



# Integrating the SNOMED CT and AMT drug models, revisited

Michael Lawley | 2019 11 01

Australia's National Science Agency

3-(4-methylbenzylidene)-camphor	(substance)
Alpha-tocopherol	(substance)
Aminolevulinic acid	(substance)
Ammonium bicarbonate	(substance)
Benzathine benzylpenicillin	(substance)
Benzathine benzylpenicillin tetrahydrate	(substance)
Bicarbonate	(substance)
Cade oil	(substance)
Calcium carbonate	(substance)
Camphor	(substance)
Carbonate	(substance)
Catridecacog	(substance)
Chalk	(substance)
Chloroxylonol	(substance)
Chlorphenesin	(substance)
Choriogonadotropin alfa	(substance)
Corifollitropin alfa	(substance)
D-alpha-tocopherol	(substance)
Danaparoid sodium	(substance)
Dimeticone 350	(substance)
Drotrecogin alfa (activated)	(substance)
Eftrenonacog alfa	(substance)
Etoposide	(substance)
Etoposide phosphate	(substance)
Factor VIII	(substance)

# History - 2012

- AMT v2, NOT part of SNOMED CT-AU
- Original Int. drug model
- Replace AMT substances with INT substances
- “align” relationship types
- Classify
- Evaluate (inspect to see what works & what breaks)

## Model alignment

AMT	SNOMED CT
Substance	Substance
Medicinal Product	Pharmaceutical / biologic product
container type, form (Australian qualifier)	Physical object
has Ingredient, ...	Has active ingredient

## Substance mapping

Details in "Development approach for reference sets", 2012-08-31

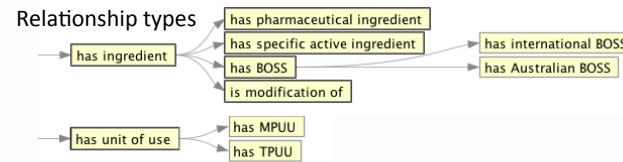
Domain of use: decision support

- potential allergies
- drug-drug interaction
- drug-disease interaction

Scope: AMT Substances actually used in an AMT Product

...	referencedComponentId	valueId	stringValue
	2447011000036100	Equivalent	385544005
	2448011000036100	Equivalent	421559001
	2449011000036100	Equivalent	395823000
	2450011000036100	Equivalent	409159000
	2451011000036100	Generalise	409159000

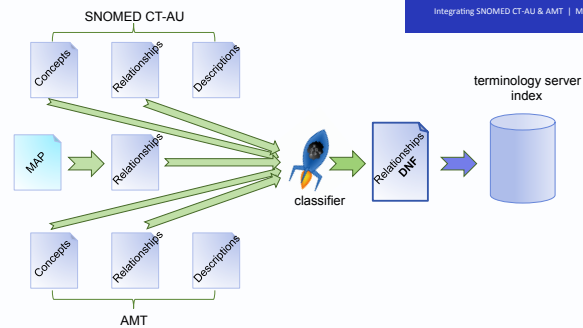
## The AMT V2 Model



Essentially everything is *primitive*

- (conservative modelling)

## Building the integrated termin



- ? 412546005 | Sodium citrate |
- plant product
- mapping relationship is wrong
- not caught by mapper review (see poster)
- flagged as a result of classification

