyngeal adenoids"
## [1] "Decreased urinary sulfate      Increased urinary sulfate"
## [1] "Decreased urinary urate      Increased urinary urate"
## [1] "Large basal ganglia      Small basal ganglia"
## [1] "Large humeral epiphyses      Small humeral epiphyses"
## [1] "Large radial epiphyses      Small radial epiphyses"
## [1] "Large sella turcica      Small sella turcica"
```

```
## [1] "FOUND BY ME, NOT BY CHRIS:"
```

```
## [1] ""
```

```
## [1] "Abnormal dark-adapted electroretinogram      Abnormal light-adapted electroretinogram"
## [1] "Abnormal hard palate morphology      Abnormal soft palate morphology"
## [1] "Abnormal large intestinal mucosa morphology      Abnormal small intestinal mucosa morphology"
## [1] "Acellular urinary casts      Cellular urinary casts"
## [1] "Activating thyroid-stimulating hormone receptor defect      Inactivating thyroid-stimulating hormone receptor defect"
## [1] "Acute bronchitis      Chronic bronchitis"
## [1] "Acute colitis      Chronic colitis"
## [1] "Acute constipation      Chronic constipation"
## [1] "Acute cutaneous wound      Chronic cutaneous wound"
## [1] "Acute disseminated intravascular coagulation      Chronic disseminated intravascular coagulation"
## [1] "Acute hepatic failure      Chronic hepatic failure"
## [1] "Acute hepatitis      Chronic hepatitis"
## [1] "Acute leukemia      Chronic leukemia"
## [1] "Acute myelomonocytic leukemia      Chronic myelomonocytic leukemia"
```

