



## **TECHNICAL** REPORT

# Prevention measures and communication strategies for hantavirus infection in Europe

**ECDC** TECHNICAL REPORT

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This report of the European Centre for Disease Prevention and Control (ECDC) was produced as a project of the European Programme for Intervention Epidemiology Training (EPIET)

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## Abbreviations

ECDC	European Centre for Disease Prevention and Control
ENIVD	European Network for Diagnostics of 'Imported' Viral Diseases
GIDEON	Global Infectious Diseases Epidemiology Network
HFRS	Haemorrhagic fever with renal syndrome
HCPS	Hantavirus cardiopulmonary syndrome
HTNV	Hantaan virus
NE	Nephropathia epidemica
PUUV	Puumala virus
DOBV	Dobrava-Belgrade virus
SAAV	Saaremaa virus
SEOV	Seoul virus
TULV	Tula virus

## Executive summary

Hantaviruses are a large group of RNA viruses that belong to the genus *Hantavirus*, family Bunyaviridae. Reservoirs for hantaviruses are mostly rodents. At least five hantaviruses – Puumala (PUUV), Dobrava-Belgrade (DOBV), Tula (TULV), Saaremaa (SAAV) and Seoul (SEOV) – circulate in Europe, but most reported human cases of infection are caused by PUUV and DOBV.

Between 2000 and 2010 the annual number of reported hantavirus cases increased in Europe, although there were significant temporal and geographical fluctuations. In 2012, a sudden increase of hantavirus activity (e.g. in Germany and Slovenia) prompted the European Centre for Disease Prevention and Control (ECDC) to reassess the hantavirus situation in Europe and review the availability and scope of preventive and control measures. ECDC summarised all available information (as of 2012) on hantavirus for a total of 29 European countries; topics covered by the survey included the effectiveness of preventive measures, communication strategies, impact assessment studies and recommended preventive measures.

This report presents the results of a literature review and a telephone survey among members of the *European Network for Diagnostics of 'Imported' Viral Diseases* (ENIVD). ENIVD is a network of European laboratories working on diagnostics of imported, rare and emerging viral infections, including tick-borne encephalitis, hantavirus and dengue. The authors identified eight publications with a focus on hantavirus prevention measures in Europe, one of which presents specific strategies on what to communicate to the general public, how to disseminate information sheets and posters, and how to make medical doctors aware of recommended preventive measures.

The situation in the 29 ENIVD member countries covered in this report was heterogeneous and varied widely (number of cases reported, presence of outbreaks in 2005–2012, distribution of the disease). The majority of the countries (26/29) had prepared institutional guidelines on preventive measures for hantavirus. Twenty-seven countries (90%) had a policy to communicate preventive measures through a variety of media in case of an outbreak; eight countries (28%) also provided information on a regular basis even before outbreaks. The most frequently used communication channels were mass media (TV, radio, newspapers), institutional websites (health and occupational health), presentations and workshops for health professionals, and articles in specialised journals. The majority of the countries have never performed impact assessment studies on the effectiveness of preventive measures, communication strategies, or awareness or knowledge studies.

To prevent further human hantavirus infections in Europe, an integrated approach needs to be established, including predictive models which are adapted to the regional situation. There is also a need to evaluate the impact of preventive measures in the affected countries and increase the level of awareness in the population at risk. This often translates into increasing the availability of pertinent information through a variety of information channels.

## Background

Hantaviruses are a large group of RNA viruses that belong to the genus *Hantavirus*, family Bunyaviridae. Reservoirs for hantaviruses are rodents, insectivores and bats [1, 2]. Worldwide, at least 22 species of hantaviruses have been found to be pathogenic to humans [3].

Known pathogenic hantaviruses are transmitted by specific rodent species, suggesting a long history of virus-rodent coevolution. Humans are accidental hosts. Chronically infected carrier rodents are most probably asymptomatic and may excrete the virus in their urine, saliva, and faeces for months [4, 5]. The viral loads may differ in different excreta. Although the persistence of the virus in excreta in the environment is unknown, it is generally estimated to be up to two weeks [6]. Transmission of the virus to humans occurs almost exclusively through the inhalation of infectious aerosol from rodent excreta (faeces, urine, saliva) [7]. Less commonly, the disease can also be transmitted through rodent bites. Person-to-person transmission has been reported only with the Andes virus in South America [8].

To date, there are at least four pathogenic hantaviruses circulating in Europe [9]: a) Puumala virus (PUUV), widely distributed, most commonly in northern and western Europe, transmitted by the bank vole, *Myodes glareolus*; b) Dobrava-Belgrade virus (DOBV), distributed mostly in south-east Europe, though the carrier species, the yellow-necked mouse, *Apodemus flavicollis* has a much wider distribution in Europe to the west and the north [10]; c) Saaremaa virus (SAAV), carried by the striped field mouse, *Apodemus agrarius*; the virus is connected to agricultural habitats and distributed in eastern and northern Europe, but without clearly documented HFRS cases [9]; d) Seoul virus (SEOV), with a worldwide distribution and carried by rats, *Rattus rattus* and *R. norvegicus norvegicus* [11]. In addition, a fifth hantavirus (Tula virus (TULV)) is carried by the common vole *Microtus arvalis* and the sibling vole, *Microtus levis*. [12, 13], (Table 1).

In addition, during the past decade several hantaviruses have been identified in insectivores in Europe: Laihia, Asikkala and Seewis viruses were found in the Eurasian water shrew (*Neomys fodiens*), the Eurasian pygmy shrew

(*Sorex minutus*) and the common shrew (*Sorex araneus*) [14], respectively. There is no evidence of human disease caused by these viruses.

**Table 1. Pathogenic hantaviruses detected in Europe**

Virus species	Carrier rodent	Disease
Puumala (PUUV)	<i>Myodes glareolus</i> (bank vole)	HFRS (mild, Nephropathia epidemica)
Dobrava-Belgrade (DOBV)	<i>Apodemus flavicollis</i> (yellow-necked mouse)	HFRS (severe)
Saaremaa (SAAV)	<i>Apodemus agrarius</i> (striped field mouse)	HFRS (mild)
Seoul (SEOV)	<i>Rattus norvegicus</i> , <i>Rattus rattus</i> (rat)	HFRS (mild, outbreaks confirmed in laboratories in the 1980s), two reported cases in France, one in the UK*
Tula (TULV)	<i>Microtus arvalis</i> , <i>Microtus levis</i> (European common vole)	HFRS

Source: [4, 9, 11, 15, 16]

\* This is a probable case which needs to be confirmed by neutralisation test

Two syndromes are caused by hantaviruses: haemorrhagic fever with renal syndrome (HFRS) as observed in Asia, Europe and recently in Africa, and the hantavirus cardiopulmonary syndrome (HCPS) as observed in the New World [17] (Table 2). The severity of the hantavirus infection varies from asymptomatic through mild to severe, with high fatality rates due to Andes and Sin Nombre hantaviruses in the New World.

The course of HFRS has been divided into five clinical phases: febrile, hypotensive, oliguric, diuretic and convalescent. The febrile phase usually last for three to five days and starts with fever, muscle pain, and headache, followed by gastrointestinal symptoms, nausea, vomiting, and abdominal or lower back pain. The hypotensive phase is characterised by hypotension, which may progress to shock and haemorrhagic manifestation. In the oliguric phase, severe haemorrhage may occur and urinary output drops dramatically (5% of patients require dialysis for PUUV and 16–48% for DOBV). Convalescence lasts weeks to months. The case fatality ranges from 0.1% (usually described for PUUV) to 15%. Usually the incubation period for HFRS is two to four weeks, ranging from a few days to nearly two months [18].

The initial HCPS symptoms resemble those of HFRS and may include fever, myalgia, headache, nausea and vomiting. The illness progresses rapidly to severe respiratory distress followed by pulmonary oedema and shock. Renal and haemorrhagic manifestations are rare in patients with HCPS. The mortality rate is up to 50%.

At present, there is no specific treatment available to hantavirus diseases. Early treatment of HFRS patients with ribavirin can reduce the severity of symptoms. However, ribavirin did not provide an apparent clinical benefit in the treatment of HCPS patients [7]. Supportive therapy and early management of patients is crucial for the survival of severe cases.

**Table 2. Clinical presentation of HFRS and HCPS**

Feature	HFRS	HCPS
Major target organ	Kidney	Lung
First phase	Febrile	Febrile 'prodrome'
Second phase	Shock	Shock, pulmonary edema
Evolution	Oliguria, diuresis, convalescence	Diuresis, convalescence
Mortality	0.1–15%	Up to 50%

Source: adapted from [19]

PUUV along with its host, the bank vole, is found in most regions of Europe, excluding the Mediterranean coastal regions and most of the Iberian peninsula and Greece. PUUV is associated with a milder form of HFRS, also referred as Nephropathia epidemica (NE), which is common in Finland, northern Sweden, Estonia, the Ardennes forest region (Belgium and France), parts of Germany, the Balkans and parts of European Russia.

In Europe (including Russia), HFRS is endemic, and every year more than 10 000 cases, mostly caused by PUUV, are reported [1, 9]. The numbers of hantavirus infection cases are increasing and vary greatly between and within countries [9, 14]. There is a considerable disease burden. In Finland, 52% of the cases were hospitalised for an average of seven days, and up to 5% needed dialysis [9]. Similarly, in Germany, the hospitalisation rate was 64% in the cases occurring between January and February 2010 [20], and 69% between October 2011 and May 2012 [21].

A vaccine against Hantaan virus (HTNV) infection called Hantavax is registered only in Korea and China. Hantavax is made from formalin-inactivated Hantaan virus derived from infected mouse brain substrate [22]. The effectiveness of the vaccination depends on the number of doses [23]. Currently, no vaccine has been licensed in

Europe. Research in vaccine development is ongoing, with three candidate vaccines in phase I testing, but large technical, regulatory and economic challenges need to be dealt with before a vaccine would become available [22].

Human behaviour plays a crucial role as a risk factor in hantavirus infections [24]. Woodcutting [25], professions related to forestry, farming, outdoor military activities or activities such as camping or using summer houses, visiting forest houses, reopening non-aerated rooms have been identified as risk factors [26]. Further risk factors include seeing or trapping rodents [27], living in buildings with entry holes [28], contact with rodents and their excreta [26], living in the vicinity of a forest [27], and smoking [28]. Wild rodents taken into homes as pets or to laboratories for research purposes have caused infections [29]. The incidence is higher among males than females [30].

