UCDenver LOINC to HPO Annotation Results

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Approach

- Children's Hospital of Colorado Data
  - PEDSnet OMOP: >800,000 patients; >300 mil labs; >30 mil conditions; >25 mil meds
  - PEDSnet experts manually agree on sets of condition, medication, and lab codes
  - October 2018: 184 unique LOINC codes
- Mapping
  - Map LOINC tests with >1 result above/below reference range (n=270 lab results)
    - Provide a term for all results
  - Manually mapping via Qualtrics Survey (September-December 2018)
    - 3 Pediatric Clinicians
    - 1 PhD Molecular Biologist with Pharmacology and lung disease expertise
    - 1 Master's-level Epidemiologist
  - Terms without satisfactory agreement re-reviewed with single clinician

Preview Survey

Example Survey Question

TEST: Reticulocytes/100 erythrocytes in Blood by Automated count (LOINC: 17849-1)

RESULT: Patient's lab result is lower than the reference range

Given this information, please select all the HP concepts that BEST map to the described patient's result.

- [ ] **Abnormal erythrocyte morphology (HP_0001877).** An abnormality of erythrocytes (red-blood cells).
- [ ] **Abnormality of reticulocytes (HP_0004312).** A reticulocyte abnormality.
- [ ] **Reticulocytopenia (HP_001896).** A reduced number of reticulocytes in the peripheral blood.
- [ ] **None.** There is no abnormal phenotype associated with this type of lab result.
- [ ] **Other.** If none of the provided options are correct, please provide a brief description of what phenotype(s) you would consider given this lab result. You can also browse the HP directly, here.

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Hyperlinks in each survey question point to LOINC official lab documentation

17849-1 Reticulocytes/100 erythrocytes in Blood by Automated count

NAME

Fully-Specified Name:	**Component**	**Property**	**Time**	**System**	**Scale**	**Method**
	Reticulocytes/100 erythrocytes	NFr	Pt	Bld	Qn	Automate count
Long Common Name:	Reticulocytes/100 erythrocytes in Blood by Automated count					
Shortname:	Retics/100 RBC NFr Auto					
DisplayName:	Reticulocytes/100 RBC Auto (Bld)					

PART DEFINITION/DESCRIPTION(S)

Part: Reticulocytes

Reticulocytes are immature red blood cells (RBC), comprising about 1% of the red cells in the human body. They develop and mature in the bone marrow a then circulate for about a day in the blood before developing into mature RBC. Like mature RBC, reticulocytes do not have a nucleus. They are called reticulocytes because of a reticular (mesh-like) network of ribosomal RNA that is visible under a microscope. Reticulocytes appear slightly bluer than other RBC when stained with Romanowsky stain. Reticulocytes are also slightly larger and thus can be identified as a high mean corpuscular volume during a full blood count done by machine.

Source: Wikipedia, **URL:** Reticulocytes (Wikipedia)

Part: Reticulocytes

In humans, reticulocytes are erythroid cells that have just undergone extrusion of their nucleus. They still contain some organelles that gradually decrease in number as the cells mature. Ribosomes are last to disappear. Certain staining techniques cause components of the ribosomes to precipitate into characteristic "reticulum" (not the same as the endoplasmic retuculum), hence the name reticulocytes.

Source: National Library of Medicine, MeSH 2006

MAPPING GUIDANCE

Description: Reticulocytes are reported as percents (per 100) of RBC's even if based on a count of 1000 RBC's or more. So the right term for a manual cour is [LOINC: 31112-6] regardless of the number of cells counted. However, today it is most likely that these are done by automated methods [LOINC: 17849- not manual methods.

Source: Regenstrief Help, **URL:** Mapper's Guide for the Top 2000 plus LOINC Laboratory Observations