```

## [1] "Acute otitis media      Chronic otitis media"
## [1] "Acute pancreatitis     Chronic pancreatitis"
## [1] "Acute respiratory acidosis   Chronic respiratory acidosis"
## [1] "Acute sinusitis        Chronic sinusitis"
## [1] "Acute tubulointerstitial nephritis   Chronic tubulointerstitial nephritis"
## [1] "Acute      Chronic"
## [1] "Adenocarcinoma of the large intestine   Adenocarcinoma of the small intestine"
## [1] "Affected      Unaffected"
## [1] "Agranulocytosis   Granulocytosis"
## [1] "Alobar holoprosencephaly   Lobar holoprosencephaly"
## [1] "Anhidrotic ectodermal dysplasia   Hidrotic ectodermal dysplasia"
## [1] "Asymmetric peripheral demyelination   Symmetric peripheral demyelination"
## [1] "Atonic seizure      Tonic seizure"
## [1] "Atypical absence seizure   Typical absence seizure"
## [1] "Atypical absence status epilepticus   Typical absence status epilepticus"
## [1] "Cleft hard palate      Cleft soft palate"
## [1] "Closed comedo      Open comedo"
## [1] "Communicating hydrocephalus   Noncommunicating hydrocephalus"
## [1] "Complete atrioventricular canal defect   Partial atrioventricular canal defect"
## [1] "Complete breech presentation   Incomplete breech presentation"
## [1] "Complete congenital stationary night blindness   Incomplete congenital stationary night blindness"
## [1] "Complete diaphragmatic absence of pericardium   Partial diaphragmatic absence of pericardium"
## [1] "Complete duplication of the 1st metatarsal   Partial duplication of the 1st metatarsal"
## [1] "Complete duplication of the distal phalanges of the hand   Partial duplication of the distal phalanges of the hand"
## [1] "Complete duplication of the distal phalanx of the 2nd finger   Partial duplication of the distal phalanx of the 2nd finger"
## [1] "Complete duplication of the distal phalanx of the 2nd toe   Partial duplication of the distal phalanx of the 2nd toe"
## [1] "Complete duplication of the distal phalanx of the 3rd finger   Partial duplication of the distal phalanx of the 3rd finger"
## [1] "Complete duplication of the distal phalanx of the 3rd toe   Partial duplication of the distal phalanx of the 3rd toe"
## [1] "Complete duplication of the distal phalanx of the 4th finger   Partial duplication of the distal phalanx of the 4th finger"
## [1] "Complete duplication of the distal phalanx of the 4th toe   Partial duplication of the distal phalanx of the 4th toe"
## [1] "Complete duplication of the distal phalanx of the 5th finger   Partial duplication of the distal phalanx of the 5th finger"
## [1] "Complete duplication of the distal phalanx of the 5th toe   Partial duplication of the distal phalanx of the 5th toe"
## [1] "Complete duplication of the distal phalanx of the hallux   Partial duplication of the distal phalanx of the hallux"
## [1] "Complete duplication of the middle phalanges of the hand   Partial duplication of the middle phalanges of the hand"
## [1] "Complete duplication of the middle phalanx of the 2nd finger   Partial duplication of the middle phalanx of the 2nd finger"
## [1] "Complete duplication of the middle phalanx of the 2nd toe   Partial duplication of the middle phalanx of the 2nd toe"
## [1] "Complete duplication of the middle phalanx of the 3rd finger   Partial duplication of the middle phalanx of the 3rd finger"
## [1] "Complete duplication of the middle phalanx of the 3rd toe   Partial duplication of the middle phalanx of the 3rd toe"
## [1] "Complete duplication of the middle phalanx of the 4th finger   Partial duplication of the middle phalanx of the 4th finger"
## [1] "Complete duplication of the middle phalanx of the 4th toe   Partial duplication of the middle phalanx of the 4th toe"
## [1] "Complete duplication of the middle phalanx of the 5th finger   Partial duplication of the middle phalanx of the 5th finger"
## [1] "Complete duplication of the middle phalanx of the 5th toe   Partial duplication of the middle phalanx of the 5th toe"
## [1] "Complete duplication of the phalanges of the 2nd finger   Partial duplication of the phalanges of the 2nd finger"
## [1] "Complete duplication of the phalanges of the 3rd finger   Partial duplication of the phalanges of the 3rd finger"
## [1] "Complete duplication of the phalanges of the 4th finger   Partial duplication of the phalanges of the 4th finger"
## [1] "Complete duplication of the phalanges of the 5th finger   Partial duplication of the phalanges of the 5th finger"
## [1] "Complete duplication of the proximal phalanges of the hand   Partial duplication of the proximal phalanges of the hand"
## [1] "Complete duplication of the proximal phalanx of the 2nd finger   Partial duplication of the proximal phalanx of the 2nd finger"
## [1] "Complete duplication of the proximal phalanx of the 2nd toe   Partial duplication of the proximal phalanx of the 2nd toe"
## [1] "Complete duplication of the proximal phalanx of the 3rd finger   Partial duplication of the proximal phalanx of the 3rd finger"
## [1] "Complete duplication of the proximal phalanx of the 3rd toe   Partial duplication of the proximal phalanx of the 3rd toe"
## [1] "Complete duplication of the proximal phalanx of the 4th finger   Partial duplication of the proximal phalanx of the 4th finger"
## [1] "Complete duplication of the proximal phalanx of the 4th toe   Partial duplication of the proximal phalanx of the 4th toe"
## [1] "Complete duplication of the proximal phalanx of the 5th finger   Partial duplication of the proximal phalanx of the 5th finger"

```

[1] "Complete duplication of the proximal phalanx of the 5th toe Partial duplication of the prox
