

A surveillance system for diseases of companion animals in the Veneto region (Italy)

This paper (No. 11052017-00098-EN) has been peer-reviewed, accepted, edited, and corrected by authors. It has not yet been formatted for printing. It will be published in December 2017 in issue **36** (3) of the *Scientific and Technical Review*

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Summary

Experts and international public health organisations stress the lack of surveillance systems for companion animal diseases and the need to implement such surveillance as a priority of the One Health perspective. This paper presents the features of a system for collection, analysis, interpretation and dissemination of data regarding the health status of pets in the Veneto region (Italy). The system involved the construction of a web-based database containing the diagnoses of transmissible and non-transmissible diseases of dogs and cats made by veterinarians in their practices, hospitals, kennels and catteries. Each diagnosis constitutes a single record, also containing data on the identification of the individual animal and on several characteristics of epidemiological relevance. The World Health Organisation (WHO) International Classification of Diseases (ICD-10) for human diseases has been adapted to canine and feline diseases to standardise the diagnostic nomenclature. Software has been specifically created for online data entry and data management. The

first results show that the main disorders were digestive (21%), dermatological (18%) and cardiovascular (11%) among 1,087 diagnostic records in dogs, and digestive (23%), dermatological (15%) and urinary (14%) among 289 diagnostic records in cats. The main causes of death are represented by cardiovascular (21%) and gastrointestinal (21%) diseases in dogs and by urinary (31%) disorders in cats. At present, no institutional surveillance system for companion animal health exists in Italy, and veterinarians joining this project and sharing the outcomes of their clinical activity act on a voluntary basis.

Keywords

Companion animal – Disease classification – Epidemiology – One Health – Surveillance – Web-application – Zoonosis.

Introduction

One Health represents an integrated approach to health that focuses on the interactions among animals, humans and the environment, and requires interdisciplinary collaborations to develop global strategies for health management (1). From this perspective, the presence of surveillance systems for the collection, organisation and sharing of health data has to be considered the first step in implementing the One Health mission in practice. The populations of pets kept in households have increased worldwide. In Italy, there are around 15 million companion animals, and 43% of families own dogs or cats (2). In spite of these figures, the epidemiological knowledge regarding these populations is limited and fragmented. The analysis of pet health status on a population scale provides useful information for understanding and managing its impact on either humans or other animals. In fact, pets closely share the domestic environment with humans and may represent a source, a reservoir or a proxy for a wide spectrum of zoonotic agents (3). Companion animals may also function as non-human sentinels for the discovery of environmental risk factors for non-communicable diseases. Finally, the epidemiology of pet diseases gives a better understanding of the risks associated with specific disorders and aids in planning effective control measures

or strategies for use in these species (improved breeding programmes, screening tests, specific training, etc.) (4).

Surveillance is the ongoing systematic collection, collation, analysis and interpretation of data and the dissemination of information to those who need to know in order to take action (5). Most of the national and international surveillance systems in place address humans or production animals. In companion animals, only information on specific diseases (e.g. rabies, cancer) is locally submitted to surveillance, often without standardisation and public commitment (3). Some projects have been developed for private purposes (e.g. kennel club or insurance databases) but systematic and well-organised collections of health data from pets are rare, with only pioneering exceptions such as VetCompass (the Royal Veterinary College, London; www.rvc.ac.uk/vetcompass), SAVSNET (the University of Liverpool Small Animal Veterinary Surveillance Network; www.savsnet.co.uk) and the Veterinary Medical Database in North America (vmdb.org). At present, similar plans do not exist in Italy. This article describes an ongoing project named Veterinary Surveillance of Pets (SVETPET) that addresses this One Health issue.

The project is carried out in cooperation by two Departments of the University of Padua (the Department of Animal Medicine, Production and Health and the Department of Information Engineering) and is funded by the Veneto Regional Council.

