Towards Demonstrating the Clinical Value of SNOMED CT in Primary Care

Ronald Cornet & Dennis Lee

IHTSDO Implementation Showcase

Thursday, October 10, 2013

Outline

1. Research Question
   - ☐ How can we demonstrate the clinical value of SNOMED CT?

2. SNOMED CT Clinical Value Framework

3. Materials

4. Methods, Results
   - ☐ Completeness of Problem List
   - ☐ Adherence of Care Guidelines
   - ☐ Completeness of Clinical Summaries

5. Summary of Clinical Value of SNOMED CT

Canadian & Dutch Initiatives

- ☐ Canadian Institute for Health Information
  - ■ EMR Content Standards
  - ■ Primary Health Care Indicators
- ☐ Canada Health Infoway
  - ■ Health System Use Project
  - ■ Primary Health Care Reference Sets
  - ■ Clinical Value Targets
- ☐ Dutch Healthcare Inspectorate / Quality Institute
  - ■ Healthcare Quality Indicators
- ☐ Netherlands' Healthcare ICT Institute (Nictiz)
  - ■ Healthcare information standards
  - ■ Generic Dataset for Transitions of Care

Canada Health Infoway Clinical Value Targets

☐ Clinical Value Level 1

General Data Use

- Enter encounter notes
- Enter problem lists

Data Capture

- Enter immunisations
- Enter vital stats
- Enter new or renewal prescriptions and print the prescription
- Generate automated alerts from within the EMR
- Generate automated reminders from within the EMR
- Receive laboratory results into the EMR
- Receive diagnostic imaging results into the EMR
- Access hospital records and encounter summaries from EMR
- Create referal letters or consultation reports

☑ Clinical Value Level 2

Data Retrieval

- Clinician's use of an EMR
- Interoperability with drug information systems
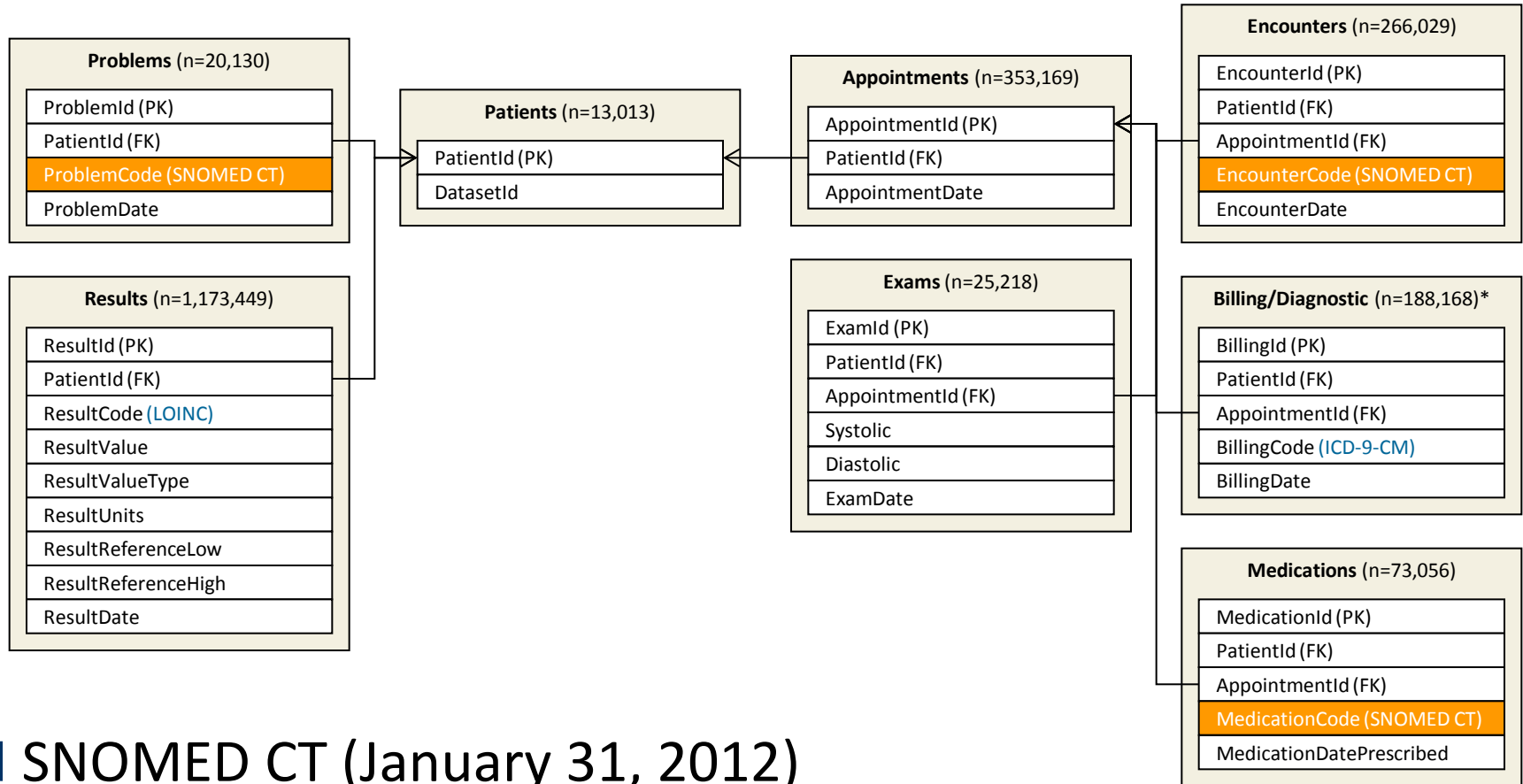- Clinician's use of electronic prescribing capability from EMR