 ## [1] "Complete duplication of the proximal phalanx of the hallux Partial duplication of the proxim
 ## [1] "Complete duplication of thumb phalanx Partial duplication of thumb phalanx"
 ## [1] "Complete left sided absence of pericardium Partial left sided absence of pericardium"
 ## [1] "Complete right sided absence of pericardium Partial right sided absence of pericardium"
 ## [1] "Complex febrile seizure Simple febrile seizure"
 ## [1] "Complex renal cyst Simple renal cyst"
 ## [1] "Conjugated hyperbilirubinemia Unconjugated hyperbilirubinemia"
 ## [1] "Cyclophoria Incyclophoria"
 ## [1] "Cyclotropia Incyclotropia"
 ## [1] "Decreased adiponectin level Increased adiponectin level"
 ## [1] "Decreased adipose tissue Increased adipose tissue"
 ## [1] "Decreased antimullerian hormone level Increased antimullerian hormone level"
 ## [1] "Decreased Arden ratio of electrooculogram Increased Arden ratio of electrooculogram"
 ## [1] "Decreased basophil count Increased basophil count"
 ## [1] "Decreased biotinidase level Increased biotinidase level"
 ## [1] "Decreased blood drug concentration Increased blood drug concentration"
 ## [1] "Decreased body fat percentage Increased body fat percentage"
 ## [1] "Decreased body mass index Increased body mass index"
 ## [1] "Decreased body weight Increased body weight"
 ## [1] "Decreased circulating 18-hydroxycortisone level Increased circulating 18-hydroxycortisone l
 ## [1] "Decreased circulating A-type natriuretic peptide level Increased circulating A-type natriur
 ## [1] "Decreased circulating androgen level Increased circulating androgen level"
 ## [1] "Decreased circulating beta-2-microglobulin level Increased circulating beta-2-microglobulin
 ## [1] "Decreased circulating beta-C-terminal telopeptide level Increased circulating beta-C-termina
 ## [1] "Decreased circulating ceruloplasmin concentration Increased circulating ceruloplasmin conce
 ## [1] "Decreased circulating chylomicron concentration Increased circulating chylomicron concentra
 ## [1] "Decreased circulating copper concentration Increased circulating copper concentration"
 ## [1] "Decreased circulating corticosterone level Increased circulating corticosterone level"
 ## [1] "Decreased circulating cortisol level Increased circulating cortisol level"
 ## [1] "Decreased circulating free fatty acid level Increased circulating free fatty acid level"
 ## [1] "Decreased circulating free T3 Increased circulating free T3"
 ## [1] "Decreased circulating free T4 level Increased circulating free T4 level"
 ## [1] "Decreased circulating globulin level Increased circulating globulin level"
 ## [1] "Decreased circulating gonadotropin level Increased circulating gonadotropin level"
 ## [1] "Decreased circulating heparan sulfate level Increased circulating heparan sulfate level"
 ## [1] "Decreased circulating IgA level Increased circulating IgA level"
 ## [1] "Decreased circulating IgG level Increased circulating IgG level"
 ## [1] "Decreased circulating IgG1 level Increased circulating IgG1 level"
 ## [1] "Decreased circulating IgG2 level Increased circulating IgG2 level"
 ## [1] "Decreased circulating IgG3 level Increased circulating IgG3 level"
 ## [1] "Decreased circulating IgG4 level Increased circulating IgG4 level"
 ## [1] "Decreased circulating osteocalcin level Increased circulating osteocalcin level"
 ## [1] "Decreased circulating progesterone Increased circulating progesterone"
 ## [1] "Decreased circulating purine concentration Increased circulating purine concentration"
 ## [1] "Decreased circulating renin level Increased circulating renin level"
 ## [1] "Decreased circulating selenium concentration Increased circulating selenium concentration"
 ## [1] "Decreased circulating T4 level Increased circulating T4 level"
 ## [1] "Decreased complex N-glycan level Increased complex N-glycan level"
 ## [1] "Decreased core 1 O-glycan level Increased core 1 O-glycan level"
 ## [1] "Decreased corneal thickness Increased corneal thickness"
 ## [1] "Decreased CSF alanine concentration Increased CSF alanine concentration"
 ## [1] "Decreased CSF albumin concentration Increased CSF albumin concentration"
 ## [1] "Decreased CSF arginine concentration Increased CSF arginine concentration"

[1] "Decreased CSF glutamate concentration Increased CSF glutamate concentration"
 ## [1] "Decreased CSF glutamine concentration Increased CSF glutamine concentration"
 ## [1] "Decreased CSF histidine concentration Increased CSF histidine concentration"
 ## [1] "Decreased CSF isoleucine concentration Increased CSF isoleucine concentration"
 ## [1] "Decreased CSF leucine concentration Increased CSF leucine concentration"
 ## [1] "Decreased CSF lysine concentration Increased CSF lysine concentration"
 ## [1] "Decreased CSF phenylalanine concentration Increased CSF phenylalanine concentration"
 ## [1] "Decreased CSF protein Increased CSF protein"
 ## [1] "Decreased CSF serine concentration Increased CSF serine concentration"
 ## [1] "Decreased CSF threonine concentration Increased CSF threonine concentration"
 ## [1] "Decreased CSF tyrosine concentration Increased CSF tyrosine concentration"
 ## [1] "Decreased CSF valine concentration Increased CSF valine concentration"
 ## [1] "Decreased CSF/serum albumin ratio Increased CSF/serum albumin ratio"
 ## [1] "Decreased cystatin C level Increased cystatin C level"
 ## [1] "Decreased DLCO Increased DLCO"
 ## [1] "Decreased female libido Increased female libido"
 ## [1] "Decreased femoral torsion Increased femoral torsion"
 ## [1] "Decreased fetal movement Increased fetal movement"
 ## [1] "Decreased fibular diameter Increased fibular diameter"
 ## [1] "Decreased fucosylation of N-linked protein glycosylation Increased fucosylation of N-linked
 ## [1] "Decreased fucosylation of O-linked protein glycosylation Increased fucosylation of O-linked
 ## [1] "Decreased glomerular