

## BIOSAFETY AND BIOSECURITY: WORLD EXPERIENCE, PROBLEMS IN UKRAINE AND MEANS OF ITS SOLUTION

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*Main problems of biosafety and biosecurity in veterinary medicine in the world are presented in the article. Basic principles and methods of system functioning in connection with spread of infectious diseases are viewed. The role of international and social organizations in context of development of standards of biosafety is presented. There is showed the necessity of creation of state program at biosafety and framework of reference-laboratories for control of animal infections.*

## ANIMAL MORTALITY: A MULTIPURPOSE SOURCE OF INFORMATION THE FRENCH EXPERIENCE

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*The implementation of a monitoring system of animal mortality on a country-wide basis requires a lot of work, but constitutes an invaluable tool for the veterinary services.*

*The data will be all the more usable and useful if the more detailed it is and if the collection is as fast, regular and exhaustive as possible.*

*To reach this result, the complete census of farms is a prerequisite and the implementation of a computerized data system is essential.*

*In three years of work with the rendering industry, the French veterinary services have set up a nation-wide system making it possible to have a permanent knowledge within a period of 8 days of animal mortality occurring in each farm listed in the country.*

*The very large quantity of collected validated data makes it possible to compute reliable statistical data at national, regional or local level. It also makes it possible – in the case of abnormal variations – to analyze data and locate the phenomena.*

*The valorisation of this monitoring is in progress. The AFSSA (3) and the INRA (4) are responsible for the scientific aspects. The ways of using the data for operational objectives in the field are also under development and will take the form of national instructions concerning animal health monitoring, the preparation of emergency plans, the detection of certain serious cases of animal ill-treatment (offence to animal welfare), and the application of the European legislation on identification and traceability of animals and by-products, in particular specified risk materials.*

*At individual level, mortality is the stage beyond which the intervention of the therapist does not have anymore an object. The action can be continued by the anatomo-pathologist, but at this stage, it is already placed – implicitly – within the framework of a collective action, i.e. carried out for the benefit no longer of the individual animal, but of the population to which it belongs.*

*At collective level, mortality is on the other hand an important indicator, which informs on the general health of a population. The study of mortality of animals for production has numerous interests from an epidemiologic point of view.*

*For example the identification of the risk factors associated with an increased mortality can help the farmers to improve their practises, their technical results and the animal welfare.*

*Monitoring the evolution of mortality on various space-time scales could in addition allow the detection of anomalies ('over-mortalities') linked with phenomena of medical interest (emergence of diseases, intoxications, heat- or cold-waves).*

**1. History of the project**

*At the end of the 90s, the French veterinary services started to develop at national level an information system (SIGAL (5)) covering all their activities: animal health, food safety, animal welfare and environmental protection.*

*In the past, veterinary services at local level had sometimes taken initiatives in relation with the rendering companies, in order to get a better knowledge of the data relating to mortality. But these actions, due only to the initiative of a few directors of veterinary services at local level, remained scattered and un-coordinated.*

*Another major element was related to the funding by the State of the cost of the collection of dead animals. These measures – which no longer exist today – have significantly helped the implementation of the program.*

*During the summer 2003 heat wave, it was possible to visualize the impact of the temperature on the mortality of animals. Picture 1 show the monthly evolution of the tonnage of dead animals (all species) collected by a given company, such as it was possible to reconstitute it *a posteriori*. The impact of this heat-wave is clearly visible: it starts in the first days of July, whereas the alarm was given only several weeks later due to lack of suitable data.*