Materials and methods

The SVETPET project is aimed at implementing the surveillance of companion animal diseases in the Veneto region. The system that has been designed and built consists of a database and a web application that allows network users to access, enter, update and display diagnostic data. The potential subjects constituting this network are approximately 600 practices/hospitals for companion animals officially registered in the Veneto region, together with the practices of the public veterinary services, of kennels and catteries and the Veterinary Teaching Hospital of the University of Padua (VTH-UP). About 1 million dogs are registered in the Veneto region and a similar

number of cats is estimated (6). The SVETPET project has been actively promoted among veterinary associations, veterinary public services, practitioners, decision makers, and experts by general meetings, educational events and personal contacts. The main criteria for inclusion of veterinarians in the network were motivation and availability.

Public and private veterinarians, who join the initiative voluntarily and without profit, need to enter data online as records. At present, only dogs and cats are considered. Each record contains the animal's geolocation by postcode, other basic information about the animal's signalment (species, breed, age, gender, weight, size and microchip ID), lifestyle (living with other animals, outdoor/indoor, shelter, home cooked/commercial/mixed diet and travel), preventive routine treatments (immunisations and *Dirofilaria immitis* prevention) and about the diagnosis. Data entry is entirely computer-assisted and a drop-down menu is provided for each item. Each veterinarian has a personal account and is allowed access to Web interactive resources, such as tables and plots describing disease occurrence, and to the periodically provided reports. To ensure complete anonymity of participants, owner names and addresses are not required and microchip IDs are encrypted.

An innovative software system has been designed and developed to manage, curate and make the collected data accessible and searchable. The software adopts a three-tiered architecture, which is a client-server system where presentation, application processing and data management functions are physically separated. The data and service layers are exposed as RESTful Web services, a Web development paradigm which allows user applications to access and manipulate epidemiological data. The system is based on previous research in the context of distributed information management systems (7, 8), and it represents an evolution for the specific requirements of the veterinary domain. The user logic is implemented as a rich Web application using responsive HTML technologies, i.e. technologies that adapt to different desktop and mobile devices to improve the user interaction and experience. The software was released after an internal trial

carried out at the VTH-UP and after several public demonstrations. The diagnosis is selected according to a standardised nomenclature, resulting from the adaptation to canine and feline diseases of the International Classification of Diseases (ICD-10) endorsed by the World Health Organization (WHO) for humans (9). The coding revision has led to a new nomenclature of about 2,000 diseases, maintaining the original tree structure and the original alphanumeric codes. New lemmas related to diseases of specific pertinence to companion animals were also included and were placed as sub-classes of the original categories. For instance, canine 'Distemper' was grouped in the original branch B34.8 'Other viral infections of unspecified site'. To refine and localise the diagnosis in space and time and to consider also chronic conditions, two kinds of diagnosis have to be distinguished when entering records in SVETPET: primary diagnosis (i.e. the reason for consultation) and secondary diagnosis (i.e. diseases that may coexist without influencing the primary diagnosis). A primary diagnosis could be a bone injury caused by a car accident in a dog suffering from diabetes, which is the secondary diagnosis. Causes of death are also recorded. Veterinarians must enter the ultimate diagnosis, which is the definitive result of their diagnostic process. In cases with inadequate diagnostic certainty, the data entry may stop at the level of the syndromic description (e.g. the code K85 'Acute pancreatitis' is entered in cases with a high degree of diagnostic accuracy; the codes R11 'Vomiting' and/or R10.0 'Acute abdomen' may be used in cases with poor diagnostic precision).

Results

The SVETPET project started in June 2013. The standardised nomenclature for dog and cat diseases was implemented 18 months later, and the first version of the software based on this nomenclature was released in February 2015. The web application (www.svetpet.maps.unipd.it/) was tested for about one month at the VTH-UP. Once this step was completed, access to the system was opened to veterinary practitioners. As of 30 June 2016, about 13% ($n = 80$) of the veterinary practices in the Veneto region have joined the project (Fig. 1). Up to this date, 1,376 diagnoses (1,087 in dogs

and 289 in cats) in 961 pets (744 dogs and 217 cats) have been entered in the database. Deaths ($n = 92$ and $n = 33$ for dogs and cats, respectively) represent 8.8% of the records. The population submitted to veterinary consultation has a sex ratio (M:F) of 1.09 in dogs and 1.03 in cats, and the median age is seven years in dogs and five years in cats. The age pyramid for gender and species is reported in Figure 2. Purebred dogs and cats comprise 52.0% and 9.2%, respectively. Gastrointestinal (21% in dogs and 23% in cats) and dermatological (18% in dogs and 15% in cats) disorders are the main health problems in both species, followed by cardiovascular (11%) and urinary (15%) disorders in dogs and cats, respectively (Fig. 3). The main causes of death are represented by cardiovascular (21%) and gastrointestinal (21%) diseases in dogs and by urinary (31%) disorders in cats (Fig. 4).

