Inventory of veterinary syndromic surveillance systems in Europe
Report

Deliverable 7, Work Package 4

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TRIPLE S
Syndromic Surveillance Systems in Europe

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1 Introduction

The inventory of the veterinary syndromic surveillance (SyS) systems in Europe was one of the objectives of the Triple-S project (Syndromic Surveillance Systems in Europe). This project, co-financed by the European commission, involved twenty four organizations from fourteen countries. The scope of the project was both human and animal health. A similar inventory of existing SyS systems has been conducted for human health. Anses[1] was responsible for the implementation of the veterinary inventory. This document presents the methodology and results of the veterinary inventory of SyS systems and set it back in the context of the Triple-S project.

Syndromic surveillance was defined by Triple-S project as

"the rapid collection, analysis, interpretation and dissemination of health-related data to enable the early identification of the impact (or absence of impact) of potential human or veterinary public-health threats which require effective public health action.

Syndromic surveillance is based not on the laboratory confirmed diagnosis of a disease but on non-specific health indicators including clinical signs, symptoms or mortality as well as proxy measures (e.g. drug sales, production collapse, etc.).

The data are usually collected for purposes other than surveillance and, where possible, are automatically generated so as not to impose an additional burden on the data providers. This surveillance tends to be non specific yet sensitive and rapid, and can augment and complement the information provided by traditional test based surveillance systems."[1]

2 Objectives

The main objective of the Triple-S project was to develop guidelines to implement syndromic surveillance systems for human and animal health. The inventory of existing veterinary SyS systems in Europe was conducted to i) assess what was the actual use of syndromic surveillance in European countries in animal health and their potential linked with human health ii) identify partners to organize a veterinary meeting on SyS for knowledge exchange iii) provide practical examples to illustrate the guidelines.

The results of the inventory were also used to determine possible typologies of veterinary SyS systems.

Veterinary systems identified through this inventory were included in the WP 5 country visits.

3 Methodology

3.1 Identifying people involved in SyS projects

The inventory was based on a survey conducted in two steps.

The first step consisted in disseminating a brief questionnaire to people potentially involved in SyS, identified through a literature review (scientific articles on veterinary SyS) and using networks of contacts in animal health. Anses, in charge of the implementation of the inventory, was responsible of two French pilot SyS system that were included in the inventory from the beginning.

The second step consisted in sending the identified person a detailed questionnaire to collect information on the system or project.

We critically reviewed all relevant scientific literature (grey and white literature) pertaining to Vet SyS. The literature was searched on public scientific database (Pubmed and Sciencedirect) as well as on Google, using advanced, customized search engine and food safety agencies websites (see appendix 1).

[1] French Agency for Food, Environmental and Occupational Health and Safety

Moreover, a list of persons potentially involved or aware of syndromic surveillance was elaborated: EFSA focal points, Chief Veterinary Officers (CVO), members of the European college of veterinary public health, members of the EFSA Animal Health and Welfare scientific panel, informal contacts (contacts of the Triple-S project's partners).

A brief questionnaire and a letter presenting the Triple-S project, the objectives of the inventory and defining what is SyS (appendix 3) were sent to all the contacts of the dissemination list.

Answers received from the brief questionnaires were analyzed to select only systems that fit with the definition of SyS.

3.2 Collection of data on existing SyS systems: long questionnaire

A long questionnaire was created to collect data on the existing veterinary SyS systems (appendix 4). As a similar inventory was conducted for human health, a harmonization of the questionnaire for both human and animal health was done to be able to compare results. The conception of the questionnaire was inspired by the one developed in the EuroMoMo project[2]. The questionnaire was divided into eight parts: personal information, general characteristics of the system, data providers, data collected, data analysis, data dissemination, use and evaluation of the system, other comments.

This questionnaire was sent to the previous selected persons with a reminder on the Triple-S project (Triple-S flyer available on the project's website) and a copy of the brief questionnaire already filled. Each person could fill in the questionnaire (word file) and sent it back via e-mail or fill in directly on the Triple-S website via a dedicated interface (https://voozanoo.invs.sante.fr//2006683906/scripts/aindex.php).

During the duration of the Triple-S project (until august 2013) new contact persons were searched by asking to each person previously identified if he/she knew other SyS systems and by promoting the project during scientific meetings.

3.3 Veterinary meeting on syndromic surveillance

A veterinary meeting was organized in Paris, September 12-14, 2011 in parallel to the Triple-S country visit in France. It allowed us to hold a common session on both human and animal health with regard to synergy between both sides. The objectives of this session were to i) share experience from both sides and encourage knowledge transfer, ii) discuss what and how information should be shared between both sides to improve respective performances.

Minutes of the meeting and a synthesis document on main ideas and issues discussed were elaborated and validated by all participants (see appendix 7).

An evaluation form was filled in by participants to have their feedback on this meeting (appendix 8). The meeting was very fruitful according to all participants. The synergy session was appreciated by 60% of the participants. The 40% that did not appreciate this session did not give comments except one participant that would have appreciated presentation on human health SyS.

3.4 Data analysis

The results of the questionnaires were registered into a MySQL database. A descriptive analysis was performed using R software. As the collection of data was ongoing for all the duration of the project, the descriptive analysis was performed using RODBC and OdfWeave packages to edit automatically an updated open office report.

As the questionnaire included a lot of questions that involved describing the results through a large number of variables, a multivariate data analysis was performed to reduce the dimensionality of the dataset. For some questions, more than one answer could be given (e.g. a system could have more than one objective or data provider). In this case each answer was considered as a binary variable and thus a group of binary variables corresponded to one question. Multiple factorial analysis (MFA) was performed. It is a principal axes method used to analyze individual observations described by several groups of variables. The principle of this method, as all factor analysis methods, is to reduce data to

[2] http://www.euromomo.eu/

their principal components [2, 3]. “Objectives of the systems”, “Data providers” and “Population targeted” were chosen as active groups of variables. Influence of these groups was balanced by MFA [3]. “Motivation for transmission of data”, “Status of the system” and “Source of funding” were used as illustrative variables/groups of variables. Modalities of low effectives were merged to avoid instability in the MFA. The analysis was performed using FactoMineR package [4] from R software (R Development Core Team (2010). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org).

4 Results

4.1 Identification of persons in charge of SyS systems

The literature review performed on October 2010 enabled to identify 14 authors of scientific papers about 10 distinct veterinary syndromic surveillance systems.

Using networks of contacts in animal health, 234 persons were identified:

- EFSA focal points (36)
- Chief Veterinary Officers (27)
- Members of the european college of veterinary public health (140)
- Members of the EFSA Animal Health and Welfare scientific panel (21)
- Other informal contacts (10)

4.2 Questionnaires

A total of 248 e-mails (see appendix 2) were sent with brief questionnaire and associated letter on April 5, 2011. Destination errors were treated on April 7, 2011.

Twenty two answers were received from 13 different countries (Austria(1), Belgium(3), Switzerland(1), Cyprus(1), Denmark(1), Spain(1), Finland(3), France(2), Greece(1), Italy(1), The Netherlands(3), Sweden(1), The United Kingdom(3)) among which 26 persons from 10 countries were selected to receive the long questionnaire (some answers involved more than one SyS system).

The long questionnaires were sent on July 22, 2011 and a reminder on August 29, 2011. Eighteen persons answered (appendix 5).

On August 2012, 2 other SyS systems were identified by contact during SVEPM congress (Society for Veterinary Epidemiology and Preventive Medecine congress) and the veterinary meeting organized by Triple-S project in September 2011.

