# **Documentation for Equivalence Classes – Flowsheet Use Cases**

## **Rationale**

The equivalence classes (grouper) provide a way to aggregate sets of observations for various purposes.

This document describes producing equivalence classes that define a set of observations that are slightly different but could be displayed in a single line of a flowsheet or aggregated for other purposes, such as in Figure 1. These classes will almost always include only one distinct analyte, but ignore some or all distinctions in methods, some distinctions in specimens, etc. Thus, the tests within one class will, with group clinically similar values. Such an equivalence assumes that the individual LOINC codes and our display names are easily available via “mouse over” or a “click though on a cell” (or some other mechanism) when the flowsheet is a live display, or are included as footnotes at the bottom of the page as shown in Figure 2. The goal is to make flowsheets easier to digest (fewer rows with more data per row), and would allow an organization’s choice to reduce the effort of mapping incoming test results to tests in their local environment that may not be as precisely defined in the receiver’s environment.

In this project, we developed equivalence rules one LOINC class at a time, because we could more easily predict the results when we focused on one class at a time. LOINC terms are constructed from six different types of parts. In general, the approach we took was to first enumerate the distinct parts of each type in a given LOINC class, e.g. the method, specimen, etc. We looked especially closely at the specimen (LOINC system) and the methods together, because the clinical distinctions among some of the sets of method and specimen are small. For example, for most tests, we ignore the distinctions between plasma and blood measurements. For some LOINC classes, we lumped time tests, e.g. 4h, 12h, 24h, together, at least for some concentrations. For some LOINC classes, we ignored distinctions by method except for special LOINC cases. The equivalence classes may also mix tests with categorical values, e.g. positive, negative, and titers, e.g. 1:25L, whose meaning will not be confused with standard numerical values in the same row because their different representations. For some LOINC classes, we also equivalence quantitative titers, arbitrary concentrations, and ordinal values because the displayed values would signal whether they were a concentration, titer, or coded answer. In a few cases, we conditioned the specimen that would be equivalenced to a specific set of analytes.

So, though we equivalence arterial, capillary, venous, mixed venous blood for most chemicals, we could not do that for the analysis of oxygen saturation or oxygen content, and we used different specimen groupings for analytes with distinct values on the arterial versus the venous side of circulation. We equivalence capillary blood to arterial blood, but only for oximeter, because in the case of oxygen saturation is measured peak surge of arterial blood into the capillary bed1, 2, 3.

We have finished the first draft for microbiology, hematology, chemistry, drug/tox, serology, and urinalysis, which constitutes the majority of the lab testing content. We do not plan to address the Chemistry challenge tests (Class Chal) at all, because the tests in that class tend to be exotic, and are not congenial to grouping because they are so specialized.

We also have plans to build a unit conversion function into the table, that would convert units of the same property into a locally preferred one, and perhaps, convert some tests with a different mass/molar conversion.

## **Process we followed:**

For each class, we have extracted all of the specimen and method dimensions of the term and defined groups and subgroups via spreadsheets that contains the whole parts.

## **Notes on Our Group Labels and Symbols:**

For some classes and terms, we have a set of parts with the word ‘other” at its end. These are used to refer to all of the parts of that type, except those that are not already called out in named groups.

This document is intended for laboratory users, so we refer to the LOINC “Component,” as an “Analyte” because that is what laboratorians usually call it, and we refer to the LOINC “System” as the “Specimen” for the same reason.

We define many named groups of parts, which are “equivalent” for the purpose of this equivalence class use-case. For example, “Intravascular - any” refers to most of the intravascular specimens, e.g. blood, serum, plasma etc. (see the enumeration of the parts it contains in the Cross-Class Specimen Part Groups). So, terms that only differed by different members of the specimen group would be equivalenced. Depending on the class, we might have many sets of part equivalence groups for multiple part types, which we put under Cross-Class Part Groups. And, the same rule would apply across multiple part types, e.g. Method, Specimen, Time. We have attached a sample output in Appendix A, and you can better digest what we are doing from the example output.