Insert Figures 1 to 4

Four basic epidemiological reports, produced from May 2015 to July 2016, have been distributed among the network and other stakeholders (veterinary associations, people responsible for human and animal health public services, academic experts). These reports summarise, in tables, graphs and maps, the demographic and diagnostic data from the records in the database. Besides descriptive reports, analytical reports are planned to assess potential emergencies and the role of risk factors for specific diseases. Reports and other interactive resources such as descriptive statistics are freely accessible by registered users on the project website.

Discussion

The SVETPET project has been operating in the Veneto region since March 2015 and represents the first monitoring system for companion animal diseases in Italy, apart from some local animal cancer registries. The key features of this system are:

- voluntary participation of veterinary practitioners

- ICD-based standardisation of the diagnostic nomenclature and consequent possibility of sharing data with other human or animal databases
- distribution of the updated information within the network of participants and to stakeholders.

The stored data are managed by the SVETPET working group and may be available on demand to other research groups for study purposes. Some critical points of the system need to be highlighted: the reference population is not the entire canine and feline population but the one requiring, for different reasons, veterinary consultation, and the voluntary base of the system does not guarantee the full representativeness of the veterinarians in terms of spatial distribution or professional experience. On the other hand, O'Neill *et al.* (4) pointed out that systems based on clinical records from primary-care practice, such as SVETPET, may benefit from stronger alignment with the general canine population and veterinary validation if compared with other approaches, such as veterinary cancer registries, referral practice clinical record databases, pet insurance databases and kennel club databases.

It should be noted that diseases of companion animals are not subject to the same national and international legislation as livestock diseases, and it is therefore difficult to adopt a valid approach to assessing the health status of pets. Unlike farmers, pet owners have no economic and legal constraints eliciting their active epidemiological role. Practitioners, therefore, are the first link in a surveillance system for pets' diseases. Only an institutional action can deal with this type of issue. One of the main objectives of the project is a significant expansion of the actual network of veterinarians joining SVETPET, in order to improve its representativeness. Furthermore, the accuracy of the diagnosis depends on several factors such as professional competence, availability of diagnostic tools, owner compliance and the nature of the condition. Accordingly, to minimise potential misleading effects, the system allows practitioners to select different levels of diagnostic detail, from a simple clinical sign to a specific

disease. Now the system has been set up, its running costs are derived from the administration expenses of the system and from the activity of two clinical epidemiologists. The software operates as a Web application that does not require any specific installation on users' machines. By its nature, SVETPET is an institutional public service offered free of charge to all its users.

To the best of our knowledge, few systems comparable with SVETPET exist, including SAVSNET and VetCompass in the United Kingdom (UK) (4, 10, 11). These systems collect electronic patient records from selected primary-care veterinary practices in the UK for epidemiological purposes, using commercial practice management software. Unlike these systems, SVETPET operates independently of commercial practice management software. The input of a single record to the system requires only a couple of minutes but constitutes extra work for the practitioner. All these systems adopt different approaches to defining a diagnosis. Whereas SAVSNET is based on two different types of data, generated by diagnostic laboratories and by syndromic diagnoses, VetCompass and SVETPET are based on standardised and detailed codes of the diagnoses derived from different nomenclatures. Despite such differences, these three systems share the same main goal, and the integration of the results seems to be achievable. For instance, a shared report format could be developed to allow comparison of the health status of different small animal populations across countries. A preliminary comparison between the published outcomes of VetCompass (11, 12, 13, 14) and those obtained by SVETPET allows some analysis. Demographic parameters show some differences:

- the median age of British dogs is lower than that of Italian dogs (4.5 versus 7.0 years)
- the sex ratio in British cats is 0.94, versus 1.03 in Italian cats
- VetCompass reports a higher proportion of purebred animals: 79% versus 52% in dogs and 11% versus 9% in cats.