4.3 Descriptive analysis

This section presents the main results from the descriptive analysis. All the results are available in appendix 6.

The different systems and their main characteristics are presented in Table 1. A list and short description of existing SyS systems was elaborated and presented on the public section of the Triple-S website (http://www.syndromicsurveillance.eu/systems-in-europe/vet-systems) after the agreement of all persons responsible of each system (Appendix 9).

Table 1: Table of European veterinary surveillance systems projects having a syndromic component identified through the Triple-S inventory process with their main characteristics

System Name (country)	Status	CA	PA	W	H	Main Objectives	Main Data providers
GMON (AU)	ACTIVE		■			General health surveillance,	Veterinary clinics
VETSTAT (DA)			■			Control of the usage of antimicrobials	Veterinary clinics, pharmacies
Sikava (FI)			■			Outbreaks detection, General health surveillance	Veterinary services, Laboratories, Farms, Slaughterhouses,
Naseva FI)			■			Outbreaks detection, General health surveillance	Veterinary Services, Laboratories, Farms, Slaughterhouses
REPAMO (FR)			■	■		Outbreaks detection	Laboratories
SAGIR (FR)				■		Outbreaks detection, General health surveillance	Laboratories
GD Monitor (NL)		■	■		■	Outbreaks detection, General health surveillance	Veterinary services and clinics, Telephone help lines
FarmFile (UK)			■	■		Outbreaks detection	Veterinary services
Equ. Surv. Reports UK)				■	■	General health surveillance	Veterinary services, clinics and school, Laboratories
VetCompass (UK)		■				General health surveillance	Veterinary clinics
Kodatabasen (SW)			■			Production management	Laboratories, Farms, Slaughterhouses
EPI (SI)		■	■			Outbreaks detection, General health surveillance	Veterinary services and clinics, Pharmacies, Laboratories, Slaughterhouses , Rendering plants
Animal Health System (SZ)	PILOTE PHASE		■			General health surveillance	Veterinary services and clinics, Farms, Slaughterhouses, Rendering plants,
MoSS-Emergences 2 (BE)			■			Outbreaks detection	Veterinary services and clinics, Telephone help lines
Provimer (SP)			■			Outbreaks detection, General health surveillance	Rendering plants
OMAR(FR)			■			Outbreaks detection, General health surveillance	Rendering plants
NERGAL-abattoirs (FR)			■			Outbreaks detection, General health surveillance	Slaughterhouses
VSD telephone log (UK)			■			Outbreaks detection, General health surveillance	Veterinary clinics, Laboratories
Poultry practice data (UK)			■			General health surveillance	Veterinary clinics
Innova AM and PM (UK)			■	■		General health surveillance	Slaughterhouses
O48M (UK)			■			General health surveillance	Farms

SAVSNET (UK)				Outbreaks detection, General health surveillance	Veterinary clinics, Laboratories
Kuukausi-ilmoitus (FI)	DATA BASE			General health surveillance	Veterinary services and clinics
CDB (SW)				Other: not define yet	Farms, Slaughterhouses
Djursjukdata (SW)				General health surveillance	Veterinary clinics and school
SVALA (SW)				Management of the diagnostic process	Veterinary clinics Laboratories, Farms, Slaughterhouses, Rendering plants
MBL(IT)	C			Surveillance of other health threats, Other	Veterinary services

CA: companion animals (e.g. dogs, cats); PA: production animals (e.g. cattle, swine, small ruminants); W: wild animals (i.e. not tamed or domesticated). ; H: horses; C: Completed

Twelve different countries answered to the long questionnaire. A total of 27 different systems were identified among which eight were previously identified through literature review. Two systems identified through the literature review were not included in this study because no answers to the long questionnaire were received.

88% of the systems were declared as active or in pilot phase. We decided to keep systems that were at an early stage called “database only” because data are already available and there is already the project to implement a syndromic surveillance systems using these data (Figure 1).

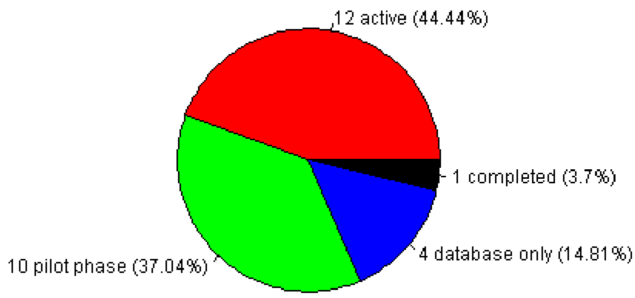

Figure 1 : Number of systems according to the status

Objectives

56% of the systems had more than one objective. 44% of the veterinary SyS systems had an objective of detection of outbreaks, 22% an objective of surveillance of other threats, 70% an objective of general health surveillance and 52% another objective.

Among the other objectives there was the use of health indicator to classify farms according to health risk.

The main targeted population was livestock. 33% of the systems targeted more than one population (Figure 2).

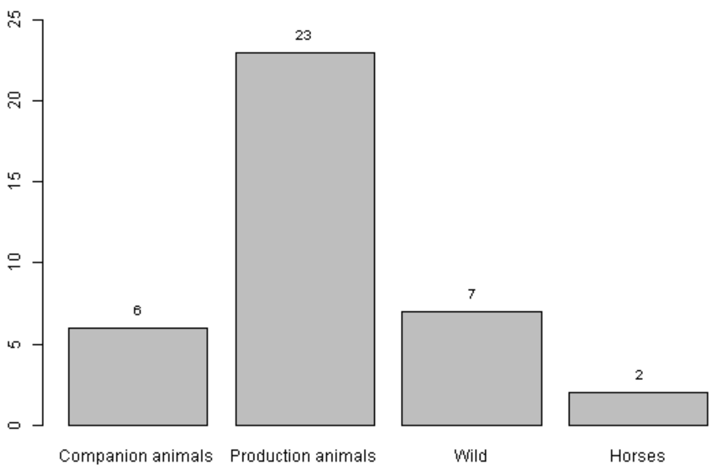

Figure 2 : Number of systems according to the targeted population.

Data collection

78% of the systems had more than one data provider. Veterinary clinics, veterinary services, laboratories and slaughterhouses were the most frequent (Figure 3).

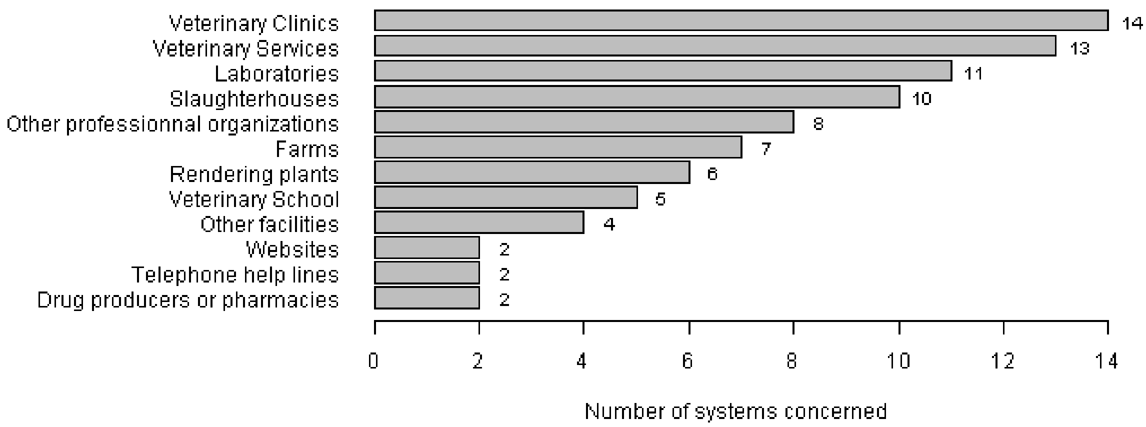

Figure 3 : Number of systems according to the type of data providers.

