SNOMED

Evaluating Performance for Summarizing Veterinary Cardiovascular Findings.

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Study Questions

- Could "free text" cardiovascular diagnoses rendered by veterinary clinicians be effectively rendered using SNOMED?

- Was SNOMED effective in categorizing and retrieving cardiovascular diagnoses?

The first question was answered by manually discovering SNOMED concepts and / or building SNOMED phrases that accurately represented the diagnosis phrases entered by clinicians.

The second question was answered by tracing the primary SNOMED concepts through the "is_a" hierarchy of SNOMED-RT to the Disease (DF-00000) root and evaluating the grouping functionality provided by SNOMED-RT.

Study Methods

- University of Missouri Medical Records
- Free text final diagnosis field
- Manually selected all text strings that appeared to be related to cardiovascular system.
- Manually encoded strings using SNOMED

The process was entirely visual inspection of the data provided by the University of Missouri College of Veterinary Medicine. No auto-encoding or automatic parsing was employed.

Sample Description

- **75 Records**
  - 73 canine, 1 feline, 1 equine
- **63 Unique strings**
  - Spelling, capitalization, punctuation
- **46 Unique diagnoses**
  - Includes combinations of diagnoses in single fields.

A string was considered to be unique if it varied in either spelling, capitalization or punctuation. "Atrial fibrilation" and "atrial fibrillation" were considered to be separate unique strings.

A concept was considered to be unique if the diagnosis along with necessary modifiers were unique. Congestive heart failure and SEVERE congestive heart failure were considered to be unique. Multiple occurrences of the same diagnosis combination were not considered to be unique.

Sample Distribution

- 10 Heart rhythms and sounds
- 8 Heart failure
- 16 Valvular
- 7 Vascular
- 6 Miscellaneous cardiac

This distribution was determined by manual inspection of the original strings.

Sample Distribution

- 8 phrases represented multiple diagnoses
  - Cause/effect type
  - Independent combinations
- 16 required modification for topography, morphology, severity, certainty or a combination of these

This distribution was determined by manual inspection of the original strings.

Results (unique diagnoses)

Well coded	39
SNOMED Code inadequate	3
Original syntax or meaning unclear	4
Total	46

SNOMED codes or code combinations were considered to be inadequate if they either failed to ACCURATELY and COMPLETELY represent the concept as represented by the original string.

The original syntax or meaning was considered to be unclear if cause and effect were implied but not stated (combination diagnoses) or if the phrasing did not lead the author to clear understanding of the intent of the phrase.

SNOMED Distribution

- 32 Unique SNOMED codes used for diagnoses and findings.
- 11 modifiers for topography, morphology, severity etc.
- 2 procedures in the diagnosis field were excluded.

The syntax used to create diagnosis modifications (post-coordination) is consistent with the syntax used by SNOMED to create concept definitions within the SNOMED-RT system (pre-coordination).

(Aside) The two procedures indicate that at least some U of M clinicians view the data entry field as "reason for visit" rather than final diagnosis.

SNOMED modifiers used

- **5 topography**
  - Base of heart, right heart (2), left heart, chest wall
- **3 morphology**
  - Valvular dysplasia (2) and prolapse
- **9 severity**
  - Mild (6), moderate, severe, grade II murmur
- **3 "certainty"**
  - Possible diagnosis (2), previous diagnosis

The topography and morphology modifications may indicate a need for attention to SNOMED content (addressed later in the talk).

The severity and certainty modifications indicate a need to carefully consider the data model in the clinical record so that these kinds of information can be supported in a SNOMED-based environment.

SNOMED code inadequate

- Portal Caval Shunt (2)

- Acquired portal-systemic shunt (D5-81500)

- Congenital portal-systemic shunt (D4-38013) was added after the beta version.

SNOMED does not have EVERY medical concept necessary to support an electronic medical record. Mechanisms are in place, however, to quickly address content short comings.

Original meaning unclear

- Endocardiosis
- Mitral Endocardiosis coded as "Myxoid transformation of mitral valve" (similar for tricuspid)
  - Next more general term "Myxoid transformation of cardiac valve"
- What should be read into clinicians diagnostic phrase "endocardiosis"?

It seems likely that this is short-hand for either mitral or tricuspid endocardiosis (or both) but this cannot be deduced from the original data.

Original meaning unclear

- Right heart murmur

- Cardiac murmur with PMI on right chest wall OR murmur diagnosed as originating from right side of heart?

- Coded:
    - Cardiac murmur (F-35600)
        - Radiating to (G-C040)
        - Chest Wall (T-D3050)
            - Has-laterality right (G-A100)

Again, this is probably short hand as it does not represent a specific diagnosis. Note that the "has-laterality" construction is appended to the chest wall and NOT to the murmur. It is critical that an appropriate syntax become part of any system designed to support nomenclature.