Prevention of hantavirus infections is based on awareness and adoption of personal preventive measures often communicated by the health authorities. Currently, the most commonly recommended preventive measure is avoidance of virus-contaminated dust. When cleaning areas with rodent droppings, the creation of airborne dust should be avoided, and moist cleaning with disinfectants is recommended; inhalation of airborne dust can be avoided or reduced by improved ventilation and face masks. Rodent control for buildings is recommended [9].

There is little knowledge about the effectiveness of commonly recommended preventive measures. Equally unclear is the effectiveness of communication strategies on hantavirus and the degree to which the public and clinicians are aware of hantavirus. In North and South America, a number of studies have been performed to evaluate the efficacy of rodent proofing and control measures for HCPS [31-35]. Communication strategies for the general public can be divided into two types of interventions: preventive measures during non-outbreak situations and rapid response during an epidemic. They usually differ in terms of communication channels used and in the frequency of publishing the information [36].

Between 2000 and 2009, the annual number of reported cases of hantavirus has increased in Europe [14]. In 2010, the steep increase in the number of cases reported in Germany [20] was the reason for ECDC's request for an overview of the hantavirus situation in Europe [14]. Again in 2012, the increase of reported number of hantavirus cases, such as in Germany [21] and Slovenia [37], prompted ECDC to reassess the hantavirus situation in Europe. Although an important body of research on hantavirus is available, an overview of the availability and scope of preventive and control measures in Europe is lacking. Furthermore, an overview of the situation in Europe is needed with respect to the impact and effectiveness of timely preventive measures, implemented communication strategies, and the knowledge and awareness of hantavirus infections in the public and among health professionals.

## Objectives

This report aims to summarise the available information (as of 2012) in European countries on:

- preventive measures and communication strategies related to hantavirus infection; and
- impact assessment studies related to hantavirus knowledge and awareness and effectiveness of recommended preventive measures.

## Methods

The project consisted of two phases and combined two methods of collecting information.

- Phase I: A review of the literature was performed in PubMed to identify available and published information on preventive measures and communication strategies related to human hantavirus infections in Europe.
- Phase II: A pre-tested telephone survey was conducted among European members from the European Network for Diagnostics of 'Imported' Viral Diseases (ENIVD) to identify unpublished information on preventive measures and communication strategies related to human hantavirus infections in Europe and to complement the information obtained from the literature review.

## Literature review

### Study question

The review of the literature aimed to answer the following study questions:

- 'What studies focusing on preventive measures against hantavirus infection in Europe have been published in PubMed between 2000 and 2012?'
- 'Which studies focusing on communication strategies regarding prevention and control of hantavirus infections in Europe have been published in PubMed between 2000 and 2012?'

## Prevention measures for hantavirus in Europe: search strategy, keywords and inclusion/exclusion criteria

The search strategy was developed as follows:

```
(((((Hemorrhagic Fever with Renal Syndrome[Title/Abstract]) OR HFRS[Title/Abstract]))
```

```
OR Hantavirus infections[MeSH Terms]) OR Hanta*[Title/Abstract]) OR Nephropathia epidemica[Title/Abstract]))
AND (((Prevention and control[MeSH Subheading])) OR Prevent*[Title/Abstract])) AND (((Europe[Title/Abstract])
OR Europe[MeSH Terms]) OR Europe*[Title/Abstract]))
```

The keywords used for searching relevant articles included terms related to 'hantavirus', 'prevention' and 'Europe'. The three groups of keywords were combined to identify literature that could potentially answer the study question.

The search strategy was run in MEDLINE via the PubMed<sup>1</sup> interface. The search was limited to those studies involving humans, published between 2000 and 2012. The inclusion and exclusion criteria that were applied to identify and select the relevant articles are presented in Table 3.

**Table 3. Inclusion and exclusion criteria that were applied to identify and select the relevant articles related to prevention measures (literature review a) or communication, health education and promotion, awareness (literature review b)**

<b>Inclusion criteria</b>	<ul style="list-style-type: none"> <li>Articles in which 'prevention measures (a)' regarding hantavirus infections, or 'communication, health education and promotion, awareness (b)' are presented in the abstract or MeSH<sup>2</sup> terms</li> <li>Study type: all</li> <li>Publication year: 2000–2012</li> <li>Geographical location: Europe</li> <li>Language restricted to member countries of ENIVD [38]</li> </ul>
<b>Exclusion criteria</b>	<ul style="list-style-type: none"> <li>Publication year before 2000</li> <li>Location outside of Europe</li> <li>Language not spoken in any of ENIVD's member countries</li> <li>Full article not available</li> </ul>

## Search strategy, keywords and inclusion/exclusion criteria: communication strategies on the prevention for hantavirus in Europe

The search strategy was developed as follows:

```
(((((Hemorrhagic Fever with Renal Syndrome[Title/Abstract]) OR HFRS[Title/Abstract]) OR Hantavirus
infections[MeSH Terms]) OR Hanta*[Title/Abstract])) AND (((Europe[Title/Abstract]) OR Europe[MeSH Terms]) OR
Europe*[Title/Abstract])) AND (((Awareness[Title/Abstract]) OR Communication[MeSH Terms] OR
communication[Title/Abstract] OR (Health Education/organization[MeSH Terms]) OR (Health
Education/methods[MeSH Terms]) OR (Health Education[Title/Abstract]) OR (Health promotion[Title/Abstract]) OR
(Media [Title/Abstract])))
```

The keywords used for searching relevant articles included terms related to 'hantavirus', 'communication, health education and promotion, awareness' and 'Europe'. The three groups of keywords were combined to identify literature that could potentially answer the study question. The inclusion and exclusion criteria that were applied to identify and select the relevant articles are presented in Table 3.

## Data extraction strategy

After running the two search queries, two independent reviewers screened titles and abstracts for relevance. If an abstract was not available, the full article was retrieved to assess its relevance. The full texts of relevant studies were retrieved and assessed for eligibility, using the inclusion and exclusion criteria defined in Table 3.

The following data were extracted from the articles: first author, publication year, language, study type, study period, preventive measures, evaluation of these measures, communication strategies, evaluation of these strategies.

## Consultation with experts

Contact points from the ENIVD network were surveyed for complementing and gathering local/national information not published in PubMed. The ENIVD network is made up of scientists from European universities, medical centres,

<sup>1</sup> <http://www.ncbi.nlm.nih.gov/pubmed>

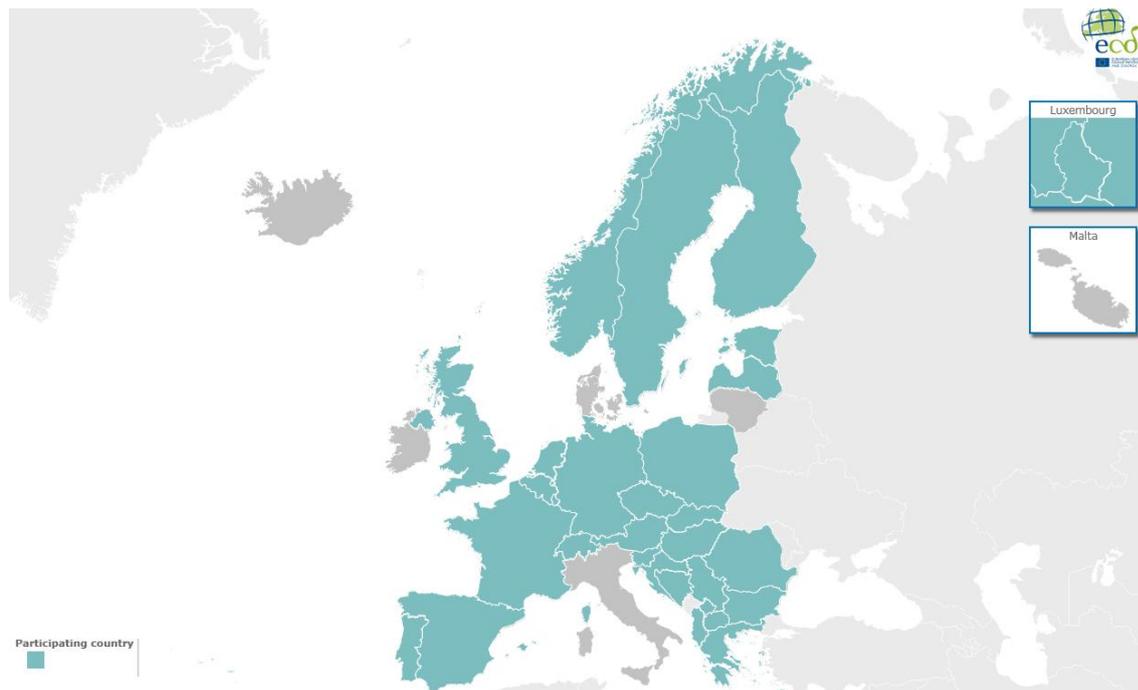
<sup>2</sup> Medical Subject Headings: thesaurus used for indexing articles for PubMed

national health institutes, and hospitals; its main objective is to maintain a network of laboratories working on diagnostics of imported, rare and emerging viral infections of European interest.

ENVID was selected because of its hantavirus research, the results of which were published in several reviews [14, 24, 39]. Contact points<sup>3</sup> from ENVID participant countries were only surveyed if their country reported at least one case of human hantavirus infection between 2005 and 2012 according to the data in the hantavirus European update published in Eurosurveillance in 2011 [14] and by the Global Infectious Diseases Epidemiology Network (GIDEON) [40].

In total, 29 countries were included in the study: Albania, Austria, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Kosovo, Latvia, Luxembourg, the former Yugoslav Republic of Macedonia, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, the Netherlands and the United Kingdom (Figure 1).

**Figure 1. European countries included in the telephone survey on prevention measures and communication strategies for hantavirus in Europe (n=29)**



Data source: EPIET, ECDC

The authors tested the questionnaire to be used for the survey. Once the content of the questionnaire was agreed upon, the ENVID contact points in each participating country were contacted by email and performed a manual search of web pages of the national (or regional, if relevant) institutes of public health, searching for information on hantavirus. The email sent to the ENVID contact points contained a cover letter inviting them to participate in the telephone survey, along with a brief document outlining the topics to be addressed (Annex 1).

The telephone survey lasted approximately 45 minutes and consisted of three parts (Annex 2):

- General information on hantavirus situation
- Preventive measures in place and communication strategies
- Assessment of the impact of preventive measures and knowledge or awareness related to hantavirus among the general population and health professionals

The exact date of the survey was selected after the experts agreed to participate in the study. In some cases the ENVID contact point answered the questionnaire by email instead of over the phone. A few ENVID contact points referred the authors to public health experts at the national or regional institute of public health for supplemental information.