The geographical coverage of the systems was national for 85% of the systems.

37% and 33% of the systems had coverage of respectively 100% of the data providers and animal population.

All systems had at least one type of data collected on ongoing basis.

Data transmission

The reasons for data providers to transmit data were the fact that it was mandatory for 48% of the systems and thanks to access to output for 44% (e.g. communication of outputs through reports). Among the other motivations there were financial compensation, altruism and mutual benefit (Table 2).

Table 2 : Number and proportion of systems according to the reason data providers transmit data to the system.

	Number of systems	Proportion of total number of systems (%)
Mandatory	13	48.1
Other motivation	13	48.1
Access to output	12	44.4
Financial compensation	2	7.4

77% of the systems used data that were already collected (totally of partially) for other reasons than surveillance. There was no additional burden for data providers for 26% of the systems and the work needed to be organized differently to collect syndromic data for 48% of the systems.

The provision of data was totally or partially automated for respectively 22% and 48% of the systems.

Table 3 : Number and proportion of systems according to the channel chosen by data provider to transmit data.

Data transmission	Number of systems	Proportion of total number of systems (%)
email	10	38
web portal	10	38
paper-mail	9	35
direct database	7	27

telephone	4	15
ftp site	1	4

Some systems propose to data providers several ways of transmission of data. Most of the systems used at least one electronical way of transmission of data: 38% via email and webportal, 27% via direct database and 4% via ftp site (Table 3).

Table 4 : Number and proportion of systems according to the frequency of transmission of data from data provider to the system.

Transmission frequency	Number of systems	Proportion of total number of systems (%)
Real time or near	13	48
Daily	5	19
Weekly	5	19
Other	4	15
Monthly	2	7
Quaterly	2	7

Real time in this questionnaire deals with immediate transmission and near real time with transmission in less than 24 hours. 48% of the systems transmitted data in real time or near real time, 19% daily and weekly. The reporting delay was real time or near real time for 19% of the systems (Table 4).

Individual data were transmitted by data providers for 85% of the systems.

About 50% of these systems collected the date of observation or registration, owner residence, animal ID Number, age and breed and sex.

Data analysis

15% of the systems were not yet monitoring indicators. 67% of the systems were monitoring more than one indicator.

The most frequent indicators monitored were clinical signs or symptoms, mortality, syndromes and medical diagnoses (Table 5).

Table 5 : Number and proportion of systems according to the type of indicator monitored.

	Number of systems	Proportion of total number of systems (%)
Clinical signs or symptoms	14	51.85
Mortality	14	51.85
Syndromes	13	48.15
Medical diagnoses	12	44.44
Autopsy lesions	8	29.63
Laboratory test submissions	7	25.93
Production indicators	5	18.52
Other indicator	5	18.52
Drug prescriptions	4	14.81
Website hits / Help line calls	2	7.41

For the 23 systems using medical observation, 11(48%) did not have coding system. Among the 12(52%) systems which had a coding system 9 systems had their own coding system, one system used a national coding system and two did not transmit the information in the questionnaire.

Table 6 : Number and proportion of systems according to the frequency of data analysis.

	Number of systems	Proportion %(/total number of systems)
Other frequency	8	30
Real or near real time	7	26
Quaterly	6	22
Annually	6	22
Weeekly	4	15
Monthly	4	15
Semestrially	2	7
Daily	1	4

Among the 25 systems that performed analyses, 30% of the systems analyzed data in real time, near real time or daily (Table 6).

Table 7 : Number and proportion of systems according to the statitical methods used.

	Number of systems	Proportion %(/total number of systems)
No statistical method	9	33
Other methods[1]	7	26
Historical Mean	4	15
Regression model	4	15
Time-series methods	4	15
Farrington method	1	4
Control chart	1	4

[1] spatial aggregation, AHC (Ascendant hierarchical clustering), z-test.

The main methods used were historical mean, regression model and time-series methods (Table 7). Eight systems performed analysis automatically. Among the 23 systems that performed analyses and transmitted information on type of analysis used, 9(33%) of systems did not use statistical methods to detect aberration (only descriptive analysis was done)..

From the alarm to the alert

The procedures to validate or not an alarm were quite similar for all systems concerned.

The alarm was transmitted to a relevant person (administrator or veterinarian) to validate it using statistical information. Then if the alarm was validated, an epidemiological investigation was requested to decide if the alarm was an alert or not.

The other procedure presented in questionnaires was to discuss the plausibility of the alarm through a group of experts.

Communication

Table 8 : Number and proportion of systems according to the kind of addressee of the data.

	Number of systems	Proportion %(/total number of systems)
Data providers	18	67
Veterinary services	12	44
Authorities	8	30
Public	7	26
Limited public	6	22
Scientific community	5	19
Professional organization	4	15
Farmers	3	11

Outputs of the system were transmitted to data providers for 67% of the systems and to public for 26% of the systems (Table 8).

Source of funding

The major source of funding came from public sector. 33% of the systems had more than one source of funding and 7% declared not need any funding as the collection of data was mandatory (Figure 4).

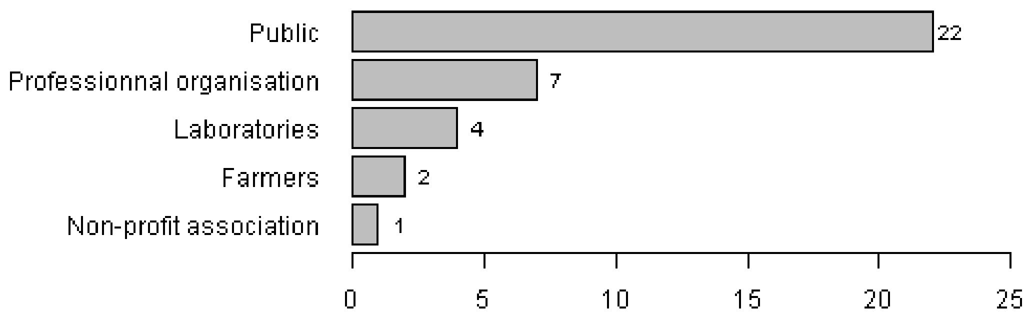

Figure 4 : Number of systems according to the source of funding.

Evaluation of the system

Nine systems had performed an evaluation but it was more an evaluation of data quality than a real evaluation of the performance of the system.

Synergy with human health

Seven systems already shared outputs of their systems with human health institute and three planned to.

The examples given were the transmission of information about alert, transmission of report with interpreted data, organization of common meetings.

