Standards in the Veterinary Medical Record

Status of Animal Health Information Standards in the United States

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The ability to consolidate and analyze animal health information from disparate sources is an essential component to statewide, regional, national and global animal disease surveillance systems. Currently, no generally accepted national standards exist in the United States for the format, structure and content of animal health information. The diversity in the way animal health information is stored often precludes consolidation that would enable more comprehensive analysis of animal disease incidence.

Although we are often not cognizant of it, we are the beneficiaries of standards every day. Much of what we do on a daily basis would not be possible, or would be extremely expensive, if we did not have standards. We are able to buy things such as electronics for our homes and workplaces without having to know very much about how they work or whether they will fit the plug. We can do this because standards for manufacturing have been established and accepted by the companies that make them. It is this way for the vast majority of appliances, vehicles, utensils and even food that we eat. Imagine purchasing a gallon of milk at the store if you knew that there were no standards for composition, contamination, additives, storage conditions or shelf life. Because of standards, we can walk into most stores and purchase items with the confidence that it will fit, or work or be wholesome and nutritious.

Benefits to Veterinary Medicine

The benefits of standards in veterinary medicine are demonstrated in many different ways. Standards can:

- Improve the content and consistency of the medical record
- Improve data sharing
- Provide a means of measuring improvements in patient care
- Improve the speed of delivery of patient care
- Reduces the need for redundant procedures
- Aids in management of medical resources (personnel and equipment)
- Improves risk management
- Provides vendors with defined specifications for performance, content, format and function.
- Improves cost recovery

It has long been accepted in the field of health information that progress is dependent on standards1 However, there are a number of current obstacles to the collection of standardized health information.

1. In many instances there is limited automation of health information. Records are still kept on paper forms, with all the inherent access and retrieval difficulties associated with such data.
2. In most cases data is collected in a site-specific manner, which often makes the form of the data incompatible with data collected at other sites.
3. Many data collection programs are targeted to a specific need. Thus data collected for a particular project may be ill suited for another that requires similar data.
4. Historically, there has been limited data exchange, especially electronically among those that collect animal health information. The perceived need for data exchange in general has been very low.

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1. Standards in the Veterinary Medical Record
5. The lack of a standardized terminology for representing animal health concepts prevents the consolidation of health data due to unclear synonymy, colloquialism or ambiguous abbreviations.
6. For complex medical concepts, the lack of classification standards prevents the terms from being interpreted consistently.
7. In veterinary medicine particularly, there have been few external forces driving standardization.

Driving Forces of Standardization

In the United States there are now a number of initiatives that will require the standardization of animal health information in order to achieve their goals. These include:

• The President’s Interagency Task Force on Food Safety (ref) This program will provide the ability to share data between a large number of US agencies involved in food safety and disease surveillance in the United States.
• The threat of emerging diseases - The global economy that was ushered in with the GATT and NAFTA treaties and the concomitant increase in trade increases the threat of diseases foreign or eradicated from the United States animal populations to again pose a threat to our domestic livestock and poultry.
• The threat of bioterrorism - The activity of radical groups with the aim to wreak havoc on the United States is a continued threat. Since the vast majority of potential bioterrorism agents also affect animals, animal populations are deal sentinels for the early detection of such attacks.

Areas of Health Standardization

There are at least five areas in animal health where standards are needed. These include:

• Messaging - the precise format and structure of the data that is used to transfer data between systems
• Nomenclature and Codes - a systematic way of representing medical concepts in a standardized fashion based on a standardized nomenclature.
• Identifiers - the unique identification of patients, clients, institutions and care providers that allows the cross-institutional sharing of medical data.
• Medical record content and structure - the specific data elements and relationships between them in a health record
• Security, authentication and confidentiality - the mechanisms to prevent unauthorized access to information.

This report covers only on the first two areas that have been formally addressed in veterinary medicine in the US.