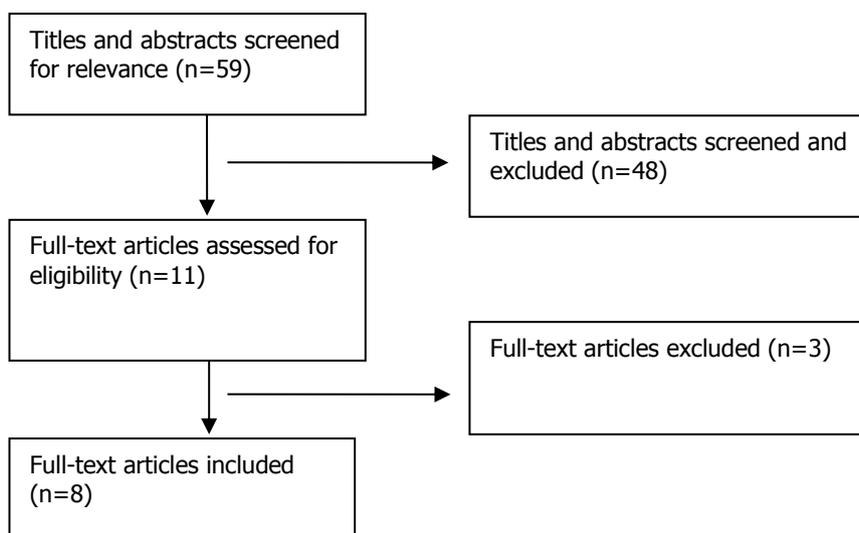
<sup>3</sup> Experts listed in <http://www.enivd.de/index.htm> and prioritising co-authors listed in [13].

## Results

### Literature review on preventive measures for hantavirus infections in Europe

A total of 59 titles and abstracts were obtained using the initial search terms. After the first screening, 11 full-text articles were read, of which three were excluded since they did not present specific information related to prevention measures. In total, eight articles were included in the review (Figure 2).

**Figure 2. Literature review flow chart for hantavirus preventive measures in Europe, 2000–2012**



### Study type and location of study

Five of the eight included articles were reviews (one systematic) that provided an update on the epidemiological situation of hantavirus infections (Table 4). Only three studies provided results of original studies or research: one outbreak report from France and two research articles from Croatia and from Sweden.

### Preventive measures and vulnerable groups presented

Both reviews and original research articles presented preventive measures. These were based mainly on general household precautions (preventing rodents from entering houses and precautions when cleaning rodent-infested areas), precautions for outdoor activities, rodent trapping and sample collection.

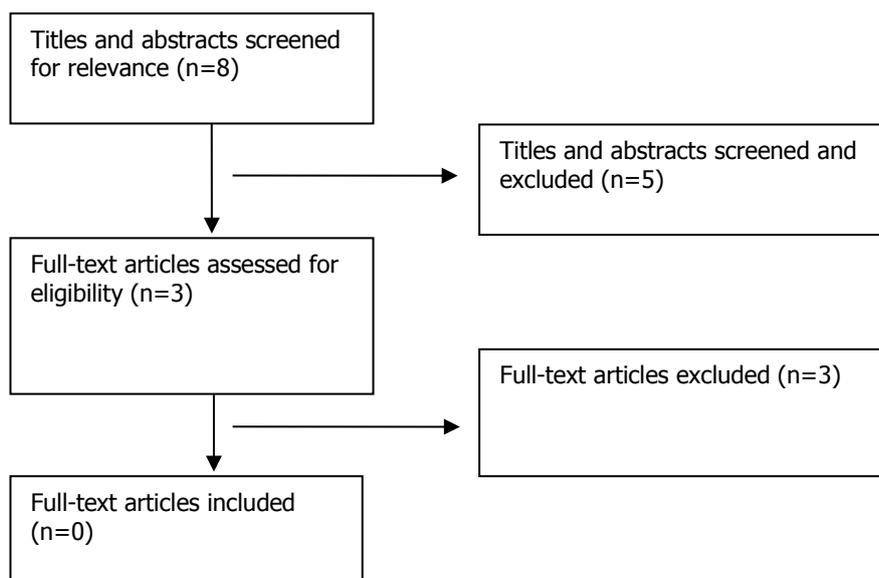
All original research articles highlighted specific vulnerable groups. Mailles et al. concluded that most of the identified cases had an occupation related to forestry or construction, or had been manipulating firewood, gardening, or performing outdoor leisure activities [41]. Mulić et al. stated that most of the cases identified in their investigation were soldiers from the Croatian army [42]. Olsson et al. highlighted specific geographical areas and periods of the year [43].

One article presented specific strategies on how to disseminate information through flyers and posters and what to communicate to the public; the article also provided suggestions on how to inform medical doctors and raise awareness about recommended preventive measures [41]. None of the articles evaluated preventive measures or referred to studies on this topic.

### Literature review on communication strategies for the prevention of hantavirus infections in Europe

A second review focused on communication strategies for the prevention on hantavirus infections in Europe. The search yielded eight articles which were screened for relevance. Although three full articles were assessed for eligibility, none of them described communication strategies for hantavirus prevention in Europe (Figure 3). However, all articles concluded that there was a need to further promote awareness and understanding of the disease among healthcare professionals [44], and that the population at risk, for example in Romania [45] and Greece [46], needed to be educated in applying appropriate prophylactic measures.

**Figure 3. Literature review flow chart for communication strategies on hantavirus in Europe, 2000–2012**



**Table 4. Preventive measures and communications strategies presented in the selected articles; systematic review (n=8)**

First author; publication year; language	Study type	Location	Objectives	Study period	Specific preventive measures → vulnerable groups	Specific communication strategies
<b>Papa A; 2012 [47] English</b>	Review	Europe	Provide global update on DOBV virus, including epidemiology, phylogeny, prevention measures and update on vaccine developments	Not indicated or not relevant	<ul style="list-style-type: none"> <li>Minimise contact with rodents during outdoor activities</li> <li>Maintain a clean house</li> <li>Keep food and water in protected areas, so as not to attract rodents</li> </ul>	NO
<b>Beeching N; 2010 [48] English</b>	Systematic review of the literature	Global, including Europe	Summarise the epidemiology of travel-related viral haemorrhagic fevers together with strategies for their prevention.	1966–2009	<ul style="list-style-type: none"> <li>Avoid contact with rodents or their excreta</li> <li>Wear masks when sweeping out habitations infested by rodents</li> </ul> → Article focuses on risks for travellers	NO
<b>Stock I; 2008 [49] German</b>	Review	Global, with focus on Germany	Summarise the current knowledge on hantavirus infections, including prevention.	Not indicated or not relevant	<ul style="list-style-type: none"> <li>Avoid contact with rodents or their excreta</li> <li>Keep food in protected areas so as to keep rodents away from houses</li> <li>Rodent control in houses, cellars, attics, sheds, etc.</li> <li>Avoid inhalation of dust when cleaning potentially contaminated rooms; use dust mask, wet all surfaces, use gloves, observe general hygiene measures</li> <li>Use disinfection and gloves when handling dead rodents or excreta.</li> </ul> → Forest workers, farmers, laboratory personnel	NO

First author; publication year; language	Study type	Location	Objectives	Study period	Specific preventive measures → vulnerable groups	Specific communication strategies
<b>Bi Z; 2008 [3]</b> <b>English</b>	Review	Global, including Europe	Summarise the current knowledge on hantavirus infections, including prevention.	Not indicated or not relevant	<ul style="list-style-type: none"> <li>Reduction of human exposure to infected rodents/excreta</li> <li>Monitoring of hantavirus prevalence in rodent populations</li> <li>Evaluation of preventive measures used in the USA</li> </ul>	NO
<b>Olsson G; 2007 [43]</b> <b>Swedish</b>	Original article: research strategy	Sweden	Describe trends on human hantavirus cases and population of bank voles in Sweden	1989-2007	<ul style="list-style-type: none"> <li>Avoid the presence of bank voles close to human habitations</li> <li>Wear masks when sweeping out habitations/handling wood in areas infested by rodents</li> <li>Accurate hand hygiene when handling rodents and disinfection of surfaces where rodents could have been present.</li> <li>Avoid garden work in dry weather conditions; wait for rainfall.</li> <li>Take precautions when trapping rodents and collecting samples</li> </ul>	NO
<b>Mailles A; 2005 [41]</b> <b>French</b>	Original article: outbreak report	France	Confirm the outbreak and take appropriate control measures	2003	<ul style="list-style-type: none"> <li>Exclusion and prevention of rodents' access to houses and avoiding the inhalation of contaminated dust were recommended.</li> </ul> <p>→ Most of the identified cases had an occupation related to forestry or construction or had been manipulating firewood, gardening or performing outdoor leisure activities</p>	Information about the disease and measures for prevention were made widely available to both health professionals and the general population
<b>Mulić R; 2002 [42]</b> <b>English</b>	Original article: research article	Croatia	Analyse epidemiologic characteristics of HFRS in Croatia, including military implications of the disease and measures for its prevention	1987–2001	<ul style="list-style-type: none"> <li>Pest control, disinfection, preventing rodent access to food and water, proper choice of camping sites (remove bushes and grass), health education.</li> </ul> <p>→ Most of the cases identified were soldiers.</p>	NO
<b>Escutenaire S; 2000 [50]</b> <b>English</b>	Review	Global, including Europe	Summarise the current knowledge (importance for animal and public health, epidemiology, pathogenesis, diagnosis, treatment and prophylaxis)	Not indicated or not relevant	<ul style="list-style-type: none"> <li>General household precautions (preventing rodents from entering houses and outbuildings and cleaning rodent-infested areas)</li> <li>Precautions for outdoor activities</li> <li>Precautions for rodent trapping and collection of samples.</li> </ul>	NO