Original meaning unclear

- Sinus arrest with ventricular escape beats (under sedation)

- Sinoatrial arrest with nodal/ventricular escape (D3-31010)
  - Associated with (G-C002) Sedated state (F-92330)

- Not considered (by me) to be an associated etiology (not causal).

From my perspective, the sedation unmasked an underlying patho-physiologic problem and was not the proximate cause of the sinus arrest. This may or may not be true. The effect is to change the "Associated with" linkage concept to "Caused by" (or similar).

Original Syntax unclear

- Right congestive heart failure with ascites

- Congestive heart failure (D3-16010)
    - Assoc-topography (G-C505) right side of heart (T-32001)
- Ascites (D5-70400)

- Ascites secondary to right heart failure would produce association that is not provided directly by the original phrase.

Although it is quite logical to assume that the ascites is a direct result of congestive heart failure, there are other possibilities. This also presents a challenge to the data model in the clinical system. If the phrase were "Ascites secondary to right congestive heart failure", the association would be clear. Would this be stored as a single diagnosis or two diagnoses with linkage provided by the record system?

Original Syntax unclear

- Mitral regurgitation/endocardiosis

- Mitral valve regurgitation (D3-29012)
- Myxoid transformation of mitral valve (D3-29102)

- The original phrase does not indicate cause and effect though it can be inferred.

Cause and effect are fairly clear here, but it is not stated explicitly. This presents similar questions about the data model in the clinical system.

Data model issues

- Reevaluation of DCM, mitral endocardiosis
- Is this a procedure (recheck) or a diagnosis?

- Canine dilated cardiomyopathy (D3-21104)
  - Prior Diagnosis (G-1001)
- Myxoid transformation of mitral valve (D3-29102)
  - prior diagnosis (G-1001)

SNOMED provides terminology appropriate to classify this entry. The medical record will have to support the ability to separate this from the first diagnosis.

It is also likely that we will want to evaluate cases like this for progression of the disease (e.g., did the severity increase with time).

Definition uncertainty

- Type II Boxer cardiomyopathy

- = ventricular dysrhythmias, normal contractility, symptoms in a boxer. Coded (here) as dilated cardiomyopathy.

- This terminology is not universally accepted. When does it go into SNOMED?

SNOMED does NOT have this concept at this time.

We have not established criteria for judging the validity and acceptance of a new medical concept. Is this a "stage" in the progression of dilated cardiomyopathy? Is the epidemiology clear (that this only occurs in Boxers) or should this be a more general concept when it enters the lexicon?

Definition uncertainty

- Ventricular premature complexes

- =ventricular premature beats?

- Ventricular premature beats (D3-31740)

Ventricular premature concepts are electrocardiographic findings. Ventricular premature beats would be discovered using a combination of EKG, auscultation and palpation (pulse). A ventricular premature complex does not ALWAYS trigger a heart beat.

In common usage, ventricular premature beats generally represent an EKG finding and were treated as such in this analysis.

SNOMED granularity

- "Right congestive heart failure, Right heart failure, Right sided CHF"

- Congestive heart failure (D3-16010)
  - Associated topography (G-C505) Right side of heart (T-32001)

- SNOMED should have a concept for Right Heart failure.

Right sided congestive heart failure is a distinct medical entity (as is left-sided). In fact, the differences between these two go well beyond "right side of heart".

Creating a new concept here is (and should be) viewed differently than having a distinct concept for every level of severity.

Rules for concept "creation" are evolving as SNOMED evolves.

SNOMED granularity

- Tricuspid prolapse

- Tricuspid valve disorder (D3-29040)
  - Associated morphology (G-C504) Prolapse (M-31050)

- SNOMED should add concept for tricuspid prolapse.

Although this concept could be formed, it probably deserves to be a unique concept in the SNOMED hierarchy.
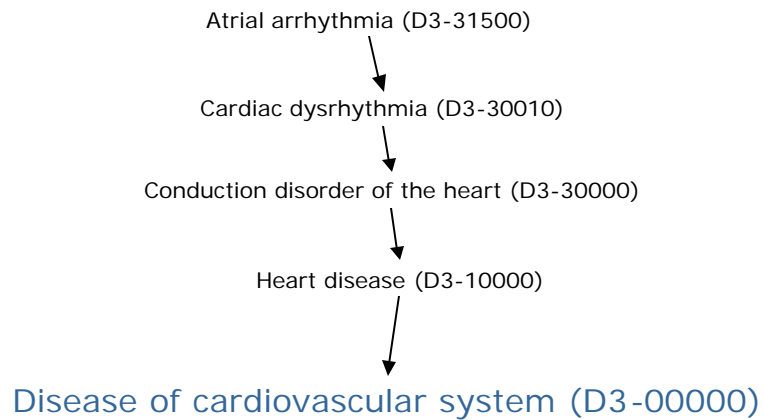
SNOMED granularity

- Subaortic Stenosis –severe

- Congenital subaortic stenosis (D4-31A30)
    - Condition severity (G-C517) Severe (G-A003)

- SNOMED should NOT have separate concepts for all possible levels of severity

Severity needs to be managed by "post-coordination" (form the complete concepts outside of the nomenclature itself). This allows for a broader range of possible systems:

1) Mild, moderate, severe
2) Grade I of IV
3) Grade I of V
4) Etc.