History

In 1995, the American Veterinary Medical Association appointed a subcommittee of the Informatics committee to specifically address the area of health information standards. This committee realized very quickly that the veterinary profession did not have the resources to develop a set of health standards de novo. The committee then focused on identifying existing standards in human medicine that most closely matched the needs of veterinary medicine. The committee began work to enhance those standards, through the normal standards development process, to meet the needs of veterinary medicine.

After review of existing standards, the committee selected three on which to focus their efforts; Health Level
Standards in the Veterinary Medical Record

Seven (HL7) a widely accepted, international messaging standard, the Systematized Nomenclature of Medicine and Veterinary Medicine (SNOMED) to represent medical concepts, and the Logical Observation Identifier Names and Codes (LOINC) terminology for the representation of clinical observations.

Health Level Seven

The ability to exchange information between one computer system and another is essential to consolidate data. Because of the variety of ways different computer systems store their information, in most cases it is difficult if not impossible to merge or consolidate data in its native form with data from another system. The reason for this is that individual computer systems were designed with their particular function in mind and did not take into consideration other ways in which their data would be used. The primary objective of most systems is to produce a report. For instance, the data collected by a diagnostic laboratory that is needed to properly identify, process, test and report on a particular specimen is substantially different than the data collected by a veterinary practice management system. In addition, because most systems are developed with specific uses in mind, they are optimized for the hardware and software environment in which they were created. This results in differences in the physical way data is stored between computer systems. These physical differences are the major obstacles to the sharing and integration of data.

HL7 attempts to overcome this obstacle by providing a structure and format for the exchange of health data. The goal of HL7 is to provide standards for the exchange of data among healthcare computer applications that eliminate or substantially reduce the custom interface programming and program maintenance that may otherwise be required. In theory, if a system is compliant with the HL7 standard, it should be able to read and write HL7 messages sent from any other HL7 compliant system. In reality, a significant amount of negotiation and cooperation is required for an HL7 interface to work properly. The amount of negotiation and rework of interfaces that is required for new systems has been reduced substantially with the broad acceptance of this standard, as well as the appearance on a number of software interface tools that ease the task of developing messages for a particular system.

The focus of HL7 since its inception has been on human acute care, which has considerable overlap with clinical veterinary medicine. The goal of the AVMA standards committee was to evaluate the standard in the context of veterinary medicine and propose enhancements that would enable it to support the unique needs of veterinary medicine.

A specific application of the standard to an existing need was selected. The Veterinary Medical Data Base (VMDB) was established in 1964 under the auspices of the Epidemiology Branch, National Cancer Institute, National Institutes of Health, to capture visit summary information from participating University-based veterinary medical teaching hospitals. The ability to automatically exchange veterinary health information was then and is now hampered by the lack of standardized electronic data exchange mechanisms. With computerization of veterinary practices and laboratories becoming more commonplace, the committee felt that the opportunity exists to apply these standards to a existing program. Thus the first goal was to match the HL7 standard with the needs of the VMDB.

Since HL7 was initially developed as a human medical standard, the most critical need was to support the identification of different animal species and breeds, as well as the particular occupation of a animal (ie. Dairy, meat, working, etc). Additionally, the concept of owner was one that was not supported. Lastly, since veterinary medicine crosses the area of public health and environmental medicine, the standard needed to support information transfer on medical data that does not originate from a living organism, such as food or soil.
After developing specific justifications for adding the needed parts to the standard, the latest version (version 2.4) has been successfully accepted by HL7, and now supports the transfer of data concerning different species and provides the ability to associate owners with their animals. This extension of the standard now allows transfer of a broad range of clinical and laboratory information not easily supported in the past.