# Consultation with experts

## General overview: surveillance systems for hantavirus in Europe

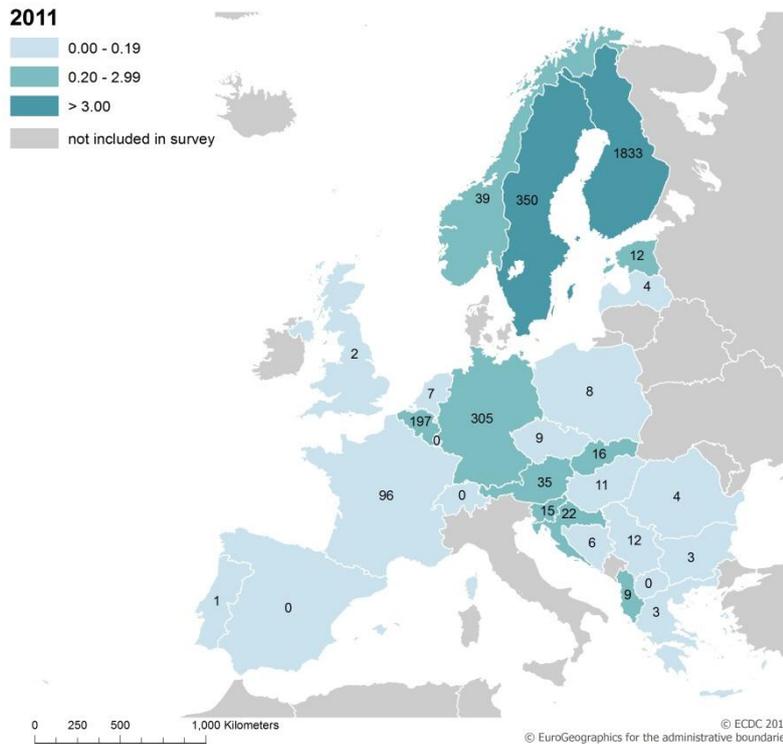
Of the 29 participating countries, 28 have a surveillance system for hantavirus infection. The first hantavirus surveillance system was established in 1963, the latest in 2008. Hantavirus infection is not notifiable in Portugal and Spain; however, Portugal passed legislation for a surveillance system in 2009, but the system is not yet operational. Hantavirus infection is not mandatorily notifiable in France and in Belgium, but the national reference laboratories in both countries report data regularly to the national institutes of public health<sup>4</sup>.

No common EU case definition for hantavirus infection is available at the European level [51], although a high number of countries use the ENIVD case definition – which is based on laboratory confirmation – for surveillance purposes (Annex 3).

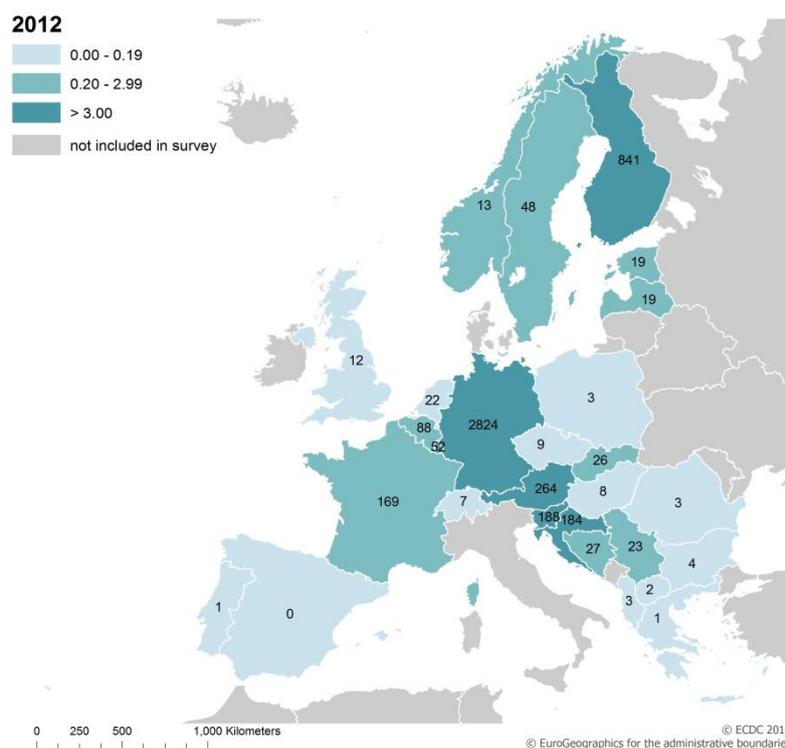
In 2011, approximately 2 900 cases of hantavirus infections were reported in the 29 participating countries (Figure 4a). The highest number of cases was notified in Finland (1 833 cases), Sweden (350 cases) and Germany (305).

In 2012, more than 4800 hantavirus infections were reported in the 29 participating countries (Figure 4b). The highest number of cases was reported in Germany (2 824 cases), Finland (841 cases) and Austria (264 cases).

**Figure 4a–b. Incidence of hantavirus infection (cases per 100 000 population) and total number of cases in 2011 (top) and 2012 (bottom), as reported in European countries (n=29)**



<sup>4</sup> In Belgium, the reference laboratory is supported by sentinel laboratories.



Data source: countries included in a telephone survey on prevention measures and communication strategies for hantavirus in Europe (see Annex 2)

Between 2005 and 2012, several countries notified hantavirus outbreaks or increases of the expected number of cases such as in Sweden or Slovenia. In Finland, outbreaks occurred in 2005 (2 526 cases) and 2008 (3 259 cases) [9]. In 2012, outbreaks occurred in Croatia (over 100 cases notified). In Germany, outbreaks were reported in 2005, 2007, 2010 [1, 52] and 2012 [21]. Romania had an outbreak in 2009 [53].

## Preventive measures

Twenty-six countries can provide institutional information on preventive measures for hantavirus. In 26 countries, this information is available at the national level. In a number of countries with low incidence this information is ready and available if needed (i.e. increase in the number of reported hantavirus cases). In three countries, institutional information on hantavirus and preventive measures are not available.

**Table 5. Accessibility of institutional information (i.e. fact sheets or guidelines) on preventive measures for hantavirus infections**

Level of accessibility	Countries	Total number (%)
<b>National level</b>	Albania, Austria*, Belgium, Bosnia-Herzegovina**, Bulgaria, Croatia, Estonia, Finland, France, Germany, Greece, Hungary, Kosovo, Latvia, Luxembourg, the former Yugoslav Republic of Macedonia, Netherlands, Norway, Portugal, Romania, Serbia, Slovakia, Slovenia, Sweden, Switzerland, United Kingdom	26 (90)
<b>Not available</b>	Czech Republic, Poland, Spain	3 (10)

\* Information on preventive measures from Germany [54] is available upon request.

\*\* Available in the Federation of Bosnia and Herzegovina and in the Republika Srpska.

In most countries, information on hantavirus is related to both the animal reservoir (i.e. rodent control, deratisation) and human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents); in five countries, mainly human–environmental aspects are covered. Three countries provide neither institutional information on hantavirus nor preventive measures for hantavirus.

In eight countries (Albania, Belgium, Croatia, Finland, Germany, Latvia, Luxembourg, the Netherlands) the information on preventive measures was tailored toward certain risk groups (including mine workers, shepherds, hunters, beekeepers, rodent controllers, foresters, hikers, summer cottage owners, or travellers).

## Communication strategies on preventive measures

Most of the countries communicate preventive measures to the general population only during outbreaks. Nine countries stated that preventive measures are communicated to the public on a regular basis. Those countries that have not faced outbreaks stated that they would communicate preventive measures if an outbreak occurred.

The most frequent communication tools are mass media (TV, radio, newspapers), institutional websites (health and occupational health), presentations and workshops for health professionals, and articles in specialised journals (hunters, pest controllers, etc.).

National public health institutes are generally responsible for the communication strategy on hantavirus, supported, if needed, by the public health services at the regional level.

## Impact assessment of the preventive measures

Two countries have assessed hantavirus preventive measures, communication strategies for preventive measures, or the level of awareness/knowledge in the general population on hantavirus (Table 6). In 2005, several small-scale studies on impact of preventive measures were conducted in Germany. In 2012, a case-control study was carried out in the German state of Baden-Württemberg to assess disease awareness, disease knowledge and implementation of preventive measures. Preliminary results indicated that controls were associated with a higher knowledge on hantavirus than cases and suggested that controls used prevention measures (e.g. wet-wiping of surfaces, ventilation, using dust masks when cleaning) more frequently than cases. A case-control study conducted in northern Sweden included questions on the use of preventive measures [55]. In Albania, a survey on the level of knowledge of hantavirus disease among the general population and health specialists is still in its early stages.

Several countries are planning to conduct impact assessment studies; however, respondents to this survey emphasised the need to perform further impact assessment studies, but were not able to carry out any such studies due to low case numbers in their countries.

**Table 6. Impact assessment of preventive measures for hantavirus conducted in European countries**

	Countries	Total no. (%)
Performed	Germany, Sweden	2 (7)
Ongoing	Albania	1 (3)
Not performed	Austria, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Finland, France, Greece, Hungary, Kosovo, Latvia, Luxembourg, the Netherlands, Norway, the former Yugoslav Republic of Macedonia, Serbia, Slovakia, Slovenia, Spain, Switzerland, Poland, Portugal, Romania, the United Kingdom	26 (90)

## Country profiles

This section contains summarised country-specific information on preventive measures for hantavirus and communication strategies as expressed in the telephone survey. The following information was provided by the contacted experts during the telephone survey.

### Albania

Hantavirus infection is notifiable since 1986. Twelve cases were reported in 2011–2012 (nine in 2011, three in 2012). Affected areas were principally located in the northern and western part of the country, where in 2010 a cluster of 12 cases was identified.

The information on preventive measures is available at the national and regional level. The information is in a different format for the general public and health professionals. The preventive measures focus on the animal reservoir (i.e. rodent control, deratisation) and the human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents). The information is tailored to the general population as well as to specific risk groups (mine workers, shepherds, populations in rural areas). Information on increased case numbers is conveyed to the general public. In addition, it is communicated to health professionals in a weekly bulletin via e-mail and is also accessible on the website of the Institute of Public Health. Information is provided via the mass media (TV, newspapers) during non-epidemic periods, along with information on Crimean-Congo haemorrhagic fever (CCHF) and enhanced during outbreaks. Posters on the streets or public transportation are used during outbreaks in endemic areas. Risk groups received tailored information during outbreaks in the form of leaflets for miners and reports for health professionals. Presentations are given at scientific meetings and conferences. At the national level, the Institute of Public Health is responsible for the communication of preventive measures, assisted by the regional level in the affected districts. If necessary, clinicians, nephrologists, may be involved.

No studies have been carried out that assess the impact of preventive measures or the impact of communication strategies on preventive measures. A survey with questions on behaviour and hantavirus disease knowledge among the general population and health professionals is ongoing.