Data Sharing

SNOMED CT Clinical Value Framework

Data Uses / Data Use Targets	Patient	Practice	Population
Data Capture	☐ Suggest diagnostic code based on encounter diagnosis ☐ Suggest encounter diagnosis based on diagnostic code ☐ Suggest adding encounter diagnosis to problem list	☐ Audit (critique) completeness of problem list and encounter diagnosis ☐ Audit (critique) accuracy of diagnostic codes	☐ Generate statistics on key clinical quality measures (CQM)
Data Retrieval	☐ Alert clinicians to drug-allergy interactions ☐ Remind clinicians to order routine tests ☐ Suggest medications based on out of range test results	☐ Audit (critique) evidence-based guideline adherence ☐ Patient recall / patient case queries ☐ Assess patient conditions	☐ Compare quality of care between practice and population
Data Sharing	☐ Generate patient clinical summary in the form of the Continuity of Care Document (CCD)	☐ Generate practice quality reports in the form of the Quality Reporting Document Architecture (QRDA) Category II and III	☐ Generate practice quality reports in the form of the Quality Reporting Document Architecture (QRDA) Category III

Materials

☐ Anonymised Primary Care Dataset (3,298 active patients)

Problems (n=20,130)
ProblemId (PK)
PatientId (FK)
ProblemCode (SNOMED CT)
ProblemDate

Patients (n=13,013)
PatientId (PK)
DatasetId

Appointments (n=353,169)
AppointmentId (PK)
PatientId (FK)
AppointmentDate

Encounters (n=266,029)
EncounterId (PK)
PatientId (FK)
AppointmentId (FK)
EncounterCode (SNOMED CT)
EncounterDate

Results (n=1,173,449)
ResultId (PK)
PatientId (FK)
ResultCode (LOINC)
ResultValue
ResultValueType
ResultUnits
ResultReferenceLow
ResultReferenceHigh
ResultDate

Exams (n=25,218)
ExamId (PK)
PatientId (FK)
AppointmentId (FK)
Systolic
Diastolic
ExamDate

Billing/Diagnostic (n=188,168)*
BillingId (PK)
PatientId (FK)
AppointmentId (FK)
BillingCode (ICD-9-CM)
BillingDate

Medications (n=73,056)
MedicationId (PK)
PatientId (FK)
AppointmentId (FK)
MedicationCode (SNOMED CT)
MedicationDatePrescribed

☐ SNOMED CT (January 31, 2012)

☐ Wright & Hahn papers

☐ Continuity of Care Document (CCD)

Encoding Results

Encoding	Problem Lists		Encounter Diagnoses		Medications	
	Total	Unique	Total	Unique	Total	Unique
Number of Records	**20,140**	**2,880**	**266,029**	**15,122**	**73,056**	**22,230**
Fully encoded record	18,298	2,246	231,963	8,541	69,513	19,564
Partially encoded record	1,666	582	27,198	5,794	0	0
Fully unencoded record	177	43	6,149	779	3,543	2,666

☐ Problem Lists
- COPD
- 13645005|Chronic obstructive lung disease (disorder)|

☐ Encounter Diagnoses
- Chronic neck pain
- 81680005|Neck pain (finding)|:
  263502005|Clinical course (attribute)|=
  90734009|Chronic (qualifier value)|

☐ Medications
- Metformin (Glucophage) 500 mg PO BID
- 109081006|Metformin (product)|

Methods Used to Demonstrate Clinical Value

No	Method	Data Use / Data Use Target	Problem	Encoun-ter	Lab Result	Diag. (ICD-9-CM)	Medica-tion	Examina-tion
1.	Completeness of problem list[1]	Data Capture Practice	✓		✓	✓	✓	
2.	Adherence of care guidelines[2]	Data Retrieval Practice	✓	✓	✓		✓	✓
3.	Completeness of clinical summaries	Data Sharing Patient	✓	✓				

1.   Wright A, et al. **A method and knowledge base for automated inference of patient problems from structured data in an electronic medical record.** J Am Med Inform Assoc. 2011 Nov-Dec;18(6):859-67.
2.   Hahn KA, et al. **Diabetes flow sheet use associated with guideline adherence.** Ann Fam Med. 2008 May-Jun;6(3):235-8.

Completeness of Problem List

☐ If patient meets one of these three definitions

- Definition 1 – **Laboratory Results** (at least 1 occurrence)
  - ☐ Haemoglobin A1c/ Haemoglobin.total in Blood - (LOINC: 4548-4) ≥7
- Definition 2 – **Billing Diagnostic Codes** (at least 2 occurrences)
  - ☐ Diabetes mellitus - (ICD-9-CM: 250) or one of its subtypes
- Definition 3 – **Medications** (at least 1 occurrence)
  - ☐ ETC: 5886 – Injectable Antidiabetic Agents & 154 – Oral Antidiabetic Agents
  - ☐ SNOMED CT: 384953001|Antidiabetic preparation (product)|& 373245004|Antidiabetic agent (substance)|

☐ And do not have any of these problems

- 21584002|Syndrome of infant of diabetic mother (disorder)|
- 9414007|Impaired glucose tolerance (disorder)|
- 73211009|Diabetes mellitus (disorder)|

☐ Then suggest adding these problems:

- Default problem
  - ☐ 73211009|Diabetes mellitus (disorder)|
- Additional options as related terms
  - ☐ 46635009|Diabetes mellitus type 1 (disorder)|
  - ☐ 44054006|Diabetes mellitus type 2 (disorder)|
  - ☐ 9414007|Impaired glucose tolerance (disorder)|
  - ☐ 68256003|Increased glucose level (finding)|
  - ☐ ...