Some differences can be found also in the occurrence of disorders: in VetCompass the most frequently affected organ systems of dogs are

integument (36%), digestive (30%) and musculoskeletal (15%), whereas in SVETPET digestive (21%), dermatological (18%) and cardiovascular (11%) disorders are most commonly reported. Based on the published data, the same comparisons in cats are quite difficult given the different aggregation criteria applied to diagnostic records. In contrast, the causes of death are partially comparable between the two systems for cats but not for dogs. The main cause of death for cats in both databases is represented by renal and urinary disorders.

The user interface of SVETPET is currently in Italian, but it can be easily converted to other languages as it relies on an international standard nomenclature (ICD-10).

Conclusions

The SVETPET project represents a pioneering effort to establish in Italy a surveillance system for companion animal diseases, mainly zoonoses. This is a key goal of the One Health vision, as stated by the international institutions WHO, the World Organisation for Animal Health (OIE), Food and Agriculture Organization of the United Nations (FAO), Centers for Disease Control and Prevention (CDC), International Society for Infectious Diseases (ISID) and World Small Animal Veterinary Association (WSAVA) (5), and by experts (e.g. the Callisto Project [15]). Planned outcomes are to monitor disease frequencies and their trends in time and space, to identify associated risk factors and to produce disease and risk maps, thus providing epidemiological knowledge to support everyday clinical practice. Further expected outcomes are to assess the risk of transmission to humans and to define the possible role of companion animals as early sentinels of emerging health threats and as models for the study of the effects of exposure to environmental risk factors. The outlook is to stimulate collaboration and networking within the veterinary profession and between human and animal health professionals, to promote general awareness of the public health relevance of companion animals, and to provide a useful tool to scientists and health policy makers.

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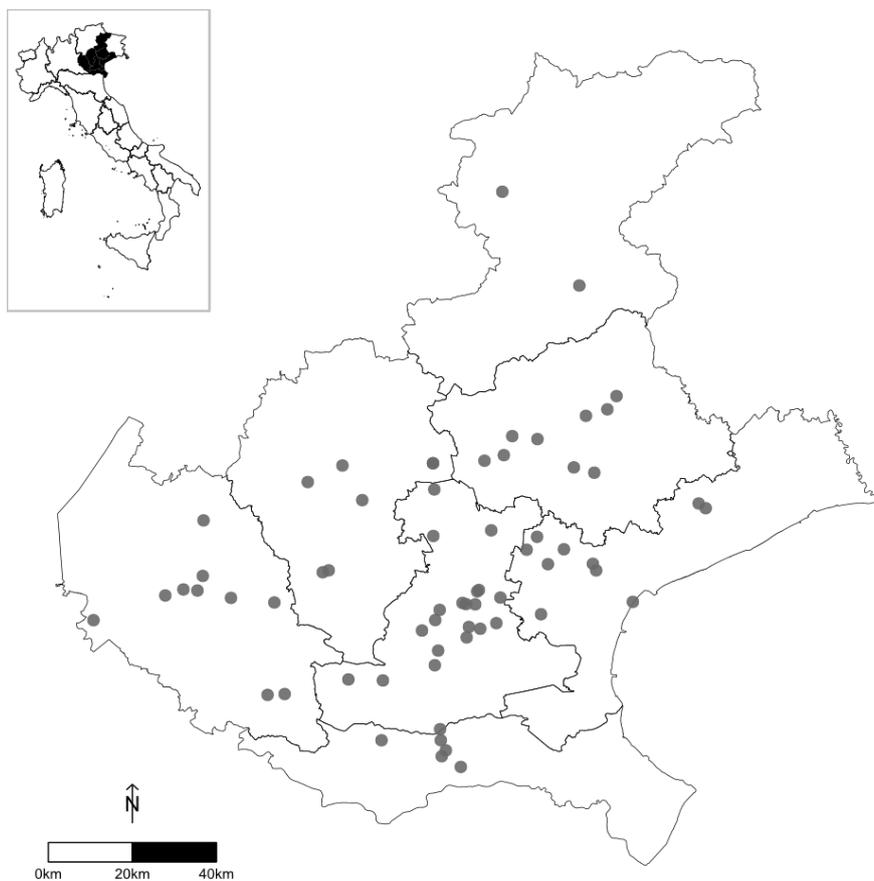


