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 through 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 bed[1, 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 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. We exclude panels always.

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.

Exclude panels from the process

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

Cross-Class Analyte ("COMPONENT") Part Groups:

> Ab and Ag: This group includes all analyte that represent antibodies (Ab) and antigen tests. (Note however, three proteins include "antigen" (Ag) as an intrinsic part of their name: Prostate specific Ag, Squamous cell carcinoma Ag, and Tissue polypeptide specific Ag. These three are really names of chemicals and not antigens to the chemical.) We use this group to decide when to include methodless tests in with the immune assay (IA) group. We use this category to put immunology test that are the same except without a method together with the IA method for the AG or the AB test respectively

Cross-Class Specimen ("SYSTEM") Part Groups:

- Intravascular-any: Bld, BldA, BldC, BldMV, BldP, BldV, Bld.dot, Plas , PlasA, PlasV, Ser, Ser/Bld, Ser/Plas, Ser/Plas/Bld, Ser/Plas.ultracentrifugal- With a few exceptions we equivalence tests with any of these specimen types

- Bld-any: Bld, BldA, BldC, BldMV, BldP, BldV. We equivalence tests that care about the cells in blood with any of these specimen types. We treat cord blood (Taken out of the umbilical cord at birth) differently because it has somewhat different content.

- BLdCo-any : BldCo,BldCoA, BldCoMV,BldCoV

- DuodGastricFld : "Duod fld/Gast fld", "Duod fld", "Gast fld" (These are close to the same in most cases

- OcularVitrFld: Ocular fluid, Vitreous fluid (these are close to identical)

Cross-Class Scale Part Groups
- OrdNomNarDoc: Ord, Nom, Nar, Doc
    - Narrative, document – these end up being a document without pre-specified in coded structure
    - ORD and NOM– assume most will be distinguished by other properties. Both of these data types have coded answers. ORDs' are usually yes/no, or rare, few, many, loaded. Noms are us usually names of things identified by the study. They will not be confused in the row of a flowsheet. However the component will almost always be different enough that they won't collapse into one row.

Class: ALLERGY

ALLERGY Specimen ("SYSTEM") Part Groups:
- <u>Intravascular - any</u>: See the Cross-Class specimen for the definition of this specimen group.

ALLERGY Method Part Groups:
- Equivalence all methods (including NULL method)

ALLERGY Property Part Groups:
- PrThrACnc: PrThr and ACnc. (This assumes the users just want to know whether the subject has allergies to the compounds in question. Terms with Mass concentrations and percent's will still be distinguished because mixing the numeric values will not make sense.)

ALLERGY Scale Part Groups:
- Use Cross-Class Scale group OrdNomNarDoc, except when the word "RAST" appears in the component. (This may have no effect due to distinctions among other properties.)

Class: Antibiotic susceptibility (ABXBACT)

ABXBACT Method Part Groups:
- <u>Method-Other</u>: Equivalence all methods (including NULL) except:
    - "Genotyping"
    - "Method for Slow-growing mycobacteria"

ABXBACT Property Part Groups:
- Equivalence all properties. (Almost all are already mixes of OrdQn.)

ABXBACT Scale Part Groups:
- <u>Scale-other</u>: All values except Nom

Class: Blood bank (BLDBK)

There do not seem be opportunities for this class, so it is left as-is.

Class: CELLMARK

CELLMARK Method Part Groups:
- Equivalence all methods (including NULL)

CELLMARK Scale Part Groups:
- Use Cross-Class Scale group OrdNomNarDoc

CELLMARK Specimen ("SYSTEM") Part Groups:
- <u>Intravascular - any</u>: See the Cross-Class specimen for the definition of this specimen group.

NOTES TO RI:
- Should see if we can take advantage of panels. If there is not much overlap will provide a nice organization of flowsheet.