## Austria

Disease surveillance of hantavirus infection was initiated in 1993. Hantavirus infection is notifiable since 2006. High numbers of cases were reported in 2004, 2007 and 2012. The Styria region was the area where most cases were reported. In 2011 and 2012, 35 and 264 cases were reported, respectively [56].

No information on preventive measures is available on the institutional website. When requested, people are referred to the information sheet to prevent hantavirus infections at the Robert Koch Institute website [54, 57]. This website contains information on the animal reservoir (including rodent control) and preventive aspects (i.e. cleaning up of cottages, avoiding exposure to rodents). Information on increased number of cases is provided to health professionals through the notification system, and indirectly to the general public through articles in newspapers. When case numbers increase, information is disseminated by using mass media (TV, radio and newspapers). Information is provided to specific risk groups (hunters) and health professionals. As the reference laboratory, the Medical University of Vienna provides information on the epidemiology of hantavirus infections at the national level.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Austria; the same holds true for studies on hantavirus awareness and knowledge of the disease. Although no impact studies were carried out, it is hypothesised that the awareness of health professionals has recently increased due to the increased number of cases.

## Belgium

Hantavirus infection is not a disease with mandatory notification in Belgium. Case reporting began in 1996 and is carried out by a sentinel network of laboratories and the National Reference Centre for Hantavirus. In 2011, 197 cases were reported [58]. In 2012, 89 cases were reported to the Scientific Institute of Public Health (WIV-ISP). Increased hantavirus activity was reported with different intervals: a three-year cycle (between 1990 and 1999) and a two-year cycle (between 1999 and 2005).

Information on preventive measures is available at the national level [58, 59] and in the Flemish region [60].

Information on preventive measures is available to the general public and health professionals (in the same format) and focuses on the animal reservoir and the human–environment interactions (i.e. cleaning up of cottages, avoiding exposure to rodents). In addition, articles about preventive measures were published in hunters magazines, in a beekeepers journal [61] and a journal for pest/rodent controllers. When there are increased numbers of hantavirus infections, information on the epidemic situation is actively provided to professionals and to the general public. Mass media (TV, radio and newspapers), emails and letters to health professionals are used as communication channels. Information to specific groups such as hunters, beekeepers and pest controllers are provided in an adapted format. At the national level, the Scientific Institute of Public Health (WIV-ISP) is responsible for the communication of hantavirus preventive measures. At the regional level, a three-monthly epidemiological bulletin is published in Flanders [62].

No impact assessment of preventive measures related to hantavirus infections has been performed, although it appears that the level of knowledge of the disease is higher in Wallonia than in Flanders, where most cases are reported (Paul Heyman, personal communication). Studies on the impact of communication on preventive measures were not carried out due to the limited number of cases in Belgium.

## Bosnia-Herzegovina

Hantavirus infection has been notifiable since 1967. Six cases were notified in 2011 and 27 in 2012. No outbreaks have been notified in Bosnia-Herzegovina during the 2005–2012 period. The last outbreak occurred in 2002.

There are institutional guidelines on preventive measures available in the two political divisions (Institute of Public Health Federation of Bosnia and Herzegovina and the Public Health Institute of Republic of Srpska). In general they are aimed at the general population although in specific occasions (i.e. outbreaks) there are specific instructions for health specialists. The guidelines include information on the reservoir (i.e. rodent control, deratisation) and the human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and are not tailored to specific risk groups.

Preventive measures are actively communicated to the public or health specialists during outbreaks, mainly through the official websites and mass media. The presented preventive measures focus mainly on the human–

environmental aspects. The institutes of public health, one in each of the political divisions, are responsible for these communication strategies.

Studies assessing the impact of preventive measures, the level of awareness, and the knowledge of hantavirus in the general population and health specialists are currently planned.

## Bulgaria

HFRS has been notifiable since 1963. In 2011 and 2012 less than five cases per year have been notified. No hantavirus outbreaks were notified in Bulgaria during the 2005–2012 period.

Institutional guidelines on hantavirus preventive measures at the national level are available to health specialists. The guidelines include information on the reservoir (i.e. rodent control, deratisation) and the human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and are not tailored to specific risk groups.

Preventive measures are actively communicated to health specialists and the general public only in certain circumstances, for example outbreaks.

No studies on impact assessment related to hantavirus preventive measures and communication strategies on preventive measures have been performed, nor have any been planned. Studies on hantavirus awareness and knowledge of the disease in the general population are under consideration.

## Croatia

Hantavirus infection has been notifiable since 1986. In 2011, 22 cases were reported. The latest outbreak occurred in 2012, and more than 184 cases were reported. The 2012 epidemic affected the whole continental part of the country, however, the majority of the cases were registered in the Zagreb region.

Information on preventive measures is available at the national level for both the general public and health professionals, albeit in different formats. The presented preventive measures focus mainly on the human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and are tailored to various risk groups: hikers, forest workers and owners of summer cottages.

In addition to mass media (TV, radio and newspapers), posters and leaflets are used as communication channels during outbreaks. Healthcare professionals are invited to symposia, conferences, seminars and lectures to improve their hantavirus knowledge, even during non-epidemic periods. Factsheets are available at the websites of the National Institute for Public Health and the University Hospital for Infectious Diseases. Information is targeted to specific risk groups and medical professionals during non-outbreak and outbreaks years.

Health-related institutions at the national and regional levels are responsible for communication strategies. The University Hospital for Infectious Diseases is also involved.

No impact assessment of preventive measures related to hantavirus have been performed. It seems, however, that an increasing number of people seek medical help in the earlier stage of hantavirus infection, which is linked to higher awareness due to information campaigns.

## Czech Republic

Hantavirus infection has been notifiable since 2003. Nine cases were notified in 2012, the same number as in 2011. In 2012, an outbreak occurred in the north-eastern part of the country.

Institutional information or guidelines on preventive measures against hantavirus are neither available at the national nor the regional level.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in the Czech Republic; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## Estonia

Hantavirus infection has been notifiable since 1990. There were 12 cases notified in 2011, and 19 in 2012. No outbreaks were notified in Estonia during the 2005–2012 period.

Information on preventive measures is available at the national level. Information is provided to the general public and health professionals, employing an identical format for both target groups. Preventive measures focus mainly

on the human–environmental aspects (cleaning up of cottages, avoiding exposure to rodents) and do not distinguish between risk groups.

No outbreaks were reported. In case of an outbreak, materials can be prepared quickly; health professionals and the general public would then be informed through the media, posters and institutional websites. National-level health-related institutions are responsible for the communication strategies.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Estonia; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## Finland

Hantavirus infection has been notifiable since 1995. There were 1834 cases notified in 2011, and 841 in 2012. Since 2005, two outbreaks have occurred. In 2005, 2526 cases were reported (2008: 3259 cases). The incidence rates were highest in the east central and northern areas of the country and lowest in the south.

Information on preventive measures is available at the national level. Information is provided to the general public and health professionals, using the same format. Preventive measures focus mainly on the reservoirs (i.e. rodent control, deratisation) and human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and do not distinguish between risk groups. Hantavirus factsheets are available on the websites of the National Institute of Health and Welfare, the Occupational Health Institute, and the Finnish Forest Research Institute [63].

Preventive measures are communicated to the public and healthcare professionals on a regular basis; communication efforts are stepped up during the high-risk season or during an outbreak. Mass media (TV, radio and newspapers) and institutional websites are used as a communication channels during epidemic and non-epidemic periods.

At the national level, the National Institute for Health and Welfare is responsible for the communication strategies.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Finland; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## France

Notification of hantavirus infection is not mandatory in France. However, the national reference laboratory regularly reports surveillance data to the National Institute of Public Health. No outbreaks were notified during 2005–2012. In some regions the number of cases has increased in comparison with previous years. Higher numbers of cases were reported in 2005 (253 cases), 2010 (155 cases) and 2012 (169 cases).

Institutional information on hantavirus preventive measures is available at the national level. The content is available in different formats [64, 65] and is directed at the general population and health professionals. Information focuses on the reservoir (i.e. rodent control, deratisation) and the human–environmental aspects (cleaning up of cottages, avoiding exposure to rodents). Preventive measures are not tailored to specific risk groups. Although not systematically disseminated, information on hantavirus and preventive measures can be actively communicated to the public and health specialists/professionals during epidemic periods at the regional or national level. In France, the Ministry of Health is responsible for the communication strategies.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in France; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## Germany

Mandatory notification for hantavirus infections was implemented in 2001. Since 2005, outbreaks were recorded in 2005 [27, 66], 2007 [67, 68], 2010 [20, 52] and 2012 [21]. In 2011, 305 cases were reported to the Robert Koch Institute (RKI) [69]. In 2012, the highest number of hantavirus cases have been reported since the introduction of mandatory notification (2824 cases) [70, 71]. Sixty percent of the cases notified in 2012 were reported from the state of Baden-Württemberg (south-west Germany), followed by Bavaria (16% of the reported cases). The most common strain occurring nationwide is Puumala (PUUV). Dobrava (DOBV) cases have been reported in the north-east. The genetic variability of the PUUV strain is very high, and different virus clades corresponded to different outbreak regions within Germany [72]. A detailed review of the epidemiology, geographical distribution of strains, endemic areas and hotspots in Germany was published recently [1]. Outbreak and longitudinal investigations have been carried out since 2004 [68, 73, 74].

Information on preventive measures is available at the national level. A guidance document on hantavirus is available to health professionals [57]; there is also a leaflet for the general public [54]. The leaflet focuses mainly on the human–environmental aspects (cleaning of potentially contaminated facility rooms such as cellars, garden houses, garages, or attics, contact with and disposal of dead mice, mouse droppings and urine). Information on preventive measures is also provided at the federal level. Mass media (TV, radio and newspapers) are used as communication tools during outbreaks. Specific risk groups at the national and regional level are targeted both in non-outbreak and outbreak years (more frequently during an outbreak), e.g. by publishing articles in professional journals for forest workers, veterinarians, soldiers and pest controllers [75]. Information is also provided at the professional national and international fairs and trade shows, e.g. at Eurocido (pest-control) and Interforst (forestry).

At the national level, RKI is responsible for communication, whereas at the regional level, state health and local health authorities are responsible.

