ICD10PCS to SNOMED standardization

The problem: Standardization

HCPCS
Bone marrow aspiration performed with bone marrow biopsy through the same incision on the same date of service

ICD-9-Proc
Aspiration of bone marrow from donor for transplant

CPT-4
Bone marrow; aspiration only

SNOMED
Aspiration of bone marrow from donor for transplant

READ
Aspiration of bone marrow NEC

OPCS4
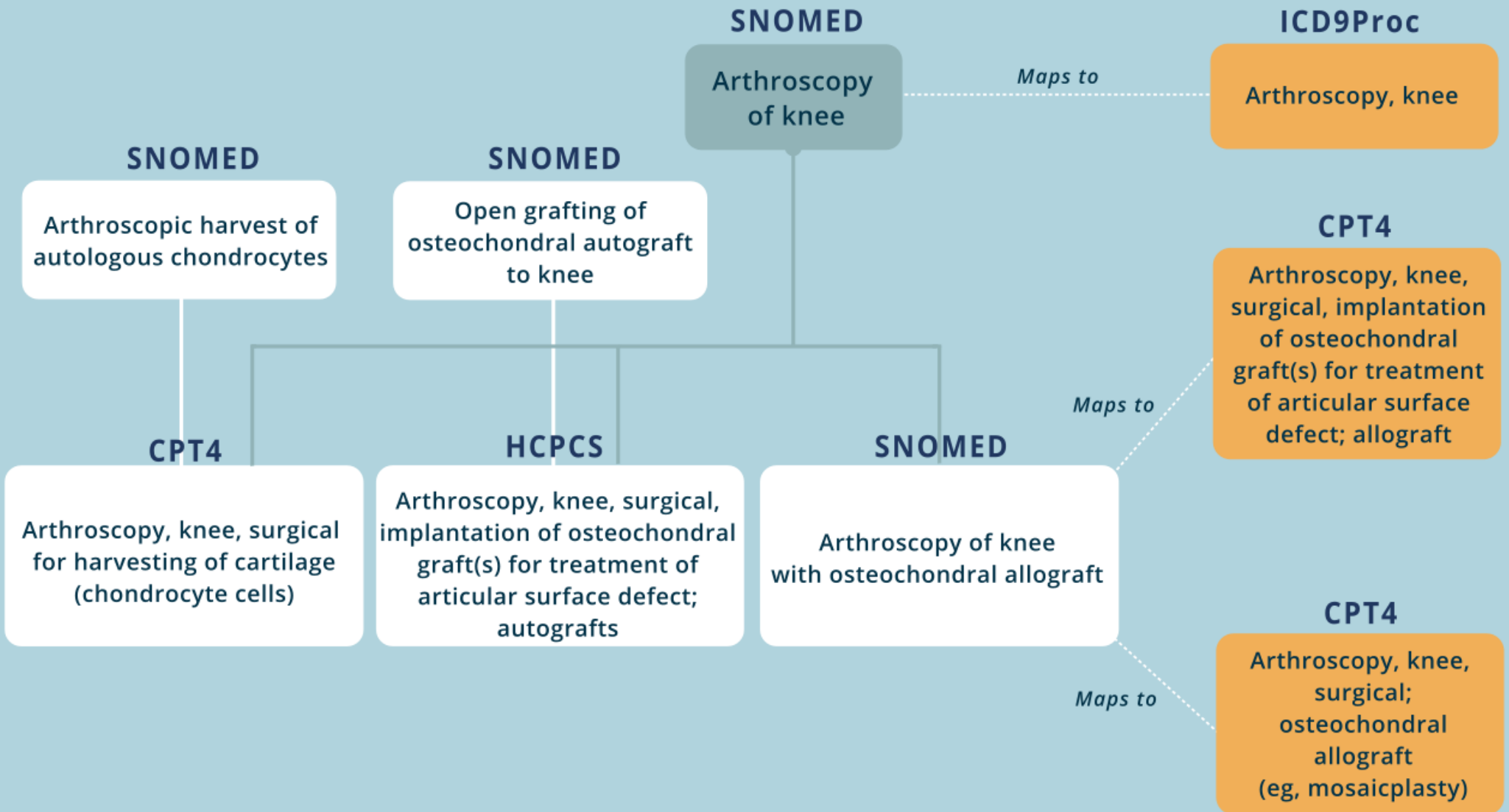Diagnostic extraction of bone marrow NEC

OPS
Bone marrow aspiration

Undergone aspiration of bone marrow

SNOMED CT is the common target for standardization.

Solution: comprehensive hierarchy

Idea behind ICD10PCS

- ICD10PCS has 7 attributes (body sites, surgical approach, type of device or drug used)

0D16479 Bypass Stomach to Duodenum with Autologous Tissue Substitute, Percutaneous Endoscopic Approach

0. Medical and Surgical
D. Gastrointestinal System
1. Bypass
6. Stomach
4. Percutaneous Endoscopic
7. Autologous Tissue Substitute
9. Duodenum

Out of ~80 000 codes, only 40 000 exist.