Wright A, et al. **A method and knowledge base for automated inference of patient problems from structured data in an electronic medical record.** J Am Med Inform Assoc. 2011 Nov-Dec;18(6):859-67.

Closer Look at Diabetes Concepts
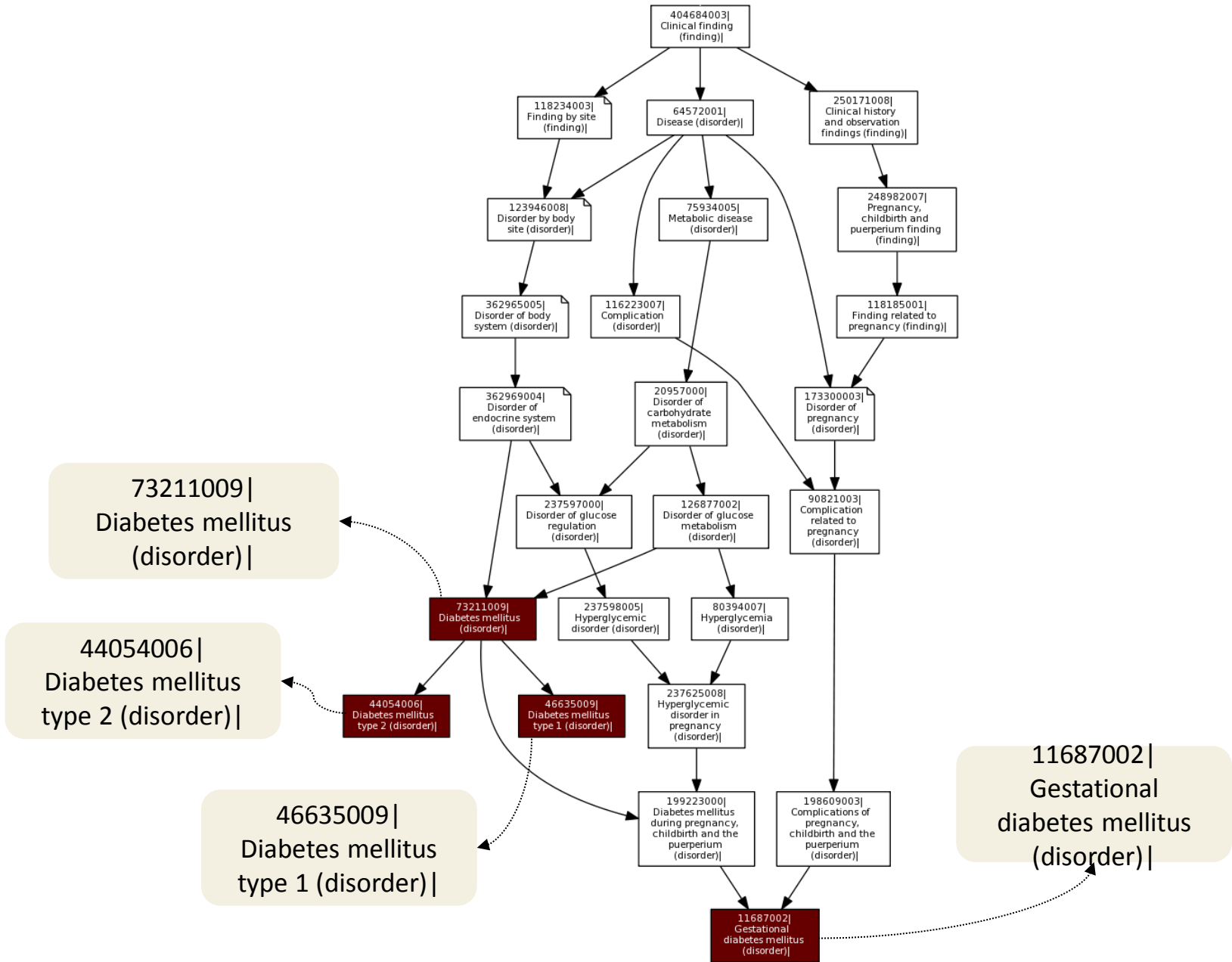
Closer Look at Antidiabetic Medications
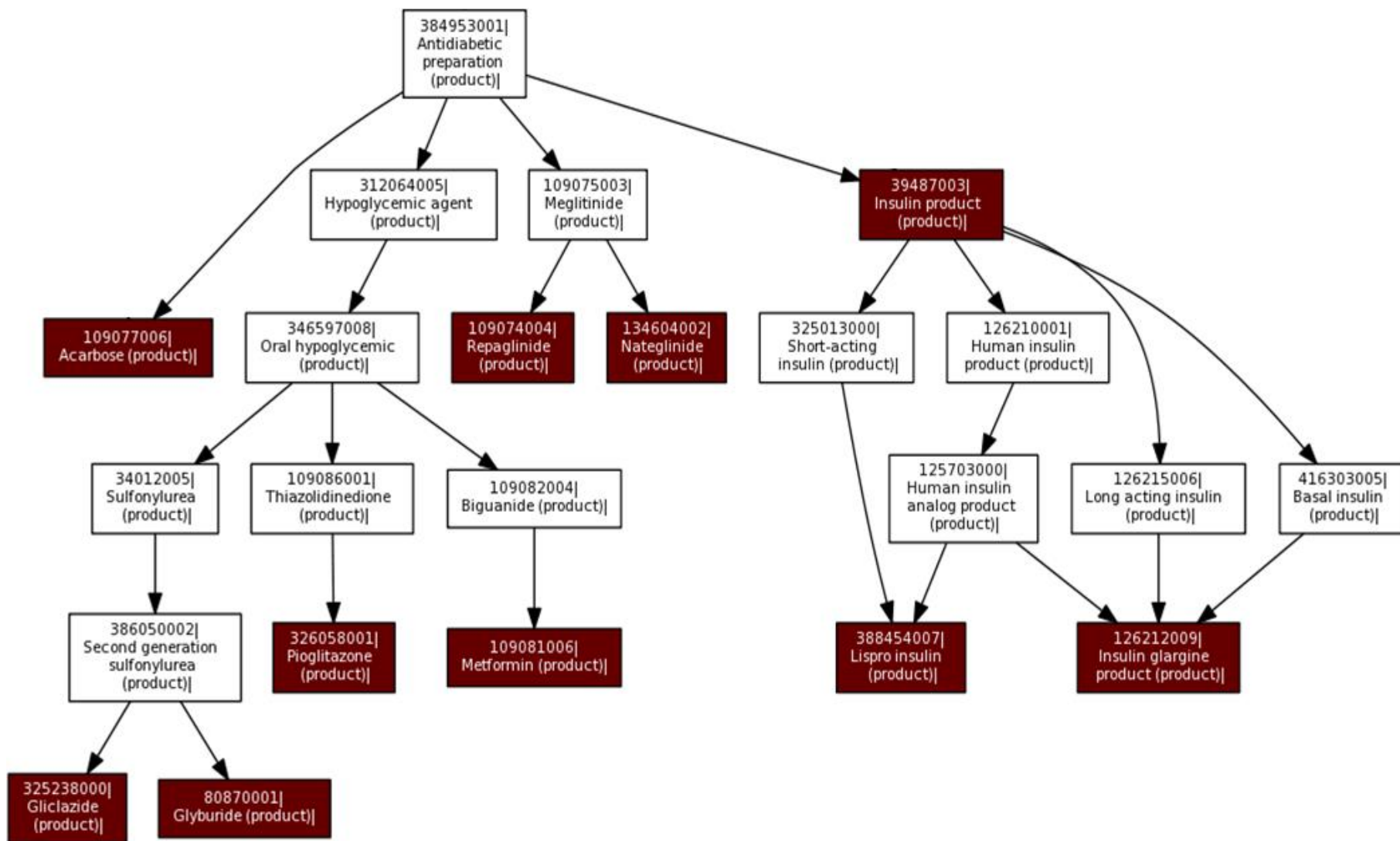
Completeness of Problem List Results