Several small-scale studies on the impact of preventive measures are available. In 2005, the effect of rodenticides was assessed during an outbreak in the Cologne area; in the Main-Spessart district the impact of rodenticides was evaluated (S. Essbauer, personal communication). In a military training area in Sigmaringen (south-west Germany), prevalence of hantavirus infection was documented before and after clearing the area by mowing the grass (S. Essbauer, personal communication). In Baden-Württemberg (south-west Germany), hantavirus disease awareness and knowledge as well as preventive measure practices are currently being assessed as part of a case-control study [76]. Preliminary results indicate that controls were more likely than cases to have some knowledge on hantavirus and hantavirus prevention measures. Recommended prevention measures such as wearing dust masks during cleaning activities in potentially contaminated rooms or while working with fresh wood were hardly ever implemented. Wetting surfaces and increasing ventilation when cleaning rooms (garages, attics, garden houses) were more frequently reported by controls than by cases. Although a large number of respondents were aware of the need to wear dust masks, this prevention measure was mostly considered as too inconvenient.

## Greece

Hantavirus infection has been notifiable in Greece since 1995. Case numbers were low in 2011 (three cases) and 2012 (one case). No hantavirus outbreaks were notified in Greece during the 2005–2012 period. Several seroprevalence studies have been conducted, and endemic foci are well characterised. Clinicians are aware of the disease and include HFRS (together with leptospirosis) in the differential diagnosis of suspected cases.

There are institutional guidelines on hantavirus preventive measures at the national level. They are available at official websites and, in phases of increased hantavirus activity, through mass media. The guidelines include information on the reservoir (i.e. rodent control, deratisation) and the human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and are not tailored to specific risk groups.

Preventive measures are actively communicated to health specialists and the general public only in certain circumstances, for example outbreaks.

Since the annual number of cases during recent years was below five, there was no need to invest in studies on the impact of preventive measures or the impact of communication strategies on preventive measures. No studies on hantavirus disease knowledge and awareness in the general population were carried out. However, a survey on hantavirus disease knowledge and awareness among clinicians showed that they are aware of the disease, especially in regions where cases have been observed in previous years.

## Hungary

Hantavirus infection is notifiable since 1998. In 2011, 11 cases were notified, and a further eight in 2012. No outbreaks were notified in Hungary during 2005–2012.

There are institutional guidelines on preventive measures at the national level. They are only available to health specialists. The guidelines include information on the reservoir (i.e. rodent control, deratisation) and the human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and are not tailored to specific risk groups.

Preventive measures are actively communicated to health specialists and the general public only in certain circumstances, for example outbreaks.

No studies on impact assessment related to hantavirus preventive measures and communication strategies on preventive measures have been performed nor planned. Currently planned is a study assessing the level of awareness and knowledge of hantavirus among health specialists.

## Kosovo<sup>5</sup>

Hantavirus infection has been a notifiable disease in the Kosovo since 1999.

No outbreaks and cases were reported in 2011. One laboratory-confirmed case was reported in 2012.

Information on hantavirus preventive measures is available at the national level and further dispatched in the six regional branches of the National Institute of Public Health. It is available to the general public and health professionals in the same format. Information on the reservoir and the human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) are addressed. In an outbreak situation, a communication strategy similar to the one for Crimean-Congo haemorrhagic fever (CCHF) will be applied: health professionals are informed directly, while the general public will receive information through the mass media. Communication on hantavirus and CCHF is provided simultaneously, regardless of the outbreak situation. Information is passed on to health professionals at meetings. The national institute of public health is responsible for communication on hantavirus, but regional administrative levels can also be included.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in the Kosovo; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## Latvia

Hantavirus infection has been notifiable since 2006. In 2011, four cases were notified; in 2012, 19 cases were registered. No hantavirus outbreaks were notified in Latvia during 2005–2012.

Information on preventive measures is available at the national level. Identical information is provided to the general public and health professionals. The presented preventive measures focus mainly on the reservoirs (i.e. rodent control, deratisation) and human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and are tailored to specific risk groups: hunters, workers in the woods, builders, ecotourists, and laboratory personnel. Preventive measures are communicated to the general public and healthcare professionals on a regular basis and intensified during high-risk season or during an outbreak. Mass media (TV, radio and newspapers) and institutional websites are used as communication channels during non-epidemic and epidemic periods.

National level health-related institutions are responsible for the communication strategies.

Studies on the impact of preventive measures, the impact of communication strategies on preventive measures, and studies on hantavirus disease knowledge and awareness are planned.

## Luxembourg

In Luxembourg, hantavirus infection has been notifiable since 2004. In 2011, no cases were notified; in 2012, 52 cases were reported. An increased number of hantavirus infections were notified in the Müllerthal area in 2005. In 2012, east and central Luxembourg reported higher case numbers compared with previous years.

Information on hantavirus preventive measures [77] is provided in the same format for the general public and health professionals and available at the national level. The information focuses on the human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and is tailored to both the general public and specific groups such as forest workers and educators.

Information for health professionals and the general public on increased hantavirus activity is published in a yearly or half-yearly report. In addition, media requests often result in additional information on hantavirus for the general public. Preventive measures are only actively communicated during outbreaks (for example in 2012). Mass media (TV, radio, newspapers) and websites [78] are also used for the dissemination of information. The government information service is responsible for all communication activities and also relays information to the press.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Luxembourg; the same holds true for studies on hantavirus awareness and knowledge of the disease.

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<sup>5</sup> This designation is without prejudice to positions on status and is in line with UNSCR 1244 and the ICJ opinion on the Kosovo Declaration of Independence. Hereafter referred to as 'Kosovo'.

## The former Yugoslav Republic of Macedonia

Haemorrhagic fever with renal syndrome has been notifiable since 2004. No cases were notified in 2011; in 2012, two cases were reported. No hantavirus outbreaks were notified during 2005–2012.

There are institutional guidelines on hantavirus preventive measures at the national level. They are mainly available to health specialists. The former Yugoslav Republic of Macedonia has established a full range of mechanisms to implement a communication plan on preventive measures which can be activated on short notice. The Ministry of Health and Institute of Public Health of the former Yugoslav Republic of Macedonia is responsible for the implementation of the plan.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in the former Yugoslav Republic of Macedonia; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## The Netherlands

Hantavirus infection has been notifiable since December 2008. In 2011, seven cases were reported; in 2012, the number increased to 22. In 2008, an exceptional cluster of cases in the province of Noord-Brabant [79] was reported [80].

Information at the national level is provided by the Centre for Infectious Disease Control at the Dutch National Institute for Public Health and the Environment (CIb-RIVM) [81] and by the Occupational Health Information website (KIZA) [82]. At the regional level, the Community Health Services (GGD) provide information. The information is available to the general public and health professionals in different formats and focuses on the human–environmental aspects. RIVM targets the general population, while KIZA focuses on occupational groups. Information on increased hantavirus case numbers is provided to public health professionals through the 'RIVM Signaleringsoverleg' and to veterinary health professionals through the 'Signaleringsoverleg Zoonosen' [83]. Information is actively communicated during outbreaks. Information can be found on the RIVM website and the KIZA website. Since 2012, RIVM has been responsible for communication strategies at the national level, while the GGD shares responsibility at the regional level. Guidance on control measures during outbreaks is provided by the RIVM, using an email-based alerting system called `inf@ct`. A similar system, called `labinf@ct`, exists to address laboratory diagnostics issues during outbreaks.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in the Netherlands; the same holds true for studies on hantavirus awareness and knowledge of the disease. A study on disease awareness among health professionals was considered useful as experts assume underdiagnosis of hantavirus infection (Harms et al., manuscript in preparation).

## Norway

Hantavirus infection has been notifiable since 1981. In 2011, 39 cases were notified (2012: 13). No hantavirus outbreaks were notified in Norway during 2005–2012.

There are institutional guidelines on preventive measures at the national level, available to health specialists and the general population [84]. The guidelines include information on the reservoirs (i.e. rodent control, deratisation) and human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and are not tailored to specific risk groups. Preventive measures are actively communicated to health specialists and the general public only in certain circumstances, for example outbreaks.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Norway; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## Poland

Hantavirus infection has been notifiable since 2002. Eight cases were notified in 2011, three in 2012. No hantavirus outbreaks were notified in Poland during 2005–2012.

Institutional information or guidelines on preventive measures on hantavirus are neither available at the national nor the regional level.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Poland; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## Portugal

Hantavirus infection is not notifiable although it is planned to be included in a new list of notifiable diseases which came into effect after new legislation was passed in 2009. One case of hantavirus infection was diagnosed both in 2011 and 2012. No hantavirus outbreaks were notified in Portugal.

There are institutional guidelines on hantavirus preventive measures at the national level. They are available to health specialists if necessary. Preventive measures are actively communicated to health specialists and the general population in certain circumstances, for example during outbreaks.

Published studies include studies of hospitalised clinical cases [85-89], hantavirus in rodents [88], and a review on diagnostics at the National Institute of Health [89].

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Portugal; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## Romania

Hantavirus infection has been notifiable since 2008. Four cases were reported in 2011, and three in 2012. Between 2005 and 2012, 27 cases of HFRS with laboratory-confirmed hantavirus infection were reported. Since 2008 – when HFRS became notifiable – between three and eight cases have been notified per year. These cases were sporadic, with the exception of one family cluster (five cases), notified in 2009 in a rural area of Neamt district [53].

There are institutional guidelines on preventive measures at the national level available to the general population and health specialists [90]. The guidelines include information on the reservoir (i.e. rodent control, deratisation) and the human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and are not tailored to specific risk groups.

Preventive measures are actively communicated to health specialists or the general public during outbreaks, mainly through official websites and mass media.

A study on hospitalised HFRS cases in Romania pointed to Dobrava virus, carried by *Apodemus flavicollis* (Penculescu-Gatej et al., submitted for publication 2013, under review). A comprehensive study on the clinical presentation of laboratory-confirmed HFRS cases in residents from eastern Romania was published in 2012 [45].

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Romania; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## Serbia

Hantavirus infection has been notifiable since 1990. In total 12 and 23 in Serbia were reported in respectively 2011 and 2012.

There are institutional guidelines on preventive measures at the national level, which are available to the general population. The guidelines include information both on the reservoir (i.e. rodent control) and the human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and are not tailored to specific risk groups.

When outbreaks occur, these preventive measures are actively communicated to the public or health specialists mainly through the official websites and media (no social networks are used). The Ministry of Health is responsible for the communication strategies.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Serbia; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## Slovakia

Hantavirus infection has been notifiable since 2007. Sixteen cases were notified in 2011, and 26 cases in 2012. No hantavirus outbreaks were notified in Slovakia during the 2005–2012 period.