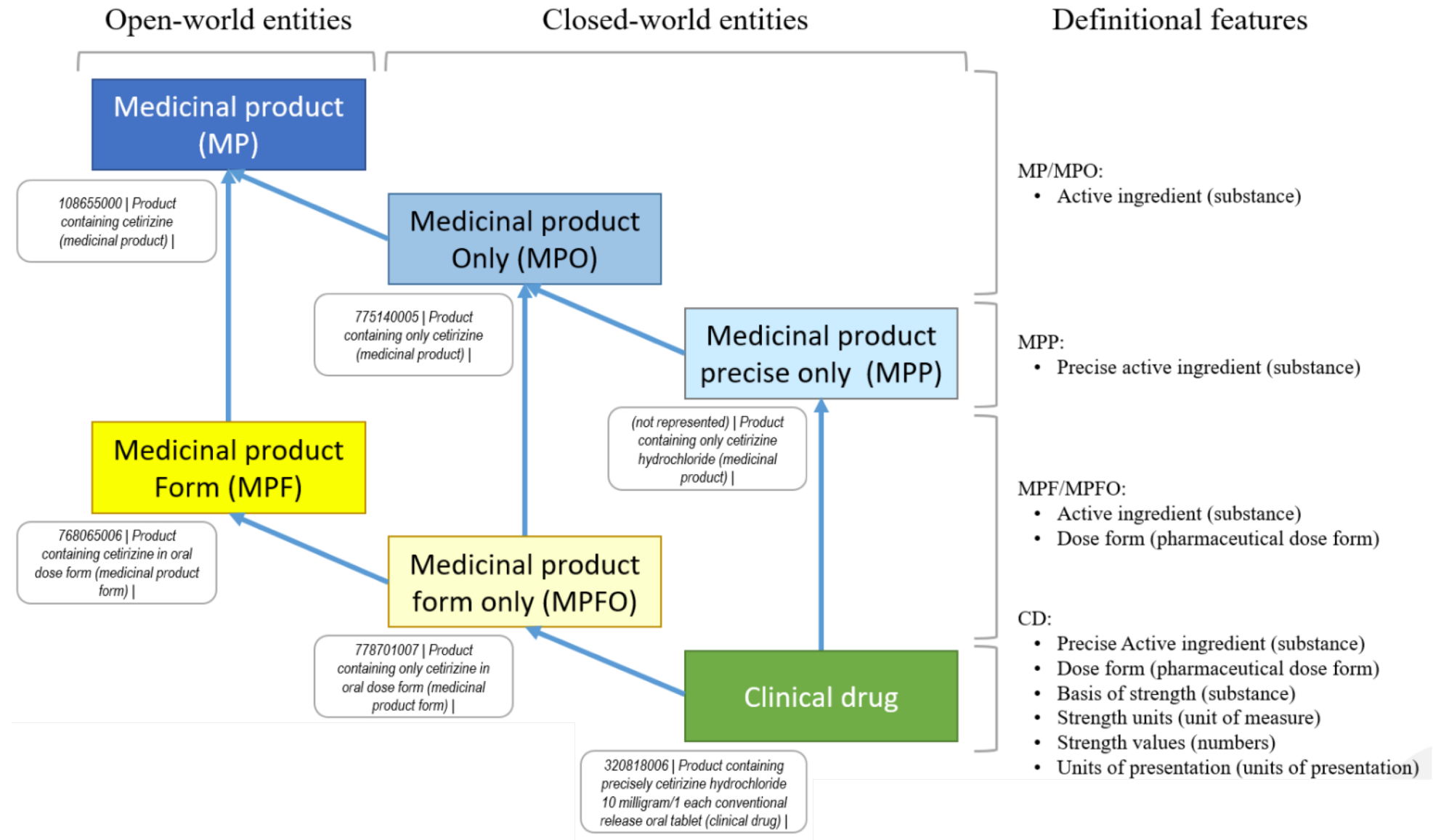


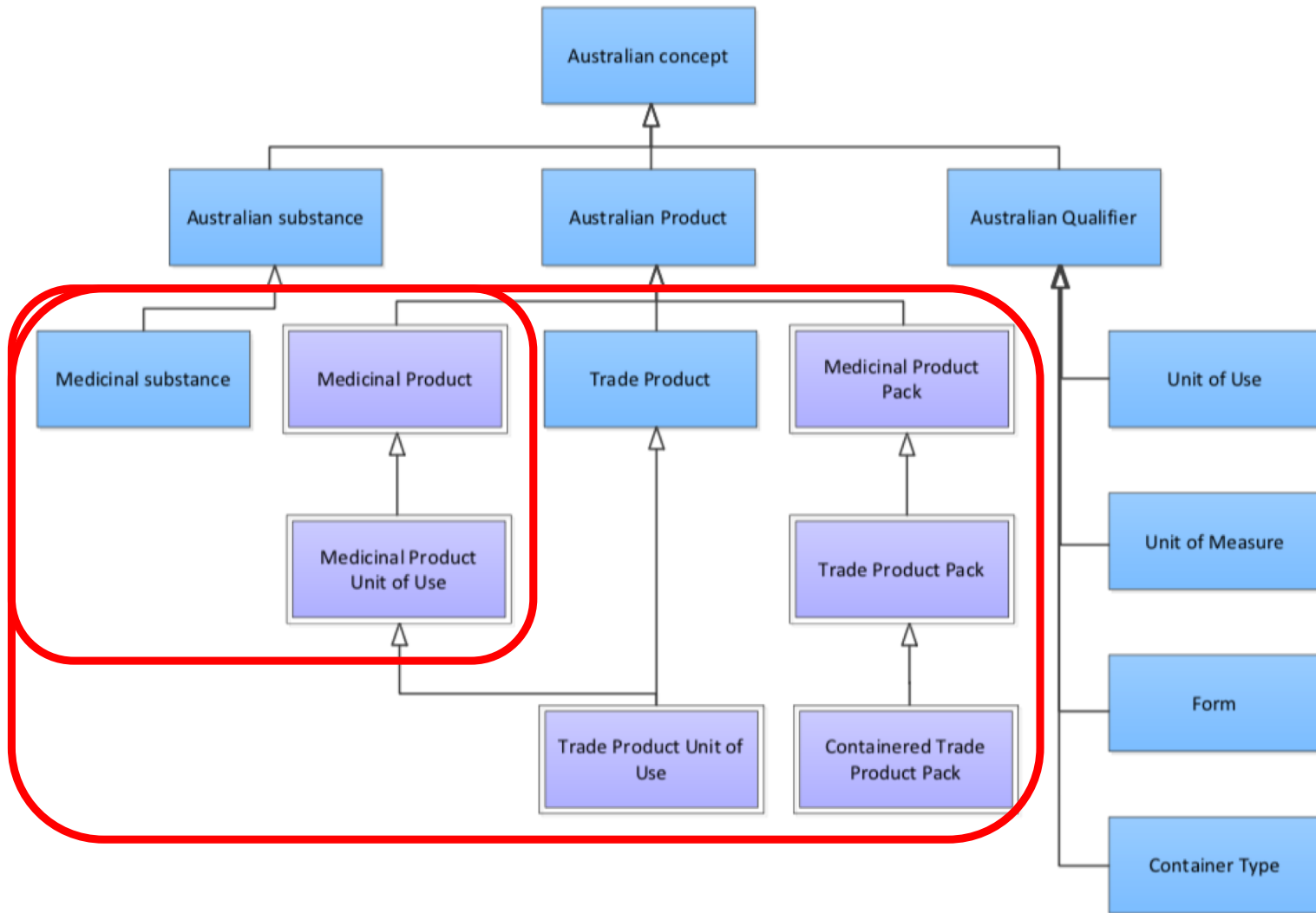
# History - 2012

- Limited value due to primitive modelling in AMT v2
- Anticipated to be resolved in AMT v3 (then in progress)
- Key challenges
  - Non-disjoint substances in Int. model
  - Lack of strength modelling
  - Lack of clarity re “has ingredient” semantics

# Six\* years later

- AMT v3 since 2014, integrated with SNOMED CT-AU
- Concrete domains
- Fully defined medication concepts
- New Int. medications model inching closer





# Model alignment

Boxes do not exactly align

Separate vs combined numerator/denominator

- Can be handled mechanically

Strengths / quantities vary between jurisdictions

- How are these chosen at International level?

GCI will aid integration / mitigate modelling style

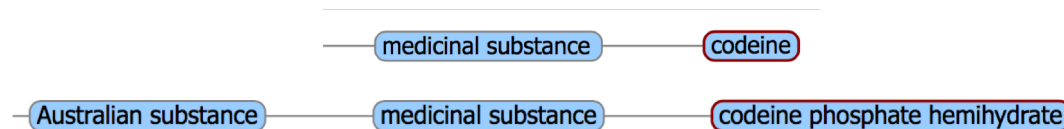




# Substances and substance classes

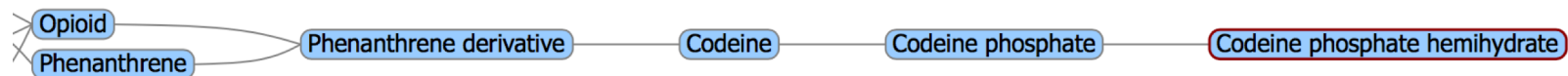
## AU Substances:

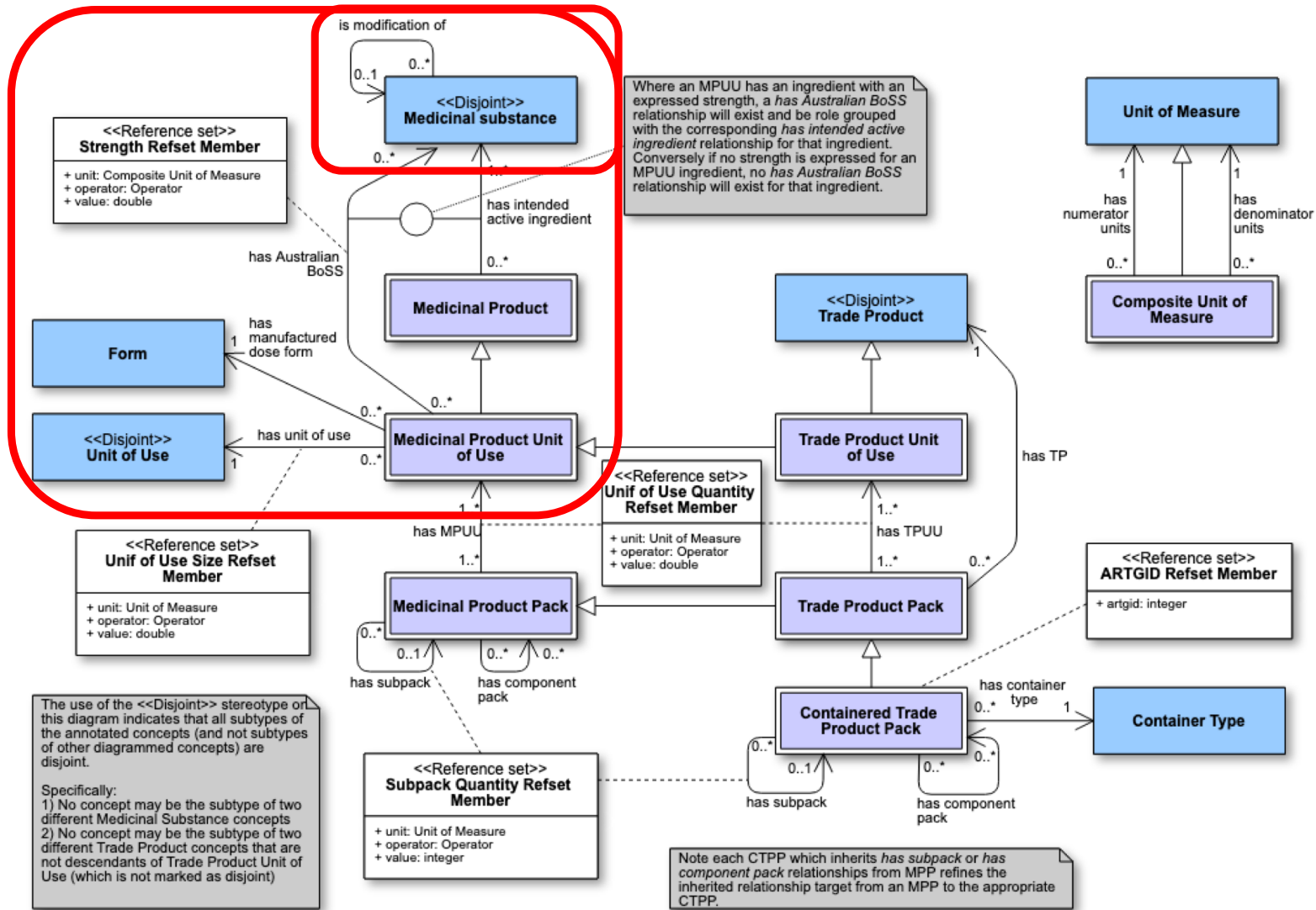
- disjoint
- no substance classes, groupers, etc



## International substances:

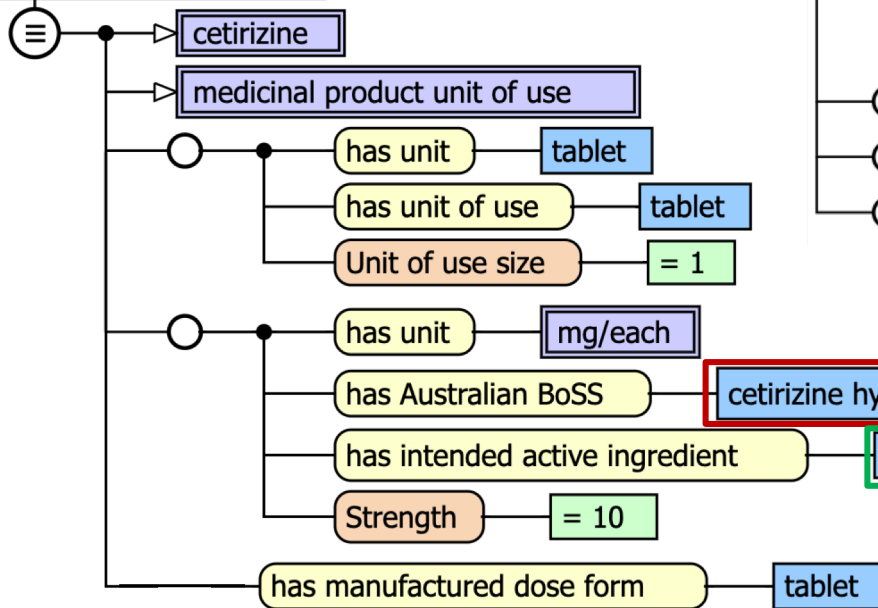
- not disjoint\*
- has substance classes, groupers, etc
- links from Clinical Findings e.g., causative agent