Atrial fibrillation (isa):

Atrial arrhythmia (D3-31500)

Cardiac dysrhythmia (D3-30010)

Conduction disorder of the heart (D3-30000)

Heart disease (D3-10000)

Disease of cardiovascular system (D3-00000)

In the SNOMED is_a hierarchy each child (arrow pointing FROM) "is a" member of the parent concept (arrow pointing TO). Read this slide:

Atrial arrhythmia "is a" Cardiac dysrhythmia

Congenital stenosis of pulmonary valve (isa):
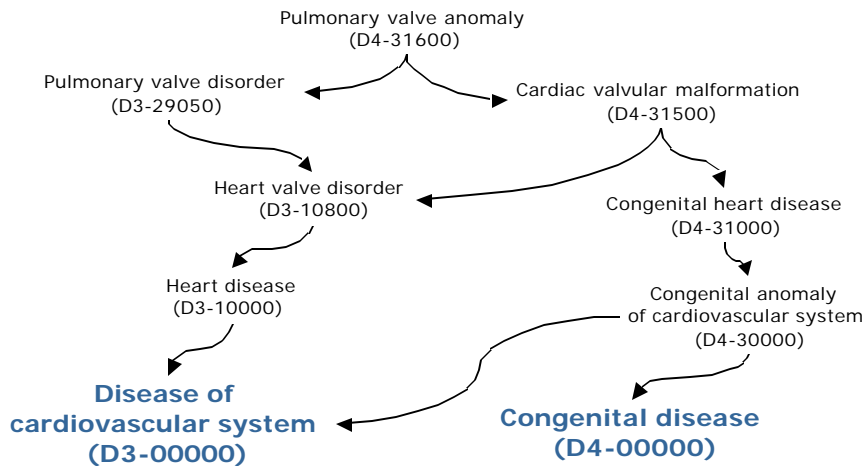
The SNOMED-RT hierarchy allows that a given concept may be a member of more than one parent concept (group).

Congenital stenosis of the pulmonary valve is BOTH a congenital disease and a disease of the cardiovascular system.

The hierarchies can be used to group diagnoses for retrieval:

"Please collect all cases that have a diagnosis that 'is_a' disease of the cardiovascular system".

Hierarchy Roots

- 5 Cardiovascular system finding
- 25 Disease of cardiovascular system
  - 21 also Disease of thorax
  - 4 also congenital disease
  - 1 also Disease of digestive system (portal – caval shunt).
- 1 Disease of abdomen (ascites)
- 1 Psychological finding (sedation)

Although certain areas of the SNOMED hierarchy require additional refinement, there were no inconsistencies in this limited analysis.

Hierarchy intermediates

- **5 Cardiovascular system findings**
  - 4 Cardiac auscultation findings
  - 1 cardiovascular pressure AND/OR pulse finding

Hierarchy intermediates allow for subdivisions within a search grouping algorithm. Of the 5 cardiovascular system findings, 4 could be further refined to auscultation findings and 1 was a pressure or pulse finding.

The ability to sub-classify is only limited by the existence of hierarchy intermediates.

Hierarchy Intermediates

- **25 Disease of cardiovascular system**
  - **20 Heart disease**
    - 8 Heart valve disorder
    - 7 Myocardial disease
      - 4 Conduction disorder
      - 3 "other" (heart failure, cardiomyopathy)
    - 5 Heart disease other (endocarditis, subaortic stenosis, hydropericardium, septal defects)
  - **3 Vascular disease**
  - **1 missing intermediate (portal – systemic shunt not "vascular disease")**
  - **1 Infectious disease (heartworm)**

The hierarchy under disease of the cardiovascular system allows for groupings based on heart vs. vascular disease. Heart disease could be further divided into valvular and myocardial diseases.

The most obvious example of a missing intermediate in the present analysis was vascular disease from the inheritance tree for portal-systemic shunt.

What intermediates would be appropriate for canine heartworm disease?

Conclusion

- SNOMED could adequately represent over 90% of the concepts included in this sample.
- SNOMED accurately organized over 90% of the concepts included in this sample.

From a technical perspective, this analysis provides evidence that SNOMED can be used effectively to capture and retrieve cardiovascular diagnosis information. Additional work is required in the following areas:

1) SNOMED veterinary content still requires expert attention (medical and informatics expertise).
2) Electronic medical records systems must be developed that accommodate a robust nomenclature (in the abstract) like SNOMED (specifically).