Class: CHEM

CHEM Analyte ("COMPONENT") Part Groups:

At present we are not distinguishing glucose tests done on blood vs ser.plas, though maybe we should, and likewise for the different colorimetric methods for protein.

The "Oxygen-related" group should not be applied for the purpose of grouping the COMPONENT values. It is only for use in in conjunction with the rules for "SYSTEM" below.

- **Oxygen-related**: Oxygen, Oxygen saturation, Oxygen content, Oxygen capacity, Oxyhemoglobin/Hemoglobin.total Oxyhemoglobin, Deoxyhemoglobin, Deoxyhemoglobin/Hemoglobin.total. Components should be included in this group even when they include sub-parts (i.e., ^ characters). (This group is only used in conjunction with the rules for "SYSTEM" below.)

CHEM Specimen ("SYSTEM") Part Groups: Lump the categories' described below the results will remain independent
- <u>Later</u>- will want to highlight intravascular specimens whose component is Gluose(exactl) se that are Ser or Ser/plas. Will require setting a flag in the table. Will not tackle that now.

- <u>Arterial*</u>: BldA, BldC, BldCoA
    - ○ 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.

- <u>Venous*</u>: BldV, BldMV, BldCoV, BldCoMV
    - ○ EXCEPTION: Only group the Venous* specimens when the analyte is contained in the Oxygen-related group (see above for the definition of Oxygen-related).

- <u>Intravascular - any</u>: See the Cross-Class specimen for the definition of this specimen group.

    - ○ EXCEPTION: Do not apply when the analyte is in the Oxygen-related group.

- <u>DuodGastricFld</u> : See the Cross-Class specimen for the definition of this specimen group

- <u>OcularVitr fld</u>: See the Cross-Class specimen for the definition of this specimen group

CHEM Property Part Groups:
These combine parts with comparable Mass and substance properties, which requires conversion using the appropriate molecular weight for the analyte.

LOINC also includes Catalitic properties, but these are quite different and would not be combined with the M* and S* properties. However, there could be scaling issues with respect to units in the same row just as there could be with mass and molar weights.

- MCnt and SCnt
- MFr and SFr
- MRto and SRto
- MRat and SRat
- Mass and Sub
- EntMass and EntSub (however almost all of the terms with Ent properties are EntSub)
- MFr.DF and SFr.DF
- MCDiff and SCDiff
- MCncSq and SCncSq
- MCrto and SCrto
- RelMCnc and RelSCnc
- RelMRat and RelSRat

CHEM Time ("TIME_ASPCT") Part Groups:
- <u>TimedSpecimen</u>: 10h, 12h, 18h, 1h, 24h, 2h, 48h, 4h, 5h, 6h, 72h, 8h

CHEM Method Part Groups:

- <u>Method-Other</u>: Includes all CHEM methods (and blank ones) except:
  "Detection limit*", "High sensitivity method", "screen*", "Confirm*"
  ("screen*" will show up for DRUG/TOX, but not for CHEM)

Class: COAG
COAG Specimen ("SYSTEMCORE") Part Groups:
- <u>Intravascular - any</u>: Bld, BldC, Plas, PPP, PPP/Bld, PRP, Ser, Ser/Plas

- All Super System terms (the text after a ^) should be distinguished. In other words, treat system and super system as unit (e.g. "PPP^control") so that different super systems won't be mixed.
  - NOTE: There is a case discrepancy between what's in the Part Super System terms which are capitalized (i.e. Control) vs what's in LOINC which is not capitalized (i.e. PPP^control)

COAG Method Part Groups:
- Method-Other: equivalence everything (including NULL methods) except Thromboelastography

COAG Property Part Groups:
- PrTitrACnc: Pr, Titr, ACnc

COAG Scale Part Groups:
- Treat them all the same--the content will speak for itself

Class: CYTO

CYTO Specimen ("SYSTEM") Part Groups:
- Genital-Female: Cvx/Vag, Vag, Cvx
- Resp-Lower: BAL, Bronchial, Bronchial brush, Sputum

CYTO Scale Part Groups:
- Equivalence all scales.