4.4 Multiple Factorial Analysis

Table 9 suggested keeping three dimensions for MFA interpretation. Results of the test of the significance of the RV coefficients between each group of active variables showed a significant correlation between data providers and targeted population and no significant correlation between objectives and each of the two other groups (Table 11). The three groups of active variables (objectives of system, targeted species, data providers and indicators monitored) had contributed to the construction of the first dimension of MFA for respectively 35.44%, 44.27% and 20.28%. The second dimension of MFA was mainly constructed by “objectives of system” and “data providers and indicators monitored” with respectively a contribution of 37.73% and 55.23%. The three groups of active variables had contributed to the construction of the third dimension of MFA for respectively 33.54%, 22.97% and 43.50% (Table 10).

	eigenvalue	percentage of variance	cumulative percentage of variance
comp 1	1.58	18.21	18.21
comp 2	1.37	15.77	33.98
comp 3	1.19	13.70	47.68
comp 4	0.83	9.59	57.27
comp 5	0.77	8.89	66.16
comp 6	0.63	7.22	73.38
comp 7	0.53	6.06	79.44
comp 8	0.41	4.70	84.14
comp 9	0.31	3.55	87.68
comp 10	0.27	3.08	90.76

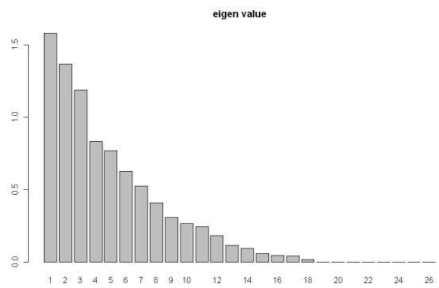

Table 9: Variance of the first ten factorial axes (right); Plot of eigen values of MFA (left).

Group of active variables		Dim.1	Dim.2	Dim.3
Objectives of system	Contribution(%)	35.44	37.73	33.54
	Correlation	0.77	0.79	0.66
Targeted species	Contribution (%)	44.27	7.04	22.97
	Correlation	0.85	0.41	0.57
Data providers	Contribution (%)	20.28	55.23	43.50
	Correlation	0.73	0.91	0.80

Table 10: Contribution and correlation of each group of active variables with each of the third first factor of the MFA.

Groups of active variables compared	RV	p-value
Objectives/Targeted species	0.10	0.55
Objectives/Data providers	0.24	0.085
Targeted species/Data providers	0.40	$8.3\ 10^{-5}$

Table 11: RV coefficient between the two groups of active variables and the p-value associated to the test of the significativity of the RV coefficient (with the Pearson type III approximation.

The first component of MFA made the distinction between two groups of data providers: the first one with farms, slaughterhouses, rendering plants, other professional organizations, veterinary services and the second one with veterinary clinics, laboratories, drug producers or pharmacies (Figure 5 and Figure 6).This first component also distinguished production animals on one hand and on the other hand wild and companion animals. Looking at illustrative variables, the first component opposed two groups of motivation for data providers to transmit information to the SyS system: mandatory motivation in one side and in other side financial compensation, access to output and other motivation. The third component opposed two different status of SyS sytem: database only on the right and active system on the left. These first two-dimension spaces of MFA showed two groups of variables presented in Table 12.

		First group of variables	Second group of variables
Active variables	Data providers	Veterinary clinics Laboratories Drug producers or pharmacies Web sites	Slaughterhouses Veterinary services Rendering plants Other professional organizations Farms Other facilities Telephone help lines
	Targeted population	Wild animals[3] Companion animals[1]	Production animals[2]
	Objectives	Outbreaks detection General health surveillance	Surveillance of other health threats Other
Illustrative variables	Motivation for transmission of data	Access to output Financial compensation Other motivation	Mandatory
	Funding	Laboratories Non-profit association	Farmers
	Status	Active	Data base only Completed

Table 12: Description of the two groups of active and illustrative variables separated in the two-dimension spaces of MFA. [1]Companion animals (dogs, cats and horses); [2]Production animals (e.g. cattle, swine, small ruminants); [3]Wild animals (i.e. not tamed or domesticated)

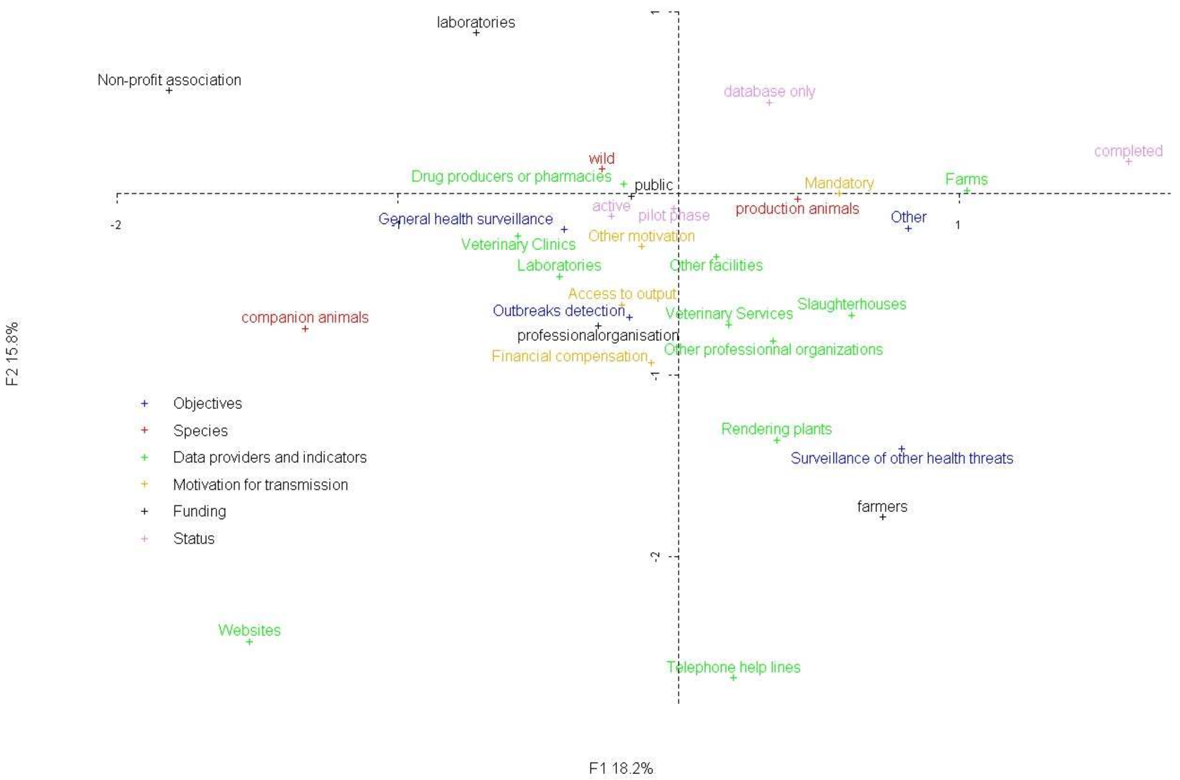

Figure 5: Representation of modalities equal to 1 of variables of MFA in the first 2-dimensional space of MFA.