**Codes, Vocabularies and Nomenclature**

Attempts to collect statistically valid data for animal health has a long history. Efforts to develop a standard veterinary nomenclature were first begun in 1938, with the establishment of the AVMA special committee on nomenclature of diseases and vital statistics of domestic animals. By 1943, there was a realization that a standard nomenclature was required before vital statistics could be tabulated.3 The committee was renamed the Special Committee on Nomenclature of Diseases and in 1955 published a preliminary report, "a Basis for nomenclature of animal diseases, topographic classification, etiologic categories".4

The next major publication on veterinary nomenclature was the Standard Nomenclature of Veterinary Diseases and Operations (SNVDO). The first edition of SNVDO was published in 1964 in limited quantities and was based on the Standard Nomenclature of Diseases and Operations (SNDO) published by the American Medical Association in 1961. An extensive revision was published in 19665 and additional modifications added through 1971.6

In 1983 the AVMA Committee on Standard Nomenclature and Coding was established (CSNC). In 1985, the first edition of SNOVET was published.7 SNOVET was a controlled vocabulary based on the second edition of SNOMED. SNOVET was incorporated into SNOMED International, which was published in 1993 with additional terminology being added with the oversight of a SNOMED secretariat located at Virginia Tech.

While SNOMED has been considered by many to be the most comprehensive, single terminology available in medicine8 and has been adopted by the AVMA, there are substantial deficiencies in veterinary terminology.9 These deficiencies, in addition to a lack of understanding in how to implement a standard vocabulary, resistance to numerical coding of health information, and a lack of exposure to the benefits of health information standardization have been major obstacles to the uniform adoption of any standard terminology in veterinary medicine. Additional efforts to standardized veterinary terminology have been attempted10, but have not been generally accepted.

While messaging standards address the way data is moved from one place to another and the format by which it is moved, they do not address content. Statistical analysis requires that the underlying data be represented in a standard way. Because of the wide variety of ways that data can be represented in the medical record, standardized nomenclatures and coding systems have been developed to attempt to bring some consistency in the way data is stored and retrieved. While nomenclatures and classification systems are not necessary to exchange medical data, they are necessary to exchange medical information. Data only become information when it can be used. Nomenclatures and classifications attempt to develop this usefulness by merging disparate data sources into a form that can be used *in toto*.

The true benefits of computerized information systems cannot be realized without standardized classification and nomenclature systems. There is an important distinction to be made between a nomenclature and classification. Whereas a nomenclature is a set of names or terms, a classification is a statistical tool and it facilitates the
quantitative study of data. It is designed to group and regroup observations so that they fit into the nomenclature.

In biology, classification is essential to the quantitative study of any phenomenon, and it is recognized that uniform definitions and uniform systems of classification are prerequisites to the advance of scientific knowledge. Likewise, in the study of illness and death a standard classification of disease and injury for statistical purposes is essential. There are a great number of approaches in the development of the classification scheme; an anatomist may want the classification based on the part of the body affected, a pathologist is primarily interested in the nature of the disease process; however, the clinician must also consider the disease from both of these angles and also needs to know etiology.

The concept of classification of disease is very subjective due to the different types of operations, characteristics and personalities of the encoder and/or the practice or institution. Thus, nomenclatures that attempt to address classification within their structure only partially accomplish it. Because of this subjectiveness, most nomenclature systems being developed are very rich in the use of synonyms. In some cases, over 60% of the entire nomenclature system consists of synonyms. This leads to additional problems with the application of standardized terminology. Because one can approach the representation of disease conditions from a number of classification methods, coding, in the absence of the semantics of the available terms, can vary considerably.

Despite the recognized issues surrounding their use, there are many benefits of standardized nomenclature and classification systems. The benefits encompass all areas of veterinary medicine by providing quantitative measurements of the frequency of specific types of activities and findings. Some of the benefits include:

- Improved inventory and retrieval of case material.
- Comparative analysis of disease findings
- Spatial and temporal trend analysis
- Adverse event avoidance
- Medical decision support

**Systematized Nomenclature of Medicine and Veterinary Medicine (SNOMED)**

The Systematized Nomenclature for Medicine and Veterinary Medicine (SNOMED), also known as SNOMED International is a multiaxial terminology first released in 1993. It currently contains over 200,000 terms including all of the terms used in the last revision of SNVDO, plus a large number of veterinary specific terms that have been added through the efforts of a Veterinary SNOMED secretariat located at Virgina Tech. It is a robust, semi-hierarchical terminology divided into axes (categorical groupings of terms) including diagnosis, morphology, topology, function, chemical and living agents, procedures, occupations and social terms as well as general modifiers. SNOMED was selected by the AVMA subcommittee on standards because of its long association with veterinary medicine.