## **Cross-Class Part groups used by more than one class:**

**Cross-Class Analyte Part Groups:**

* Ab and Ag: This group includes all analyte that represent antibodies and antigen tests. However, three proteins include “antigen” as an intrinsic part of their name: Prostate specific antigen, Squamous cell carcinoma antigen, and Tissue polypeptide specific antigen. We use this group to decide when to include method less tests in with the immune assay group.
* **Cross-Class Specimen Part Groups:**
* Intravascular - any: Bld, BldA, BldC, BldMV, BldP, BldV, Plas , PlasA, PlasV, Ser, Ser/Bld, Ser/Plas, Ser/Plas/Bld, Ser/Plas.ultracentrifugal
  + Comment: We do not aggregate specimens taken during catheterization from specific sites in the circulation, because they have special use in catheterization reports, the names need to be distinguished and should not be collapsed in a group
* Bld - any: Bld, BldA, BldC, BldMV, BldP, BldV,
* BLdCo - any : BldCo,BldCoA, BldCoMV,BldCoV
* DuodGastricFld : Duodenal fluid, Duodenal fluid or Gastric fluid, Gastric fluid
* OcularVitr fld: Ocular fluid, Vitreous fluid

## **Class: CHEM**

**CHEM Analyte Part Groups:**

* Oxygen-related: Oxygen saturation, Oxygen content, Oxyhemoglobin, Deoxyhemoglobin

**CHEM Specimen Part Groups:**

* Intravascular - any: See the Cross-Class specimen for the definition of this specimen group.
* Arterial\*: BldA, BldC\*
  + EXCEPTION: Only group the Arterial\* specimens when the analyte is contained in the Oxygen-related analyte group (see above for the definition of Oxygen-related).. Note also that capillary blood is arterial from the point of view of a pulse oximeter.
* Venous\*: BldV, BldMV
  + EXCEPTION: Only group the Venous\* specimens when the analyte is contained in the Oxygen-related group (see above for the definition of Oxygen-related).
* BldCo-Venous\* : BldCoV, BldCoMV
  + EXCEPTION: Only group the BldCo-Venous\* group when the analyte is contained in the Oxygen-related group (see above for the definition of Oxygen-related).
* DuodGastricFld : See the Cross-Class specimen for the definition of this specimen group
* OcularVitr fld: See the Cross-Class specimen for the definition of this specimen group

**CHEM Property Part Groups:**

* PrTitrSCnc: PrThr, Titr, SCnc
  + Comment: SCnc is the most common numeric property in this class, and we group it with Titr and PrThr because each of them will be self-distinguishing in the sequence of results in the flowsheet. We do the same kind of Property groups for the other classes for the same reason.

**CHEM Time Part Groups:**

* Timed Specimen: 10h, 12h, 18h, 1h, 24h, 2h, 48h, 4h, 5h, 6h, 72h, 8h

**CHEM Method Part Groups:**

* Chem-Method-Other: Includes all CHEM methods except for those with distinct numerical detection limits and thresholds, e.g. Detection limit <=0.005 mIU/L, Detection limit <= 5ng/L, etc.
  + Comment: This content is still under development and we will probably exclude additional methods from this coarse group.

## **Class: DRUG/TOX**

**DRUG/TOX Specimen:**

* Intravascular-any: See the Cross-Class for the definition of this specimen group
* OcularVitr fld: See the Cross-Class specimen for the definition of this specimen group

**DRUG/TOX Method:**

* Drug/Tox-Method-Other: All methods except for the DRUG/TOX methods that have Confirm, Screen or thresholds, e.g. >250mg in the Method name.

**DRUG/TOX Property:**

* PrMCnc: PrThr, MCnc

## **Class: HEM/BC**

**HEM/BC Specimen:**

* Bld-any: See the Cross-Class specimen for the definition of this specimen group
* BldCo-any: See the Cross-Class specimen for the definition of this specimen group
* DuodGastricFld: See the Cross-Class specimen for the definition of this specimen group

**HEM/BC Property:**

* PrTitrNCnc: PrThr, Titr, NCnc

**HEM/BC Method:**

* HEM-BC-Method-Any: All HEM/BC methods are grouped together.
  + Comment: We may have to revisit this decision. Definitely want to treat So, Auto + Manual and null method for cell counts as the same.