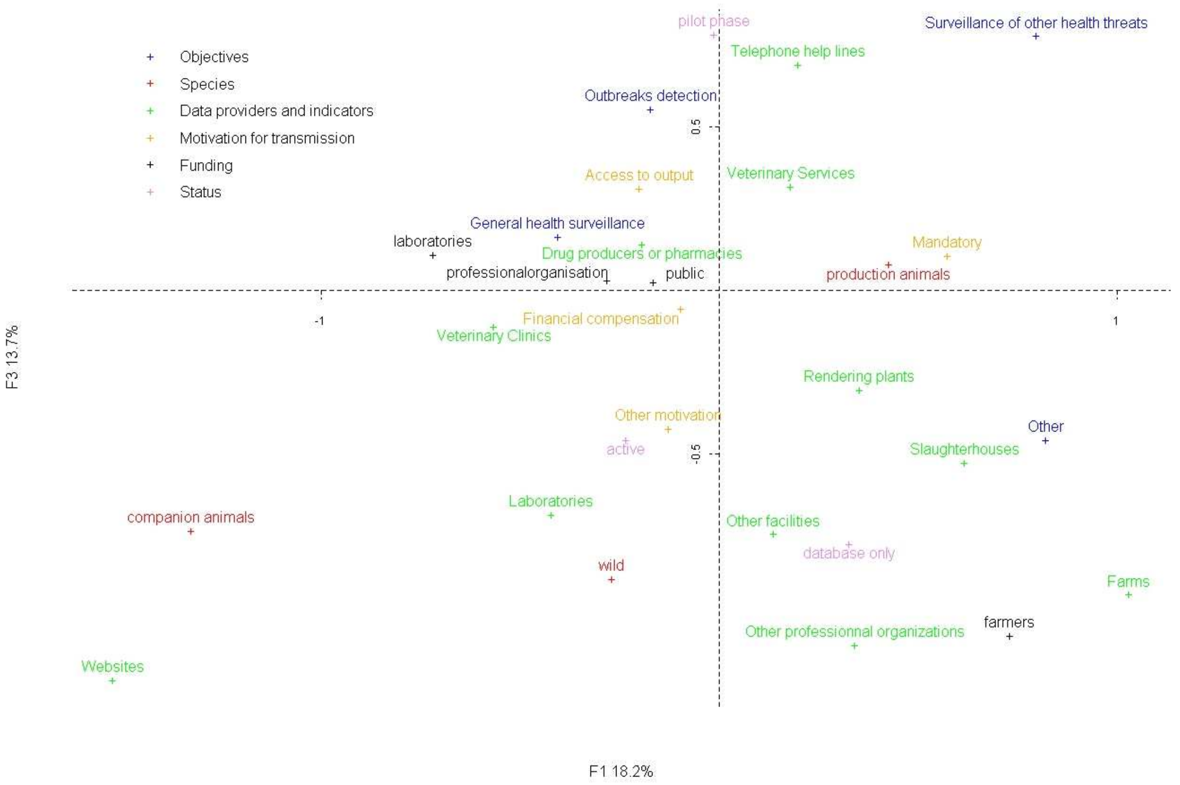

Figure 6: Representation of modalities equal to 1 of variables of MFA in the first and third factorial axis of MFA.

4.5 Veterinary meeting on syndromic surveillance

Nineteen persons (included four organizers from Anses) from eleven European countries participated to the veterinary session among which eight participants were funded by the Triple-S project.

Eleven existing and planned systems were presented followed by discussion on the different steps of the implementation of a syndromic surveillance system so as to gather information for writing guidelines for the implementation of syndromic surveillance systems.

5 Discussion

The discussion section is based on both results of the inventory of veterinary syndromic surveillance systems and on knowledge exchange between Triple-S partners and participants of the Triple-S veterinary meeting.

5.1 Importance of SyS in animal health

Among the 27 systems identified through the process of inventory presented in this document, only eight had been previously identified with literature review which showed the relevance of an active approach to perform this inventory (based on a dedicated questionnaire). As syndromic surveillance in animal health is quite recent, few publications on active systems exist making incomplete an inventory only based on literature review.

Even if most of the systems were declared as active or in pilot phase, not all the systems would be considered as SyS systems in regard to the Triple-S SyS definition (real time or near real time collection and data analysis automatically performed). There is a real interest in developing SyS systems using existing database but in animal health the implementation of such systems is at the beginning. The important amount of relevant and available data combine with the increasing interest for SyS (increasing of publications and meeting in Paris) is a good indicator of the emergence of new SyS systems in animal health during the following years.

We can notice that in animal health, some data are mandatory collected through European law to guarantee for example meat traceability. For instance all information on animal identification and movement must be registered at individual level for bovine which make data on bovine mortality available with 100% of the population covered for potential SyS.

5.2 Issues of SyS

5.2.1 Involving data providers

It was considered as particularly challenging to convince data providers to share the syndromic data they routinely collect since most of this data are of economical interests, e.g. reflect the activities of private vet clinics or animal production performances. However experiences of participants of the Triple-S veterinary meeting showed that there are many inexpensive and efficient ways to reward data providers and get them involved in such systems (e.g. access to aggregated data, rapid synthetic feedback, benchmarking, diagnosis aid, etc.).

It is advisable to use data already collected, in particular regulatory-based, data which is the situation of most SyS systems identified in the inventory. Implementation of SyS system should not lead to additional burden for data providers.

All participants of the Triple-S veterinary meetings agreed on the fact that feedback to data providers is a first step to maintain their motivation; 67% of the existing SyS systems in Europe already do this transmission of information back to data providers. Feedback to data providers is an accessible tool to improve syndromic surveillance system.

5.2.2 Data quality and standardization

Data quality and standardization were also identified as a key challenge. Indeed, most projects are based on existing data which were originally not collected for surveillance purpose, and which thus could be of low quality (bias, precision, etc.). Participants of veterinary meeting also reported the lack of standardization of clinical information (definition and name of clinical signs, syndromes, causes of death, etc.) in veterinary sciences which is a hindrance to harmonization and comparability among systems. The inventory showed that 41% of the systems did not use a coding system (i.e. predefined list of closed items).

5.2.3 Data analysis

Discussions during the veterinary meeting and results of the inventory showed that even if more and more syndromic data (from vet clinics, slaughterhouses, fallen plants or labs) are now collected or accessible to vet epidemiologists, they lack of tools and strategy to analyze them. Even when data analysis is carried out, few systems had defined protocol to interpret statistical alarms and answer them with adequate actions.

5.2.4 Real time issue

58% of the systems did not transmit data in real time or near real time. Most of the SyS definitions consider the real time collection and analysis of data as a main characteristic of syndromic surveillance systems [1, 5-7]. On one hand, many veterinary SyS systems are mixing different notification systems and are partly real time (online data transmission) and partly not (data transmission through paper forms, registered in a second time in the database). On another hand, some systems are collecting data in real time, but from events that are not frequent e.g. clinical signs observed during quarterly farm visits.

Defining syndromic surveillance according to the real-time collection of data is perhaps not adequate for veterinary SyS. Timeliness is a goal for all surveillance systems aiming at early detection and seems not specific to syndromic surveillance. The implementation of real-time process can cost a lot of money and its added value should be carefully evaluated. A balance between timeliness and costs has always to be found. Most survey respondents and meeting participants considered that real time was more an objective than an obligation for animal health SyS systems. For most, what really defined SyS system was the nature of the indicators monitored.

5.3 Differences between animal and human health SyS

Carrying out surveillance based on not-diagnostic data is tempting especially in animal health.

Indeed a formal diagnosis is probably less often reached in veterinary than in human medicine. Possibilities for carrying out further investigations are often very limited by the animal's owner will and resources. Laboratory tests are generally used only in case of good cost-benefit ratio especially for livestock. Thus using SyS seems particularly relevant and cost effective in animal health as most information available is not diagnostic.

Differences between human and animal health SyS systems can be identified, notably regarding data sources which can be common to both human and animal health SyS (e.g. clinical information, consumption of medications, laboratories requests) but also specific to human (school and work absenteeism) or animal (rendering plants, slaughterhouses) health (Figure 7). The later the data are collected in the diagnosis process the more specific the SyS is and the lower is the proportion of the exposed population targeted (Figure 7).

There is a real interest in developing SyS using existing databases but contrary to human health, in animal health the implementation of such systems is at an initial stage compared to human health.

