Web-based geographic information system tools and international surveillance network for bluetongue in the Balkans and south-east Europe (East-BTNet)

Paolo Calistri, Lara Savini, Carla Ippoliti & Annamaria Conte

Summary

Bluetongue (BT) is an infectious, non-contagious vector-borne disease. Since 1998, the disease has spread across the Mediterranean Basin and into the Balkans. During a Workshop devoted to the electronic identification of animals and bluetongue, held in Civitella del Tronto, Teramo, in December 2002, the representatives of Balkan and Eastern Mediterranean countries stated the need for implementing a regional surveillance network capable of collecting and disseminating relevant epidemiological data on BT. Consequently, the 'Cooperation for implementing a surveillance network for bluetongue in the Balkan area' (East-BTNet) project was implemented by the World Organisation for Animal Health Collaborating Centre for veterinary training, epidemiology, food safety and animal welfare (*Istituto Zooprofilattico dell'Abruzzo e del Molise 'G. Caporale'*). The information network established within the East-BTNet project is based on internet links and on geographic information system website technologies. This facilitates the rapid collection, analysis, interpretation and dissemination of large quantities of data generated by the national monitoring programmes of countries participating in the project (Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, the Former Yugoslav Republic of Macedonia, Malta, Romania, Serbia and Montenegro, Slovenia and Turkey).

Sistemi informativi geografici su Web e la rete di sorveglianza internazionale della bluetongue nei Balcani ed in Europa sud orientale (East-BTNet)

Riassunto

La bluetongue (BT) è un'infezione, non contagiosa, trasmessa da vettori. Dal 1998 la malattia si è diffusa nel Bacino del Mediterraneo e nei Balcani. Nel corso di un Workshop sull'identificazione elettronica degli animali e la bluetongue, tenutosi a Civitella del Tronto, Teramo, nel Dicembre 2002, i rappresentanti dei Paesi Balcanici e del Mediterraneo sud orientale convenirono sulla necessità di realizzare una rete di sorveglianza regionale capace di raccogliere e diffondere i dati epidemiologici sulla BT rilevanti. Di conseguenza, un progetto dal titolo "Cooperazione per la realizzazione di una rete di sorveglianza per la bluetongue nell'area balcanica" (East-BTNet) è stato messo in atto dal Centro di Collaborazione dell'Organizzazione Mondiale della Sanità Animale per la formazione veterinaria, epidemiologia,

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sicurezza alimentare e benessere animale (Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise 'G. Caporale'). La rete informativa realizzata nell'ambito del progetto East-BTNet si basa su collegamenti internet e su tecnologie Web applicate ai sistemi informativi geografici. Tale approccio velocizza la raccolta, analisi, interpretazione e diffusione di grosse quantità di dati generati dai programmi nazionali di monitoraggio dei Paesi partecipanti al progetto (Albania, Bosnia-Erzegovina, Bulgaria, Croazia, Cipro, Repubblica ex-Yugoslava di Macedonia, Malta, Romania, Serbia e Montenegro, Slovenia e Turchia).

Parole chiave

Balcani, Bluetongue, Reti, Sistema informativo geografico, Sorveglianza, Web.

Introduction

Bluetongue (BT) is an infectious, non-contagious vector-borne disease. Ruminants are susceptible to the infection and the disease generally affects sheep. Since 1998, BT has spread across the Mediterranean Basin into the Balkan Region and more recently into Central Europe.

The spread of the BT virus cannot solely be controlled through bans on animal movements. Measures taken at the national level tend to be inadequate when facing a transboundary disease such as BT. Consequently, during a workshop on the electronic identification of animals and bluetongue which was held in Civitella del Tronto, Teramo (Italy) in December 2002, the representatives of Balkan and eastern Mediterranean countries expressed the need to implement a regional surveillance network that was able to collect and disseminate relevant epidemiological data on BT. Between 2003 and 2005, a bluetongue surveillance project (Cooperation for implementing a surveillance network for bluetongue in the Balkan area – East-BTNet) covering the Balkan region was implemented by the World Organisation for Animal Health (OIE: Office International des Épizooties) Collaborating Centre for veterinary training, epidemiology, food safety and animal welfare of the *Istituto*

Zooprofilattico dell'Abruzzo e del Molise 'G. Caporale (OIE CC-IZS A&M). The countries that participated in this project were Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, the Former Yugoslav Republic of Macedonia, Malta, Romania, Serbia and Montenegro, Slovenia and Turkey. The project was promoted by the Abruzzo Region of Italy and funded by the Italian Ministry of Foreign Affairs. A report of the activities of the East-BTNet project, as well as a detailed description of the surveillance network implemented has been presented by Dall'Acqua *et al.* (6).

In this paper we present the potential of certain value-added products derived from the use of Web-based geographic information system (GIS) applications in the context of international surveillance networks, with particular emphasis on the benefits of using GIS tools in a network for the surveillance of BT in the Balkans and south-eastern Europe.

Materials and methods

The information network established within the East-BTNet project is based on internet links and on GIS website technologies.

The website (www.east-btnet.izs.it/index.htm) is accessible through commonly available internet browsers (Microsoft Internet Explorer and Netscape). The system is entirely automated and can be accessed only by authorised users through an electronic authentication procedure, after supplying a username and password. Two servers have been used to host all the GIS applications and functions.

The map services were created using Environmental Systems Research Institute (ESRI) internet map server technology (ArcIMS® 9.0); the geodatabase used to collect spatial and epidemiological data is a Relational Data Base Management System (RDBMS) based on Oracle® 8.1.7 and geographic data are managed by ArcSDE® 9.0 software (10).

To create a common geographic database, the OIE CC-IZSA&M GIS team conducted a preliminary study to standardise subnational administrative maps (second administrative

Paolo Calistri, Lara Savini, Carla Ippoliti & Annamaria Conte

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level boundaries) of countries participating in the project, in close collaboration with the representatives of all countries involved.

Further technical details of the GIS application and its principal functions have been described by Savini *et al.* (10).

Results

A Web-based surveillance network (www.east-btnet.izs.it/index.htm) was implemented to manage the collection of epidemiological data generated by the veterinary services of countries participating in the East-BTNet project. The website is divided into different sections, as follows:

- five sections are dedicated to the collection and retrieval of technical, scientific, legislative and training documents regarding the disease and the project
- one section hosts a discussion forum on BT
- one section lists links to other relevant Web resources
- one section is devoted to BT data collection, retrieval, analysis and visualisation through the GIS application.

Specifically in the GIS section (Fig. 1), information generated by national serological and entomological surveillance programmes implemented by participating countries and BT occurrence data published weekly by the OIE (www.oie.int/eng/info/hebdo/A_info.htm) or collected by the Animal Disease Notification System of the European Commission was collated and visualised.

It is noteworthy that the GIS application developed within the East-BTNet website is not only used for the presentation and analysis of spatial data, but it represents an exclusive interface for accessing data entry and retrieval forms (10). New data are entered directly online after selecting the administrative boundary involved (Fig. 2A). The system verifies the accuracy of new data before updating the database (Fig. 2B). Newly entered information is automatically displayed on a map by simply using the refresh button (Fig. 2C). Updating of layers with new features (for example, addition of a new point on the map) is performed immediately after the authorised user inputs new data.

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Figure 1
Geographic information systems section of the website developed within the East-BTNet project
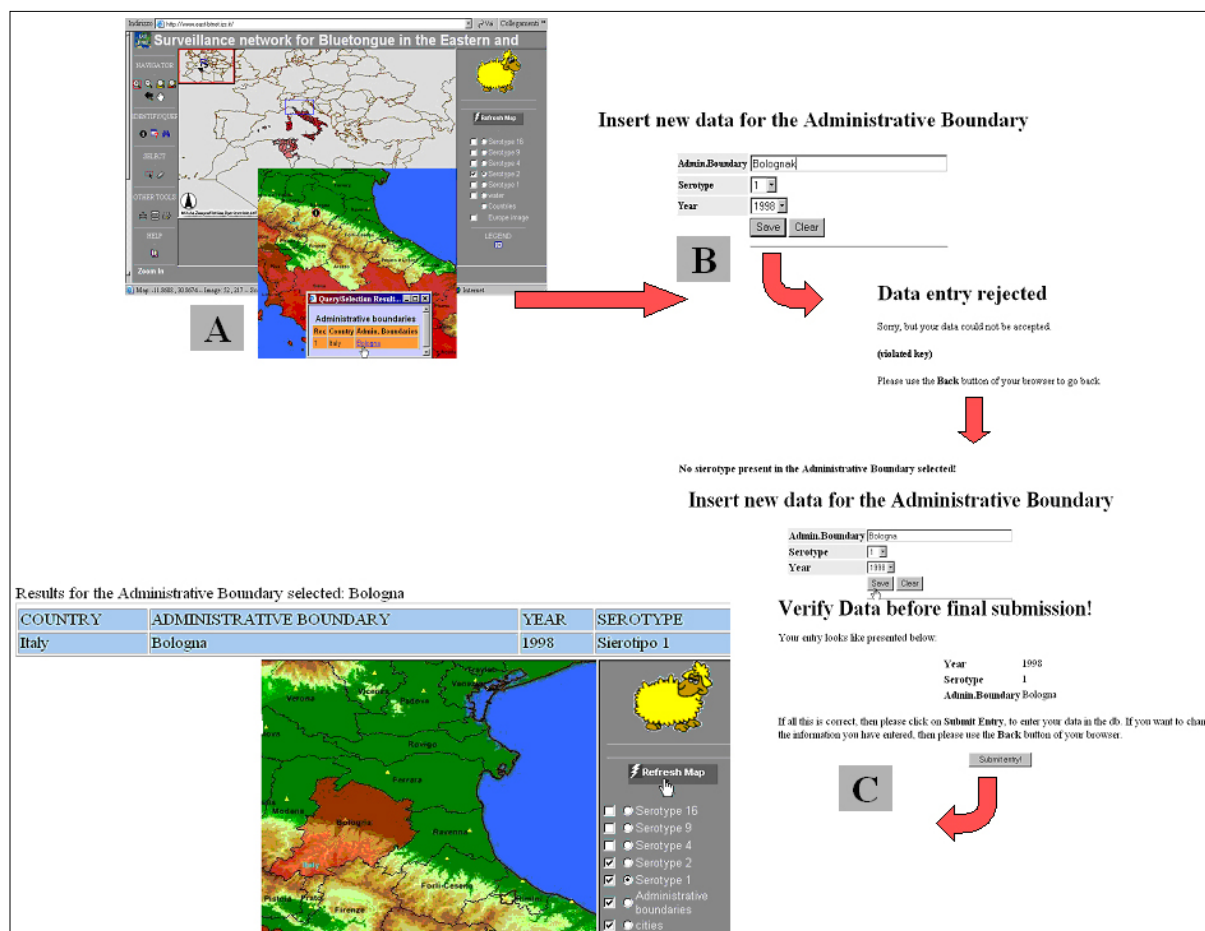

Figure 2
East-BTNet project website
Steps for displaying (A) and updating (B and C) data on disease distribution

Discussion

Davenhall (7) defines a community health surveillance system as a network that consistently gathers, integrates and analyses data on health indicators, occurrences and transmissions of diseases in a population, monitors the capabilities of the health system/level of health protection in that population and spatially relates all this information using GIS.

Boulos (2) considers that traditionally two types of GIS applications can be distinguished by:

▪ health outcomes and epidemiological applications

▪ health care delivery applications (planning health care services, accessibility and utilisation).

Using GIS tools in surveillance systems has several advantages. For example, GIS applications may enhance data analysis capabilities, facilitating the understanding of disease dynamics and patterns of disease spread, and increasing the promptness of responses by competent authorities to potential disease alerts. These applications represent an essential tool for investigating the spatial aspects of diseases occurrence and the effectiveness of control measures. As a result of advances in personal computer performance, GIS technologies have been used

Paolo Calistri, Lara Savini, Carla Ippoliti
& Annamaria Conte

Web-based geographic information system tools and international surveillance
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with success in the building of predictive spatial disease models.

The development of Web-based GIS applications in the veterinary field has led to the collection and dissemination of information on several infectious diseases at national and international levels (3, 5, 8). Web-based GIS applications are used in several international surveillance networks. For example, the World Health Organization (WHO) has developed the Communicable Disease Global Atlas (www.who.int/health_mapping/tools/globalatlas/en/index.html) that compiles data and statistics on infectious diseases at country, regional and global levels. In particular, four worldwide networks have been established to collect epidemiological and diagnostic data on influenza (FluNet: gamaps erver.who.int/GlobalAtlas/home.asp), dengue (DengueNet: www.who.int/csr/disease/dengue/denguenet/en/), rabies (RabNet: www.who. int/rabies/rabnet/en/) and the severe acute respiratory syndrome (1, 9, 11, 12). Other international organisations have used Web-based GIS applications as part of global surveillance networks, namely: the Global Livestock Production and Health Atlas (GLiPHA: www. fao.org/ag/aga/glipha/index.jsp) developed by the Food and Agriculture Organization of the United Nations (FAO) (4) and the World Animal Health Information System (WAHIS) implemented by the OIE.

The international information network established within the East-BTNet project has been enhanced by the use of GIS technologies. In particular, the use of maps as a user's main interface for data access has facilitated the harmonisation of information that needs to be collected. GIS applications have not been used solely as ancillary tools for data analysis and representation, but they represent a fundamental common language used by the competent authorities of several dissimilar countries.

Further improvements to the East-BTNet network might be considered for the future, including the following:

- forecasting tools able to predict the spread of the disease, given a number of variables (for example, density of susceptible animals, presence and abundance of competent vectors) and the application of alternative control methods ('what if' scenarios); this will facilitate the decision-making process of animal health authorities.
- extending data collection to other disease agents (for example, emerging zoonotic agents, other vector-borne diseases) and establishing an operational link with the WAHIS database developed by the OIE
- allowing participating countries to utilise dedicated Web pages and GIS functions for internal purposes (for example to share information between central and peripheral veterinary offices)
- improving real-time systems through the continuous transfer of data
- developing national and regional health indicators that are updated automatically.

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network for bluetongue in the Balkans and south-east Europe (East-BTNet)

Paolo Calistri, Lara Savini, Carla Ippoliti
& Annamaria Conte

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