Information on preventive measures is available at the national level. The information is provided to the general public and health professionals in the same format. The presented preventive measures focus mainly on the reservoirs (i.e. rodent control, deratization) and human–environmental aspects (i.e. cleaning up of cottages,

avoiding exposure to rodents). Preventive measures are tailored to the general population and do not address specific risk groups. Factsheets are available on the website of the National Institute of Public Health.

Preventive measures are communicated to healthcare professionals and the general public on a regular basis, with enhanced activities during an outbreak. Mass media (TV, radio and newspapers) and institutional websites are used as communication channels during non-epidemic periods; the same channels would be used during an epidemic.

At the national level, the National Institute for Public Health is responsible for communication strategies.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Slovakia; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## Slovenia

Hantavirus infection has been notifiable since 1985. In 2012, 188 cases were notified (2011: 15 cases). Between 2005 and 2012, outbreaks were reported in 2005, 2008 and 2012 [37]. The largest outbreak so far was in 2012.

There are institutional guidelines on hantavirus preventive measures at the national level, available to the general population and health specialists [91]. Guidelines include information on the reservoir (i.e. rodent control, deratisation) and the human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and are not tailored to specific risk groups.

Preventive measures are actively communicated to the public or health specialists during outbreaks, mainly through official Slovenian websites and mass media.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Slovenia; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## Spain

Although Spain has no mandatory reporting for hantavirus haemorrhagic fever, surveillance of all haemorrhagic fevers was introduced in 2003. Therefore, cases of viral haemorrhagic fever (including hantavirus infection) must be reported immediately to the National Coordination Center for Alerts and Health Emergencies and to the National Center of Epidemiology. Although a higher prevalence of hantavirus antibodies was retrospectively identified from people with hepatic problems, no autochthonous cases of haemorrhagic fever with renal syndrome due to hantavirus were reported [92, 93]. No hantavirus cases or outbreaks were notified in Spain during 2005–2012, but at least two imported cases were reported during this period [94, 95]. There is no institutional information on preventive measures for hantavirus infection available, neither at national nor regional levels. However, Spain has all mechanism in place to carry out preventive measures in an outbreak situation. Also, a set of communication strategies is available.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Spain; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## Sweden

Hantavirus infection has been notifiable since 1988. In total, 48 cases were reported in 2012 (2011: 350 cases). Puumala hantavirus infection (Nephropathia epidemica) is endemic in northern Sweden [43] (mainly in the Västerbotten, Norrbotten, Västernorrland and Jämtland counties); the yearly number of cases have varied between 48 in 2005 and 2193 in 2012.

Institutional guidelines on preventive measures at the national level are available to health specialists and the general population. Regions with a high incidence of hantavirus infections have their own format. The guidelines include information both on the reservoir (i.e. rodents) and human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents) and are not tailored to specific risk groups.

These preventive measures are actively communicated to health specialists and the general public during outbreaks, mainly through official websites and mass media.

One study attempts to assess the risk of hantavirus infections in the Swedish population by predicting bank vole abundance [96]. There are also impact assessment studies on preventive measures and the levels of awareness/knowledge among the general population. In a risk-factor study on hantavirus in northern Sweden, no differences in potential preventive measures were observed between cases and controls. A low response rate

might have contributed to the lack of statistically significant results. Although the level of knowledge towards the hantavirus disease was appreciated as high in the Swedish population, the uptake of potential preventive measures in Northern Sweden was generally considered limited, possibly due to low population awareness regarding these measures and their effectiveness (A. Gherasim, SMI, Sweden, personal communication).

## Switzerland

Hantavirus infections have been notifiable since 1988. No cases were reported between 1988 and 1999. Between 2000 and 2011, a range of zero to four cases per year were notified. In 2012, seven cases were confirmed: two cases were infected in Germany, one in the Kosovo, one in Slovenia, and one in Liechtenstein. For two cases, the geographic origin of the infection was unknown. Switzerland was never affected by outbreaks.

General information on hantavirus epidemiology and on the respective preventive measures [97] as well as the number of reported hantavirus cases [98] are available from specific web pages maintained by the Federal Office of Public Health (FOPH). This information is provided at the national level to the general public and health professionals in German and French, using the same format. The epidemiological situation is regularly assessed, and if there is an unusual increase of case numbers, a report is published on the news website [99] of FOPH. The actors at the subnational level (cantonal medical officers) are regularly contacted by FOPH to coordinate measures and exchange information; this would also apply in phases of increased hantavirus activity. Recommendations on preventive measures are available on a travel-specific website [100], which FOPH supports also financially. Concerning the epidemiology of communicable diseases and communication at the national level, FOPH is the authority in charge.

Concerning the sharp increase of hantavirus case numbers in southern Germany between autumn 2011 and 2012, a summary of the respective Eurosurveillance report [21] was published on the Safetravel website.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in Switzerland; the same holds true for studies on hantavirus awareness and knowledge of the disease.

## United Kingdom

Hantavirus infection has been notifiable since 1984 (under 'viral haemorrhagic fevers'). In 2010, hantavirus infection was removed from the list of diseases for which reporting is mandatory, although reporting is still encouraged. The presence of Seoul hantavirus in rats was confirmed in January 2013 [11].

There is institutional information on preventive measures available at the national level for the general public [101]. In terms of preventive measures, the guidelines/fact sheets include information on the reservoir (i.e. rodents) and the human–environmental aspects (cleaning up of cottages, avoiding exposure to rodents). These preventive measures are not tailored to specific risk groups. Preventive measures are actively communicated to the public only in certain circumstances (e.g. hantavirus identification in pet rats), mainly through institutional websites and press releases.

The Health Protection Agency is responsible for communication strategies at the national level.

No studies on the impact of preventive measures or the impact of communication strategies on preventive measures have been carried out in the United Kingdom; the same holds true for studies on hantavirus awareness and knowledge of the disease.

# Discussion

## Literature review

In the PubMed database only eight publications with a focus on prevention measures for hantavirus infection in Europe [3, 41, 43, 47-50] were identified. Most of them were reviews and not original research articles. Presented preventive measures were related to both the animal reservoir (i.e. rodent control, deratisation) and human–environmental aspects (i.e. cleaning up of cottages, avoiding exposure to rodents). None of the publications elaborated on the effectiveness of and/or on the acceptability of these prevention measures in Europe. Only one article contained information related to specific communication strategies. Although a number of publications might have been missed in this review (search limited to PubMed; only papers published in the languages of the ENIVD network), results clearly show the need for further research in this topic.

## Survey

The 29 participating countries showed heterogeneity in terms of number of cases reported, presence of outbreaks between 2005 and 2012, and distribution of the disease in the country. In total, approximately 4800 hantavirus cases were reported by 29 European countries in 2012 (2011: >2900). Surveillance systems for hantavirus infections in the various countries were initiated between 1963 and 2008. This overall heterogeneity, along with the lack of a common case definition, has to be taken into account when analysing and interpreting surveillance data.

The majority of the participating countries have produced institutional guidelines on preventive measures for hantavirus. Most countries made this information publicly available at the national level. In one of the participating countries, no guidelines were produced, but this was in a country with only a few imported cases.

During an outbreak, most countries actively communicate preventive measures to the general population. Countries that were never (or not recently) affected by an outbreak, confirmed the availability of a public communication policy for outbreaks. The most frequent communication channels used are mass media, institutional websites (health and occupational health), presentations and workshops for health professionals, and publications in specialised journals (hunters, pest controllers). Communication activities are stepped up during phases of increased hantavirus activity.

Understanding the complex and multifactorial causes (including reservoir ecology, virus ecology and anthropogenic factors) leading to hantavirus emergence in Europe is crucial for an improved and timely prevention strategy [102]. Modelling approaches, adapted to the local situation, are required to determine predictive indicators of increased risk for humans (e.g. [103]). Predictive models may also improve the timely communication of preventive measures. In Baden-Württemberg (Germany), a multi-disciplinary project was initiated in 2012 in order to develop an early-warning system. Setting up an early-warning system for hantavirus risk based on interdisciplinary collaboration between institutes for public health, environment and animal health would ensure timely recommendations for persons at risk [104]. Sweden has developed models to predict and verify bank vole abundance in autumn and thus predict the risk of acquiring HFRS. Results obtained were used to raise public awareness and clinical preparedness [96].

In general, national public health institutes are responsible for communication on preventive and control measures for hantavirus; they are often supported by regional public health services in highly endemic areas.

Finally, this study showed that a majority of countries have never performed impact assessment studies on the effectiveness of preventive measures, communication strategies, or disease awareness and knowledge. There are a few notable exceptions, for example Sweden and Germany. Several countries acknowledge the need for, and importance of, such studies. There is also need to conduct more studies assessing the impact of control measures for groups at high risk of acquiring hantavirus infection.

An outbreak of HCPS in Yosemite National Park, California, USA in summer 2012 [105] might have helped to increase the level of awareness and knowledge of this infection in Europe. The US Centers for Disease Control and Prevention (CDC) informed ECDC that more than 1 900 EU residents had been at risk of exposure to hantavirus at Yosemite. ECDC and the European Commission (Directorate General for Health and Consumers) provided Member States with the contact details of affected people so that they could be informed of potential exposure [106].

Several factors have to be considered when attempting to increase the knowledge and level of awareness of hantavirus infection. Obviously, the first factor is the content, for example whether the information provided is aimed at specific risk groups, health professionals, or the general population; or whether the information focuses on the animal reservoir and the human–environmental aspects. Depending on the various risk factors in endemic areas, the content of the information may have to be adapted.

The second factor is the timing of the communication activities. According to the survey results, most countries provide information in times of increased virus activity, with additional information disseminated during hantavirus infection outbreaks. In Chile, public awareness activities are carried out all year round and reinforced in summer when the risk of exposure increases. This two-stage prevention approach has been fairly successful [33]. Although the epidemiology and severity of the two syndromes (HCPS and HFRS) are different, it should be investigated whether the American approach could be adapted to the prevention of hantavirus in Europe.

The third factor is the dissemination of information via the various communication channels. The study showed that the main communication channels in Europe are newspapers, TV, radio, and institutional websites. These channels have proved to be the most effective, particularly during outbreaks. In Panama and Chile, the general public is informed via television, newspapers, radio, and the internet in acute crisis situations [33]. Other target groups, for example young people, are more easily reached through social media.

These three points (what, when and how) are essential in increasing the awareness of the population, particularly those sections of the population that are at higher risk. Striking a good balance between content, timing and dissemination method is essential when planning communication strategies for hantavirus disease.

Although concerns of causing 'health message fatigue' are undeniably justified, public awareness campaigns do in fact increase the level of knowledge and awareness of hantavirus infection, thus making it easier to implement prevention measures.