BASIC ATTRIBUTES

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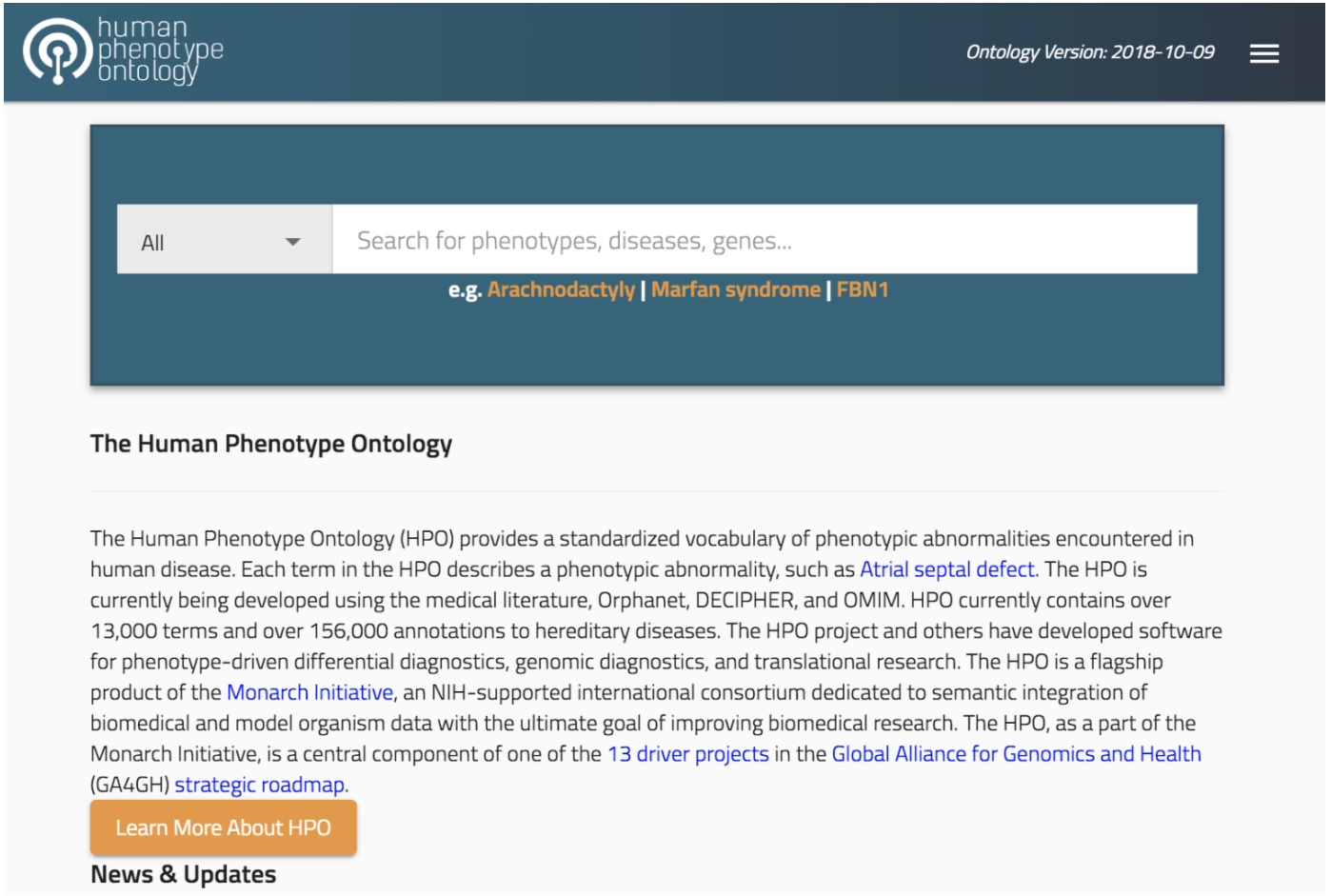
Hyperlinks in survey questions allow respondents to search for alternative HPO terms



Evaluation

- Clinician agreement
  - ⅔ agreement
- Biologist/Epidemiologist agreement
  - Did the biologist and epidemiologist agree?
  - Did either the biologist or the epidemiologist agree with at least 1 clinician?
- LOINC2HPO and Final UCDenver agreement
  - Did the final term decided by the above methods match what the LOINC2HPO method chose?