## **Class: MICRO**

**MICRO Analyte/organism:**

* STD-Causing \*: Chlamydia trachomatis, Haemophilus ducreyi, HSV, HSV1 , HSV2 , (Herpes Simplex Virus 1+2), Mycoplasma genitalium, N gonorrhoeae, Trichomonas vaginalis, Ureaplasma urealyticum+Ureaplasma, <HPV high risk>, < HPV probably high risk>, <HPV low risk>, <HPV indeterminate risk>
  + HPV high risk: E6 + E7, 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 66, 68
  + HPV probable high risk: 26, 73, 82
  + HPV low risk: 6, 11
  + HPV indeterminate risk: 69

**\***HIV not included because the specimens do not line up with the specimens of the others STD-causing organizms

**MICRO Property**

* PrACncTitr : PrThr, ACnc, Titr

**MICRO Specimen**

* Anorectral-Genital-Urinary – The following are only grouped when the analyte is one of the STD-causing organisms (see Micro Analyte group for the definition)
  + AnalRectalStool : Anal, : Anogenital Anorectal, Anorectal/Stool, Rectum, Stool
  + Genital, Genital, Genital fld
  + Genital-Female : Endometrium, Genital Lochia, Vag, Cvx, Genital mucus, Cvm, Vag+Rectrum
  + Genital-Male: Penis, Prostatic fluid, Semen (qualify by STD)
  + UrineUrethra: Urethra, Urine, Urine sediment
* BodyFluid : Body fld, XXX.body fluid
* DuodGastricFld : See the Cross-Class specimen for the definition of this specimen group
* EyeCorneaConjunctiva : Eye, Crn, Cnjt
* Intravascular - any : See the Cross-Class specimen for the definition of this specimen group
* Intravascular-any-BPU : BPU, BPU.autologous, SerPl^bpu
* Intravascular-any-donor : Bld^donor, Bone^donor, Plas^donor, Ser/Plas^donor, , Ser^donor,
* IntravascularLine: Catheter tip, Line
* LungTissue: Lung, Lung tiss
* OcularVitr fld: See the Cross-Class specimen for the definition of this specimen group
* Resp: Respiratory, Sputum
* Resp-Lower: BAL, Bronchial, Bronchial brush, Respiratory.lower, Sptt, Sputum/Bronchial
* Resp-Upper: Nose, Nph, Pharynx, Respiratory.upper, Thrt
* SmallLargeIntestineBx: TGLI/TSMI, TSMI
* Tissue: Tissue, XXX.tissue
* TubesDrains: Cannula specimen, Drain
* WoundUlcer: Wound, Wound.deep, Wound.shlw, Ulc

**MICRO Method:** For the method, we grouped stains together based on their clinical use. Please see the table for the full list of stains underneath the grouper.