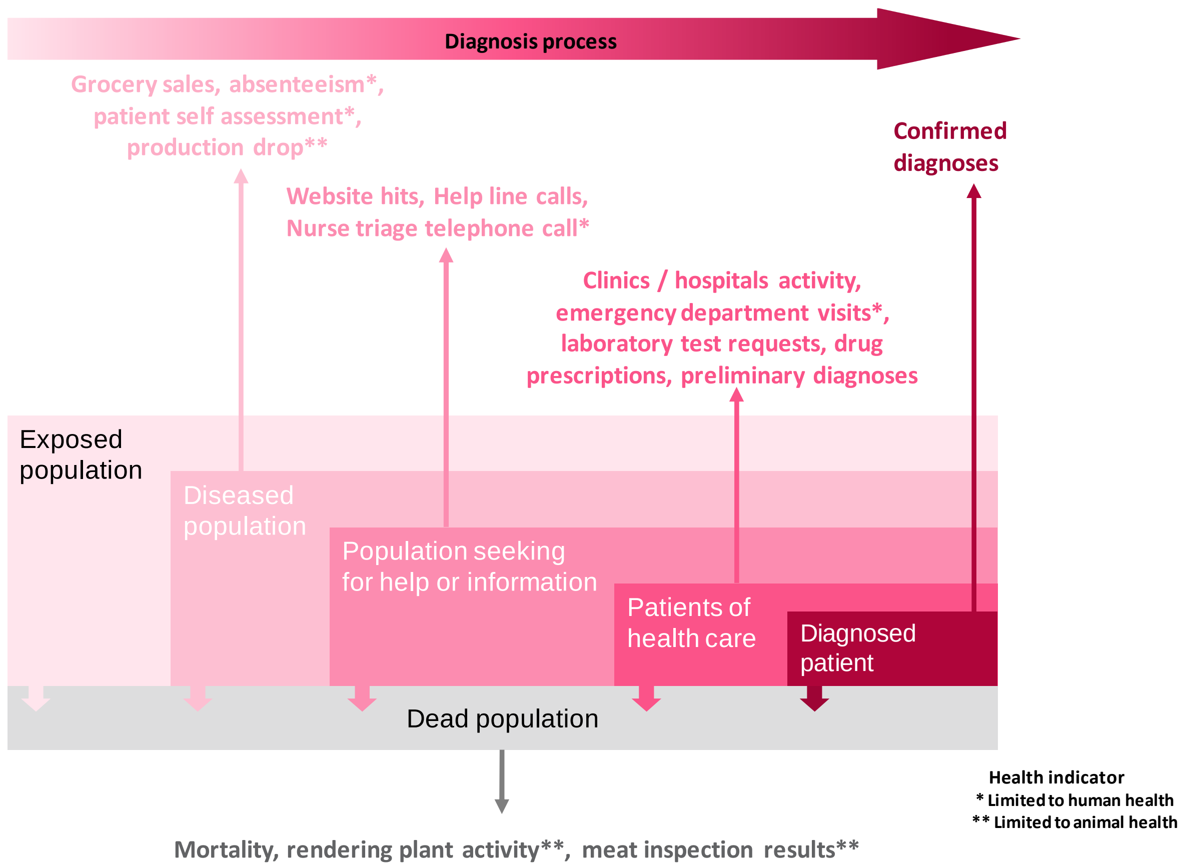

Figure 7: Data sources for human and animal health SyS according to diagnosis process.

5.4 Synergies between human and animal health and between traditional and syndromic surveillance

Taking into account limits of traditional approaches to deal with infectious diseases, the Wildlife Conservation Society initiated since 2004 a global and preventive approach named One World-One Health. The objective is to strengthen the links between human health, animal health and environment as no one of these sectors has enough knowledge and resources to prevent the emergence or resurgence of diseases in today's globalized world [8, 9]. Syndromic surveillance, as traditional surveillance, has to be considered from the perspective of the One health initiative.

Human and animal health epidemiologists face common statistical and epidemiological issues when dealing with syndromic surveillance (e.g. use of data collected for other purpose than surveillance; standardization of clinical observations; syndrome definition; anomaly detection; interpretation of unspecific signals; response to alerts). Both sides have thus interest in sharing their experiences and knowledge to improve their respective systems.

The results of the inventory of veterinary SyS systems showed that 40% of the identified systems already shared or have planned to share information with human health sector. For these systems the collaboration between human and animal health sector was based on regular meeting to discuss about outputs of the systems e.g. GD – Veekijker (GD Animal health monitor) system in the Netherlands [10], Farmfile system in the UK [11]. Collaborations reported were mainly focused on zoonotic diseases certainly because zoonoses is a major concern nowadays since 75% of the emerging infectious diseases have been identified as zoonoses [8, 12].

It could be relevant to regularly share information to improve SyS systems performances on both sides in terms of timeliness, reactivity and awareness. Timeliness and sensitivity for detecting a threat common to human and animal can be better on one or the other side, depending on which species develop symptoms stronger and earlier after exposure (animal sentinel). West Nile disease is an interesting example because several countries had already implemented SyS systems with synergies between human and animal health. SyS of West Nile disease could be based on both surveillance of wild bird mortality, horses' neurologic syndrome and human clinical suspected cases. In the Netherlands and France, the syndromic surveillance of West Nile is based on the notification by veterinarians of neurological syndrome associated with previous fever [13, 14].

Other types of health events having an impact on both animal and human population could theoretically worth synergies between the two sides. Synergies could help to evaluate the impact of an identified health event, or reassure on the absence of impact of environmental pollution accident.

SyS produces unspecific alarms that need to be investigated. Sharing results between animal and human SyS could help exclude some artifacts and limit the false alarm rate, if for example alarms are confirmed only when observed in animal and human populations which are similarly exposed. Concomitant alert from human and animal systems would add confidence in a signal suggesting the presence of a health threat.

6 Conclusion

This study showed the current state of veterinary SyS in Europe and its perspectives. The descriptive analysis distinguished two types of existing European SyS systems. The first type of systems, more advanced was identified in the private sector and focused on companion animals whereas the second type was at an early stage, based on data mandatory collected and targeted livestock sector.

Physicians are far more advanced in SyS than veterinarians. Currently, among the surveillance systems considered as syndromic by the veterinarian epidemiologists, there is none that fulfill all the requirements of the existing SyS definitions. The real or near real-time collection of data is not always carried out.

SyS systems are considered as complementary to other existing surveillance systems and are not meant to replace them. It is an additional tool to detect changes or events that would not be detected otherwise.

European regulation requires member states to collect many data to guarantee for example meat traceability. It could be an asset to improve comparability of SyS inputs and thus outputs in European countries. Looking at the data collected in European countries, systems developed or planned in animal health, it seems relevant to think about implementing a SyS system based on animal mortality data as an extension of the existing EUROMOMO project in human health.

Synergies between human and animal health SyS should be relevant in the same way as for traditional surveillance especially for zoonotic diseases detection but not only. Detection of environmental incident and quantification of impact or reassurance on the absence of impact are other interesting fields for synergies. The transmission of outputs from both sides is the easiest way for such synergies even if the common collection and analysis of both human and animal health data is another option already chosen by American systems.

The statistical analysis was one of the weak points identified in most of the existing or planned veterinary SyS systems. A huge amount of data of interest for SyS is collected but few of them are analyzed properly. The guidelines for the implementation of SyS systems and network of people involved in SyS elaborated by the Triple-S project could provide a solution to enhance and spread veterinary SyS in European countries.