CYTO Component Part Groups:
- MicroCyto: Microscopic observation, Cytology report

Class: DRUGDOSE

Fine as is.

Class: DRUG/TOX

Follow rules for class CHEM, except:

DRUG/TOX Scale Part Groups:
- Use Cross-Class Scale group OrdNomNarDoc

Class: FERT

FERT Method Part Groups:
- Equivalence all methods, including NULL methods.

FERT Scale Part Groups:
- Use Cross-Class Scale group OrdNomNarDoc

Class: HEM/BC

HEM/BC Specimen ("SYSTEM"):
- 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:
- PrThrTitrNCnc: PrThr, Titr, NCnc

HEM/BC Method:
- HEM-BC-Method-Any: No HEM/BC methods are distinguished so all tests of one kind will be in the same group regardless of the methods.

Class: MICRO

MICRO Analyte/organism ("COMPONENT")
- <u>STD-Causing</u> *: 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>
    - <u>HPV high risk</u>: E6 + E7, 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 66, 68
    - <u>HPV probable high risk</u>: 26, 73, 82
    - <u>HPV low risk</u>: 6, 11
    - <u>HPV indeterminate risk</u>: 69

    Patterns for STD-Causing, for "COMPONENTCORE" (% means wildcard):

    1. %HPV E6+E7%
    2. Chlamydia%
    3. Haemophilus ducreyi
    4. Herpes simplex virus%
    5. Human papilloma virus%
    6. Mycoplasma genitalium
    7. Mycoplasma sp%
    8. Neisseria gonorrhoeae
    9. Trichomonas sp
    10. Trichomonas vaginalis
    11. Ureaplasma%

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

MICRO Property
- <u>ACncTitr</u>: ACnc, Titr

MICRO Specimen ("SYSTEM")
- <u>Anorectal-Genital-Urinary</u> – The following are only grouped when the analyte is one of the STD-causing organisms (see Micro Analyte group for the definition)
    - <u>AnalRectalStool</u>: 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
- <u>BodyFluid</u> : 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.
- 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

    o 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

    o 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

  o 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

  o Comment: For information only

- IA-IF-Null*: CIE, EIA, EIA.RST, EMIA, IA, IA.rapid, IF, Rapid, RIA, RIPA

  o 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

  o 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

  o Comment: For information only

- Viral cult: Shell vial culture

- Viral smear-HSV+VZV: Tzanck smear

    o Comment: For information only

- Yersinia pestis stains: Wayson stain

    o Comment: For information only

Class: MOLPATH – excludes MOLPATH.MISC

MOLPATH Specimen ("SYSTEM"):
- Amn: Amnio fld, Amnio fld/CVS, CVS, Tiss^Fetus, POC
- Bld: Bld, Bld/Tiss, Bld/Bone mar, Bone mar, Buccal, Cells.XXX
- Keep the somatic specimens as is:
    o Cancer specimen
    o Breast cancer specimen
    o Stool
    o CSF
    o Urine
    o Plas

Class: SERO

SERO Specimen ("SYSTEM"):
- Intravascular-any: See the Cross-Class specimen for the definition of all this specimen group.

SERO Property:
- PrThrTitrACnc: PrThr, Titr, ACnc (Presence or Threshold, Titer, Arbitrary Concentration). The distinctions among these 3 should be obvious in a flowsheet and they can be disaggregated to show them separately when needed.

SERO Method:
- Aggl: Aggl, Aggl.adult RBC, Aggl.cord RBC, LA, Sheep cell aggl; ("LA" = "Latex agglutination")

- IA-IF-Null*: see MICRO for the definition of this method grouper

    o 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.

- Molecular-genetics: Molgen, RFLP probe

- Method-Other: Lump all other methods including null method 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 sed

UA Property:

- <u>PrThrNaric</u>: PrThr, Naric

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

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