Fig. 1
Distribution of veterinary practitioners participating in the SVETPET network in the Veneto region

Black lines indicate the administrative boundaries of the Provinces

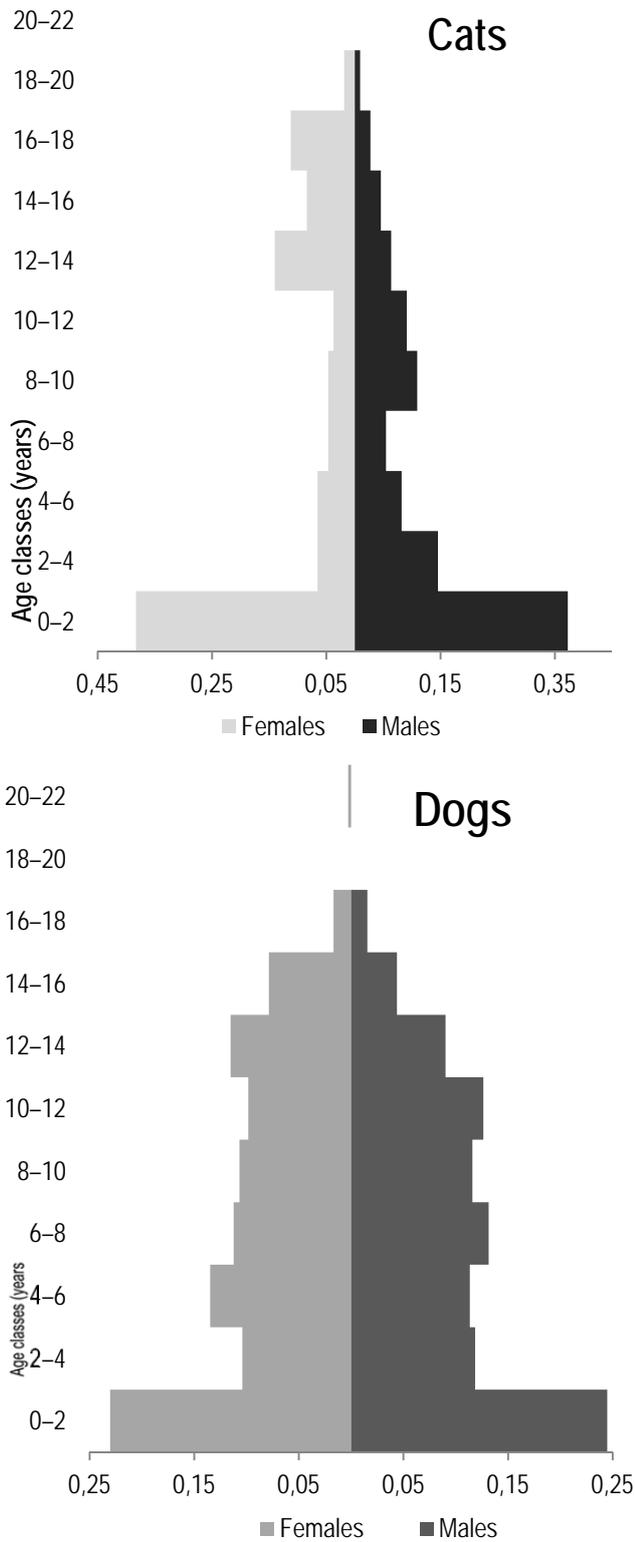


Fig. 2
Age and sex distribution of dogs and cats in the SVETPET database