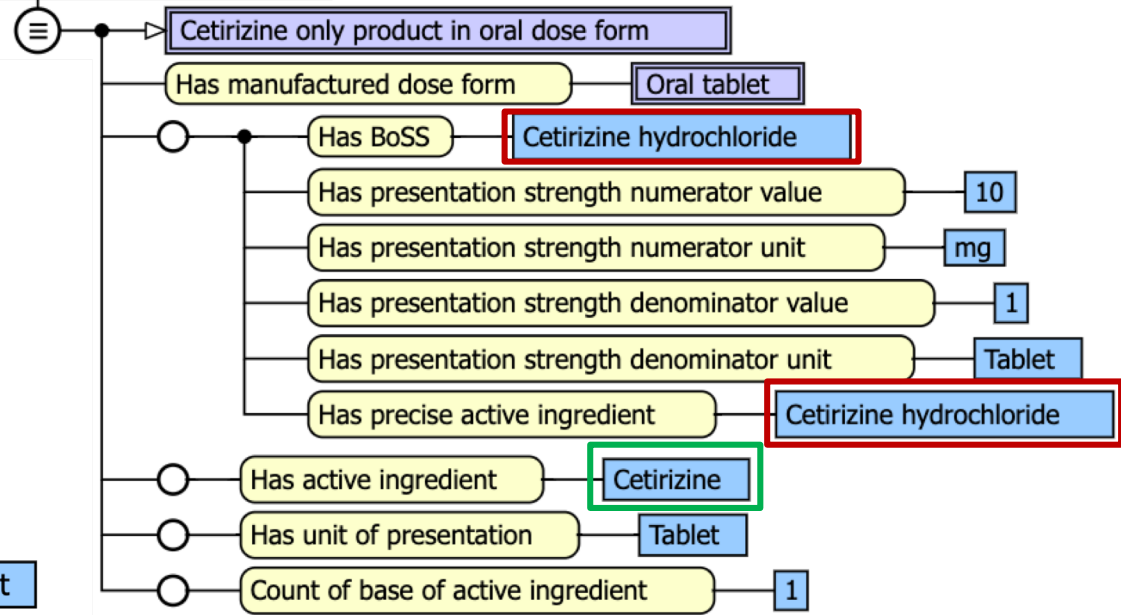




cetirizine hydrochloride 10 mg tablet



Cetirizine hydrochloride 10 mg oral tablet



# Goal

Can we **automatically**:

- distinguish “*real*” Int. substances from groupers,
- update their modelling (re-parent them),
- substitute them for AU substances



# AU Substance map

From AU Substance to International Substance  
Constructed lexically (mostly)

Does not account for modelling conflicts

- calcium carbonate (AU substance) == Calcium carbonate (substance)
- calcium (AU substance) == Calcium (substance)
- BUT Calcium carbonate (substance) ISA Calcium (substance)
- AND calcium carbonate (AU substance) DISJOINT WITH calcium (AU substance)

Includes some broader-than maps

- (“target generalises source”)



# Integration heuristics

1. Int. substances that are targets of map are “real” (not groupers)
2. If have children, change the ISA relationships to point at nearest ancestor that is not a target of the map (i.e., not a grouper)
3. Optionally add an isModificationOf relationship from old child to old parent
4. Replace all AU substances in the relationships file with the corresponding Int. substance (OR: Add an equivalence axiom between each of the substance codes)



# Illustrative example\*

INT has hierarchy:

ACE Inhibitor	ISA	Substance
Enalapril	ISA	ACE Inhibitor
Enalapril sulphate	ISA	Enalapril
Enalapril nitrate	ISA	Enalapril

AU has:

Enalapril (AU)	ISA	Substance AU
Enalapril sulphate (AU)	ISA	Substance AU
Enalapril carbonate (AU)	ISA	Substance AU

Map has:

Enalapril (AU)	Equivalent To	Enalapril
Enalapril sulphate (AU)	Equivalent To	Enalapril sulphate

\* Invented modified forms



# Illustrative example

Then transformed relationships are:

ACE Inhibitor	ISA	Substance
Enalapril	ISA	ACE Inhibitor
Enalapril sulphate	ISA	ACE Inhibitor
Enalapril sulphate	isModificationOf	Enalapril
Enalapril nitrate	ISA	ACE Inhibitor
Enalapril nitrate	isModificationOf	Enalapril
Enalapril carbonate	ISA	Substance





# After classification

Query Expression:

[ [help](#) ] [ [spec](#) ]

```
* : 246075003 |Causative agent| =  
  < 30344011000036106 |Australian substance|
```

Showing 1 to 10 of 3961 rows

[Download](#)

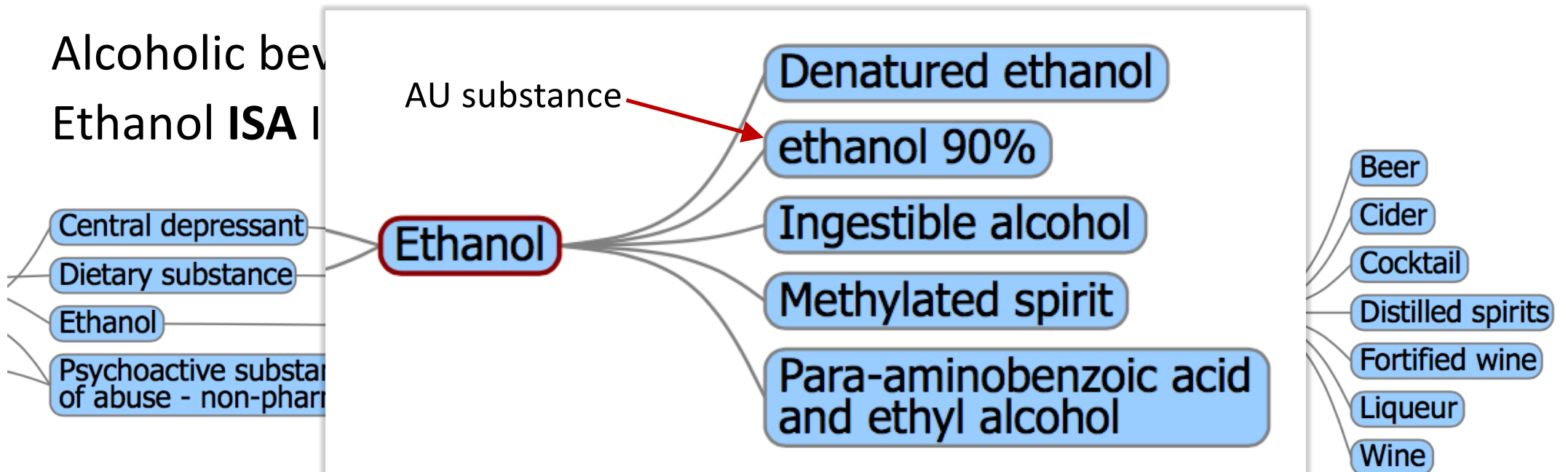
CODE	DESCRIPTION
291857001	Thyroxin poisoning of undetermined intent
290498007	Accidental thiopental sodium poisoning
724697004	Abuse of nicotine
60199004	Methadone poisoning
293650007	Cimetidine allergy
129638002	Haemolytic anaemia due to hyperbaric oxygen
291568009	Cefazolin poisoning
290787007	Levodopa poisoning of undetermined intent
293074006	Cycloserine adverse reaction
294867005	Factor XIII products allergy



# On inspection

Non-grouper substances should not have children?

Alcoholic bev  
Ethanol ISA I



## Later that year...

- Int. substance hierarchy updated in 20180731
  - Substance problem solved!
  - ?
  - Let's check...
- 
- If we're done, then no "real" substances will violate disjointness requirement



# Analysis

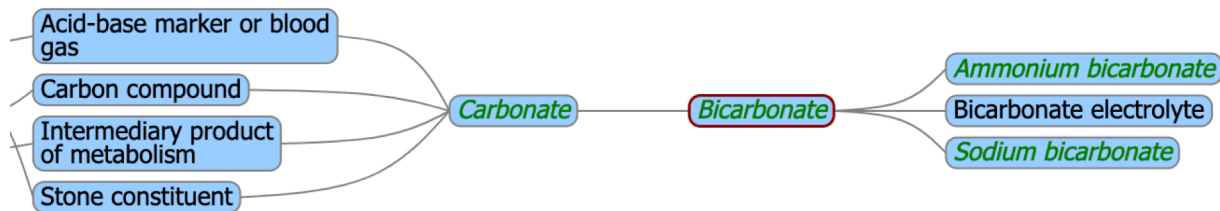
“real” substances that are descendants of other “real” substances