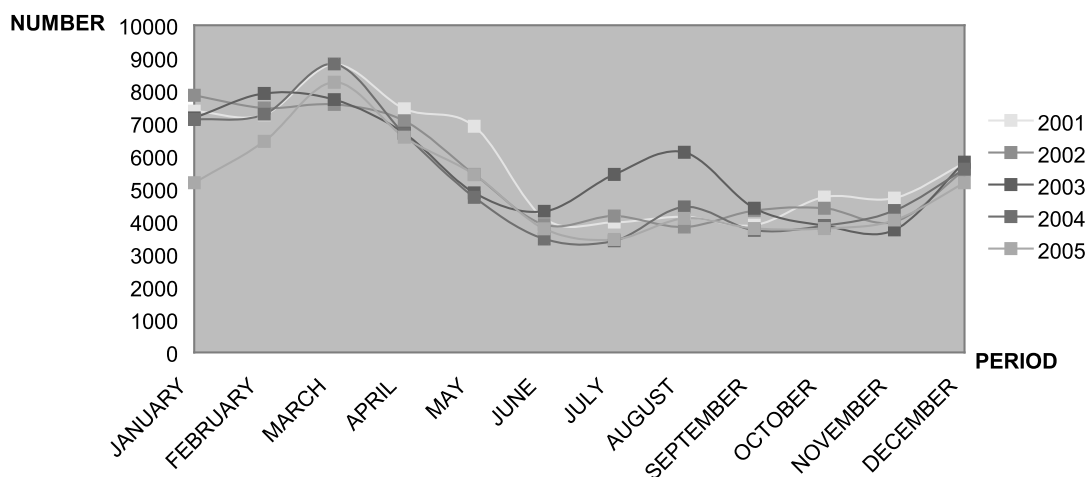
<sup>1</sup> Inspecteur g n ral de la sant  publique v t rinaire = Inspector general of veterinary public health Conseil G n ral de l'Alimentation, de l'Agriculture et des Espaces Ruraux (CGAAER) = High Council for Food, Agriculture and Rural Spaces. The CGAAER is an advisory body to the French minister of food, agriculture and fisheries. It consists in the assembly of the highest ranking civil servants of the ministry.

<sup>2</sup> Direction g n rale de l'alimentation (Directorate general for food): The French central competent authority in the veterinary field

<sup>3</sup> AFSSA: Agence fran aise de s curit  sanitaire des aliments. The French food safety agency, in charge of the risk assessment

<sup>4</sup> INRA: Institut national de la recherche agronomique

<sup>5</sup> SIGAL: Syst me d'Information G n ral de l'Alimentation (global food information system)



**Picture 1.** Number of dead animals collected by a given rendering plant in the centre of France between 2002 and 2005

It was thus necessary to set up a system making it possible to obtain an early and detailed knowledge of mortality, and for this reason, to centralize in the information system of the veterinary services the data linked to the daily activity of the rendering companies.

In this context, contact was made at the beginning of 2005 with the national organization of rendering companies.

The message transmitted to the chief executive officers was double:

- by transmitting your data, you take part in the protection of animal and public health and this will contribute significantly to enhance the image of your activities in the public opinion;

- but moreover, this transmission – if it is carried out on a daily basis – will constitute a totally transparent declaration of activity and nobody will dispute anymore your figures at the time of financial negotiations, whether it be with the State or the farmers' organizations.

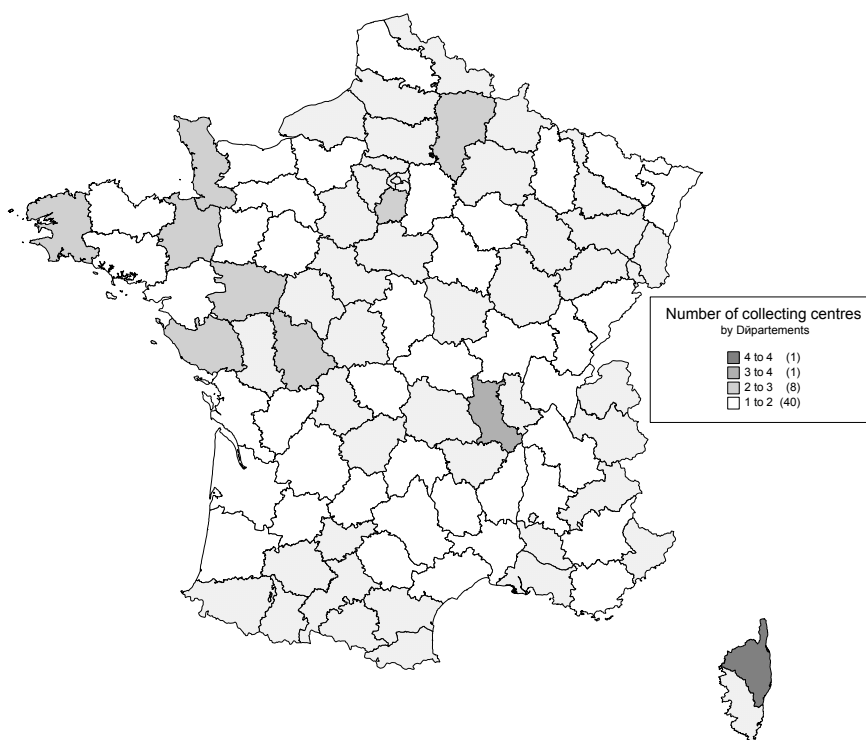
Formulated like this, the proposal was very well accepted by the companies. A series of working meetings was launched, which lasted almost three years and led in April 2008 to the setting up of the system which will be described later on.