No	Definition	Patients identified in definition	Patients without diabetes in problem list	Percent without diabetes in problem list
1.	Definition 1 (Laboratory results ≥ 1) Haemoglobin A1c ≥ 7	110	1	0.9%
2.	Definition 2 (Billing codes ≥ 2) Diabetes mellitus	168	11	6.5%
3.	Definition 3 (Medications ≥ 1) Antidiabetic medication	235	32	13.6%
	Total number of unique patients	**274**	**42**	**15.3%**
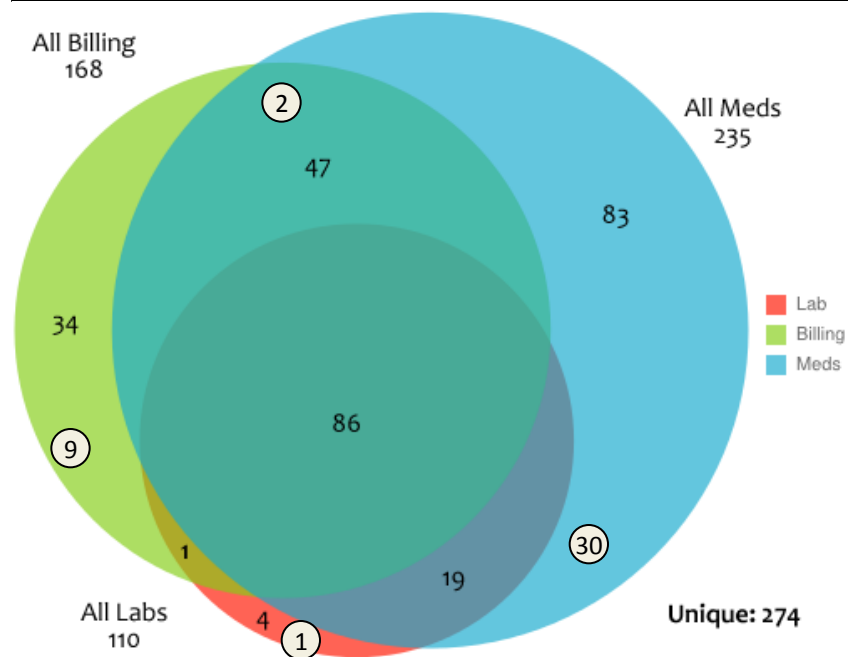
- ☐ **42 (15%)** patients have at least one **Haemoglobin A1c ≥7**, at least two billing codes of **250**, or at least one **antidiabetic medication**, do not have diabetes on the problem list.