filtration rate Increased glomerular filtration rate"
 ## [1] "Decreased glucagon level Increased glucagon level"
 ## [1] "Decreased glucose-6-phosphate dehydrogenase level in blood Increased glucose-6-phosphate del
 ## [1] "Decreased glucose-6-phosphate dehydrogenase level in dried blood spot Increased glucose-6-ph
 ## [1] "Decreased glucose-6-phosphate dehydrogenase level in leukocytes Increased glucose-6-phosphat
 ## [1] "Decreased glucose-6-phosphate dehydrogenase level in red blood cells Increased glucose-6-ph
 ## [1] "Decreased glucose-6-phosphate dehydrogenase level in tissue Increased glucose-6-phosphate d
 ## [1] "Decreased HDL2a concentration Increased HDL2a concentration"
 ## [1] "Decreased HDL2b concentration Increased HDL2b concentration"
 ## [1] "Decreased HDL3a concentration Increased HDL3a concentration"
 ## [1] "Decreased HDL3b concentration Increased HDL3b concentration"
 ## [1] "Decreased HDL3c concentration Increased HDL3c concentration"
 ## [1] "Decreased head circumference Increased head circumference"
 ## [1] "Decreased heart rate variability Increased heart rate variability"
 ## [1] "Decreased helper T cell proportion Increased helper T cell proportion"
 ## [1] "Decreased hemoglobin concentration Increased hemoglobin concentration"
 ## [1] "Decreased hepatic echogenicity Increased hepatic echogenicity"
 ## [1] "Decreased high-mannose N-glycan level Increased high-mannose N-glycan level"
 ## [1] "Decreased immunoglobulin level in body fluid Increased immunoglobulin level in body fluid"
 ## [1] "Decreased incisura length Increased incisura length"
 ## [1] "Decreased intestinal transit time Increased intestinal transit time"
 ## [1] "Decreased intracranial pressure Increased intracranial pressure"
 ## [1] "Decreased LDL cholesterol concentration Increased LDL cholesterol concentration"
 ## [1] "Decreased level of carnosine in blood Increased level of carnosine in blood"
 ## [1] "Decreased level of GABA in serum Increased level of GABA in serum"
 ## [1] "Decreased level of platelet-activating factor Increased level of platelet-activating factor"
 ## [1] "Decreased libido Increased libido"
 ## [1] "Decreased male libido Increased male libido"
 ## [1] "Decreased mannose-binding protein level Increased mannose-binding protein level"
 ## [1] "Decreased mannosylation of N-linked protein glycosylation Increased mannosylation of N-link
 ## [1] "Decreased mean corpuscular hemoglobin concentration Increased mean corpuscular hemoglobin c
 ## [1] "Decreased mean corpuscular volume Increased mean corpuscular volume"
 ## [1] "Decreased monosialylated core 1 O-glycan level Increased monosialylated core 1 O-glycan lev

[1] "Decreased muscle glycogen content Increased muscle glycogen content"
 ## [1] "Decreased phosphoribosylpyrophosphate synthetase level Increased phosphoribosylpyrophosphate synthetase level"
 ## [1] "Decreased pituitary glycoprotein hormone alpha subunit level Increased pituitary glycoprotein hormone alpha subunit level"
 ## [1] "Decreased proportion of CD4+CD25+ regulatory T cells Increased proportion of CD4+CD25+ regulatory T cells"
 ## [1] "Decreased proportion of CD4-positive T cells Increased proportion of CD4-positive T cells"
 ## [1] "Decreased proportion of CD4-positive, alpha-beta memory T cells Increased proportion of CD4-positive, alpha-beta memory T cells"
 ## [1] "Decreased proportion of CD8-positive, alpha-beta memory T cells Increased proportion of CD8-positive, alpha-beta memory T cells"
 ## [1] "Decreased proportion of CD8-positive, alpha-beta TEMRA T cells Increased proportion of CD8-positive, alpha-beta TEMRA T cells"
 ## [1] "Decreased proportion of central memory CD4-positive, alpha-beta T cells Increased proportion of central memory CD4-positive, alpha-beta T cells"
 ## [1] "Decreased proportion of central memory CD8-positive, alpha-beta T cells Increased proportion of central memory CD8-positive, alpha-beta T cells"
 ## [1] "Decreased proportion of class-switched memory B cells Increased proportion of class-switched memory B cells"
 ## [1] "Decreased proportion of effector memory CD8-positive, alpha-beta T cells Increased proportion of effector memory CD8-positive, alpha-beta T cells"
 ## [1] "Decreased proportion of gamma-delta T cells Increased proportion of gamma-delta T cells"
 ## [1] "Decreased proportion of immature B cells Increased proportion of immature B cells"
 ## [1] "Decreased proportion of immature gamma-delta T cells Increased proportion of immature gamma-delta T cells"
 ## [1] "Decreased proportion of marginal zone B cells Increased proportion of marginal zone B cells"
 ## [1] "Decreased proportion of memory B cells Increased proportion of memory B cells"
 ## [1] "Decreased proportion of memory T cells Increased proportion of memory T cells"
 ## [1] "Decreased proportion of naive B cells Increased proportion of naive B cells"
 ## [1] "Decreased proportion of naive CD4 T cells Increased proportion of naive CD4 T cells"
 ## [1] "Decreased proportion of naive CD8 T cells Increased proportion of naive CD8 T cells"
 ## [1] "Decreased proportion of naive T cells Increased proportion of naive T cells"
 ## [1] "Decreased proportion of plasmablasts Increased proportion of plasmablasts"
 ## [1] "Decreased proportion of transitional B cells Increased proportion of transitional B cells"
 ## [1] "Decreased proportion of unswitched memory B cells Increased proportion of unswitched memory B cells"
 ## [1] "Decreased QRS voltage Increased QRS voltage"
 ## [1] "Decreased red blood cell count Increased red blood cell count"
 ## [1] "Decreased resting energy expenditure Increased resting energy expenditure"
 ## [1] "Decreased salivary cortisol level Increased salivary cortisol level"
 ## [1] "Decreased