### 2. Organization of the rendering activities in France

Since a law of 31 December 1975, since partly replaced by EU Regulation 1774/2002, the organization of the rendering activities in France has been very centralized and industrialized.

To date, the whole territory is covered by 3 companies of national size, which are often part of multinational companies.

In the field, the operating units are distributed into 53 intermediate establishments (*collecting centres*) and 11 transformation plants. Those of these units which have their own information system are called 'Centres Emetteurs' ('Transmitting Centres'), because they transmit data to the national veterinary information system.



**Picture 2.** Distribution of collecting centres in France

3. Presentation of the data-gathering system

Between summer 2005 and spring 2008, an electronic data interchange system (EDI-SPAN) <sup>(6)</sup>, adapted to the management of the data concerning dead animals, was designed and formalized.

The detailed technical specifications of this system are the subject of a document, compiled by the French veterinary services and which was communicated to the rendering companies in order to be used as a basis for adapting their data-processing tools.

This document specifies the various interchange formats of data concerning dead animals, and also the ones concerning by-products collected in the food business establishments (slaughterhouses, cutting plants, etc).

As a matter of memory, the data are transmitted in the form of XML files.

There are 2 types of files according to the context:

- tours (rounds) <sup>(7)</sup> carried out by the trucks of each centre (normal mode);
- requests for removals of dead animals (exceptional mode in the event of crisis).

The main data transmitted is presented below:

a) Data relating to the tour:

- Identification number of the round
- This number must be unique at the national level: it is prefixed by the initials of the establishment having carried out the round with date and time;

- Hours of beginning and end of the round;

- Registration number of the truck;

- Mileage at the beginning and end of the round;

- Tare weight and laden weight of the vehicle in tons with a precision of 1 kg.

b) Data concerning dead animals

- Identifier of the establishment (Type + Value);

There are several types of possible identifiers for an establishment.

The value, combined with the type, identifies the establishment as unique at national level.

- Name of the establishment (owner or holder);

- Address of the establishment: building - road - locality - postal code - locality code;

- Date and time of the visit;

- Address of the farm: building - road - locality - postal code - locality code;

- Category of animals (list of national reference - see below);

- Nature of the removed animal(s) (individual or batch);

- System of estimate of the weight (weighed or estimate) ;

- Type of production: Meat or Milk;

- Sex;

- N° of identification of the animal (bovines, sheep, pig);

- Weight estimated with removal by species in kg (individual animal or batch);

- Net weight of removal in tons with a precision with kg (individual animal or batch);

- Number of collected animals;

- Information concerning the identification;

- Geo-referencing of removal (UTM) (not currently generalized).

The definition of the categories of animals is important, because it in the final analysis makes it possible to have more or less detailed information. It is important that this categorisation is established in relation with epidemiologists so that the data produced by the system are relevant.

**Table 1** – Categories of animals

<i>Bovine</i>	<i>Small ruminant</i>	<i>Swine</i>	<i>Equine</i>	<i>Poultry</i>	<i>Others</i>
Calves <21	Male goats	Maternity piglets	Adult horses	Laying hens	Rabbits
Bovines < 6 months	Female goats	Post-weaning piglets	Foals	Fat poultry	Deer
Bovines < 9 months	Kids < 1 month	Pigs	Donkeys	Broilers	
Bovines <12 month	Rams	Reproductive pigs	Ponies	Ostriches	
Bovines < 18 months	Ewes		Cross-bred		
Bovines < 24 months	Fattening lambs		Still-born		
Bovines > 2 years	Lambs < 1 month				
Buffaloes					

c) Methods of transmission

In all cases, the data is transmitted electronically (EDI).