Adherence of Care Guidelines

☐ Diabetes **assessment scores** were based on documentation in the medical record of five assessments (20 points each):

- ■ Haemoglobin A1c level tested in the past six months
- ■ Urine microalbumin level tested in the past year
- ■ Low-density lipoprotein cholesterol (LDL-C) level tested in the past year
- ■ Smoking status
- ■ Blood pressure

☐ Diabetes **treatment scores** consisted of documentation in the medical record of 4 measures (25 points each):

- ■ Haemoglobin A1c level at or below 8% or use of a hypoglycemic agent
- ■ Urine microalbumin level below 30 mg/g (3.39 mg/mmol) or use of an angiotensin-converting enzyme (ACE) inhibitor or angiotensin II receptor blocker (ARB)
- ■ LDL-C below 100 mg/dL (2.59 mmol/L) or use of lipid-lowering agent
- ■ Blood pressure at or below 130/85 mm Hg or use of an antihypertensive agent

Hahn KA, et al. **Diabetes flow sheet use associated with guideline adherence.** Ann Fam Med. 2008 May-Jun;6(3):235-8.

Smoking Status

- 365981007|Finding of tobacco smoking behavior (finding)|
- 160616005|Trying to give up smoking (finding)|
- 160617001|Stopped smoking (finding)|
- 65568007|Cigarette smoker (finding)|
- 8517006|Ex-smoker (finding)|
- 77176002|Smoker (finding)|
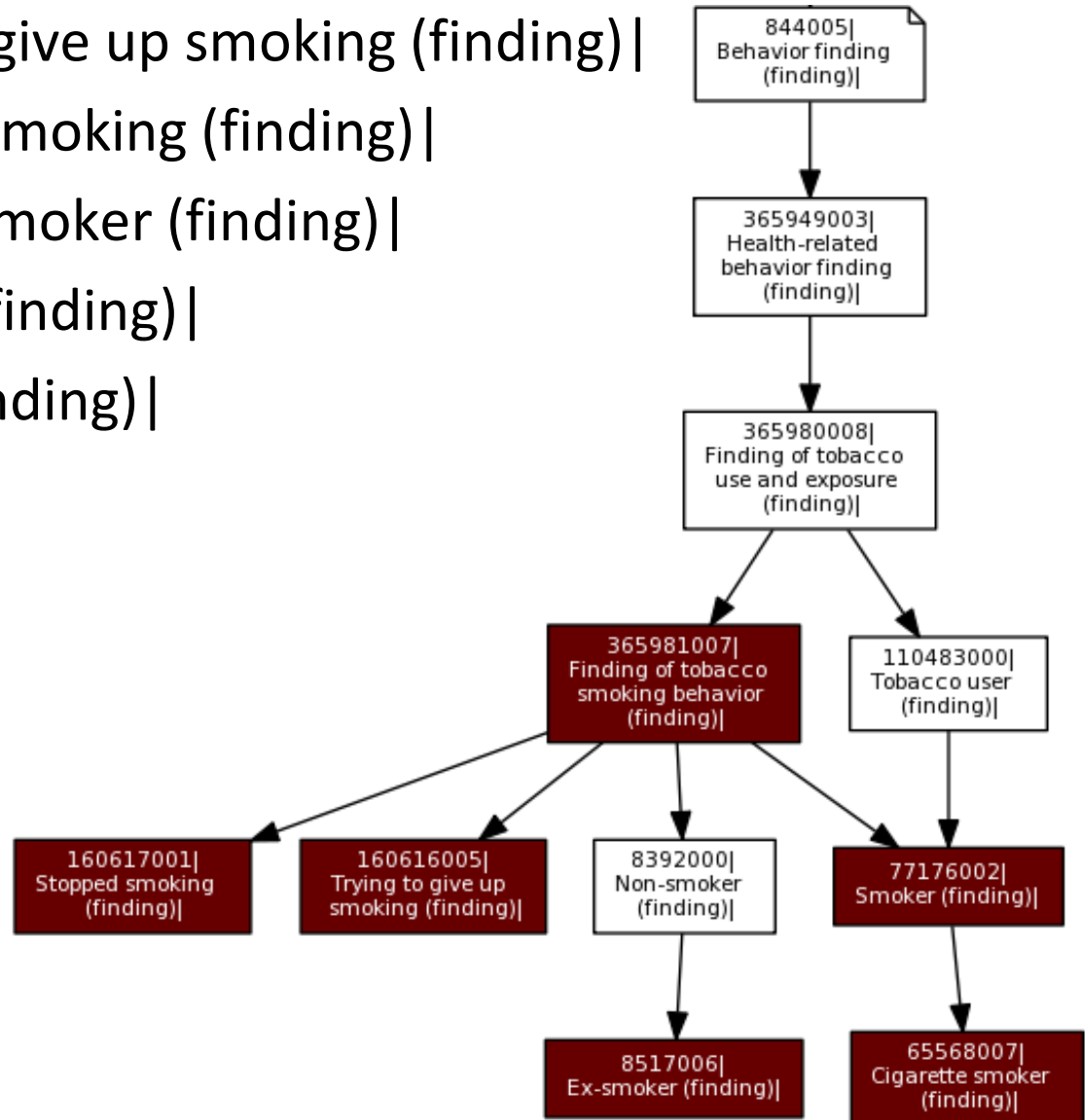
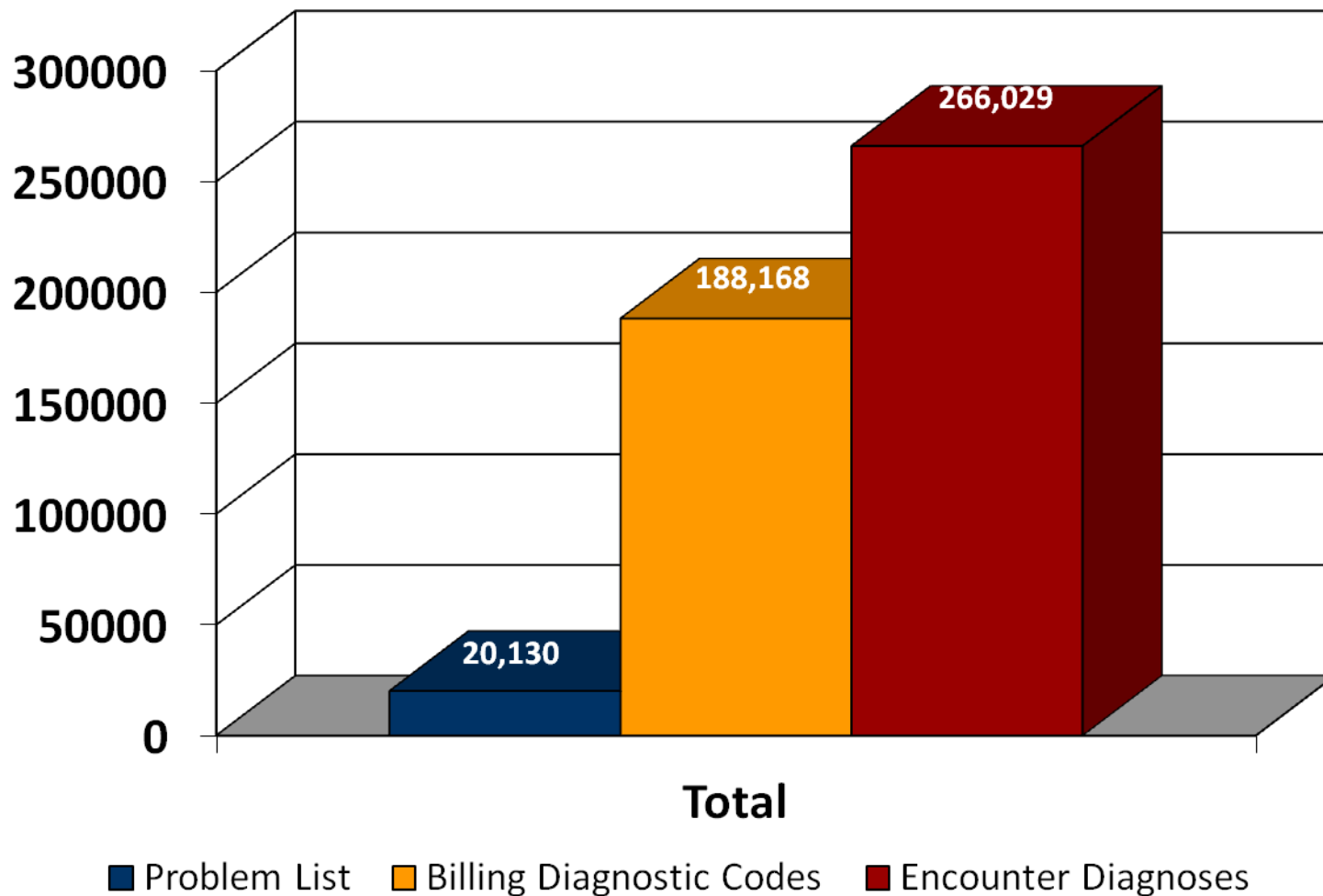# *Adherence of Care Guidelines Results*