scrotal rugation Increased scrotal rugation"
 ## [1] "Decreased serum estradiol Increased serum estradiol"
 ## [1] "Decreased serum estriol Increased serum estriol"
 ## [1] "Decreased serum estrone Increased serum estrone"
 ## [1] "Decreased serum ferritin Increased serum ferritin"
 ## [1] "Decreased serum insulin-like growth factor 1 Increased serum insulin-like growth factor 1"
 ## [1] "Decreased serum iron Increased serum iron"
 ## [1] "Decreased serum leptin Increased serum leptin"
 ## [1] "Decreased serum testosterone level Increased serum testosterone level"
 ## [1] "Decreased serum zinc Increased serum zinc"
 ## [1] "Decreased sialylated N-glycan level Increased sialylated N-glycan level"
 ## [1] "Decreased sialylation of N-linked protein glycosylation Increased sialylation of N-linked protein glycosylation"
 ## [1] "Decreased size of the clitoris Increased size of the clitoris"
 ## [1] "Decreased skull ossification Increased skull ossification"
 ## [1] "Decreased superoxide dismutase level Increased superoxide dismutase level"
 ## [1] "Decreased T3/T4 ratio Increased T3/T4 ratio"
 ## [1] "Decreased total hemolytic complement activity Increased total hemolytic complement activity"
 ## [1] "Decreased total iron binding capacity Increased total iron binding capacity"
 ## [1] "Decreased uridine diphosphate glucose-4-epimerase level in plasma Increased uridine diphosphate glucose-4-epimerase level in plasma"
 ## [1] "Decreased uridine diphosphate glucose-4-epimerase level in red blood cells Increased uridine diphosphate glucose-4-epimerase level in red blood cells"
 ## [1] "Decreased urinary 1-methylhistidine Increased urinary 1-methylhistidine"
 ## [1] "Decreased urinary 3-methylhistidine Increased urinary 3-methylhistidine"
 ## [1] "Decreased urinary copper concentration Increased urinary copper concentration"
 ## [1] "Decreased urinary potassium Increased urinary potassium"
 ## [1] "Decreased urine alpha-ketoglutarate concentration Increased urine alpha-ketoglutarate concentration"

[1] "Decreased urine urobilinogen Increased urine urobilinogen"
 ## [1] "Decreased VLDL cholesterol concentration Increased VLDL cholesterol concentration"
 ## [1] "Decreased waist to hip ratio Increased waist to hip ratio"
 ## [1] "Disproportionate short stature Proportionate short stature"
 ## [1] "Disproportionate tall stature Proportionate tall stature"
 ## [1] "Dysgerminoma Germinoma"
 ## [1] "Early chronotype Late chronotype"
 ## [1] "Early inspiratory crackles Late inspiratory crackles"
 ## [1] "Early spermatogenesis maturation arrest Late spermatogenesis maturation arrest"
 ## [1] "Fast-growing nails Slow-growing nails"
 ## [1] "Happy demeanor Unhappy demeanor"
 ## [1] "Heavy-chain paraproteinemia Light-chain paraproteinemia"
 ## [1] "High anterior hairline Low anterior hairline"
 ## [1] "High insertion of columella Low insertion of columella"
 ## [1] "High maternal serum alpha-fetoprotein Low maternal serum alpha-fetoprotein"
 ## [1] "High maternal serum chorionic gonadotropin Low maternal serum chorionic gonadotropin"
 ## [1] "High posterior hairline Low posterior hairline"
 ## [1] "High pulse pressure Low pulse pressure"
 ## [1] "High serum calcifediol Low serum calcifediol"
 ## [1] "High serum calcitriol Low serum calcitriol"
 ## [1] "High-frequency sensorineural hearing impairment Low-frequency sensorineural hearing impairment"
 ## [1] "High-output congestive heart failure Low-output congestive heart failure"
 ## [1] "Hodgkin lymphoma Non-Hodgkin lymphoma"
 ## [1] "Ketotic hypoglycemia Nonketotic hypoglycemia"
 ## [1] "Large cell lung carcinoma Small cell lung carcinoma"
 ## [1] "Large earlobe Small earlobe"
 ## [1] "Large face Small face"
 ## [1] "Large for gestational age Small for gestational age"
 ## [1] "Large foramen magnum Small foramen magnum"
 ## [1] "Large forehead Small forehead"
 ## [1] "Large intestinal polyposis Small intestinal polyposis"
 ## [1] "Large placenta Small placenta"
 ## [1] "Large vessel vasculitis Small vessel vasculitis"
 ## [1] "Medial calcification of large arteries Medial calcification of small arteries"
 ## [1] "Medullary thyroid carcinoma Non-medullary thyroid carcinoma"
 ## [1] "Monoclonal elevation of IgG heavy chain Monoclonal elevation of IgG light chain"
 ## [1] "Neoplasm of the large intestine Neoplasm of the small intestine"
 ## [1] "Non-obstructive azoospermia Obstructive azoospermia"
 ## [1] "Non-restrictive ventricular septal defect Restrictive ventricular septal defect"
 ## [1] "Non-secretory adrenocortical adenoma Secretory adrenocortical adenoma"
 ## [1] "Non-small cell lung carcinoma Small cell lung carcinoma"
 ## [1] "Nonopposable triphalangeal thumb Opposable triphalangeal thumb"
 ## [1] "Nonproductive cough Productive cough"
 ## [1] "Nonprogressive cerebellar ataxia Progressive cerebellar ataxia"
 ## [1] "Nonprogressive encephalopathy Progressive encephalopathy"
 ## [1] "Nonprogressive visual loss Progressive visual loss"
 ## [1] "Nonprogressive Progressive"
 ## [1] "obsolete Decreased proportion of CD4+ central memory cells obsolete Increased proportion of
 ## [1] "Primary amenorrhea Secondary amenorrhea"
 ## [1] "Primary Caesarian section Secondary Caesarian section"
 ## [1] "Primary hyperaldosteronism Secondary hyperaldosteronism"
 ## [1] "Primary hypercortisolism Secondary hypercortisolism"
 ## [1] "Primary hyperparathyroidism Secondary hyperparathyroidism"
 ## [1] "Secondary hyperparathyroidism Tertiary hyperparathyroidism"

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## [1] "Submucous cleft hard palate      Submucous cleft soft palate"