Examples:
00UM3JZ Supplement Facial Nerve with Synthetic Substitute, Percutaneous Approach
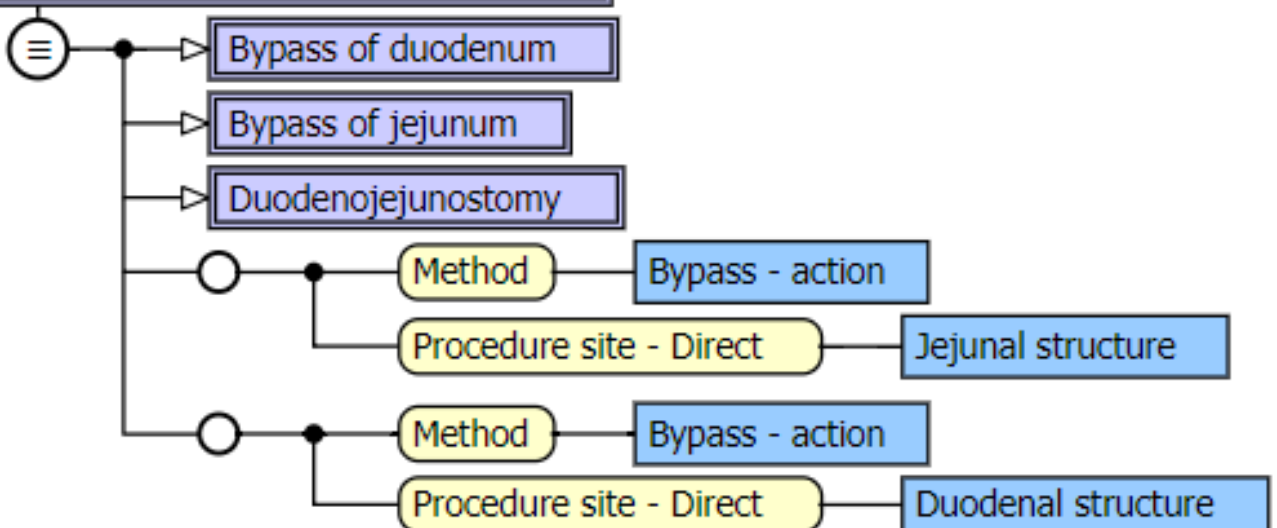**3E0604Z** Introduction of Serum, Toxoid and Vaccine into Central Artery, Open Approach

SNOMED model:

- SNOMED procedures also have attributes

- Own attribute-value pairing mode, multiaxial hierarchy

- Inherited from ancestor concepts, normally with increased granularity
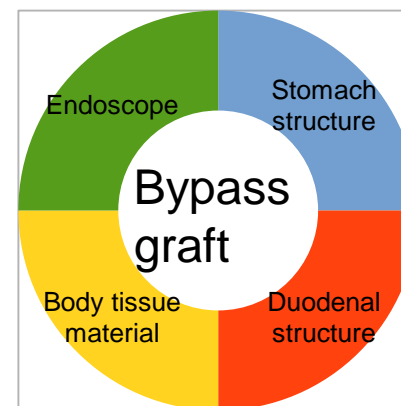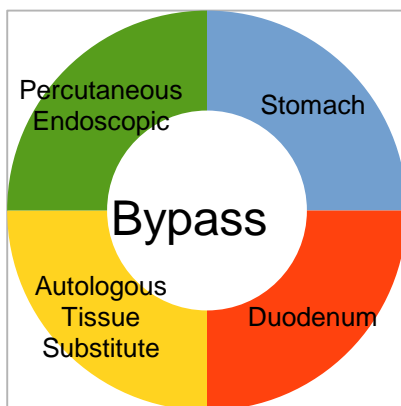
Parents:

Attributes:

Attribute translation for ICD10PCS

Less than 2000 unique attributes - mapped manually

0D16479 "Bypass Stomach to Duodenum with Autologous Tissue Substitute, Percutaneous Endoscopic Approach"

0. Medical and Surgical	removed as direct ancestor of «Bypass graft»
D. Gastrointestinal System	removed as direct ancestor of «Stomach»
1. Bypass	48537004 Bypass graft (procedure)
6. Stomach	69695003 Stomach structure (body structure)
4. Percutaneous Endoscopic	37270008 Endoscope (device)
7. Autologous Tissue Substitute	413675001 Body tissue material (substance)
9. Duodenum	38848004 Duodenal structure (body structure)

Filtering cycle - automated part
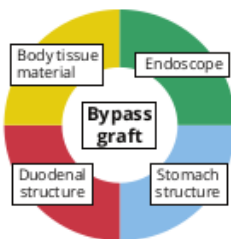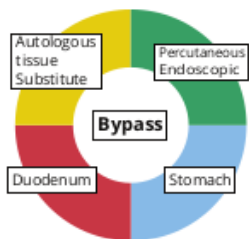
Attribute transition