Criteria	Total	%
Assessment Scores (20 points per criteria; Overall average: 43.2)		
1. Haemoglobin A1c level tested in the past six months	86	39.4%
2. Urine microalbumin level tested in the past year	73	33.5%
3. Low-density lipoprotein (LDL-cholesterol) level tested in the past year	129	59.2%
4. Smoking Status	23	10.6%
5. Blood pressure	160	73.4%
Criteria met: **5** (n=4, 1.8%), **4** (n=45, 20.6%), **3** (n=47, 21.6%), **2** (n=47, 21.6%), **1** (n=36, 16.5%), **0** (n=39, 17.9%)		
Treatment Scores (25 points per criteria; Overall average: 39.8)		
1. Haemoglobin A1c level at or below 8% or use of a hypoglycemic agent	78	35.8%
2. Urine microalbumin level below 30 mg/g creatine or use of an angiotensin-converting enzyme (ACE) inhibitor or angiotensin II receptor blocker (ARB)	58	26.6%
3. LDL-cholesterol below 100 mg/dL or use of lipid-lowering agent	97	44.5%
4. Blood pressure at or below 130/85 mm Hg or use of an antihypertensive agent	114	52.3%
Criteria met: **4** (n=21, 9.6%), **3** (n=34, 15.6%), **2** (n=57, 26.1%), **1** (n=47, 21.6%), **0** (n=59, 27.1%)		

Completeness of Clinical Summaries

	Pt	Prac	Pop
Capture			
Retrieval			
Sharing			

☐ Where are most coded information found?

Legend: ■ Problem List ■ Billing Diagnostic Codes ■ Encounter Diagnoses

Values shown: 20,130 (Problem List), 188,168 (Billing Diagnostic Codes), 266,029 (Encounter Diagnoses). X-axis: Total.