Version (AU)	Count
20180131	443
20190630	94

The 94 are descendants of just 58 Int. substances

Big improvement, and a manageable todo list

# Examples



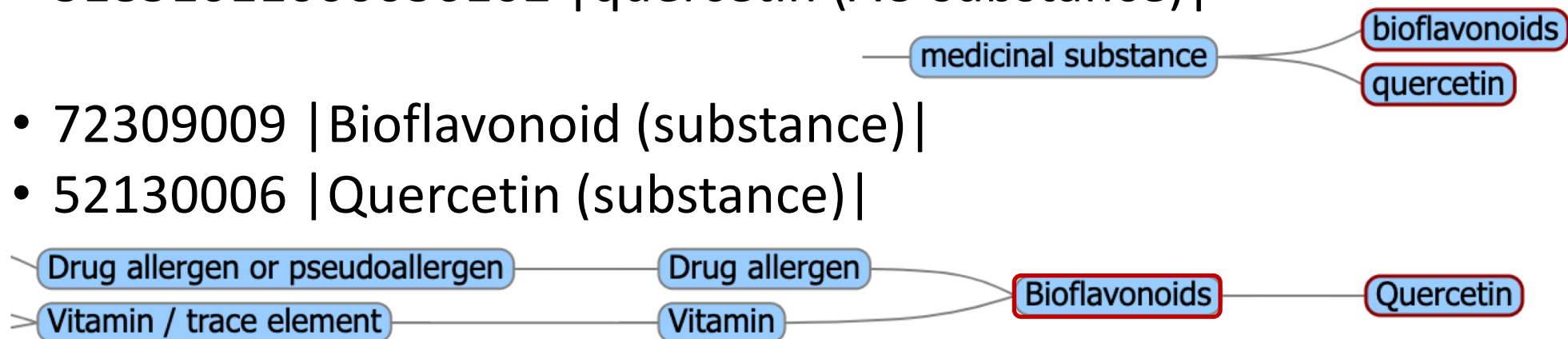
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Etoposide phosphate	(substance)
Factor VIII	(substance)

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# Analysis

- 30838011000036101 | bioflavonoids (AU substance) |
- 31851011000036102 | quercetin (AU substance) |
- 72309009 | Bioflavonoid (substance) |
- 52130006 | Quercetin (substance) |





Ana...

- 308380110

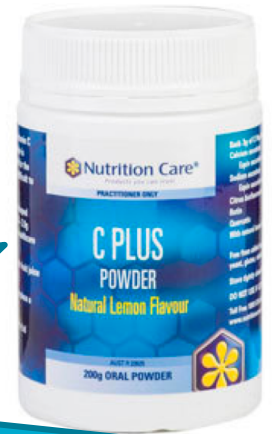
- 7230900

- 521

Drug allergen or pseudo

Vitamin / trace element

C Plus (Nutrition Care) (ascorbic acid 724.2 mg / 1 g + bioflavonoids 50 mg / 1 g + quercetin 30 mg / 1 g + rutoside 50 mg / 1 g) powder for oral liquid



oids

erctin

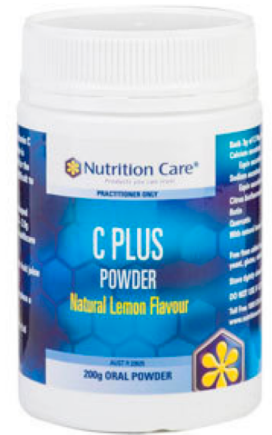
avonoids

Quercetin

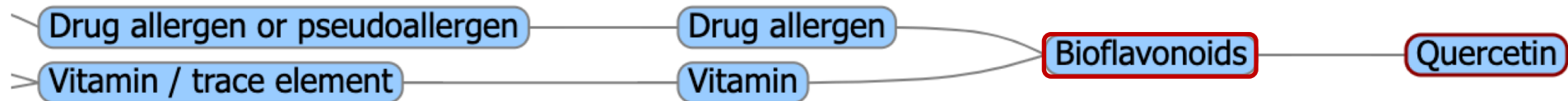


# Analysis

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- 31851011000036102 | quercetin (AU substance) |



- 72309009 | Bioflavonoid (substance) |
- 52130006 | Quercetin (substance) |



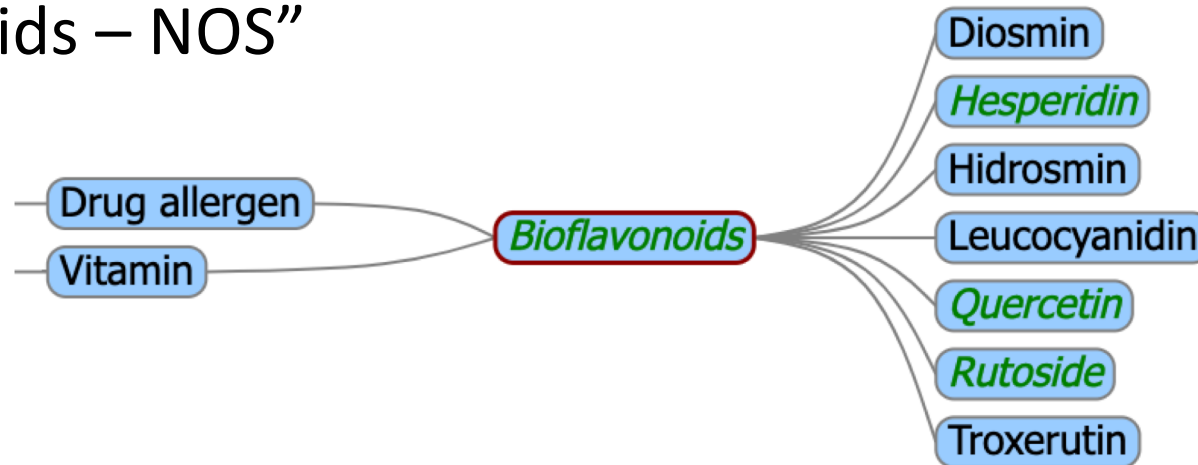
- 922039011000036104  
| ascorbic acid + **bioflavonoids** + **quercetin** + rutoside |





# Analysis

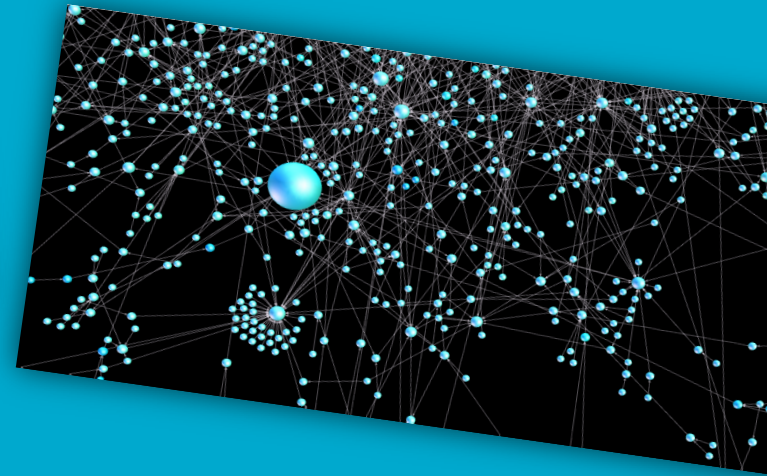
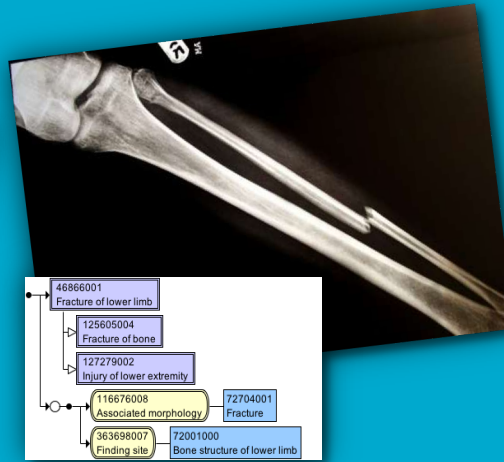
- INT bioflavonoids is a class; not “real”
- AMT bioflavonoids is some kind of “bioflavonoids – other” or “bioflavonoids – NOS”



130 mg bioflavonoids total, with quercetin 30 mg + rutoside 50 mg

# Contemporaneous work

- 2019, McMurtrie & Bodenreider
  - AMT v3, RxNorm, new Int. drug model
  - Very ambitious and comprehensive
  - Uses
    - AU-Int. Substance map
    - Concrete domains
    - General Concept Axioms (GCAs)
  - **Very** promising results
  - On the cusp of useable & useful internationally interoperable terminology



# Thank you

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