Each 'Transmitting Centre' sends every day:

- the list of the interventions carried out (at D+8);

- the list of the requests for collecting of dead animals received the day before.

In the first case, the objective is to obtain data validated individually (big animals) or by batch (poultry).

In the second case, the objective is to obtain 'in real time' the data allowing a statistical picture of the evolution of a phenomenon

<sup>6</sup> The specifications of the EDI-SPAN system are public and may be obtained on request (available in French only).

<sup>7</sup> A 'tour' refers to all the dead animals collected between two unloading of the vehicle at the collecting centre.

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already detected, to even detect a phenomenon which will be identified at a second stage.

### 4. Possibility of valorisation of the collected data

Knowing that the specified data is sent and inserted into the national information system on a daily basis and that it can be regarded as exhaustive, it is possible to implement different data processing in order to present the information available for a use in the fight against the pathological phenomena having an impact on the breeding and the national economy.

The stress must be laid on the fact that such a tool is fully in the scope of the State veterinary services in charge of the security of the national territory with respect to animal health.

#### a) Measure economic losses related to animal mortality

The first result of the program is to constitute a real measuring instrument of animal mortality, which is the first stage of a scientific approach and the base the administrative and operational action.

The first result is given by the raw summation of the data received from the various rendering companies: it consists in the quantification of the losses linked to animal mortality.

Taking into account the data available, it is possible to draw up such an assessment at national level, but also at regional and local levels.

Table 2 below gives the number of dead animals for the various categories of bovines during the year 2009.

**Table 2** – Bovine mortality 2009 by category of animal

Categories	<21 J	21 J – 6 months	6 to 9 months	9 to 12 months	12 to 18 months	18 to 24 months	> 2 years
Total	738.108	233.536	40.257	30.011	36.799	21.841	308.431

The interest of an objective acknowledgment of animal mortality, detailed by species, is to make the various actors (farmers, veterinary practitioner, veterinary services and economic services) aware of the importance of the phenomenon for the economy. It is the first application of the program, but not the only one.

#### b) Definition of a permanent measuring instrument

Before considering mortality as the indication of an emergent phenomenon, it is advisable to regard it as the image of an existing phenomenon. Animal mortality represents considerable economic losses which it is important to try to prevent. This means launching studies and actions, and then being able to measure the results of these actions.

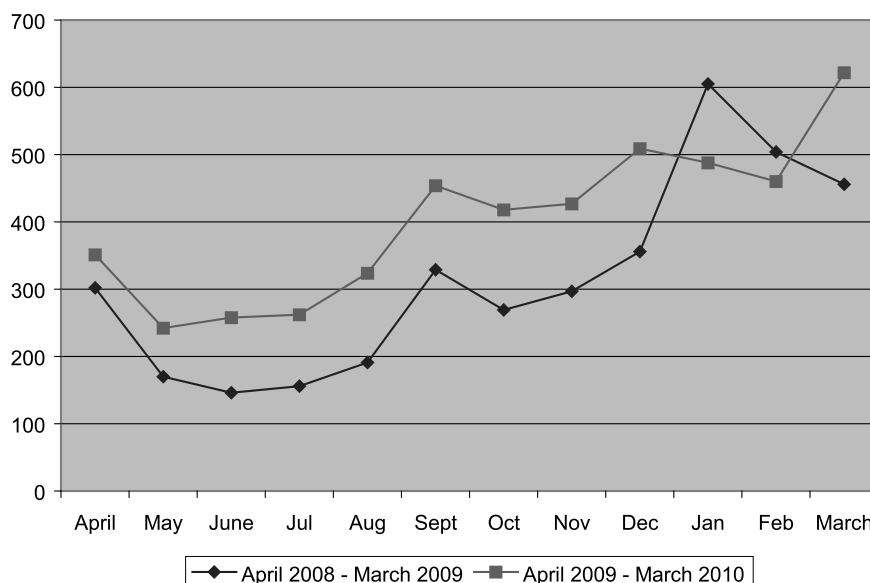
From this point of view, while being based on same calculations, repeated periodically, the country can be equipped with a measuring instrument of animal mortality, and consequently a measuring instrument of the result of the actions undertaken to try to limit it, and even an assessment of the investment which it is reasonable to make with respect to the results that may be expected from these actions.

#### c) Measurement of the 'background noise': prerequisite for the detection of a possible emergence

The repeated measurement of animal mortality by category of animals with a given periodicity leads directly to the drawing of a mortality curve, which is a time-sorted juxtaposition of the results of the successive assessments.

Before being able to formulate a suspicion as for the probable appearance of an emergent phenomenon, on the basis of an observed increase in mortality for a species, or a category of animals in a given area, it is essential that the measuring instrument be calibrated beforehand. This calibration consists in establishing which level of mortality must be regarded as 'usual', i.e. to define what we would call the 'background noise' for a laboratory instrument.

It is only in comparison with the level of this 'background noise' that it will be possible to determine if an increase in the mortality of a category of animals in an area, is significant or not, and in the event of the answer being yes could alert on the appearance of an unknown phenomenon.



**Picture 3** Mortality of young calves during two successive 12 months periods in the department of Vienne (France)

It must be noted that, strictly speaking, this measurement of the mortality 'background noise' is a precondition to the evaluation of any variation, be it positive (*progressive reduction of the losses related to better management of their animals by the farmers*) or negative, sign of the emergence of a phenomenon (*here again at national, regional, local or individual level*);

d) Backing up the suspicion of an emergence or to monitor the evolution of a phenomenon

If we take the example of the heat-wave which struck France during the summer 2003 (see the curve presented in the introduction), it is possible to evoke a working method which could be described as 'Computer-Assisted Detection':

– Each night, the central system processes the data received during the day and produces the corresponding figures. It will be a rather heavy table, because it is not sufficient to carry out this calculation at national level only. Indeed, the sensitivity of the method is likely to be very degraded by an effect of dilution if a pathological phenomenon appears in only one area. It is thus advisable to retain the right geographical level, by preferably choosing it in cooperation with the establishment of the veterinary services in the field. In all cases, the choice of the suitable geographical entity will result from a compromise between the size of the zone which should not be extended too much and the numbers of figures that it is advisable or possible to treat every day. It must be noted that here again it is possible to have two different configurations for peace time and crisis time.

In France, the implementation of this device at a regional level would lead to the daily calculation of a table of 22 lines (for the 22 areas) and 31 columns corresponding to the 31 categories of animals identified (see above).

Carrying out such a calculation on a daily basis does not pose any particular technical problem.

– When calculation is made, it is advisable to program the comparison of the figures with those of the 'background noise', by performing a test ('Historical averages method' or 'Farrington method', classically used in epidemiology, can be implemented here) making it possible to check if the mortality of the previous day, for each category of animals and each area, presents a statistically significant variation compared to the background noise.

– The information system must thus be programmed to produce an alarm only when a variation of mortality of a category of animals in a given zone exceeds a mathematically defined threshold at a given time<sup>(8)</sup>.

e) Possible integration with the preparation of the contingency plans for contagious diseases

If the detection process works and the existence of an outbreak is confirmed, it is then possible to go to a higher level of alarm, for example by programming the information system so that it carries out calculations either only at the regional level, but departmental level (4 to 8 départements per region in France), in order to allow a finer monitoring.

The detection system is then reconfigured into the monitoring system: the information system produces every day - for the categories of animals sensitive to the disease - a curve of departmental mortality allowing the central and local competent authorities to have a precise knowledge of the situation in the field and to be able to provide to political authorities reliable and useful elements to help decision making.

f) Back to normal times: control of the implementation of the veterinary legislation

Here, the data processing is brought to the maximum, since the mortality is calculated at the level of each farm. As it is the case for a geographical area, it is essential to compare the rough figures with a reference. In the case of farms, a mortality rate can be calculated by referring the number of animals dead on a farm during one period, to the size of the herd (animals-day) - which is generally known by the veterinary services - during the reference period.

Indeed, the loss of 10 piglets does not have the same significance in a maternity of 15 or 500 sows.

From these calculations, it is possible to insert into the information system the significant thresholds from which the computer will be able to produce periodically a list of farms showing an abnormally high death rate.

In the specific context of the European legislation, that is quoted here only as an illustration, two practical applications can be considered:

– Contribution to the monitoring of the implementation of the legislation on animal identification (*bovine, ovine, porcine*): the mortality rate, calculated at the farm level, could be taken into account in the risk analysis carried out by the veterinary services to select on a hierarchical basis the farms in which they will carry out official controls of the good implementation of the legislation on animal identification;

– Contribution to the monitoring of the protection of the animals, in conformity with the Community legislation in this field;

In the same way, the existence of an abnormally high death rate on a farm may be the sign of bad practices of the farmer, constituting infringements to the legislation on welfare.

5. Prospects for improvement:

a) Taking the geographical coordinates into account

The data processing specifications of the system envisage data exchanges concerning the geo-localization of place where the dead animal was collected. A number of applications are expected in this field, but the program is not yet operational, because the companies must first equip their vehicles with a positioning system, which involves potentially significant investments.

b) Scientific study in progress

The Ministry for food, agriculture and fisheries joined the AFSSA and the INRA to develop the analysis of data collected by the EDI-SPAN system, within the framework of a project entitled OMAR<sup>(9)</sup>.

The objectives of this project are:

– to produce reliable statistics of mortality, using relevant indicators;

– to model 'usual' mortality in time and space;

– to design a monitoring system of mortality able to detect the appearance of anomalies, possibly associated with phenomena of veterinary interest (emergences of diseases, intoxication).

The first work was devoted to the definition of the reference level of bovine mortality, species for which exhaustive population and mortality data is available since 2001. The description of the death rates was led with respect to individual, temporal and space factors. The tendency and the seasonal variation of the weekly time series of the death rates since 2001 were studied according to the age and the type of production. In addition, of the standardized mortality ratio (SMR) were estimated at various scales (by zip code, by hexagonal geometrical space unit of 20 km) then mapped in order to evaluate the heterogeneity of mortality on the French territory. The results of this descriptive work will be the subject of reports/ratios bound for the principal actors of the animal health of each département.

In one second stage, the excesses of mortality which have occurred in the French bovine population in 2007-2008, whereas the Bluetongue epizootic spread, were described starting from a method close to that developed by the INSERM<sup>(10)</sup> to study the effects of the 2003 heat wave in the human population. In each département, the notifications of mortality transmitted to the national data base of

<sup>8</sup> We keep in mind the fact that the level of the 'background noise' is not a permanent feature. In particular, the animal health measures taken by the actors in the field generally lead to the result of reducing it. It is then necessary to re-calibrate the system.

<sup>9</sup> OMAR: Observatoire de la mortalité des animaux de rente = Observatory of the mortality of animals for production

<sup>10</sup> INSERM: Institut national de la santé et de la recherche médicale – National institute for health and medical research

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identification since 2001 were analysed in three stages:

- Modelling of the temporal evolution of the death rates as from a reference period (2003-2006);
- Prediction of the death rates expected for 2007-2008 and application to the population present;
- Comparison of the expected mortality with mortality really observed.

This work made it possible to describe the space-time evolution (by week and *département*) of excesses of mortality in France during the Bluetongue episode.

Other studies will be launched soon, in particular to study risk factors associated with an increased mortality: individual (*age, sex, type of production*), linked to the farm (*size, type of activity*) or to the environment (*climate, altitude*).

The study of a possible link between the weather factors (*temperature and hygrometry*) and bovine mortality, and in particular the study of the effects of the heat wave in this species, will be the specific work object. The results obtained will have up to what point to indicate the adjustment on weather parameters can improve the predictions of the models under consideration for the future monitoring system.

The work of designing an early warning system based on the daily data flow from the rendering industry is due to begin as soon as September 2011.

### **МОНІТОРИНГ СМЕРТНОСТІ СІЛЬСЬКОГОСПОДАРСЬКИХ ТВАРИН: ЦІЛІ, МЕТОДИ ТА ПРАКТИЧНЕ ЗАСТОСУВАННЯ ФРАНЦУЗЬКОГО ДОСВІДУ ВЕТЕРИНАРНИМИ СЛУЖБАМИ**

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*У статті представлені матеріали щодо моніторингу смертності сільськогосподарських тварин. Визначено цілі, методи, практичного застосування французького досвіду ветеринарними службами.*