## [1] "Undetectable dark-adapted electroretinogram      Undetectable light-adapted electroretinogram"

## [1] "FOUND BY CHRIS, NOT BY ME:"

## [1] ""

## [1] "Tall stature      Short stature"
## [1] "Polyuria      Decreased urine output"
## [1] "Wide mouth      Narrow mouth"
## [1] "Macroglossia      Microglossia"
## [1] "Short upper lip      Long upper lip"
## [1] "Large fontanelles      Small fontanelle"
## [1] "Progressive microcephaly      Progressive macrocephaly"
## [1] "Small face      Large face"
## [1] "Narrow face      Broad face"
## [1] "Long face      Short face"
## [1] "Hypertelorism      Hypotelorism"
## [1] "Short philtrum      Long philtrum"
## [1] "Hypoplasia of the maxilla      Hyperplasia of the maxilla"
## [1] "Short chin      Tall chin"
## [1] "Broad forehead      Narrow forehead"
## [1] "Small forehead      Large forehead"
## [1] "Wide nose      Narrow nose"
## [1] "Short neck      Long neck"
## [1] "Microcornea      Megalocornea"
## [1] "Long eyelashes      Short eyelashes"
## [1] "Thick eyebrow      Thin eyebrow"
## [1] "Long palpebral fissure      Short palpebral fissure"
## [1] "Hypodontia      Increased number of teeth"
## [1] "Microdontia      Macrodontia"
## [1] "Hypoplasia of the thymus      Thymus hyperplasia"
## [1] "Hypothyroidism      Hyperthyroidism"
## [1] "Hypertension      Hypotension"
## [1] "Hypoparathyroidism      Hyperparathyroidism"
## [1] "Increased circulating gonadotropin level      Decreased circulating gonadotropin level"
## [1] "Hyperinsulinemia      Hypoinsulinemia"
## [1] "Increased circulating renin level      Decreased circulating renin level"
## [1] "Hyperaldosteronism      Decreased circulating aldosterone level"
## [1] "Parathyroid hypoplasia      Parathyroid hyperplasia"
## [1] "Long clavicles      Short clavicles"
## [1] "Hypertrichosis      obsolete Hypotrichosis"
## [1] "Broad palm      Narrow palm"
## [1] "Large hands      Small hand"
## [1] "Short umbilical cord      Long umbilical cord"
## [1] "Hyporeflexia      Hyperreflexia"
## [1] "Limitation of joint mobility      Joint hypermobility"
## [1] "Onychogryposis      Thin nail"
## [1] "Broad nail      Narrow nail"
## [1] "Short toe      Long toe"
## [1] "Long hallux      Short hallux"
## [1] "Leukopenia      Leukocytosis"
## [1] "Hypoglycemia      Hyperglycemia"

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[1] "Hyperammonemia Hypoammonemia"
 ## [1] "Hypophosphatemia Hyperphosphatemia"
 ## [1] "Hyperuricemia Hypouricemia"
 ## [1] "Hypercalciuria Hypocalciuria"
 ## [1] "Hyperkalemia Hypokalemia"
 ## [1] "Hyperglycinemia Hypoglycinemia"
 ## [1] "Hypertriglyceridemia Hypotriglyceridemia"
 ## [1] "Increased CSF lactate Reduced CSF lactate"
 ## [1] "Pancreatic hypoplasia Pancreatic hyperplasia"
 ## [1] "Small foramen magnum Large foramen magnum"
 ## [1] "Thickened calvaria Thin calvarium"
 ## [1] "Lymphadenopathy Lymph node hypoplasia"
 ## [1] "Hypoventilation Hyperventilation"
 ## [1] "Decreased circulating total IgM Increased circulating IgM level"
 ## [1] "Hypocalcemia Hypercalcemia"
 ## [1] "Hyponatremia Hypernatremia"
 ## [1] "Hyperchloriduria Hypochloriduria"
 ## [1] "Hypomagnesemia Hypermagnesemia"
 ## [1] "Hypoalbuminemia Hyperalbuminemia"
 ## [1] "Hyperlipidemia Hypolipidemia"
 ## [1] "Increased urinary potassium Decreased urinary potassium"
 ## [1] "Hyperphosphaturia Hypophosphaturia"
 ## [1] "Hypochloremia Hyperchloremia"
 ## [1] "Increased circulating cortisol level Decreased circulating cortisol level"
 ## [1] "Hypercholesterolemia Hypocholesterolemia"
 ## [1] "Elevated alkaline phosphatase Low alkaline phosphatase"
 ## [1] "Hypermethioninemia Hypomethioninemia"
 ## [1] "Increased circulating IgG level Decreased circulating IgG level"
 ## [1] "Elevated serum creatinine Decreased serum creatinine"
 ## [1] "Increased serum ferritin Decreased serum ferritin"
 ## [1] "CNS hypomyelination CNS hypermyelination"
 ## [1] "Short palm Long palm"
 ## [1] "Increased body weight Decreased body weight"
 ## [1] "Increased skull ossification Decreased skull ossification"
 ## [1] "Reduced bone mineral density Increased bone mineral density"
 ## [1] "Increased circulating purine concentration Decreased circulating purine concentration"
 ## [1] "Biconcave vertebral bodies Biconvex vertebral bodies"
 ## [1] "Short middle phalanx of finger Long middle phalanx of finger"
 ## [1] "Thyroid hypoplasia Thyroid hyperplasia"
 ## [1] "Long proximal phalanx of finger Short proximal phalanx of finger"
 ## [1] "Small placenta Large placenta"
 ## [1] "Broad femoral neck Narrow femoral neck"
 ## [1] "Peripheral hypomyelination Peripheral hypermyelination"
 ## [1] "Generalized hyperpigmentation Generalized hypopigmentation"
 ## [1] "Long upper eyelashes Short upper eyelashes"
 ## [1] "Macular hypopigmentation Macular hyperpigmentation"
 ## [1] "Foveal hyperpigmentation Foveal hypopigmentation"
 ## [1] "Increased muscle glycogen content Decreased muscle glycogen content"
 ## [1] "Increased adipose tissue Decreased adipose tissue"
 ## [1] "Enlarged epiphysis of the distal phalanx of the 5th finger Small epiphysis of the distal phalanx of the 5th finger"
 ## [1] "Enlarged epiphysis of the proximal phalanx of the 5th finger Small epiphysis of the proximal phalanx of the 5th finger"
 ## [1] "Enlarged epiphysis of the middle phalanx of the 5th finger Small epiphysis of the middle phalanx of the 5th finger"
 ## [1] "Enlarged epiphysis of the middle phalanx of the 4th finger Small epiphysis of the middle phalanx of the 4th finger"
 ## [1] "Enlarged epiphysis of the distal phalanx of the 4th finger Small epiphysis of the distal phalanx of the 4th finger"

[1] "Enlarged epiphysis of the proximal phalanx of the 4th finger Small epiphysis of the proximal phalanx of the 4th finger"