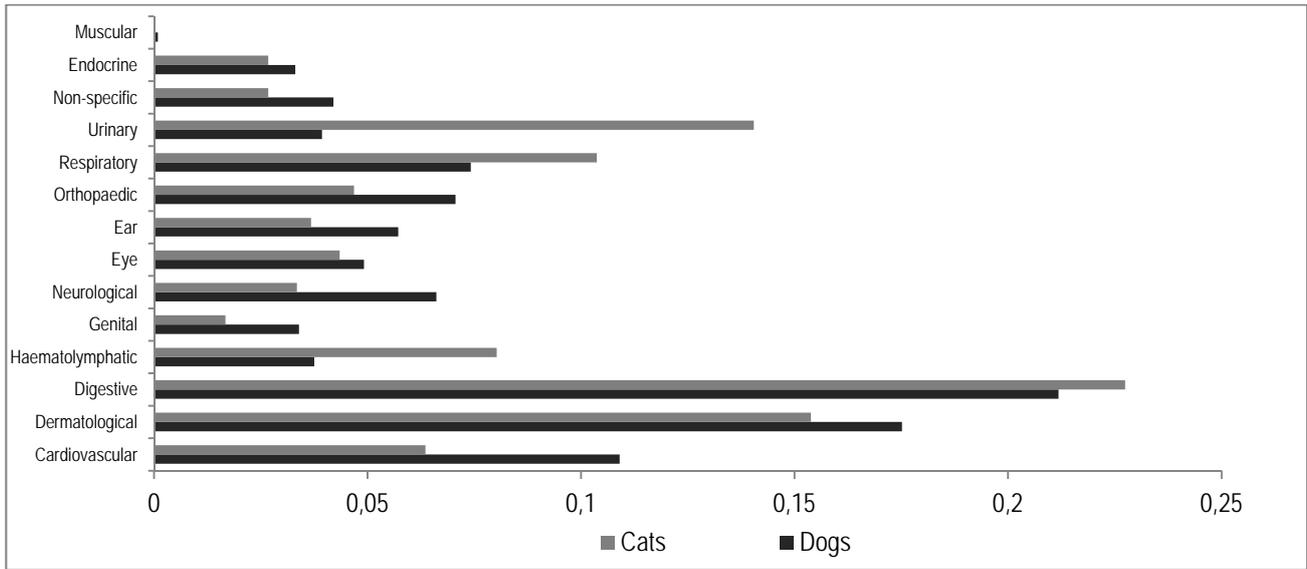


Fig. 3
Prevalence of dog and cat disorders recorded in the SVETPET database

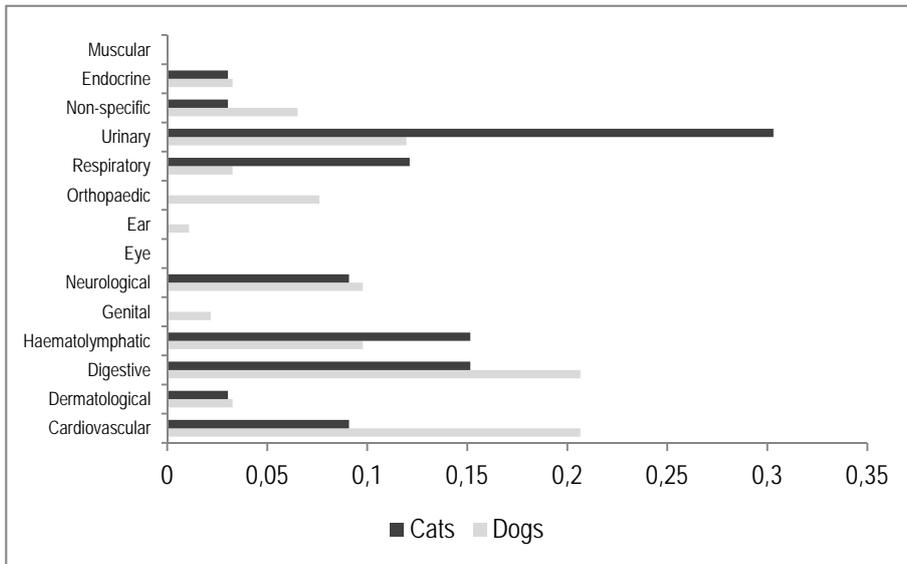


Fig. 4
Prevalence of causes of death in dogs and cats recorded in the SVETPET database