It is important to recognize that SNOMED is only a standardized source terminology for the storage and retrieval of health information from computer systems. It is not a medical records system, a database or encoding software. This has led to some misconceptions as to how to implement SNOMED.

The advantage of a controlled vocabulary becomes apparent when it is realized that there are multiple ways to say the same thing in medicine. For example, a respiratory infection of a bird caused by the fungus *Aspergillus sp.*, may be listed as; Aspergillosis, Fungal pneumonia, Granulomatous pneumonia, Mycotic pneumonia, or Aspergillus pneumonia.
SNOMED attempts to reconcile this variety of terms by assigning a single code to all of the terms that represent the concept. All terms are listed as a single hierarchy within an axis. Since a concept cannot be duplicated, a single concept can only be contained in one hierarchy. Functionally this philosophy breaks down when one considers that given such a structure, a disease such as bacterial pneumonia can only be represented as a bacterial disease or a respiratory disease, but not both.

The recognition of this deficiency has resulted in a monumental effort to build semantics into SNOMED. This new terminology is called SNOMED-RT (reference terminology). SNOMED-RT contains over 260,000 explicit relationships between terms that allows one to identify the relationship of a term with all other appropriate terms. Thus through a series of term-association-term triplet, one can identify a complete structural relationship for a medical concept.

Table 1 shows the relationships that exist for the concept of a bacterial pneumonia caused by *Pasteurella sp.* (SNOMED code DE-13151)

<table>
<thead>
<tr>
<th>ISA</th>
<th>D2-50000</th>
<th>Disease of lung</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISA</td>
<td>DE-13100</td>
<td>Pasteurella infection</td>
</tr>
<tr>
<td>ASSOC-TOPO</td>
<td>T-28000</td>
<td>Lung</td>
</tr>
<tr>
<td>ASSOC-ETIOLOGY</td>
<td>L-22803</td>
<td>Pasteurella haemolytica</td>
</tr>
<tr>
<td>ASSOC-ETIOLOGY</td>
<td>L-10000</td>
<td>Bacterium</td>
</tr>
<tr>
<td>ASSOC-ETIOLOGY</td>
<td>L-00110</td>
<td>Infectious agent</td>
</tr>
</tbody>
</table>

Over the past five years, substantial progress has been made in the additional of animal health related terminology to the SNOMED nomenclature. Initial analysis of the required terminology to support laboratory and pathological diagnoses from 1993 through 1999 at the California Animal Health and Food Safety Laboratory is listed in the table below.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number of Terms</th>
<th>Percent SNOMED Coverage</th>
<th>Etiology</th>
<th>Number of terms</th>
<th>Percent SNOMED coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total terms</td>
<td>1211</td>
<td>45.7%</td>
<td>Total terms</td>
<td>1453</td>
<td>59.4%</td>
</tr>
<tr>
<td>Top 25%</td>
<td>5</td>
<td>100.0%</td>
<td>Top 25%</td>
<td>6</td>
<td>100.0%</td>
</tr>
<tr>
<td>Top 50%</td>
<td>20</td>
<td>94.7%</td>
<td>Top 50%</td>
<td>23</td>
<td>91.3%</td>
</tr>
<tr>
<td>Top 75%</td>
<td>79</td>
<td>82.3%</td>
<td>Top 75%</td>
<td>87</td>
<td>90.8%</td>
</tr>
<tr>
<td>Top 90%</td>
<td>205</td>
<td>74.1%</td>
<td>Top 90%</td>
<td>241</td>
<td>85.5%</td>
</tr>
<tr>
<td>Terms Used &lt;5 times</td>
<td>487</td>
<td>32.4%</td>
<td>Terms used &lt;5 times</td>
<td>698</td>
<td>43.8%</td>
</tr>
</tbody>
</table>