Attributes for 0D16479 "Bypass Stomach to Duodenum with Autologous Tissue Substitute, Percutaneous Endoscopic Approach"
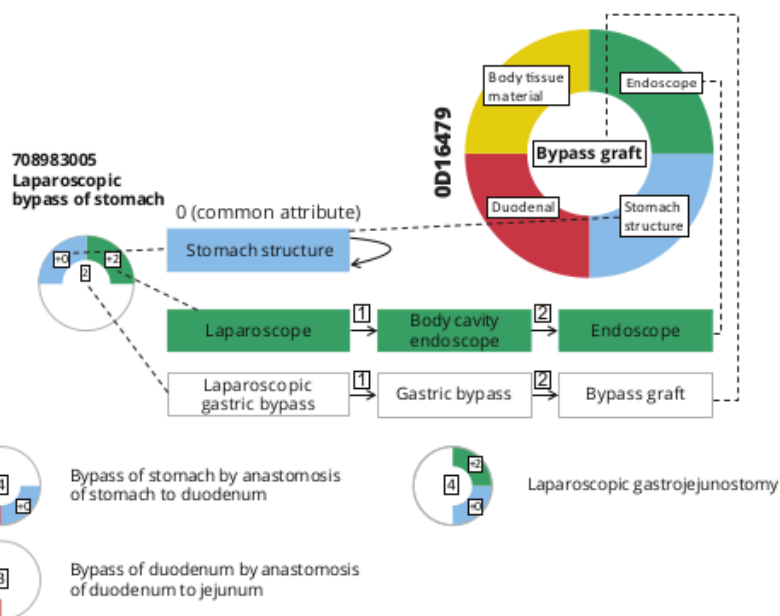
Hierarchical representation:

1. Medical and Surgical
2. Gastrointestinal System
3. Bypass
4. Stomach
5. Percutaneous Endoscopic
6. Autologous Tissue Substitute
7. Duodenum

When mapped to SNOMED CT attributes:

1. Medical and Surgical - removed as direct ancestor
2. Gastrointestinal System - removed as direct ancestor
3. 48537004|Bypass graft (procedure)
4. 69695003|Stomach structure (body structure)
5. 37270008|Endoscope (device)
6. 413675001| Body tissue material (substance)
7. 38848004|Duodenal structure (body structure)

Examples from test pool

708983005
Laparoscopic bypass of stomach

0 (common attribute)

Bypass of stomach by anastomosis of stomach to duodenum

Laparoscopic gastrojejunostomy

Bypass of duodenum by anastomosis of duodenum to jejunum

Filtering cycle

Procedure-attribute is always defined at least once across entire ICD10PCS, every other attribute is needed for further specification. At this moment we process candidates remaining in test multiple times, aiming to find closest parents with smallest difference in each of defining attributes

For each meaningful defining attribute

1. Copy remaining pool; keep only SNOMED candidates that have match on defining attribute currently investigated.

In red pool, keep only SNOMED CT procedures with
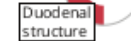
2. Find what is the biggest number of matches each ICD10PCS procedure has per candidate; keep only candidates with maximum amount of matches in attributes between source and target.

358575006
Gastroduodenostomy — stay,

305621000
Bypass of duodenum by anastomosis of duodenum to jejunum — is removed

3. Among remaining candidates keep those with most precise attribute set: defined by having smallest sum of distances between attributes of candidate and ICD procedure (adding up min_levels_of_separation).

358575006
Gastroduodenostomy — = 1 stays,

18692006
Bypass gastroenterostomy — = 3 is removed

4. Among remaining candidates keep those closest to procedure-attributes (max_levels_of_separation).

358575006
Gastroduodenostomy — stays,

427980007
Sleeve gastrectomy with duodenal switch — is removed

Switch to the next attribute

All attributes processed

Write remaining matches in the final table

Exit cycle

Results (in numbers)