* Aerobic cult: Aerobic culture, Aerobic culture 25 deg C incubation
* AFB stains – Acid fast stain, Acid fast stain, Acid fast stain.Kinyoun, Acid fast stain.Kinyoun modified, Acid fast stain. Ziehl-Neelsen, Carbol-fuchsin stain, Kinyoun stain, Night blue stain, Rhodamine stain, Rhodamine-auramine fluorochrome stain, Wade stain
* Aggl: Aggl, Aggl.rapid, Aggl.micro, HA, HAI, LA, Sheep cell aggl
* Anaerobic cult: Anaerobic culture , Anaerobic culture 25 deg C incubation
* Anthrax stain: M'Fadyean stain
  + Comment: For information only
* Blood film: Malaria smear
* Blood film – Thick: Malaria thick smear, Thick film
* Blood film – Thin: Malaria thin smear, thin film
* Chlamydia-Rickettsia stain: Macchiavello stain
  + Comment: For information only
* CSF gram negatives stain: Methylene blue stain. Loeffler, Neisser stain
* Cult: Anaerobic+Aerobic Culture, Biopsy Culture, Culture, Culture @1:100, Culture.FDA method, Cytotoxin tissue culture assay, Intravascular line culture, Organism specific culture
* Diphtheria: Alberts stain, Methylene blue stain.Loeffler, Neisser stain
* Elph : Electrophoresis, Immunoelectrophoresis, PAGE, PFGE
* EM Virus stain: Microscopy.electron, Microscopy.electron.negative stain, Microscopy.electron.thin section
* Endospore stain: Malachite green stain
  + Comment: For information only
* Fungal stains: Calcofluor white preparation, Fungus stain
* Giemsa or Acridine orange stains: Acridine orange Giemsa stain, Acridine orange stain, Giemsa stain, Giemsa stain.3 micron, Giemsa stain. May-Grunwald, Modified Giemsa, Wright Giemsa stain
* Gram stains: Crystal violet stain, Gram stain
* HBsAG stain: Orcein stain
  + Comment: For information only
* IA--IF-Null\*: CIE, EIA, EIA.RST, EMIA, IA, IA.rapid, IF, Rapid, RIA, RIPA
  + Comment: We also include null methods in this class but only when the analytes have “Ab” or “Ag” in the name. See the Cross-Class Analyte group for the definition of this group.
* IB\*: IB, IB.test strip
* Immune diffusion: ID, Immune diffusion
* Intestinal parasite stains: Brilliant cresyl blue, Safranin stain, Trichrome stain modified, Trichrome stain, Trichrome stain, Gomori-Wheatley, Trichrome stain.Masson, Trichrome stain.Masson modified
* Leprosy stain: Fite-Faraco stain
  + Comment: For information only
* Light microscopy: Microscopy.light, Microscopy.light.HPF, Microscopy.light.LPF
* Molecular genetics: Amplification/Sequencing, Molgen, Probe.amp, Probe.amp,sig, Probe.amp.tar, Probe.mag capture, Sequencing
* PCP and yeast: Methenamine silver nitrate stain, Methenamine silver stain.Grocott, Methenamine silver stain.Jones
* Resp Cult: ARDS Cult, CF Resp Cult, Resp Cult
* Seratia species: Methyl green stain, Methyl green-pyronine Y stain
* Silver stains: Silver impregnation stain.Dieterle, Silver nitrate stain, Silver stain, Silver stain.Fontana-Masson, Silver stain.Grimelius, Steiner stain, Warthin-Starry stain
* Skin Fungi: KOH Preparation
  + Comment: For information only
* Viral cult: Shell vial culture
* Viral smear-HSV+VZV: Tzanck smear
  + Comment: For information only
* Yersinia pestis stains: Wayson stain
  + Comment: For information only

## **Class: SERO**

**SERO Specimen:**

* Intravascular – any: See the Cross-Class specimen for the definition of this specimen group.

**SERO Property:**

* PrTitrACnc: Presence or Threshold, Titer, Arbitrary Concentration

**SERO Method:**

* SERO-Aggl: Aggl, Adult RBC Aggl, Cord RBC Aggl, Latex agglutination, Sheep Cell Agglutination
* IA-IF-Null\*: see MICRO for the definition of this method grouper
  + Comment: We also include null methods in this class but only when the analytes have “Ab” or “Ag” in the name. See the Cross-Class Analyte group for the definition of this group.
* SERO-Molecular genetics: molecular genetics, RFLP
* SERO—Method-Other: all methods found in the serology class except those that depend on temperature (18 deg C inc, 22 deg C inc, 28 deg C inc, 30 deg C inc, 37 degree C incubation, 4 deg C inc, Cold).

## **Class: UA**

**UA System:**

* UrUrnS: Urine, Urine sediment

**UA Property:**

* PrNaric: PrThr, Naric

**UA Method:**

* UA-MicroscopyCount: Microscopy, Microscopy.light, Microscopy.light. HPF, Microscopy.light.LPF, Auto, Automated, Automated count, Computer assisted, Manual Count
* UA-Fat stain: Oil red O stain, Sudan IV stain
* Refractrometry: Refractrometry, Refractrometry.automated
* Strip: Test strip, Test strip.automated

## **GROUP Tallies by Class**

In this draft output, here are the grouping numbers for each class:

* CHEM: 989 tests grouped into 384 groups, with 8976 tests left ungrouped
* DRUG/TOX: 2677 tests grouped into 1240 groups, with 5170 tests left ungrouped
* HEM/BC: 1072 tests grouped into 434 groups, with 1154 tests left ungrouped
* MICRO: 5576 tests grouped into 2215 groups, with 6195 tests left ungrouped
* SERO: 1179 tests grouped into 472 groups, with 1505 tests left ungrouped
* UA: 313 tests grouped into 92 groups, with 135 tests left ungrouped

# **Sources**

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