Results

OMOP	LOINC	Result	LOINC Label	Clinician 1	Clinician 2	Clinician 3	Biologist	Epidem	L2H	Final Term	Term Definition	Clin-Clin	Biol-Epi	Clin-Biol|Epi	L2H-Final	Notes
3027597	1968-7	Low	Direct bilirubin serum/plasma	None	None	None	HP:0001939 | HP:0020054	HP:0004363		HP:0004364	Abnormality of Nitrogen Compound Homeostasis	1	0	0	NA	
3010421	11558-4	Low	pH of Blood	HP:0001941	HP:0001941	HP:0001941	HP:0001941	HP:0001941	HP:0001941	HP:0001941	Acidosis	1	1	1	1	Term removed from most recent set of codes
3004501	2345-7	Low	Glucose [Mass/volume] in Serum or Plasma	HP:0001943	HP:0001943	HP:0001943	HP:0001943	HP:0001943	HP:0001943	HP:0001943	Hypoglycemia	1	1	1	1	
3020891	8310-5	High	Body temperature	HP:0001945	HP:0001945	HP:0001945	HP:0001945	HP:0001945	HP:0001945	HP:0001945	Fever	1	1	1	1	
3012501	11555-0	Low	Base excess in Blood by calculation	HP:0004360	HP:0011106	HP:0001942	HP:0001948	HP:0011106		HP:0004360	Abnormality of Acid-Base Homeostasis	0	0	1	NA	
3012501	11555-0	High	Base excess in Blood by calculation	HP:0200114	None	HP:0200114	HP:0001948	HP:0011105		HP:0200114	Metabolic Alkalosis	1	0	0	NA	Term removed from most recent set of codes
3008295	2692-2	High	Osmolality of Serum or Plasma	None	HP:0003228	None	HP:0001986	HP:0003228		HP:0011032	Abnormality of Fluid Regulation	1	0	1	NA	Osmolality doesn't appear to be in the HPO. Although osmolality tests are able to indicate a water imbalance, the test alone can be inconclusive as to which particular solute is the cause of the health problem. [Lab Tests Online:osmolality/tab/glance]
3011958	16362-6	High	Ammonia [Moles/volume] in Plasma	HP:0001987	HP:0001987	HP:0001987	HP:0001987	HP:0001987	HP:0001987	HP:0001987	Hyperammonemia	1	1	1	1	
3020891	8310-5	Low	Body temperature	HP:0002045	HP:0002045	HP:0002045	HP:0002045	HP:0002045	HP:0002045	HP:0002045	Hypothermia	1	1	1	1	
3037556	3084-1	High	TEST: Urate [Mass/volume] in Serum or Plasma (LOINC: 3084-1)	HP:0002149	HP:0002149	HP:0002149	HP:0002149	HP:0002149	HP:0002149	HP:0002149	Hyperuricemia	1	1	1	1	
3020630	2885-2	High	Protein [Mass/volume] in Serum or Plasma	HP:0002152	HP:0002152	HP:0002152	HP:0002152	HP:0002152	HP:0002152	HP:0002152	Hyperproteinemia	1	1	1	1	
3023103	2823-3	High	Potassium [Moles/volume] in Serum or Plasma	HP:0002153	HP:0002153	HP:0002153	HP:0002153	HP:0002153	HP:0002153	HP:0002153	Hyperkalemia	1	1	1	1	
3022192	2571-8	High	Triglyceride [Mass/volume] in Serum or Plasma	HP:0002155	HP:0002155	HP:0002155	HP:0002155	HP:0002155	HP:0002155	HP:0002155	Hypertriglyceridemia	1	1	1	1	
3019050	31017-7	High	Tissue transglutaminase IgA Ab [Units/volume] in Serum	HP:0002608	HP:0002608	HP:0002608	HP:0002608	HP:0002608		HP:0003261 | HP:0002608	Increased IgA Level | Celiac Disease	1	1	1	NA	The *best* answer would be Increased antibody level in blood HPO:0010702. Higher than normal value on this lab "aids the diagnosis of celiac disease" but could also be associated with other diseases (e.g. dermatitis herpetiformis is also in LOINC description)
3007164	2458-8	Low	IgA [Mass/volume] in Serum or Plasma	HP:0002720	HP:0002720	HP:0002720	HP:0002720	HP:0002720		HP:0002720	IgA Deficiency	1	1	1	NA	

Preliminary Results

- Clinician agreement (⅔ vote)
  - 95.6% (n=258) agreement

- Biologist/Epidemiologist agreement
  - Bio-Epi: 80.4% (n=217)
  - Bio|Epi-Clinician: 90.7% (n=245)

- LOINC2HPO and Final HPO Term UCDenver agreement
  - 156 mapped results overlap (113 unique LOINC codes)
    - 71.2% (n=111)
    - 36 not mapped because HPO terms were added after the survey was administered

Preliminary Results - Disagreements

- More Specific Terms Identified
  - n=2 terms
  - Example: Bilirubin.direct [Mass/volume] in Serum or Plasma (LOINC: 1968-7)
    - LOINC2HPO: HP:0002904 - Hyperbilirubinemia
    - UCDENVER: HP:0002908 - conjugated hyperbilirubinemia

- Found Potential Errors
  - n=6 terms
  - Example: International Normalized Ratio (INR) in Platelet poor plasma by Coagulation assay (LOINC: 6301-6)
    - LOINC2HPO: HP:0003540 - Impaired platelet aggregation (DEF: platelet-rich plasma)
    - UCDENVER: HP:0001928 - Abnormality of coagulation

Preliminary Results - Disagreements

- New terms not available during survey construction
  - n=36 terms
  - Example: Sesame Seed IgE Ab [Units/volume] in Serum (LOINC: 6242-2)
    - HP:0500093 - IgE-mediated food allergy
    - HP:0410228 - Increased anti-plant based food allergen IgE antibody level

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