This table shows that the most frequently used terms in a veterinary diagnostic laboratory setting are well covered by the terminology. Infrequently used terms are more likely to not be covered in the terminology, although through the use of multiple term representation, it may be possible to improve these numbers. As the
understanding of the relationships between terms becomes better defined, and as additional terms are submitted to the secretariat, this coverage will rapidly improve. A formal mechanism for the submission of potential new terms has been developed at the secretariat and is currently being used by a number of veterinary institutions.

**Logical Observation Identifier Names and Codes (LOINC)**

LOINC has been developed over the past 4 years at the Regenstrief Institute, Indiana University, Purdue University Indianapolis, Indiana. It is a database providing a set of universal names and ID codes for identifying clinical and laboratory test results. Its purpose is to facilitate the exchange and pooling of clinical laboratory results, such as blood hemoglobin or serum potassium, for clinical care, outcomes management, and research\textsuperscript{11}. It is a publicly available standard that can be accessed by anyone having internet capabilities.

Messaging standards, such as HL7 discussed above provide the structure for the transfer of laboratory data. SNOMED provides highly structured information about clinical and diagnostic results; however, prior to LOINC there was no adequate standard naming convention or coding convention for test names and result formats. The LOINC codes are not intended to transmit all possible information about a test. They are only intended to identify the test result. The codes represent a fully specified result name that consists of six parts:

1) The analyte, or what is being measured.
2) The property of the measurement, (e.g., a ratio, a mass concentration, an enzymatic catalytic rate).
3) The time period of the measurement (e.g. a point observation or an observation integrated over time).
4) The type of specimen (e.g. urine, tissue, serum).
5) The general precision (e.g., whether the measure is quantitative (a number) or qualitative (red, blue, green, ordinal (1+,2+,3+) or nominal (one of a list of possibilities)).
6) Where relevant, the method used to produce the test.

The fully specified name consists of at least the first five components, separated by a colon. For example, a fully specified name for a serology test which detects antibodies to the bovine virus diarrhea virus in serum using ELISA would be:

Bovine Diarrhea Virus AB:ACNC:PT:SER:ORD:EIA

where the first component is the antibody being measured; ACNC represents an arbitrary concentration; PT determines that this is a point in time measurement; SER is the code for the serum sample; ORD is the code for an Ordinal measurement and; EIA is the code for an enzyme immunosorbent assay.

Using this format, one of the authors (JC) has done substantial mapping of LOINC to the test lists of veterinary diagnostic laboratories throughout the United States. Additionally, all of the diagnostic tests listed for animal diseases in the Office International des Epizooties (OIE) Manual of Standards for Diagnostic Tests and Vaccine\textsuperscript{12} have been formatted to the LOINC structure. Since the LOINC database was initially created to support human clinical and laboratory medicine, the vast majority of tests needed for veterinary medicine were not available. The mapping efforts over the past two years have now provided over 1000 tests to the standard. Due to the substantial expressiveness of the LOINC fully specified terms, it is now possible to transmit information regarding tests results with much greater specificity than was available in the past. Mapping efforts, as with all terminology related standardization are ongoing, with the goal of having all of the most commonly performed
tests performed in veterinary laboratories represented in the standard by the end of 2000.

**Conclusions**

Efforts over the past two years have now created a foundation for the standard transmission storage and retrieval of animal health information. While much remains to be done, these early efforts are beginning to come to fruition. Guides for the implementation of these standards in veterinary software are currently being written. Many of the benefits of standardization will be dependent on the widespread adoption of these standards as well as continued improvements and refinements of terminology to support animal health. It is hoped that the efforts now underway in the United States can merge efficiently with those in other countries to provide a universal health information structure that will benefit the growing global trade.

**References**

2. HL7 version 2.3.1, Chapter 1, 1999. Health Level Seven, Ann Arbor, MI.