 ## [1] "Enlarged epiphysis of the middle phalanx of the 3rd finger Small epiphysis of the middle phalanx of the 3rd finger"
 ## [1] "Enlarged epiphysis of the distal phalanx of the 3rd finger Small epiphysis of the distal phalanx of the 3rd finger"
 ## [1] "Enlarged epiphysis of the proximal phalanx of the 3rd finger Small epiphysis of the proximal phalanx of the 3rd finger"
 ## [1] "Enlarged epiphyses of the 5th finger Small epiphyses of the 5th finger"
 ## [1] "Enlarged epiphyses of the 4th finger Small epiphyses of the 4th finger"
 ## [1] "Enlarged epiphyses of the 3rd finger Small epiphyses of the 3rd finger"
 ## [1] "Enlarged epiphyses of the 2nd finger Small epiphyses of the 2nd finger"
 ## [1] "Enlarged epiphysis of the distal phalanx of the 2nd finger Small epiphysis of the distal phalanx of the 2nd finger"
 ## [1] "Enlarged epiphysis of the middle phalanx of the 2nd finger Small epiphysis of the middle phalanx of the 2nd finger"
 ## [1] "Enlarged epiphysis of the proximal phalanx of the 2nd finger Small epiphysis of the proximal phalanx of the 2nd finger"
 ## [1] "Enlarged epiphysis of the proximal phalanx of the thumb Small epiphysis of the proximal phalanx of the thumb"
 ## [1] "Enlarged epiphysis of the distal phalanx of the thumb Small epiphysis of the distal phalanx of the thumb"
 ## [1] "Enlarged thumb epiphysis Small thumb epiphysis"
 ## [1] "Reduced number of teeth Increased number of teeth"
 ## [1] "Short distal phalanx of finger Long distal phalanx of finger"
 ## [1] "Enlarged epiphysis of the 1st metacarpal Small epiphysis of the 1st metacarpal"
 ## [1] "Short metacarpal Long metacarpals"
 ## [1] "Enlarged epiphyses of the hallux Small epiphyses of the hallux"
 ## [1] "Enlarged epiphysis of the proximal phalanx of the hallux Small epiphysis of the proximal phalanx of the hallux"
 ## [1] "Enlarged epiphysis of the distal phalanx of the hallux Small epiphysis of the distal phalanx of the hallux"
 ## [1] "Enlarged epiphysis of the 1st metatarsal Small epiphysis of the 1st metatarsal"
 ## [1] "Enlarged epiphyses of the toes Small epiphyses of the toes"
 ## [1] "Enlarged epiphyses of the phalanges of the hand Small epiphyses of the phalanges of the hand"
 ## [1] "Enlarged epiphyses of the distal phalanges of the hand Small epiphyses of the distal phalanges of the hand"
 ## [1] "Enlarged epiphyses of the middle phalanges of the hand Small epiphyses of the middle phalanges of the hand"
 ## [1] "Enlarged epiphyses of the proximal phalanges of the hand Small epiphyses of the proximal phalanges of the hand"
 ## [1] "Hyperpituitarism Hypopituitarism"
 ## [1] "Enlarged epiphyses Small epiphyses"
 ## [1] "Hypoplasia of the premaxilla Hyperplasia of the premaxilla"
 ## [1] "Broad uvula Narrow uvula"
 ## [1] "Long uvula Short uvula"
 ## [1] "Increased urinary copper concentration Decreased urinary copper concentration"
 ## [1] "Hyperlipoproteinemia Hypolipoproteinemia"
 ## [1] "Increased corneal thickness Decreased corneal thickness"
 ## [1] "Elevated circulating luteinizing hormone level Decreased circulating luteinizing hormone level"
 ## [1] "Erythroid hyperplasia Erythroid hypoplasia"
 ## [1] "Granulocytic hyperplasia Granulocytic hypoplasia"
 ## [1] "Monocytosis Monocytopenia"
 ## [1] "Increased urine alpha-ketoglutarate concentration Decreased urine alpha-ketoglutarate concentration"
 ## [1] "Hypocitraturia Hypercitraturia"
 ## [1] "Enlarged pituitary gland Small pituitary gland"
 ## [1] "Hyponatriuria Hypernatruria"
 ## [1] "Hypermagnesiuria Hypomagnesiuria"
 ## [1] "Narrow jaw Broad jaw"
 ## [1] "Increased serum testosterone level Decreased serum testosterone level"
 ## [1] "Increased circulating androgen level Decreased circulating androgen level"
 ## [1] "Chorioretinal hypopigmentation Chorioretinal hyperpigmentation"
 ## [1] "Long lower eyelashes Short lower eyelashes"
 ## [1] "Increased head circumference Decreased head circumference"
 ## [1] "Increased size of the clitoris Decreased size of the clitoris"
 ## [1] "Enlarged epiphyses of the 2nd toe Small epiphyses of the 2nd toe"
 ## [1] "Enlarged epiphyses of the 3rd toe Small epiphyses of the 3rd toe"
 ## [1] "Enlarged epiphyses of the 4th toe Small epiphyses of the 4th toe"

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## [1] "Enlarged epiphyses of the 5th toe      Small epiphyses of the 5th toe"
## [1] "Enlarged epiphysis of the distal phalanx of the 2nd toe      Small epiphysis of the distal phalanx of the 2nd toe"
## [1] "Enlarged epiphysis of the middle phalanx of the 2nd toe      Small epiphysis of the middle phalanx of the 2nd toe"
## [1] "Enlarged epiphysis of the proximal phalanx of the 2nd toe      Small epiphysis of the proximal phalanx of the 2nd toe"
## [1] "Enlarged epiphysis of the distal phalanx of the 3rd toe      Small epiphysis of the distal phalanx of the 3rd toe"
## [1] "Enlarged epiphysis of the middle phalanx of the 3rd toe      Small epiphysis of the middle phalanx of the 3rd toe"
## [1] "Enlarged epiphysis of the proximal phalanx of the 3rd toe      Small epiphysis of the proximal phalanx of the 3rd toe"
## [1] "Enlarged epiphysis of the distal phalanx of the 4th toe      Small epiphysis of the distal phalanx of the 4th toe"
## [1] "Enlarged epiphysis of the middle phalanx of the 4th toe      Small epiphysis of the middle phalanx of the 4th toe"
## [1] "Enlarged epiphysis of the proximal phalanx of the 4th toe      Small epiphysis of the proximal phalanx of the 4th toe"
## [1] "Enlarged epiphysis of the distal phalanx of the 5th toe      Small epiphysis of the distal phalanx of the 5th toe"
## [1] "Enlarged epiphysis of the middle phalanx of the 5th toe      Small epiphysis of the middle phalanx of the 5th toe"
## [1] "Enlarged epiphysis of the proximal phalanx of the 5th toe      Small epiphysis of the proximal phalanx of the 5th toe"
## [1] "Long ear      Short ear"
```