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Appendix 1: Litterature review methodology

This appendix presents the queries used for literature review on SyS systems according to the database. For each query the number of results is précised. A reference was considered relevant when the answers to the following questions were yes: Does this reference deal with veterinary syndromic surveillance ? and is it a European SyS?

Database	Query	Number of results (article or web page)	Number of relevant results
Pubmed	veterinary[sb] AND (syndrom*[Title/Abstract]) AND (surveillance[Title/Abstract]) AND (« animal »[Title/Abstract] OR vet*[Title/Abstract])	44	8
	veterinary[sb] AND (“surveillance”[Title] OR “monitoring”[Title] OR “early warning”[Title]) AND (syndrom*[Title] OR “non specific”[Title] OR “unspecific”[Title] OR “automated”[Title] OR “real time”[Title] OR “production”[Title] OR “pre diagnostic”[Title] OR “mortality”[Title] OR “death”[Title])	200	17
Science Direct	TITLE-ABSTR-KEY((syndrom*) AND (surveillance) AND (animal OR vet*)	40	2
	(syndromic) AND (surveillance) AND (animal OR veterinar*)[All Sources(Agricultural and Biological Sciences,Computer Science,Environmental Science,Veterinary Science and Veterinary Medicine)]	53	7
Google using the advanced search function	veterinary OR veterinarian OR animal “syndromic surveillance” filetype:pdf	112	7
	veterinary OR veterinarian OR animal “syndromic surveillance” filetype:ppt	129	5
google (customized search engine search)[3]	*"animal health" OR "santé animale" europe OR europa) with “animal health” search engine*	61	10
	"animal health" OR "santé animale" europe OR europa) with « epidemiosurveillance » search engine	216	12
Food safety agencies websites4	“Syndromic surveillance”	0	0

The list of identified relevant articles is presented below:

[3] search engines conceived by an expert of Ministry of Agriculture (Bruno Peiffer).
[4] List of websites available on http://www.bfr.bund.de/cm/364/eu-food-safety-almanac.pdf

Alton, G. D., Pearl, D. L., Bateman, K. G., McNab, W. B., Berke, O., 2010. Factors associated with whole carcass condemnation rates in provincially-inspected abattoirs in Ontario 2001-2007: implications for food animal syndromic surveillance. BMC Vet Res. 6, 42.

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Appendix 2: List of contacts for brief questionnaire

Appendix 3: Brief questionnaire and associated letter

Appendix 4: Long questionnaire

Appendix 5: List of contacts for long questionnaire

Appendix 6: Descriptive analysis

Appendix 7: Minutes and synthesis document of the veterinary meeting on SyS

Appendix 8: Results of the evaluation forms, Meeting on veterinary SyS

Appendix 9: List of veterinary syndromic surveillance systems as presented on Triple-S website

Austria

GMON (Health Monitoring System for Cattle)

GMON is a wide health monitoring project started in 2006. Veterinary diagnostic data, to be documented by law (law of animal drug control) is standardised, validated and recorded into a central cattle database. Besides the provision of reports for herd management and preventive measures, the assessment of breeding values for health traits and monitoring of health statuses are project objectives.

Contact: Walter Obritzhauser

Belgium

MoSS: Monitoring and Surveillance System-Emergences2

MoSS is a web application/multilingual website allowing for the time and geo-referenced descriptions of atypical syndromes, the clustering of similar cases, the onset of an alert signal sent to best-fitting Experts. The communication around the cases is organized on dedicated forum pages, leading to the early identification of the causative agent(s).

Contact: Marc Dispas

Denmark

VETSTAT

All data on purchase of medicine (antimicrobials and vaccines) to production animals are collected in Denmark (how much/which antimicrobials are subscribed by the veterinarian). Data can easily be amalgamated to look on the usage on e.g. specific animal species / disease syndromes / specific antimicrobials / some geographical areas or the entire country in the objective to control the usage of antimicrobials.

Contact: Kristian Moller

Finland

Kuukausi-ilmoitus

Kuukausi-ilmoitus is a Finnish program in which veterinarians must give a monthly report about certain notifiable diseases to the central veterinary authorities. The report also contains information about other animal diseases and syndromic illnesses. No statistical analyses are performed on these data at that stage.

NASEVA

Naseva is an online register for Finnish cattle farms. The system documents the history of the health care management on the farms at the national level.
Data is collected from veterinarians (farm visits, management plan), laboratories (sample results), slaughterhouses (meat inspection data) and veterinary or production surveillance databases (via interface; production data and medication data) and from the farms (medication data). Data are not used for syndromic surveillance at that stage.

Contact: Erja Tuunainen

SIKAVA

Sikava is an online register for health classification of Finnish pig farms. The system documents the history of the health care management on the farms at the national level. Data is collected from veterinarians (farm visits, management plan), laboratories (sample results), slaughterhouses (meat inspection data) and veterinary or production surveillance databases (via interface; production data and medication data) and from the farms (medication data). Data are not used for syndromic surveillance at that stage.

Contact: Sanna Nikunen

France

NERGAL-Abattoir

NERGAL-Abattoir is a pilot data basis created in 2005 to collect data in ten bovine abattoirs in real time during the slaughtering process. A study will be conducted from 2011 to 2014 to evaluate the relevance of these data to implement a syndromic surveillance system. Propositions to improve the existing system will be noted and taken into account for the future version of Nergal-Abattoir which is provided to be developing in more abattoirs in France.

Contact: Céline Dupuy

OMAR

The OMAR project (Observatoire de la Mortalité des Animaux de Rente) was launched in 2009 with the aim to analyze data collected by fallen stock companies, and to design a monitoring system able to detect anomalies possibly associated with health events. Pick calls from farmers to rendering plants are daily registered (including number of animals, species, age group, farm location, date of call) and automatically transmitted to the system. About 1.2 million cattle death notifications are yearly collected. For now only retrospective analysis were conducted, the interest of these data for syndromic surveillance is still being evaluated.

Contact: Jean-Baptiste Perrin

REPAMO (French network for the surveillance of Mollusc diseases)

Since 1992, REPAMO is the French surveillance system dedicated to wild and farmed marine mollusc diseases. It is run by Ifremer on behalf of the Ministry of Agriculture and has 19 correspondents in 13 locations on the Channel, Atlantic and Mediterranean coasts of France. Data are collected from local competent authority, laboratories and REPAMO correspondents. The objectives of the system are the notifiable disease surveillance, the mortality outbreaks investigations and the implementation of 2-3 years surveys on targeted host-pathogen associations

Contact: Cyrille François

SAGIR

Since 50 years, SAGIR carries out epidemiosurveillance and epidemiovigilance of wildlife fatal or disabling diseases, including toxicovigilance, in order to help the hunting managers and risk assessors and managers. SAGIR network is a participatory network of wildlife surveillance, which aims at conducting outbreak-based surveillance and when necessary, it also implements targeted surveillance. Three objectives guide the network: conservation, public and animal health. Data are collected from laboratories, hunter's federation and public technician. There is no syndromic surveillance system in place at that stage.

Contact: Anouk Decors

Italy

MBL (Dairy cow mortality)

MBL is a survey conducted from 01/01/2002 to 31/12/2008 on dairy cattle more than 24 months so as to evaluate local patterns of mortality and to test data availability and reliability. Death notifications from veterinary services were used to model mortality and detect excess of mortality as an alert. This survey was a preliminary work for the future implementation of a syndromic surveillance system based on mortality data in Italy.