We have found direct parents for more than 40 000 leaf-level ICD-10-PCS concepts most
commonly encountered in patient data
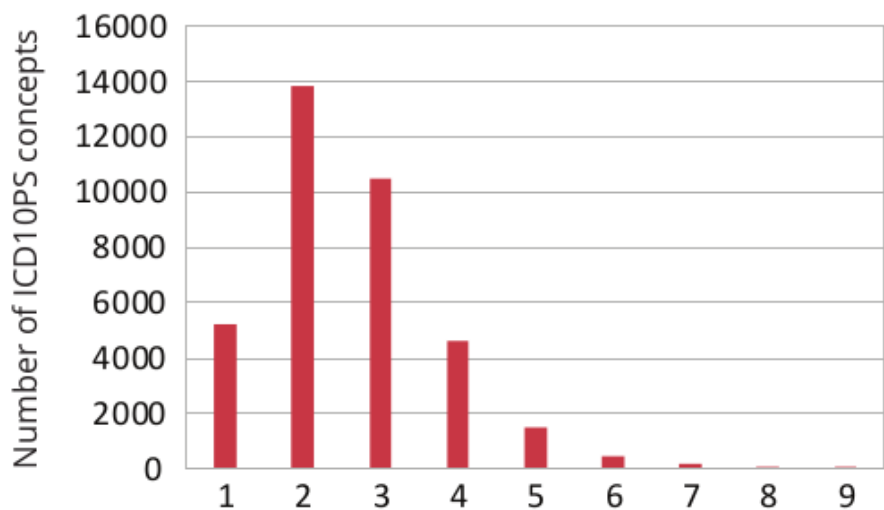
Number of immediate ancestors per ICD10PCS concept
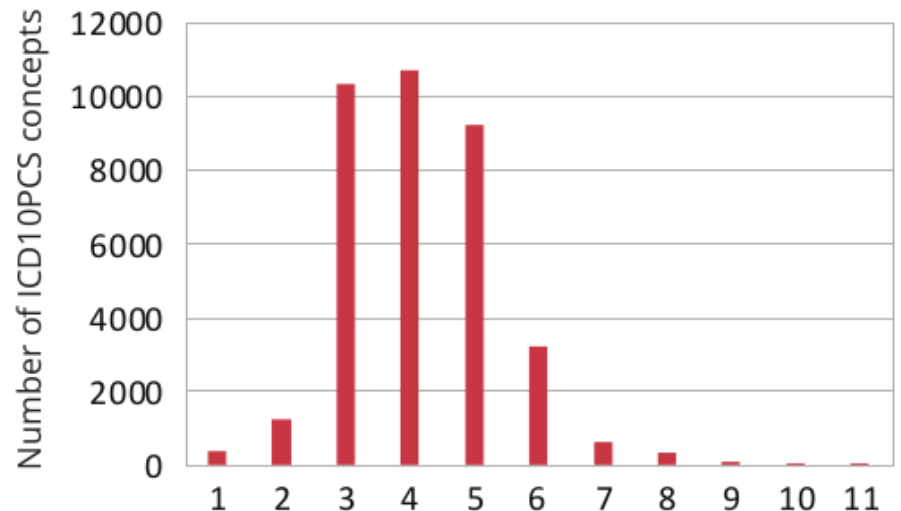
Number of active attribute relations per ICD10PCS concept

Multiple parents for ICD10PCS concepts exist because of high granularity and the need
to represent each aspect of the procedure

Bypass Left Kidney Pelvis to Left Ureter, Open Approach (ICD10PCS)

Open repair of kidney or renal pelvis (SNOMED)

Bypass of ureter (SNOMED)

High number of attributes (>5) is caused by inheriting new attributes from SNOMED
parents

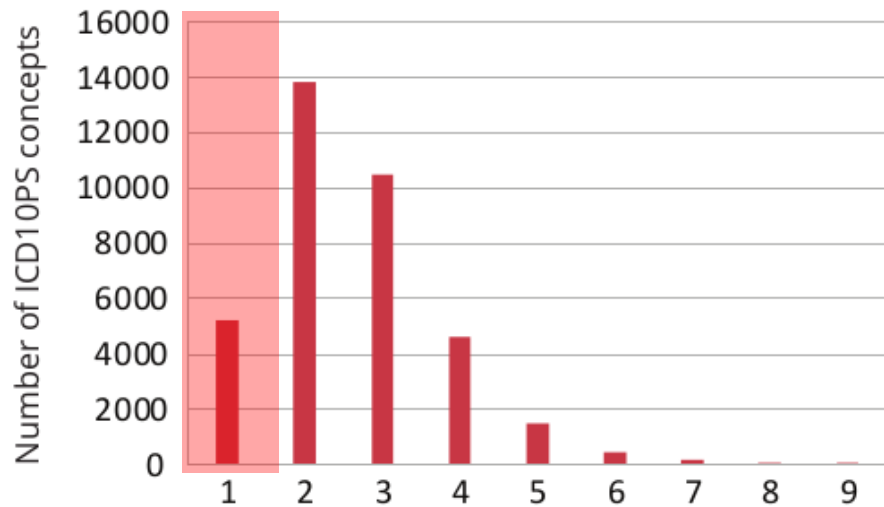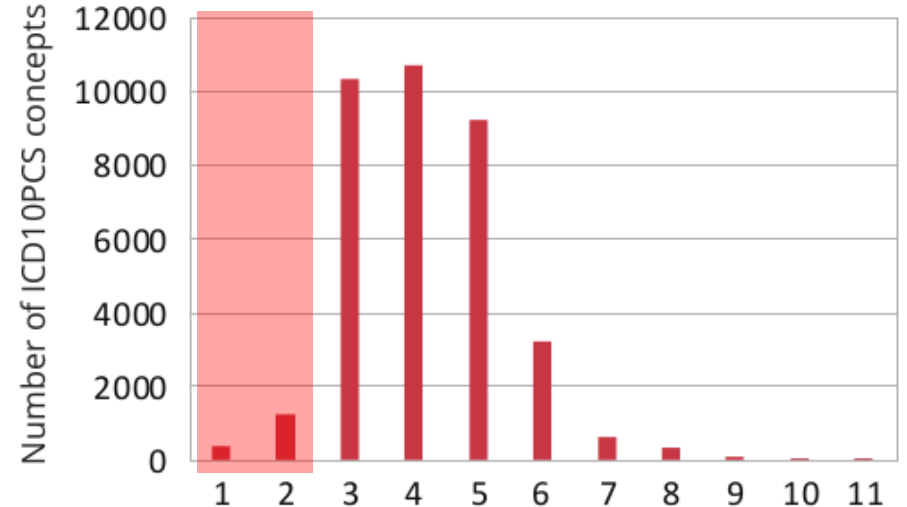# Marginal cases: Low number of parents & attributes:

Number of immediate ancestors per ICD10PCS concept

Number of active attribute relations per ICD10PCS concept

- Psychotherapy, Yoga, Osteopathic procedures, Counselling etc.
  Such procedures fall outside of SNOMED attribute-value model and have generic ancestors

concept_id	concept_code	concept_name
2788028	5A0955Z	Assistance with Respiratory Ventilation, Greater than 96 Consecutive Hours
2788036	5A1935Z	Respiratory Ventilation, Less than 24 Consecutive Hours
2788037	5A1945Z	Respiratory Ventilation, 24-96 Consecutive Hours
2788038	5A1955Z	Respiratory Ventilation, Greater than 96 Consecutive Hours
2788842	8E0ZXY1	In Vitro Fertilization
2788843	8E0ZXY4	Yoga Therapy
2788845	8E0ZXY6	Isolation
2790624	F003GYZ	Communicative/Cognitive Integration Skills Assessment of Neurological System - Whole Body using Other Equipment
2790625	F003GZZ	Communicative/Cognitive Integration Skills Assessment of Neurological System - Whole Body

Marginal cases: High number of parents:
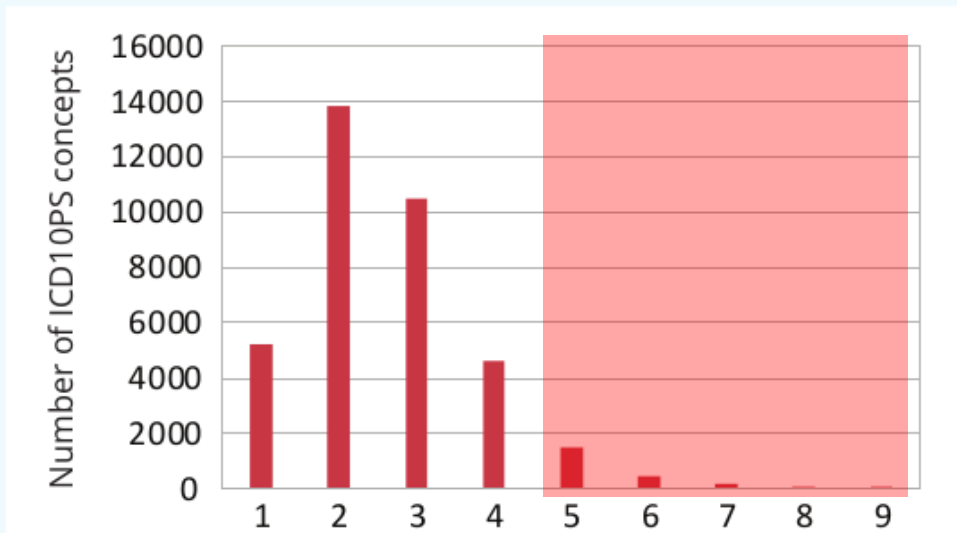
Number of immediate ancestors per ICD10PCS concept
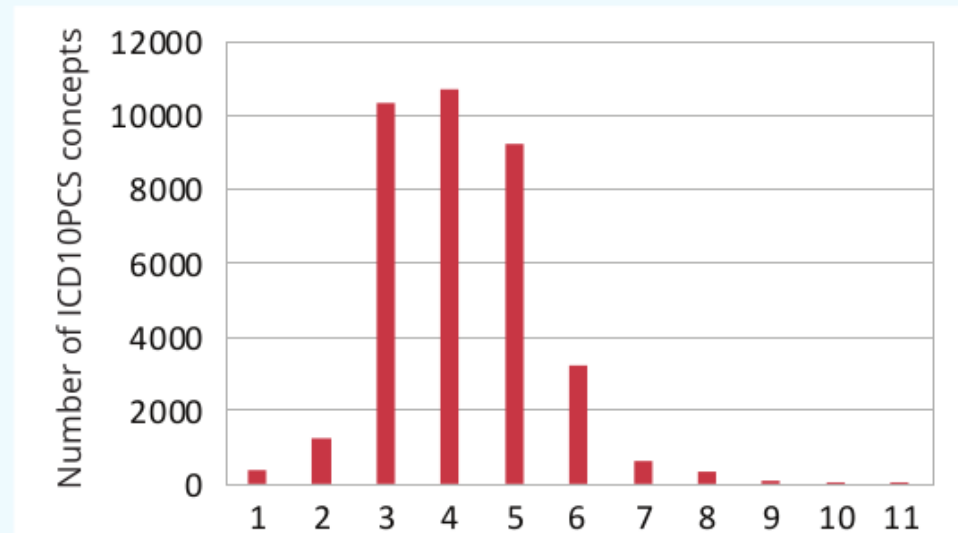
Number of active attribute relations per ICD10PCS concept

1. Dublicating branches in SNOMED (transfers, grafts, autotransplantations)
2. Complex procedures which belong to multiple subhierarchies: Biopsies (both biopsies and excisions)

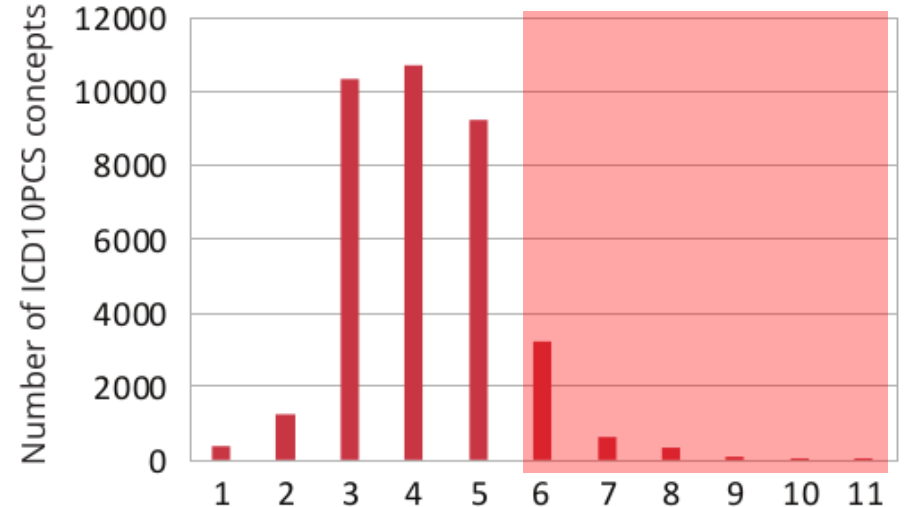| concept_id	concept_code	concept_name		relationship_id	concept_id	concept_code	concept_name
2757712	0KXB0Z2	Transfer Left Lower Arm and Wrist Muscle with Skin and Subcutaneous Tissue, Open Approach	Is a	4002541	119829000	Integumentary system transposition
2757712	0KXB0Z2		Is a	4030027	107768003	Operative procedure on shoulder AND/OR arm
2757712	0KXB0Z2		Is a	4200535	53088000	Autogenous transplantation
2757712	0KXB0Z2		Is a	4331324	22622008	Muscle transposition
2757712	0KXB0Z2		Is a	40490903	447086009	Procedure on skin and/or subcutaneous tissue
2757712	0KXB0Z2		Is a	42709784	449656008	Transposition of tissue of upper limb
2758240	0MB14ZX	Excision of Right Shoulder Bursa and Ligament, Percutaneous Endoscopic Approach, Diagnostic	Is a	4002372	119626005	Shoulder excision
2758240	0MB14ZX		Is a	4027404	107737002	Musculoskeletal system excision
2758240	0MB14ZX		Is a	4030027	107768003	Operative procedure on shoulder AND/OR arm
2758240	0MB14ZX		Is a	4198260	51860002	Diagnostic procedure on musculoskeletal system
2758240	0MB14ZX		Is a	4202517	53767003	Endoscopic biopsy
2758240	0MB14ZX		Is a	4332514	430223006	Biopsy of upper limb

Marginal cases: High number of attributes:
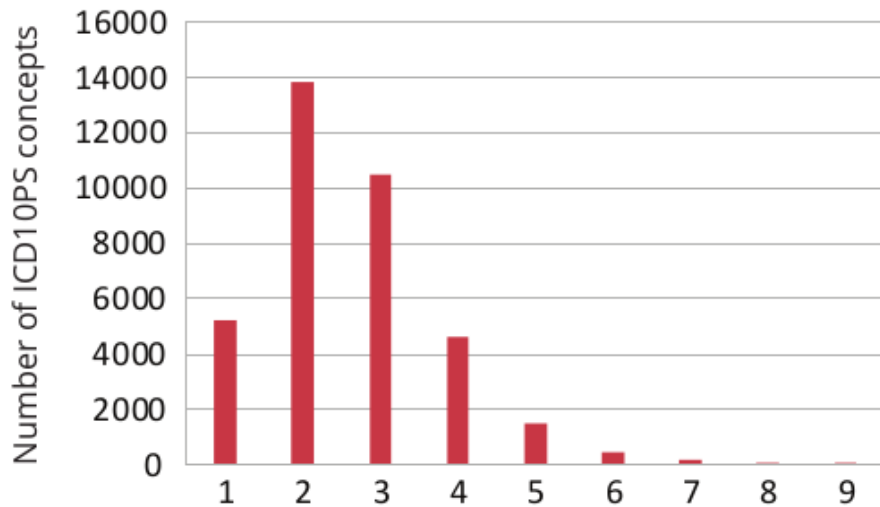
Number of immediate ancestors per ICD10PCS concept

Number of active attribute relations per ICD10PCS concept

Extremely specific procedures without close enough representation.
Inherit different attributes from their SNOMED ancestors:

concept_id	concept_code	concept_name		concept_class_id	concept_id	concept_code	concept_name
2725909	02703TZ			Body Structure	4219982	41801008	Coronary artery structure
2725909	02703TZ	Dilation of Coronary Artery, One Artery with Radioactive Intraluminal Device, Percutaneous Approach		Physical Object	4024282	19443004	Radioactive implant
2725909	02703TZ			Physical Object	4150246	310362005	Angioplasty catheter
2725909	02703TZ			Physical Object	4280677	65818007	Stent
2725909	02703TZ			Qualifier Value	4013298	103388001	Percutaneous approach
2725909	02703TZ			Qualifier Value	4106470	257867005	Insertion - action
2725909	02703TZ			Qualifier Value	4127468	261449002	Transluminal approach
2725909	02703TZ			Qualifier Value	4257977	410817004	Dilation repair - action

Physical Object	4024282	19443004	Radioactive implant
Physical Object	4150246	310362005	Angioplasty catheter
Physical Object	4280677	65818007	Stent

Should have been one attribute!

Results - seamless extension of SNOMED model inside CDM tables

SNOMED CT hierarchy

358575006 Gastroduodenostomy

0D16879
Bypass Stomach to Duodenum with Autologous Tissue Substitute, Via Natural or Artificial Opening Endoscopic

708983005 Laparoscopic bypass of stomach

173872002 Therapeutic endoscopic operations on duodenum
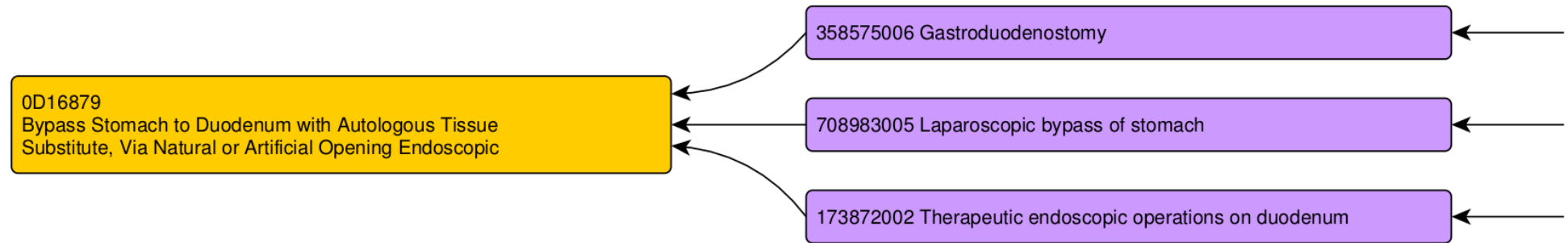
Attributes for
0D16879 Bypass Stomach to Duodenum with Autologous Tissue Substitute, Via Natural or Artificial Opening Endoscopic

relationship_type	attribute_code	attribute_name
Has dir proc site	38848004	Duodenal structure
Has dir proc site	413675001	Body tissue material
Has dir proc site	69695003	Stomach structure
Has intent	262202000	Therapeutic
Has method	360021005	Bypass - action
Using acc device	37270008	Endoscope

ICD10PCS descendants of SNOMED concepts

39 ICD10PCS concepts are now descendants

concept_id	concept_code	concept_name	domain_id	vocabulary_id
4286804	69031006	Excision of breast tissue	Procedure	SNOMED