RO exploration

I extracted the terms from the current version of the RO, then got the absolute frequencies of their words:

```
/Users/kevincohen/Dropbox/Scripts-new/lexicalFrequency.pl experimental-outputs/ro.terms.txt
```

... which reveals imbalances in the use of words that are clear opposites, e.g.:

- during 11 before 4 after 2
- to 49 from 16 towards 1 *how about away?*
- directly 18 indirectly 8
- indirect 2 direct 2

... which suggests that I could be adding a bunch of opposite terms to the ontology.

So, I ran the current version of my antonym-finding script:

```
code/findAntonyms.pl resources/ontologies/ro.2021-03-08.obo.txt |wc -l
```

... which finds 43 pairs of opposites.

Next step: find overlap with Mike's resources/ontologies/predicates.txt.

For next weeks...

0. With Bill, reorganize repository and merge with TRANSLATOR's
1. Test cases in human-readable form
2. Handle substitutions (e.g. hypercalcemia vs. hypocalcemia)
3. Suffixes (e.g. hydrophilic vs. hydrophobic)
4. Word-internal, possibly (might produce a lot of false positives later when we do generation)

For reproducibility

```
## R version 4.0.1 (2020-06-06)
## Platform: x86_64-apple-darwin17.0 (64-bit)
## Running under: macOS 10.16
##
## Matrix products: default
## BLAS: /Library/Frameworks/R.framework/Versions/4.0/Resources/lib/libRblas.dylib
```

```

## LAPACK: /Library/Frameworks/R.framework/Versions/4.0/Resources/lib/libRlapack.dylib
##
## locale:
## [1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
##
## attached base packages:
## [1] stats      graphics  grDevices  utils      datasets  methods   base
##
## other attached packages:
## [1] ontologyIndex_2.7   forcats_0.5.1      stringr_1.4.0
## [4] dplyr_1.0.4         purrr_0.3.4        readr_1.4.0
## [7] tidyr_1.1.1         tibble_3.0.1       ggplot2_3.3.2
## [10] tidyverse_1.3.0     ggVennDiagram_0.5.0
##
## loaded via a namespace (and not attached):
## [1] Rcpp_1.0.4.6        lubridate_1.7.9     class_7.3-17
## [4] assertthat_0.2.1    digest_0.6.25       utf8_1.1.4
## [7] R6_2.4.1            cellranger_1.1.0    futile.options_1.0.1
## [10] backports_1.1.8     reprex_1.0.0        evaluate_0.14
## [13] e1071_1.7-3         httr_1.4.1          pillar_1.4.4
## [16] rlang_0.4.10        readxl_1.3.1        VennDiagram_1.6.20
## [19] rstudioapi_0.11     rmarkdown_2.3       labeling_0.3
## [22] munsell_0.5.0       broom_0.7.4         compiler_4.0.1
## [25] modelr_0.1.8        xfun_0.15           pkgconfig_2.0.3
## [28] htmltools_0.5.0     tidyselect_1.1.0    fansi_0.4.1
## [31] crayon_1.3.4        dbplyr_2.1.0        withr_2.4.1
## [34] sf_0.9-8            grid_4.0.1          jsonlite_1.7.0
## [37] gtable_0.3.0        lifecycle_0.2.0     DBI_1.1.0
## [40] magrittr_1.5         formatR_1.8          units_0.7-1
## [43] scales_1.1.1        KernSmooth_2.23-17  cli_2.0.2
## [46] stringi_1.4.6       farver_2.0.3        fs_1.4.1
## [49] xml2_1.3.2          futile.logger_1.4.3  ellipsis_0.3.1
## [52] generics_0.0.2      vctrs_0.3.6         lambda.r_1.2.4
## [55] tools_4.0.1         glue_1.4.1          hms_1.0.0
## [58] yaml_2.2.1          colorspace_1.4-1    classInt_0.4-3
## [61] rvest_0.3.6         knitr_1.29          haven_2.3.1

```