Contact: Ines Crescio

Slovenia

EPI (System for monitoring, reporting and notification of animal diseases)

EPI is a web based application which allows data transfer in real time. The system comprises three different parts. The first part covers an animal disease notification system of OIE listed diseases at our national level. The second part is used for the diagnostics, which includes all procedures; including sampling from the field, as well as examinations and results from the labs. The last part covers mandatory vaccinations on the national level. Currently we are developing a fourth part, which will be used for disease outbreak management and control.

Contact: Marko potocnik

Spain

PROVIMER

PROVIMER is a system developed by the Government of Catalonia for the surveillance of data from fallen stock collectors, with the aim of detecting possible outbreaks of animal diseases in its early stages. Routine weekly data transfer, for baseline mortality monitoring and detection of abnormal values, is complemented with immediate email notification of carcass collection requests exceeding acceptable limits (number of animals by specie, according to the insurance company criteria).

Contact: Lucas Arinero Aparicio

Sweden

Centrala Djurdatabasen (CDB) Central Cattle Database

The central cattle registry, held by the Board of Agriculture, is a mandatory system for the identification and registration of bovine animals. It is primarily used in authority controls of stock numbers but it has/can also be used for contact tracing during outbreaks. The database is also a link in the national system for blood sampling of cattle at abattoirs (for surveillance purposes). Extracts from the database are regularly downloaded and used by abattoirs to check the age of animals slaughtered, to decide on BSE control measures. Information about animal movements and death with cause of death are registered in the data base. Data are currently not used for syndromic surveillance.

Contact: Ann Lindberg

Djursjukdata (National Animal Disease Recording System)

Djursjukdata is a central registry on veterinary treatments held by the Board of Agriculture that mainly concerns production animals. Data such as clinical diagnoses, treatment prescribed, drugs name and quantity are reported by veterinary practitioners in the field. Data are currently not used for syndromic surveillance.

Contact: Ann Lindberg

Kodatabasen

Kodatabasen is the dairy industry's database. Information on all herds and cows affiliated to production recording (milk or meat), pedigree registration, AI services and any of the control programmes that the industry is responsible for are registered. Information from slaughterhouses and diagnostic laboratories are also registered. Certain herd health indicators are monitored on a regular basis, covering several areas such as calf and young stock health, udder health, claw health, metabolic disorders, culling and mortalities, reproduction etc. The data are currently not used for syndromic surveillance.

Contact: Ann Lindberg

SVAs system för Laboratorie Arbete (SVALA) (SVA's system for Laboratory work)

SVALA is the LIMS system of the National Veterinary Institute (SVA), which is the major diagnostic lab for animal diseases (production, companion and wild animals) in Sweden, covering pathology, bacteriology, virology, parasitology as well as chemistry. Data are currently not used for syndromic surveillance.

Contact: Ann Lindberg

Switzerland

Animal Health System

The Animal Health System is a project still in its pilot phase whose objectives are general health surveillance and the early detection of new and re-emerging diseases in production and wild animals. The potential application of a syndromic surveillance system for livestock health is being investigated using data from the Federal Veterinary Office such as the national cattle registry, post-mortem inspection results (at the carcass-level) in the slaughterhouses, laboratory test requests by veterinarians and production indicators such as bulk milk sampling test results. Furthermore, we are looking into incorporating additional private data on fallen stock (held by rendering plants), milk production and reproduction indicators (held by breeding associations), post-mortem inspection results at the organ-level (held by slaughterhouses) and reports of equine neurological disorders to the Equinella network. Very little clinical or treatment data are currently centrally recorded in Switzerland but the project is considering ways to encourage data transmission from veterinary clinics and farmers. Passive monitoring of wildlife health is carried out by FIWI (the national reference laboratory).

Contact: Jürg Danuser

The Netherlands

GD Monitor/GD Animal Health Monitor

Since 2002, a telephone helpdesk has been implemented in the Netherland for production animals. Farmers and veterinarians can contact the helpline and data on animal disease, symptoms or syndromes are collected in a database. Census data from other sources are used (rendering plant, Identifaction&registration system, breeding organizations, milk quality data, milk production data, farm voluntary health certification statuses, AHS laboratory results). Statistical analyses are performed and outputs are discussed within an experts group to interpret alert and determine relevant investigation. Quarterly reports for Government, levy boards and industry are produced.

Contact: Linda van Wuyckhuise

United Kingdom

BEVA/AHT/Defra Equine Surveillance Reports

The quarterly equine disease surveillance reports are produced by the Department for Environment, Food and Rural Affairs (Defra), the British Equine Veterinary Association (BEVA) and the Animal Health Trust (AHT). The report collates equine disease data arising from multiple diagnostic laboratories and veterinary practices throughout the United Kingdom giving an insight into equine disease occurrence on a national and international scale. Introduction of a syndromic surveillance component is planned on 2012/2013.

Contact: Andrew Paterson

Farmfile

The FarmFile database includes epidemiological data on all diagnostic submissions sent to AHVLA Regional Laboratories. The data are used to identify changes in the profile of endemic disease and the emergence of undefined disease. Scheduled reports include analyses of; disease trends, submissions where a diagnosis is not reached (DNR), syndromes and data quality.

Contact: Eamon Watson

Innova AM (ante mortem) & PM (post mortem) Data Recording System

Innova AM and PM is an electronic system to enable the collection of AM & PM inspection results at slaughterhouses for all species (currently used for poultry and pigs; in progress for cattle, sheep and other species). One of the objectives is that the system could create a data base for Great Britain and generates automatic reports to fulfil the requirements for the collection and communication of inspection results (CCIR). Data are not used for syndromic surveillance at that stage.

Contact: Alex Gonzalez

Over 48 month (O48M) Fallen stock

Data are collected from farmers and rendering plants on dead cattle over 48 months through surveillance for TSE (brain stem testing of older cattle). Information on date of death and reason for death (in a free text field) is available. "Reason for death" is only available for adult on-farm cattle deaths. Data are not used for syndromic surveillance at that stage.

Contact: Eamon Watson

Poultry Practice Data

Poultry practice Data is a database to record pathology data directly from poultry veterinarians. Data collected are simple data about husbandry, disease picture and post mortem observations from a standard list. Data are not used for syndromic surveillance at that stage.

Contact: Eamon Watson

SAVSNET (Small Animal Veterinary Surveillance Network)

SAVSNET is a national initiative to ethically collect data from companion small animals (Cats, dogs, rabbits etc) from two sources in the UK; Commercial diagnostic labs and veterinary surgeons in practice. The data will be analysed for temporal and spatial patterns, and risk factors for health and disease (eg age, sex, breed). Data analyses will be published on line for members of the public and vets, and in peer reviewed papers where appropriate. Scientists will be able to apply for access to data.

Contact: Alan Radford

Vet. Surveillance Division (VSD) telephone log

VSD telephone log is a database to record data from telephone discussions between AHVLA laboratories and vet practitioners about animal health for production animals. Data from individual laboratories are aggregated and analyzed to supplement routine surveillance activities.

Contact: Eamon Watson

VetCompass (Veterinary Companion Animal Surveillance System)

The Royal Veterinary College (RVC), in collaboration with the University of Sydney, is undertaking a nationwide survey of small animal disease. The aims of this project are to investigate the range and frequency of small animal health problems seen by veterinary surgeons working in general practice in the United Kingdom and highlight major risk factors for these conditions. We are doing this through the routine capture of first opinion clinical data via electronic patient records held with practices' Practice Management Systems (PMSs).

Contact: