

Data management systems for the bovine viral diarrhoea eradication programme in Switzerland

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Summary

A programme to eradicate bovine viral diarrhoea was launched in Switzerland in 2008 with the aim of eradicating the causal virus. During the first year of the programme, the entire population of 1.6 million cattle were tested for the presence of the virus; in the following three years an additional 1.8 million calves were tested. The complexity of information generated during the eradication programme, together with a tight schedule, made computerised data management a necessity. To organise, coordinate and supervise the programme, extensions were made to the computerised information system ISVet, of the Swiss Veterinary Service, which provides automated documents for both the Veterinary Service and private veterinarians. Specific data are accessible by user groups via the BVD-Web platform, ISVet and the Swiss animal movement database. The functionalities of the structure and the reports needed to control

the progress of the programme are described in detail. The authors also discuss the major advantages, disadvantages and pitfalls when planning an eradication programme using a national centralised database over a distributed computer network.

Keywords

Bovine viral diarrhoea – Data management – Eradication – Switzerland.

Introduction

Switzerland is dedicated to the eradication of bovine viral diarrhoea virus (BVDV) and in 2008 a programme was instituted to eliminate the virus from the Swiss cattle population. In general, the approach followed well-accepted principles for BVD eradication in eliminating persistently infected (PI) animals, which shed the virus for their entire lifetime (1); however, the programme was novel, given the short time periods taken to screen for PI animals and the implementation of movement restrictions for entire herds. Initially, all herds were screened for PI animals; thus the entire population of 1.6 million cattle were tested in one year. An additional 1.8 million calves born in the following three years post-screening were also tested for the presence of the virus (2, 3, 4).

Large numbers of people were necessary for this task of sampling and testing, therefore it was essential to develop a computerised management system to organise, coordinate and supervise the eradication programme.

For the programme to be organised and efficient, the functionality of ISVet, the existing computerised management system of the Swiss Veterinary Service, was enhanced and upgraded to provide access from the Internet via the BVD-web platform.

This paper provides details of the Swiss BVDV eradication programme and the development and use of multiple data management systems, the interconnections of these databases, and the

obligatory critical control points for successful implementation and use of these systems.

Methodology

Eradication programme

The BVD eradication programme was led and coordinated by the Swiss Federal Veterinary Office (SFVO) and began in 2008. The Regional Veterinary Offices (RVOs) organised the sampling procedure and implemented the measures to be taken when PI animals were identified. Official sample takers collected ear-notch samples from all animals on a farm, using special ear tags, and sent them to one of the certified laboratories for virus testing. In the case of an inadequate ear-notch sample, another blood sample would be collected subsequently. Samples were analysed either by enzyme-linked immunosorbent assay (ELISA) or by real-time reverse-transcription polymerase chain reaction (rtRT-PCR) to detect animals testing positive for the presence of antibodies against the virus. In the case of an initially positive result, the farmer could decide whether to cull the animal directly or to verify the result through a confirmatory rtRT-PCR on a blood sample. Animals testing negative at the confirmatory test were considered uninfected. Details of the laboratory procedures are not within the scope of this paper and are described elsewhere (4). The eradication programme comprised three main phases (Table I), with private veterinarians sampling animals during the first phase and farmers sampling and ear-tagging their animals during the later phases.

Phase 1 included testing the entire cattle population for BVDV in order to detect and eliminate all PI animals. There were two sampling rounds in phase 1: the first from January to July 2008 included all cattle that were moved to alpine pastures; the second round from October to December that year included all remaining untested cattle. Detected PI animals were put under movement restriction and slaughtered within a few days. During the second round, no movements between farms were allowed until all animals on the premises had returned a negative test result. On premises where a PI

animal was detected, all pregnant cattle were put under movement restriction until they had given birth.

In phase 2, beginning in January 2009, all newborn calves were tested for BVDV and if a PI animal was detected it was sent directly to slaughter. All pregnant cattle on the respective premises were restricted from being moved to other premises. From autumn 2009 onwards, farms received a BVD-free status if all cattle tested negative and no movement restrictions were in place.

In phase 3, testing of newborn calves for BVDV antigen continued. In addition to the measures implemented in phase 2, if a PI animal was identified, all cattle on the farm were placed under movement restrictions until investigations into the source of infection had been completed. In 2012, the testing of all newborn calves continued in parallel with the first serological surveys.

Architecture and data flow of the database system

Before the start of the field work in the BVD eradication programme, several existing national data-management systems were connected, enlarged and enhanced with added features and tools (Fig. 1). An exchange of data between the connected databases, and farm classification according to the expert system, took place every night in an automated process.

Since 1999, the Swiss animal movement database (AMD) has recorded all cattle- and farm-related data, such as births, animal movements, and slaughter or deaths of cattle. Each animal has a unique ear-tag number registered in the database. The AMD is accessible by all farmers and animal traders, so that any movement restrictions, based on the BVD status of individual animals, can be accessed by farmers, animal traders and Veterinary Services on the Internet or using the short message service (SMS).

All laboratories involved in the eradication programme reported test results to a centralised laboratory database (ILD) run by the SFVO. The strength of the database lay in the accessibility of its centralised

and standardised collection of laboratory results from several decentralised veterinary laboratories. Technically, the laboratories transferred encrypted data records to a designated SFVO mailbox, using the MAPI software protocol from Microsoft and encryption technology from Pretty Good Privacy (PGP 2.6.3i for MS-DOS). An automatic procedure constantly checked the SFVO mailbox for new mail, decrypted any new packages of data that had arrived, performed validation checks on the data, saved the valid records in an Oracle database (version 9.1) and sent a confirmation E-mail to the dispatching laboratory.

Data records were standardised using an in-house messaging format. Each record with its particular combination of attributes was saved with a unique identification (ID) in the database. Laboratories were obliged to transfer test results not later than one day following test completion, thus ensuring a rapid flow of data. Incoming files usually contained up to several thousand records, each one representing one BVD analysis of one sample from a single animal, tested using one diagnostic method in one laboratory. If an animal was retested for confirmation purposes, a second record was sent to the ILD. The transfer of data and validation of records were supervised by SFVO operators. Failures of data transfer for technical reasons and the rejection of data records because of incomplete identifiers or values were manually corrected in the database by SFVO operators.

The Swiss computerised data collection system, ISVet, was developed to provide a centralised repository of animal health data to improve the monitoring of animal health trends in Switzerland and is a centralised government network available to users in federal government and the RVOs. The system supports the day-to-day operations of RVOs through integration and communication with existing systems. The 'core' of ISVet consists of an Oracle database, a business application layer (.NET) and a user interface, deployed using the terminal server technology Citrix. All users of ISVet see the same user interface and are permanently connected to the same database. The availability of system features and access to data are controlled by security systems at different levels of organisation: federal

government, regional government or individual users. The exchange of data between ISVet and the BVD-Web platform provides updated information on herds and animals to veterinarians in the field through a system-independent Web browser. In ISVet, premises are the basic unit of reference, and information on the animals and the laboratory results are linked to this unit.

Before the start of the eradication programme, ISVet was already providing facilities that aided the workflow of the programme, such as the management and grouping of farms, people and organisations. For example, veterinarians were allocated to each farm for official tasks by the RVO, or farms selected for a certain programme were grouped in projects. Additional important features were geographic information system (GIS) functionalities and the integration of multiple languages.

Building on this existing system, the BVD eradication programme was implemented, using mainly a set of interconnected projects. Using ISVet, a project can be created for any planned programme at the national or regional level; a project has a defined start and end and a particular task that needs to be done by allocated persons. For BVD, all premises where the same task had to be performed (for example, taking blood samples for confirmation) were allocated to one project. After a particular task was completed, the premises were automatically transferred to the next project with the subsequent required task. To date, BVD eradication has been implemented through 18 projects, each of which was related to a specific phase of the programme, even if the tasks of some projects were similar.

Specific functions were added for the BVD eradication programme, the most important of which were incorporated into an expert system running overnight. These processes included the importation and linking of AMD-registered data on individual cattle and premises with laboratory data from the ILD. The expert system analysed individual animals, premises, laboratory and operational data and calculated a disease status for every farm and animal. Because of the complexity of influencing factors, all premises and animals were checked and

recalculated every time the system was run. Based on the disease status, premises and tasks were allocated to relevant projects, during which they were automatically allocated to veterinarians who completed the required tasks, such as initial or follow-up sampling, or to the RVO, who printed the required notifications, such as orders to dispose of infected animals or notifications of movement restrictions. In addition, information on movement restrictions was exported to the AMD so that it would be available to all farmers the next day.

The expert system used to assign disease status and allocate premises to a project is a complex, rule-based system. As a result of the large quantity of data involved and the need to process the data as quickly as possible, rules were coded using structured query language (SQL) statements that were executed directly in the database. The rules of the expert system were modified to account for knowledge gained during the eradication programme and the associated SQL statements were adapted, as required. Before each adaptation was released for general use, the system went through a phase of rigorous validation and verification, with the result that the expert system performed extremely well. Of the several million decisions that were made by the expert system, processing errors could be measured only in the hundreds. Most often, the errors occurred because of unexpected anomalies in the data and were repaired by manipulating the data directly in the database until the expert system code could be corrected.

The BVD-Web platform shared data with users from outside the governmental network, such as private veterinarians, who had secure access to a set of tasks allocated to them by the system. Once registered, veterinarians could log onto the platform using personal IDs and passwords, and immediately be presented with a list of allocated premises. Each veterinarian could then select a group of premises and print out the relevant documents, which included data on the premises, animals and test results, as well as instructions and notifications for the veterinarian and the farmer. One of these documents served as a laboratory order form to be returned to the laboratory with the collected samples. The documents were designed

by the SFVO and customised in ISVet to meet specific RVO needs; for example, logos or differing legal requirements.

Organisation and delegation of sampling

The RVOs allocated all the premises to veterinarians by defining a specific relationship between each veterinarian and the premises. These relationships needed to be entered only once in ISVet and were managed by the RVOs, usually by grouping the premises geographically and allocating these to a veterinarian in the region. Once defined, the relationships were used to automatically assign tasks to the relevant veterinarians via BVD-Web. The veterinarians used the platform to organise their tasks and print the necessary documents (Fig. 2). For sampling the animals, ear tags, each with a unique number, and associated stickers with numbers and bar codes were supplied. After sampling, the device containing the skin sample (biopsy) was labelled with the same number as the ear tag, and the associated sticker was attached to the document listing the animals.

Management and control in the Regional Veterinary Offices

To manage the workflow, 18 phase-specific projects were set up in ISVet. Depending on the test results and the phase of the programme, the premises appeared in the relevant projects. This allowed users in RVOs to work on specific tasks and to control the process (Table I). In all projects, users had access to the relevant information on all cattle on the premises (Fig. 3). All available test results were displayed with the date and method of analysis for each animal. The programme phase and BVD status were displayed for all premises.

Monitoring the programme

Specific reports and data filters assisted in monitoring the progress of the programme. For the RVOs, reports contained only the farms relevant to that RVO, whereas the SFVO had access to all data. All users were able to create simple filters; if more advanced filters were needed, they were constructed by experienced users or a programmer. New reports were developed, on request, by the SFVO. Any

anomalous reports were identified by the SFVO; for example, positive laboratory results not assigned to an animal in the system.

Discussion

In the Swiss BVD eradication programme, the ability of ISVet to connect national databases and transform data into workflow information was a crucial factor from the outset. To the authors' knowledge, information in the scientific literature on applied data-management systems in veterinary public health is scarce. Among the 25 examples of veterinary information systems at national or international level that have been listed (5, 6), most are descriptions of functional parts, such as AMDs (7), or systems for inspection at slaughter (8). Others are aimed only at specific branches of livestock production (9).

Two veterinary information systems, EpiMan in New Zealand (10, 11) and the disease control system (DCS) of the Department for Environment, Food and Rural Affairs in the United Kingdom (6), have a wider range of functionalities and are thus comparable to ISVet. The EpiMan system has been published in a scientific journal and is described as a decision-making support system for national disease control programmes, aimed at informing decision-makers before or during such programmes. EpiMan does not provide facilities for technical or operational work, and the input data need to be manually imported and are static. In contrast, the DCS is a Web-accessed database developed to assist during an outbreak of a highly contagious disease. The DCS was in the fledgeling phase in 2001 and came into use during the outbreak of foot and mouth disease that year, thus showing some 'teething' problems. Some new features have been added to the DCS since then, particularly the automatic creation of lists for the vaccination contractor and the export of data to financial systems to validate compensation payments.

More recently, a national animal health information system (NAHIS) has been introduced in Australia (12). The system is flexible and web-based, and is designed to support Australian animal disease surveillance programmes by enabling online submission of nationally

relevant data and providing automated data-analysis summaries and customised output reports. The system functions as a national focal point for animal surveillance programmes. Unlike ISVet, NAHIS is not meant to provide tools for operational or technical workflows, but is a flexible and service-oriented state-of-the-art system, which even has embedded statistical analyses using R, a language and environment for statistical computing (13).

The United States Department of Agriculture provides information on some data-management systems on the Internet; for example, the Veterinary Services Process Streamlining System and the National Animal Health Reporting System. Another example of a governmental system is the Tierseuchennachrichtensystem (14) in Germany.

As the number of publications on such systems in the literature is low, the exchange of ideas and solutions between governments is limited and often difficult. With the introduction of supra-national veterinary information systems, such as the World Animal Health Information Database of the World Organisation for Animal Health (15) or the bluetongue network EUBT-NET of the Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise 'G. Caporale' (16), the use of national systems to collect national animal-health data might become more widely adopted. At both national and international levels, the electronic acquisition and automated exchange of data avoids changes in the medium of the data, which can often result in typing or copy/paste errors, and thus leads to greater accuracy. However, these processes need a high level of documentation and standardisation.

During the course of the BVD eradication programme, thousands of decrees, information sheets and other documents specific to each farmer had to be distributed. For example, on farms with PI animals, after entering the insemination data at the RVO, a list of all animals under movement restriction had to be made available. Using ISVet, all premises with these conditions appeared in the same project and the documents were created automatically by the system.

Although the RVOs were already using ISVet for some tasks, the system was not being used extensively. Use of the system on a daily

basis required intensive training, which was provided by the SFVO; in addition, a manual on the use of ISVet and the BVD-Web was developed. Although the principal use of the system was quickly understood, constant support was needed from the SFVO. The option of having RVO-specific documents for every project was appreciated. Nevertheless, implementing those documents in ISVet was complicated and cumbersome, even for the trained SFVO staff.

Initially there were doubts about the acceptance of the BVD-Web platform by practitioners. Some problems arose because of inadequate hardware or software but these were quickly solved and, soon after its introduction, most veterinarians did not want to work without the BVD-Web.

One of the major advantages of the system was the way in which RVOs and the SFVO could control the programme's progress. Any cattle without a test result and any PI animals that had not been slaughtered appeared on specific reports and these cases could be tackled immediately.

One positive effect of the programme was the clean-up of the AMD. Dead animals not notified to the database – thus classified as alive but without a test result according to the system – prevented premises from entering the next phase of the programme and consequently their cattle were under movement restrictions. This prompted farmers to notify the animals correctly. Living animals that were not notified to the AMD were identified on a specific list, showing test results without a corresponding animal in the database. About 1% of test results needed clarification by the SFVO.

From the SFVO's viewpoint, the major disadvantages of the system were the complexity of the project structure and the difficulty of data retrieval. However, a balance is always needed between data protection, information technology security and the functional requests of different user groups.

All BVD information on every single animal was available from the beginning of the eradication programme and, during its course, a

growing volume of animal and farm data became available. With an average cattle population of 1.6 million living animals, an annual replacement rate of 20% and every animal receiving a BVD test, the database grew very rapidly and formed the basis of several statistical analyses and subsequent epidemiological assessments. Archived data allowed workers to identify factors that could have contributed to the spread of the disease, which should help in the planning of future surveillance programmes.

Case investigations were facilitated by an overview of animal movements as well as disease status and were possible only because the time dynamic of movements was considered.

The priority of ISVet was to provide a tool to facilitate the progress of the work and allow the goals of the programme to be achieved in an efficient way. Accessing data for epidemiological analyses was challenging. All dynamically generated documents (for example, the preparation of animal lists) were created using a third party, the .NET report-writing and generation tool ActiveReports. This allowed users to define the data to be included in the reports using SQL statements that were executed directly in the database. In general, ISVet is able to work with ActiveReport, Word, Excel, PDF and text documents. ActiveReport documents can be exported to text files and imported into other programmes such as Access, Excel or a statistical programme, such as R. However, depending on the complexity of the query, this sometimes slowed down the whole environment, resulting in ISVet being unavailable to users during the time when requests were being made.

Another way of accessing data was directly from the Oracle database, using database query tools such as Oracle Discoverer. However, access was restricted to the SFVO and only trained members of staff were able to use this facility. Data retrieval from both ISVet and Oracle Discoverer also became more cumbersome when the volume of data that needed to be exported reached critical size. An alternative to working directly in ISVet or through Oracle Discoverer would be to

connect to the database directly through external programmes dedicated to performing analysis.

Conclusions

The information system ISVet is a tool for data management, analysis, backup and business administration for disease control. The system allows the Veterinary Service to handle work processes on a shared information technology platform. The exchange of data within the Veterinary Service and with external bodies can be organised in a standardised, resource-saving and efficient way. However, although ISVet proved very effective for these workflow processes, it showed some limitations in the accessibility of archived data. To support the system and clarify data, considerable human and financial resources may need to be invested at the SFVO level. Nevertheless, ISVet was crucial for the efficient organisation, coordination and supervision of the Swiss BVD eradication programme and enabled it to be a success.

Experience gained from the BVD eradication programme has already led to the expansion of ISVet for other purposes. In 2008, 2009 and 2010, the ruminant population in Switzerland was vaccinated against bluetongue. The system for BVD was modified for this purpose, in that some additional features were added to ISVet and the BVD-Web was enlarged to the BVD/BT-Web. The principle of the bluetongue programme was the same as for the BVD eradication programme.

The structural concept of ISVet (the use and linkage of existing databases) proved useful for workflow processes and it should be possible to use similar systems in other countries.

Conflict of interest statement

None of the authors of this paper has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of this paper.

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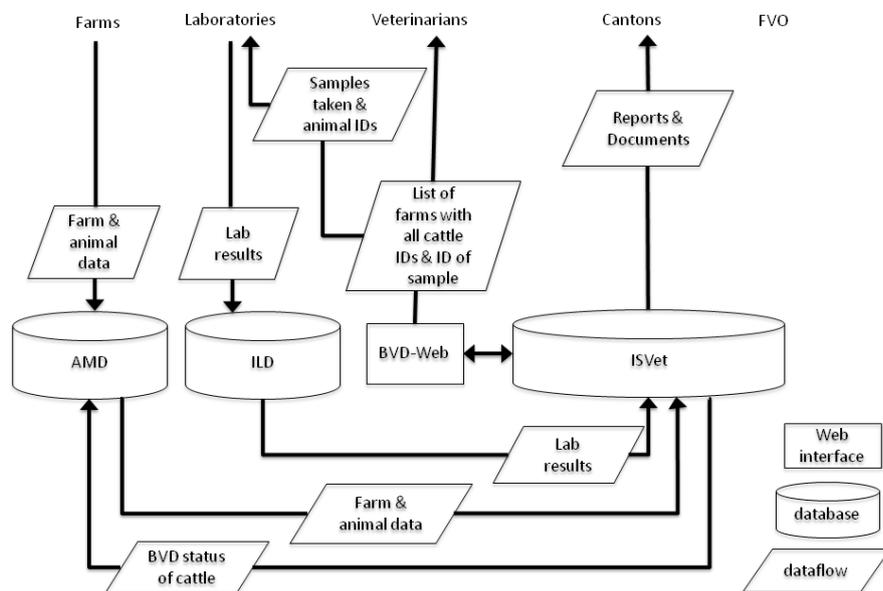
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Canton: an administrative division in Switzerland (there are 26 cantons)

Fig. 1

Structure of the sampling and information network used in the eradication of bovine viral diarrhoea in Switzerland

The animal movement database (AMD) contained information on farms and cattle, provided by the farmers. Samples, cattle identifications (IDs) and the sample IDs as barcodes were sent to the laboratories. Results were transmitted to the centralised laboratory database (ILD) and automatically transferred to the database of the veterinary information system (ISVet). The web platform BVD-Web provided the necessary information for taking samples from the ISVet database to the veterinarians. Based on several parameters (laboratory result, herd of origin, pregnancy, herd disease status), a bovine viral diarrhoea (BVD) status was automatically assigned to each animal and herd. Depending on this status, animals and herds under movement restrictions were identified in the AMD and the information was visible to all farmers. All relevant reports and documents for regional veterinary offices and the Swiss Federal Veterinary Office (FVO) were generated from ISVet

The screenshot shows the 'BVD Probennahme' (BVD Sampling) module of the ISVet system. The page title is 'Vorbereitungsliste' (Preparation list). The table below displays the test results for various animals, with columns for Animal ID, Name, Street, City, Status, Movement restrictions, phase, date, and counts for initial and secondary phases, as well as testing status.

Animal ID	Name owner	Street	City	Status	Movement restrictions	phase	date	Initial pos	pos	emobv	Unclear	Not tested	completed	
105				BVD Initialphase (Sperrung 1. Grades)		Initialphase	27.08.2008	0	1	0	0	7	27	<input type="checkbox"/>
105				BVD Initialphase (Sperrung 1. Grades)		Initialphase		1	0	0	0	3	5	<input type="checkbox"/>
105				BVD Initialphase (Sperrung 1. Grades)		Initialphase	01.09.2008	0	1	1	0	2	7	<input type="checkbox"/>
105				BVD Initialphase (Sperrung 1. Grades)		Initialphase	11.08.2008	0	0	0	1	0	10	<input type="checkbox"/>
105				BVD mit Ausrottungsprogramm nicht begonnen		Initialphase	01.09.2008	0	0	0	0	5	11	<input type="checkbox"/>
105				BVD Initialphase (Sperrung 1. Grades)		Initialphase	01.09.2008	0	1	0	0	0	5	<input type="checkbox"/>
105				BVD Betrieb nicht gesperrt		Sekundärphase		0	0	0	0	0	13	<input checked="" type="checkbox"/>
105				BVD Initialphase (Sperrung 1. Grades)		Initialphase	01.09.2008	0	1	0	0	14	15	<input type="checkbox"/>
105				BVD Betrieb nicht gesperrt		Sekundärphase	01.09.2008	0	0	0	0	0	6	<input checked="" type="checkbox"/>

Fig. 2

Example page of the BVD-Web platform

The display of details of farms, animals and test results in the module ‘farms’ in the veterinary information system ISVet (unit names, addresses and animal identifications are partially hidden)

The screenshot displays the ISVet software interface. At the top, there's a search bar and a 'Project Units' section with a table of farm details. Below that is an 'Animals' table listing individual animals with their IDs, birth dates, and statuses. At the bottom, a 'Laboratory Results' table shows test outcomes for specific samples, including the date, animal ID, result, specific item, species, labors, laboratory reference, method, and material.

Unit Name	Postal Street	Postal	Post	Postal Town	Car	Animal Move	Office of	added	assigned	due	dispatched	Assigned To Unit	removed
Karlshof	Amalienstr.	10721	Germany	FR	1537453	FR1000	10.10.2008	21.03.2009			15.09.2010	Stierlein	
Figliter Arne	Böhlertstr.	78	9305	Berg St	GB	1596576	513211	08.12.2008	08.12.2008		26.05.2010	Prattler	
Hanscher Sarah	Köhlern	32	1666	Gründelberg	FR	1903210	FR1000	06.12.2008	18.09.2009		14.06.2010	Gemeier	
Schäfer August	Acker	72	0124	Maut	ZH	1249593	ZH0195	11.02.2009	12.10.2009		11.06.2010	Krieger	
Künz Hugo	Zum Graben		4716	Vörschenschlo	SO	1556100	SO1000	15.11.2008	16.11.2008		14.06.2010	Stamer	
Foster David	Im Wald		6154	Hutten	LD	1600660	LUX369	21.02.2009	22.02.2009		07.06.2010	Wucherer	
Von Ritz Georges	Dorf		8872	Vriesen	GL	1048485	GL1617	01.10.2009	30.03.2010		16.06.2010	Schwemmer	
Frankowald Ruedi	Bahnhofstr.		1184	Vinzel	VO	2031651	VO5732	02.09.2009	30.03.2010			Krieger	
Suppenberg Julian	Waldstr.		2912	Roche-d'Or	JU	1681680	JU6802	17.03.2009	19.03.2009		10.06.2010	Schall	

Animal ID	TV	Animal Name	Birth Date	Slaughter d.	Is alive	Mother ID	Date of ins.	BVDL	Inoculatio	DateComp	BVDStatus
CH1200000001	0001		29.09.2009	07.11.2008	Dead	CH1200467		P		27.11.2008	infected O-309
CH1200000002	0002		01.09.2009	01.09.2009	Dead	CH1200344		P		01.10.2009	infected O-309
CH1200000003	0003		06.06.2010	31.12.2999	Living	CH1200467					verdetje O-305
CH1200000004	0004		16.08.2000	21.12.2999	Living			N			handebar
CH1200000005	0005		16.12.2000	31.12.2999	Living			N			handebar
CH1200000006	0006		16.02.2001	06.08.2009	Dead			N			handebar
CH1200000007	0007		10.07.2001	05.01.2009	Dead			N			handebar
CH1200000008	0008		03.09.2001	31.12.2999	Living			N			handebar
CH1200000009	0009		01.04.1995	12.10.2009	Dead		14.05.2009	N			handebar
CH1200000010	0010		27.09.2001	27.10.2008	Dead			N			n-infected O-309
CH1200000011	0011		24.10.2001	09.11.2009	Dead			N			handebar
CH1200000012	0012		05.03.2002	27.10.2008	Dead			N			n-infected O-309
CH1200000013	0013		09.04.2001	31.04.2010	Dead			N			handebar

Sample ID	Animal ID	Result of	Specific Item	Species	Labors	Laboratory refer	Method	Material
17.10.2008	CH1200050	Positive	MD (Mucosal Disease)	Bovine	44	4662791	OCE	Swages
25.10.2008	CH1200050	Positive	MD (Mucosal Disease)	Bovine	44	CH12000502791	OCE	blood

Fig. 3
Example page of the veterinary information system, ISVet
 The display of details of farms, animals and test results in the veterinary information system (unit names, addresses and animal identifications are fictitious)

Table I
Description of the most important projects in the ISVet veterinary information system and their relation to various phases of the bovine viral diarrhoea eradication programme

	Phase 1a Pre-pasturing phase	Phase 1b Intensive phase	Phase 2 Calf phase	Phase 3 Surveillance phase
Time period	January to July 2008	October to December 2008	October 2008 to September 2009	October 2009 to December 2011
Testing regime	All cattle younger than two years must test negative for BVDV antigen before going to summer pasturing	Testing of all cattle not previously tested	All newborn calves must be tested for BVDV	Only farms with all animals testing negative and without MR enter the surveillance phase. Testing of newborn calves for BVDV antigen continues until the end of 2011
Measures	No MR was implemented. Immediate slaughter of PI animals	Animals were under MR from the time samples were taken until laboratory results were available. On farms with PI animals, all pregnant cattle on the farm were under MR until calving. PI animals were immediately slaughtered	Newborn calves were under MR until they tested negative. On farms with PI animals, all pregnant cattle on the farm were under MR until calving. PI animals were immediately slaughtered	Newborn calves were under MR until they tested negative. On farms with PI animals, all pregnant cattle on the farm were under MR until calving. PI animals were immediately slaughtered. All cattle on the farm were under MR until investigations into the source of infection were completed
Project A All cattle farms to be tested (displayed in BVD-Web)	Veterinarians took samples, as indicated by the BVD-Web. When the document for a farm was printed, the date of printing was displayed on the BVD-Web and in ISVet. The RVO had an overview of farms where samples had not been taken. Farms with initial positive tests (only one positive test) or PI animals enter another project (see project E and F)			
	From the day sampling began on the farm (print date), MR until all test results were negative			
Project B and C Phase 2 and 3 – Farms with all cattle testing negative			After phase 1, farmers were responsible for the sampling of newborn calves. Farms with all animals testing negative entered project B and received the status 'no MRs'. From 1 October 2009 onwards, farms with all animals testing negative and without animals under MR automatically entered phase 3 and received the status 'BVD-free'. Pregnant animals with MR received the status 'MR'. Farms with animals testing positive entered projects E and F. If calves were registered in the AMD and tested negative within 4 weeks after birth, the farm stayed in the project. If an empty test tube arrived at the laboratory or no test result was available within 4 weeks after birth, the farm was moved to Project D	
Project D Farms with animals lacking test results (empty samples or no test result) (displayed on BVD-Web, calves list)			About 4% of the samples were empty or were not sent to the laboratories. In both cases the sampling had to be repeated, either by a veterinarian or the farmer, depending on the RVO. MR was applied to the animal until it tested negative	

Rev. sci. tech. Off. int. Epiz., **32** (3)

Project E

Farms with initial positive animals
(displayed on BVD-Web,
confirmation list)

The veterinarian printed the list that included the details of specific animals, with the order (official document) to take a sample for confirmation, a list of all cattle on the farm (for recording insemination data) and the decree on the MR. In phases 1 and 2, only the initial positive animal was under restriction. In phase 3, MRs were applied to the whole herd until investigations into the source of infection were completed

Project F

Farms with confirmed positive (or
dead initial positive) animals

Except in phase 1a, the whole farm was put under MR until the PI animal was slaughtered. In phase 3, in-depth investigations to explain the source of infection and to trace potentially infected animals that had left the farm were carried out. For all pregnant animals on the farm, the date of insemination was recorded and they were automatically put under MR. The decree to slaughter the PI animal and any other documents (questionnaires, etc.) for more detailed investigations were distributed by the RVO

Project G

Farms with animals under MR

Pregnant animals on the farm were automatically put under MR by entering the insemination data, and the farm entered project G. As soon as all pregnant cattle under MR had given birth, the farm moved back to project B or C

AMD: animal movement database

BVD: bovine viral diarrhoea

BVDV: bovine viral diarrhoea virus

ISVet: veterinary information system

MR: movement restriction

PI: persistently infected animals

RVO: Regional Veterinary Office