Closer Look at Problems and Encounters

73211009|Diabetes mellitus (disorder)|

46635009|Diabetes mellitus type 1 (disorder)|

44054006|Diabetes mellitus type 2 (disorder)|

2 **27** **142**

1 **31** **33**

3 **103** **90**
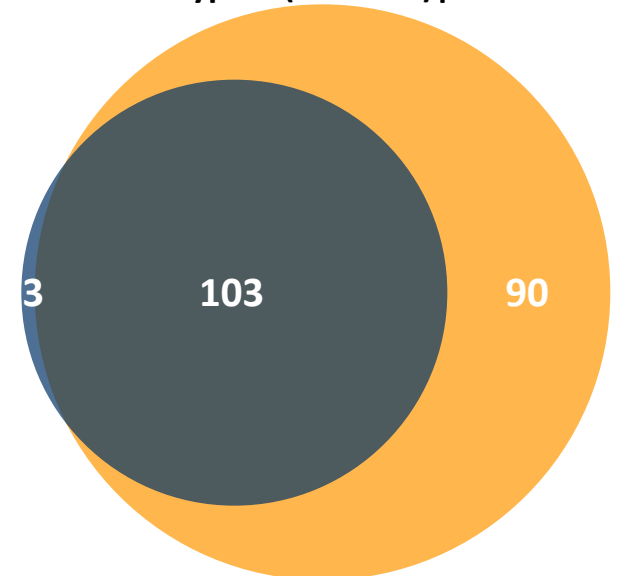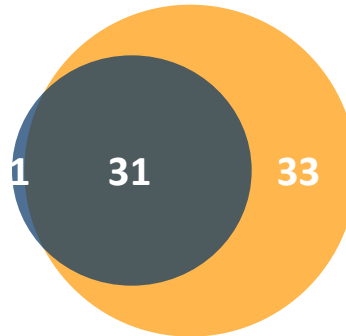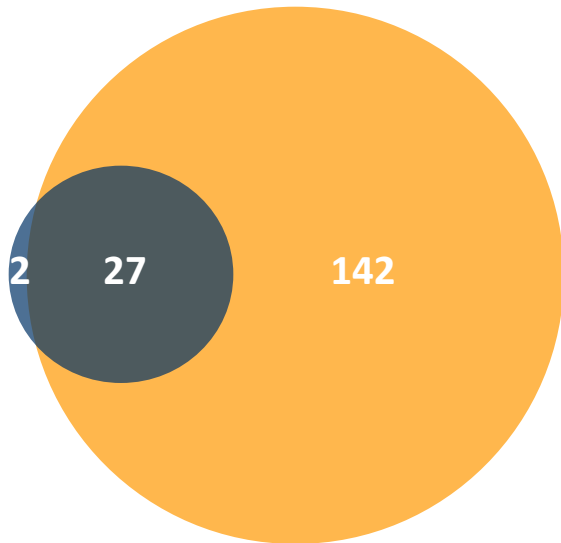
Total Patients: 171 (19% overlap)

Total Patients: 65 (48% overlap)

Total Patients: 196 (53% overlap)

Problem List

Encounter Diagnoses

Continuity of Care Document Sections

2.16.840.1.113883.10.20.1.13
Summary Purpose

2.16.840.1.113883.10.20.1.9
Payers

2.16.840.1.113883.10.20.1.1
Advance Directive
- **Include:** 365870005|Finding of resuscitation status (finding)|

2.16.840.1.113883.10.20.1.5
Functional Status
- **Include:** 105501005|Dependence on enabling machine or device (finding)|

2.16.840.1.113883.10.20.1.11
Problems
- **Include:** 64572001|Disease (disorder)|
- **Exclude:** 281647001|Adverse reaction (disorder)|

2.16.840.1.113883.10.20.1.4
Family History
- **Include:** 57177007|Family history with explicit context (situation)|

2.16.840.1.113883.10.20.1.15
Social History
- **Include:** 365949003|Health-related behavior finding (finding)|

2.16.840.1.113883.10.20.1.2
Allergies, Adverse Reactions & Alerts
- **Include:** 281647001|Adverse reaction (disorder)|
- **Include:** 420134006|Propensity to adverse reactions (disorder)|

2.16.840.1.113883.10.20.1.8
Medications
- **Include:** 373873005|Pharmaceutical / biologic product (product)|

2.16.840.1.113883.10.20.1.7
Medical Equipment
- **Include:** 303607000|Biomedical equipment (physical object)|

2.16.840.1.113883.10.20.1.6
Immunisations
- **Include:** 127785005|Administration of substance to produce immunity, either active or passive (procedure)|

2.16.840.1.113883.10.20.1.16
Vital Signs
- **Include:** 118227000|Vital signs finding (finding)|

2.16.840.1.113883.10.20.1.14
Results
- **Include:** 442618008|Abnormal finding on evaluation procedure (finding)|

2.16.840.1.113883.10.20.1.12
Procedures
- **Include:** 387713003|Surgical procedure (procedure)|

2.16.840.1.113883.10.20.1.3
Encounters

2.16.840.1.113883.10.20.1.10
Plan of Care
- **Include:** 243120004|Regimes and therapies (regime/therapy)|

Completeness of Clinical Summaries Results

Summary Purpose	**Payers**	**Advance Directive (30)** 304253006|Not for resuscitation (finding)|	**Functional Status** N/A
Problems (*) 73211009|Diabetes mellitus (disorder)|	**Family History (80)** 312824007|Family history of cancer of colon (situation)|	**Social History (4.2k)** 65568007|Cigarette smoker (finding)|	**Allergies, Adverse Reactions & Alerts (130)** 292055008|Codeine adverse reaction (disorder)|
Medications N/A	**Medical Equipment (100)** 87405001|Cane, device (physical object)|	**Immunisations (2.4k)** 86198006|Influenza vaccination (procedure)|	**Vital Signs (500)** 61086009|Pulse irregular (finding)|
Results (70) 313172000|Colonoscopy abnormal (finding)|	**Procedures (800)** 52734007|Total replacement of hip (procedure)|	**Encounters**	**Plan of Care (2.2k)** 67516001|Detoxification therapy (regime/therapy)|