concept_id	concept_code	concept_name	vocabulary_id	distance
2751078	0HBT0ZX	Excision of Right Breast, Open Approach, Diagnostic	ICD10PCS	1
2751079	0HBT0ZZ	Excision of Right Breast, Open Approach	ICD10PCS	1
2751080	0HBT3ZX	Excision of Right Breast, Percutaneous Approach, Diagnostic	ICD10PCS	1
2751081	0HBT3ZZ	Excision of Right Breast, Percutaneous Approach	ICD10PCS	1
2751082	0HBT7ZX	Excision of Right Breast, Via Natural or Artificial Opening, Diagnostic	ICD10PCS	1
2751086	0HBTXZX	Excision of Right Breast, External Approach, Diagnostic	ICD10PCS	1
2751087	0HBTXZZ	Excision of Right Breast, External Approach	ICD10PCS	1
2751088	0HBU0ZX	Excision of Left Breast, Open Approach, Diagnostic	ICD10PCS	1
2751089	0HBU0ZZ	Excision of Left Breast, Open Approach	ICD10PCS	1
2751090	0HBU3ZX	Excision of Left Breast, Percutaneous Approach, Diagnostic	ICD10PCS	1
2751091	0HBU3ZZ	Excision of Left Breast, Percutaneous Approach	ICD10PCS	1
2751092	0HBU7ZX	Excision of Left Breast, Via Natural or Artificial Opening, Diagnostic	ICD10PCS	1
2751093	0HBU7ZZ	Excision of Left Breast, Via Natural or Artificial Opening	ICD10PCS	1
2751096	0HBUXZX	Excision of Left Breast, External Approach, Diagnostic	ICD10PCS	1
2751097	0HBUXZZ	Excision of Left Breast, External Approach	ICD10PCS	1
2751098	0HBV0ZX	Excision of Bilateral Breast, Open Approach, Diagnostic	ICD10PCS	1
2751099	0HBV0ZZ	Excision of Bilateral Breast, Open Approach	ICD10PCS	1
2751100	0HBV3ZX	Excision of Bilateral Breast, Percutaneous Approach, Diagnostic	ICD10PCS	1
2751101	0HBV3ZZ	Excision of Bilateral Breast, Percutaneous Approach	ICD10PCS	1
2751103	0HBV7ZZ	Excision of Bilateral Breast, Via Natural or Artificial Opening	ICD10PCS	1
2751106	0HBVXZX	Excision of Bilateral Breast, External Approach, Diagnostic	ICD10PCS	1
2751107	0HBVXZZ	Excision of Bilateral Breast, External Approach	ICD10PCS	1
2751108	0HBW0ZX	Excision of Right Nipple, Open Approach, Diagnostic	ICD10PCS	3
2751109	0HBW0ZZ	Excision of Right Nipple, Open Approach	ICD10PCS	3
2751110	0HBW3ZX	Excision of Right Nipple, Percutaneous Approach, Diagnostic	ICD10PCS	3
2751111	0HBW3ZZ	Excision of Right Nipple, Percutaneous Approach	ICD10PCS	3
2751116	0HBWXZX	Excision of Right Nipple, External Approach, Diagnostic	ICD10PCS	3
2751117	0HBWXZZ	Excision of Right Nipple, External Approach	ICD10PCS	3
2751118	0HBX0ZX	Excision of Left Nipple, Open Approach, Diagnostic	ICD10PCS	3
2751119	0HBX0ZZ	Excision of Left Nipple, Open Approach	ICD10PCS	3
2751120	0HBX3ZX	Excision of Left Nipple, Percutaneous Approach, Diagnostic	ICD10PCS	3

Why are all concepts kept Standard?

ID ▼	CODE ▼	NAME ▼		
4062872	171479006	Open division of brain tissue		
Subsumes		Division of Brain, Open Approach	2722333	ICD10PCS
		Division of Cerebral Hemisphere, Open Approach	2722336	ICD10PCS

Why not 'Maps to'?

00800ZZ **Division of Brain, Open Approach** exists next to **00870ZZ** **Division of Cerebral Hemisphere, Open Approach** in ICD10PCS vocabulary

If we build 'Maps to' for **00800ZZ**, clinical procedures coded **00870ZZ** would become a subset of such procedures.

Citing B4.1a of official ICD10PCS guidelines:
If a procedure is performed on a portion of a body part that does not have a separate body part value, code the body part value corresponding to the whole body part.
Example: A procedure performed on the alveolar process of the mandible is coded to the mandible body part.

That means **00800ZZ** actually is "Division of **Other Brain**, Open Approach"
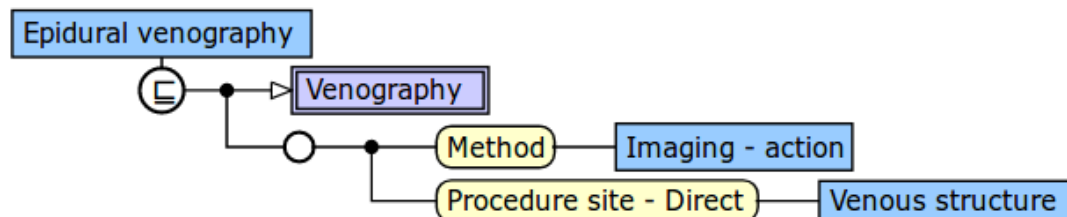# Possible, but requires additional analysis and rules!

What problems have we faced?

Main problem: Inconsistency

- Generic attributes and parents of specific concepts.

- Often we have trouble finding the right concept due to their 'sloppy' assigned attributes.

- Problematic concepts need to be excluded manually during debugging process

This will lead to any venous imaging procedure being matched directly to Epidural Venography

Next steps

- Extend hierarchy to all leaf-level ICD10PCS concepts

- SNOMED automated QA and attributes reassignment

- Generalization of algorithm to accommodate other possible sources (currently testing for German OPS)

- Integration of ICD10PCS Hierarchy concepts and ICD10PCS own attributes to also exist in SNOMED hierarchical tree

Procedure domain

done:

- ICD9Proc, OPCS4, ICD10PCS, HCPCS

upcoming

- OPS – we are working on them using ICD10PCS approach
- CPT4 – no attributes defined, needs investigation

The same principles as for ICD10PCS are used