Sample Encounter Diagnoses

- 66590003|Alcohol dependence (disorder)|
- 128869009|Infestation by Sarcoptes scabiei var hominis (disorder)|
- 223475005|Consulting with (procedure)|
- 54150009|Upper respiratory infection (disorder)|
- 225358003|Wound care (regime/therapy)|
- 117614|Review by pathologist (procedure)|
- 48532005|Muscle strain (disorder)|
- 18070006|Impacted cerumen (disorder)|
- 16932000|Nausea and vomiting (disorder)|
- 62315008|Diarrhea (finding)|
- 103742009|Renewal of prescription (procedure)|
- 427898007|Infection of tooth (disorder)|
- 271737000|Anemia (disorder)|
- 8943002|Weight gain finding (finding)|
- 43116000|Eczema (disorder)|
- 19943007|Cirrhosis of liver (disorder)|
- 235595009|Gastroesophageal reflux disease (disorder)|
- 39898005|Sleep disorder (disorder)|
- 191997003|Persistent insomnia (disorder)|
- 49727002|Cough (finding)|
- 10743008|Irritable bowel syndrome (disorder)|
- 299709002|Dental abscess (disorder)|
- 4556007|Gastritis (disorder)|
- 422587007|Nausea (finding)|
- 61582004|Allergic rhinitis (disorder)|
- 418363000|Itching of skin (finding)|
- 191813001|Chronic alcoholism in remission (disorder)|
- 89362005|Weight loss finding (finding)|

- 182782007|Dermatitis (disorder)|
- 248342006|Underweight (finding)|
- 74506000|Bereavement due to life event (finding)|
- 60442001|Perforation of tympanic membrane (disorder)|
- 79890006|Loss of appetite (finding)|
- 45007003|Low blood pressure (disorder)|
- 236071009|Chronic diarrhea (disorder)|
- 25374005|Gastroenteritis (disorder)|
- 276444007|Generalized pruritus (finding)|
- 69322001|Psychotic disorder (disorder)|
- 30037006|Anal fissure (disorder)|
- 371088008|Reactive airways dysfunction syndrome (disorder)|
- 426232007|Environmental allergy (disorder)|
- 95891005|Influenza-like illness (finding)|
- 75694006|Pancreatitis (disorder)|
- 228281002|Problem drinker (finding)|
- 196746003|Persistent vomiting (disorder)|
- 200936003|Lupus erythematosus (disorder)|
- 396550006|Blood test (procedure)|
- 429196001|Partial obstruction of small bowel (disorder)|
- 68154008|Chronic cough (finding)|
- 14760008|Constipation (disorder)|
- 68566005|Urinary tract infectious disease (disorder)|
- 417746004|Traumatic injury (disorder)|
- 266261006|Raynaud's phenomenon (finding)|
- 271823003|Tachypnea (finding)|
- 4800001|Pyu...

- 55464009|Systemic lupus erythematosus (disorder)|
- 292055008|Codeine adverse reaction (disorder)|
- 28560003|Hypovolemia (disorder)|
- 33688009|Cholestasis (finding)|
- 43275000|Otitis (disorder)|
- 37610005|Inflammation of cervix (disorder)|
- 281255004|Small bowel obstruction (disorder)|
- 271739002|Wax in ear canal (finding)|
- 235494005|Chronic pancreatitis (disorder)|
- 83414005|Macrocytic anemia (disorder)|
- 48813009|Lymphocytopenia (disorder)|
- 243114000|Support (regime/therapy)|
- 281032009|Well woman health check (procedure)|
- 385955003|Foot care (regime/therapy)|
- 3135009|Otitis externa (disorder)|
- 414521009|Internal hordeolum (disorder)|
- 20928004|Ulcer of anus (disorder)|
- 68653001|Anal pain (finding)|
- 77880009|Rectal pain (finding)|
- 86198006|Influenza vaccination (procedure)|
- 12866006|Pneumococcal vaccination (procedure)|
- 3951002|Proctitis (disorder)|

Improved Organisation

- ☐ Allergies, Adverse Reactions and Alerts
  - ■ 292055008|Codeine adverse reaction (disorder)|
  - ■ 426232007|Environmental allergy (disorder)|
- ☐ Social History
  - ■ 228281002|Problem drinker (finding)|
- ☐ Immunisation
  - ■ 86198006|Influenza vaccination (procedure)|
  - ■ 12866006|Pneumococcal vaccination (procedure)|
- ☐ Vital Signs
  - ■ 271823003|Tachypnea (finding)|
- ☐ Plan of Care
  - ■ 225358003|Wound care (regime/therapy)|
  - ■ 385955003|Foot care (regime/therapy)|
- ☐ Problem (Sample)
  - ■ 54150009|Upper respiratory infection (disorder)|
  - ■ 19943007|Cirrhosis of liver (disorder)|
  - ■ 10743008|Irritable bowel syndrome (disorder)|
  - ■ 371088008|Reactive airways dysfunction syndrome (disorder)|
  - ■ 68566005|Urinary tract infectious disease (disorder)|
  - ■ 281255004|Small bowel obstruction (disorder)|

Summary of Clinical Value of SNOMED CT

- ☐ Improved Completeness
  - ■ Data Capture
- ☐ Simplified Retrieval
  - ■ Data Retrieval
- ☐ Improved Organisation
  - ■ Data Sharing