There is a need to assess the effectiveness of recommended prevention measures, particularly measures which are frequently disregarded, for example the wearing of dust masks.

Large differences are observed in case numbers between countries, which may be partly explained by differences in case definitions, differences in the surveillance systems, but also by differences in the overall awareness of care providers and the general population. Surveys targeting awareness and disease knowledge would allow for better prevention of hantavirus infections in the affected countries.

## Strengths and weaknesses of the study

This is the first European summary on available preventive measures for hantavirus infection, covering 29 European countries. The ENIVD network was instrumental in establishing contacts between local hantavirus experts and the authors of this study.

Countries where no hantavirus cases were reported between 2005 and 2012 were excluded from this study. Also excluded were countries where the ENIVD network has no members. However, it cannot be ruled out that hantavirus is circulating in these countries, which also implies that HFRS could soon also appear.

The overwhelming majority of screened data was retrieved at the national level (websites). Useful data at local or regional levels may have been missed. Also, some information sources may have been missed due to language limitations.

Many differences among studied countries were observed, in terms of incidence, surveillance systems, and case definitions – which further complicates the establishment of a common European approach in terms of guidelines, control measures, and common case definition for hantavirus infections [51]. However, the authors believe it is possible to produce a set of general guidelines for Europe that could subsequently be adapted to the local situation and integrated into the national public health system.

## Conclusions

- European countries use a number of different case definitions when notifying hantavirus infections. A common case definition at the European level would help to make data more comparable.
- In several European countries the number of hantavirus cases has increased in the last few years. As preventive measures differ from country to country, it would be helpful for these countries to share information on preventive measures as well as strategies to communicate them.
- Recommended preventive measures may not be based on evidence and their impact on the incidence of hantavirus infection has not yet been thoroughly assessed in Europe. There is a need for affected countries to assess the impact of preventive measures.
- In order to improve the prevention of hantavirus infections, a better understanding of the risk factors, risk groups, and the effectiveness of preventive measures is required. This should involve multidisciplinary collaboration between public health officers, rodent ecologists, climatologists, risk modellers, risk communication experts and clinicians ('one health' approach).
- There is a need for studies on the impact of communication strategies (including dissemination method and contents of health messages) on the relevant target groups with regard to disease awareness, disease knowledge, and preventive measures (acceptability, feasibility).

# Annex 1. Short guide for experts for the telephone survey

## *Dear member of the ENIVD,*

We are contacting you since you participated as an ENIVD member in the last update on the hantavirus situation in Europe in 2010<sup>6</sup>. Prior to the telephone interview we collected published information on hantavirus in your country (literature review and internet search in relevant websites such as the National Institute of Public Health). We will discuss this information during the interview.

The interview will be semi-structured and it will consist of open questions which mainly aim at

- 1) ensuring that the information that we found is correct and comprehensive, and
- 2) including additional information that is unpublished.

Please find below the topics we will address to you during the telephone interview. If you think that we should address this interview to somebody else who is more acquainted with the topic/some of your colleagues could help us to complete the information, we would appreciate if you could provide us the name, affiliation and contact information of the person you consider we should contact in addition to you.

## **Part I. General information**

- Is hantavirus notifiable in your country? If yes, from which year onwards?
- Have there been cases notified in 2011 and 2012?
- Have there been hantavirus outbreaks notified between 2005 and 2012 in your country?

## **Part II. Preventive measures and communication strategies**

### **a) preventive measures**

- Is there any institutional information (such as fact sheets, or guidelines) on preventive measures for hantavirus infections available in your country?
- If yes, which is the level of accessibility (i.e. general public, health specialists...) of this information?
- Which is content of this information (i.e. focused on the reservoir, humans, environment...)?

### **b) communication strategies**

- With regards to the seasonal hantavirus epidemiological situation, do you inform the health professionals/population on a regular basis or in an ad hoc manner in case of outbreak?
- Once the preventive measures are implemented, are they communicated to the public/health professionals?
- Which communication strategies have been used (i.e. media, leaflets, websites, social networks...)?
- Are they intensified in specific situations (i.e. during an outbreak, high risk season)?
- Who is normally responsible for these communication strategies?
- What is the content of these communication strategies (i.e. focused on the reservoir, humans, environment...)?

## **Part III. Assessment of the impact**

- Are you aware of any kind of impact assessment of preventive measures / communication strategies implemented in your country?
- Are you aware of any kind of assessment of the level of awareness/knowledge among general population/ health professionals in your country?

We really appreciate your collaboration. The results of this survey will allow to identify possible knowledge gaps on preventive measures and communication strategies, and to better promote evidence-based public health interventions toward hantavirus diseases in Europe.

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<sup>6</sup> Heyman P, Ceianu CS, Christova I, Tordo N, Beersma M, João Alves M, et al. A five-year perspective on the situation of haemorrhagic fever with renal syndrome and status of the hantavirus reservoirs in Europe, 2005–2010. Euro Surveill. 2011 Sep 8;16(36)

## Annex 2. Questionnaire for the telephone survey

To be filled by the interviewer

Date: \_\_\_\_/\_\_\_\_/\_\_\_\_ (dd/mm/yyyy) (Interview date previously agreed by email following the invitation to participate in the study)

Name of the interviewer: \_\_\_\_\_

Identification of expert

Name of expert: \_\_\_\_\_

Job position: \_\_\_\_\_

E-mail: \_\_\_\_\_ Tel: \_\_\_\_\_ Tel 2: \_\_\_\_\_

ID questionnaire: \_\_\_\_\_ (Country\_FamilyName) \_\_\_\_\_

### Part I. General information

*Note for the interviewer: First we should inform about what we have found for the respective country in the manual search and then we should ask about the unknown/the additional info. We will present the information we have already gathered while performing the interview, so we can ensure that the information we have found is complete and correct.*

**Q1.** Is hantavirus infection notifiable in your country? (or administrative unit if the interview is taking place with an expert at a regional level)

Yes  No  Don't know

**Q2.** If yes, from which year?

**Q3.** Have there been hantavirus cases notified (increase of cases notified in a given area during a given period of time) during 2011 and 2012 in your country? (cases in previous years are already published in Eurosurveillance)

**Q4.** Have there been hantavirus outbreaks notified (more cases than expected in a given area during a given period of time) during 2005 and 2012 in your country? (or administrative unit if the interview is taking place with an expert at a regional level)

Yes  No  Don't know

**Q5.** If yes,

Outbreak	Year	Geographical location of the outbreak	Published? (include reference) (article, abstract, press note)
1			
2			
3			

### Part II. Preventive measures and communication strategies

*Note for the interviewer: First we should inform about what we have found for the respective country in the manual search and then we should ask about the unknown/the additional info. We will present the information we have already gathered while performing the interview, so we can ensure that the information we have found is complete and correct.*

#### Preventive measures

**Q6.** Is there any institutional information (i.e. fact sheets or guidelines) on preventive measures for hantavirus infections available?

Yes, at national level  Yes, at regional level  no  Don't know

If yes,

**Q7.** Level of accessibility of this information

- available to the general public
- available to health professionals (restricted access)
- available to both in the same format
- available to both in different formats

**Q8.** Indicate which types of preventive measures are presented?

- The control measures are mainly focused on the reservoir (i.e. rodent control, deratisation...)
- The control measures are mainly focused on humans/environment (how to clean up cabins, how to avoid exposure to rodents)
- The control measures target both the reservoir and the humans/environmental aspects
- Don't know

**Q9.** Are these preventive measures tailored to any specific population group?

- No, they target the general population
- Yes, please specify: \_\_\_\_\_ (i.e., hunters or workers in the woods, physicians, nephrologists, travellers...)
- Both

#### Communication strategies on preventive measures

**Q10.** Do you provide information on a regular basis to health professionals and the general public when there is a seasonal increase of hantavirus cases or during outbreaks?

- Yes, to health professionals
- Yes, to the general public
- No

If yes, how? \_\_\_\_\_

**Q11.** Are preventive measures communicated to the public?

- Yes, on a regular basis
- Yes, on a regular basis and enhanced preceding a high-risk season and/or during an outbreak
- Yes, only preceding high-risk season
- Yes, only during an outbreak (in the area or in a neighbouring area)
- Yes, only under very specific circumstances (i.e. after the notification of an imported case)
- No
- Don't know

**Q12.** Which communication strategies have been used?

	Non-epidemic period			During an outbreak		
Media (TV, radio, newspaper):	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Posters on the street, public transport	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Institution websites	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Specific to risk groups (i.e. journals or websites for hunters, excursionists, travellers)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Social networks	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Don't know
Other, please specify _____						

**Q13.** Who is responsible for these communication strategies?

- National level health-related institutions (i.e. ministry of health/national institute of public health/national veterinary institute)
- Regional level health-related institutions
- Non health-related institutions or societies (i.e. ministry of agriculture/forestry)

- It depends (i.e. differences between non-epidemic periods and during an outbreak, please specify) \_\_\_\_\_
- Other, please specify \_\_\_\_\_

**Q14.** What is the content of these communication strategies?

- The control measures are mainly focused on the reservoir (i.e. rodent control)
- The control measures are mainly focused on humans/environment (i.e. how to clean up cabins, how to avoid exposure to rodents)
- The control measures target both the reservoir and the humans/environmental aspects
- Don't know

**Part III. Assessment of the impact**

*Note for the interviewer: First we should inform about what we have found for the respective country in the manual search and then we should ask about the unknown/the additional info. We will present the information we have already gathered while performing the interview, so we can ensure that the information we have found is complete and correct.*

**Q15.** Are you aware of any kind of impact assessment of the preventive measures implemented in your country?

- Yes, in regular basis
- Yes, in ad hoc manners
- No
- It's been planned
- Don't know

If yes, which ones and which indicators are used to evaluate this impact (citation, in order to find the conclusions of the assessment) \_\_\_\_\_

**Q16.** Are you aware of any kind of impact assessment of the communication strategies on preventive measures in your country?

- Yes, in regular basis
- Yes, in ad hoc manners
- No
- It's been planned
- Don't know

If yes, which ones and which indicators are used to evaluate this impact (citation, in order to find the conclusions of the assessment) \_\_\_\_\_

**Q17.** Are you aware of any kind of study that assesses the level of awareness/knowledge of general population on hantavirus in your country?

- Yes, in regular basis
- Yes, in ad hoc manners
- No
- It's been planned
- Don't know

If yes, which ones and which indicators are used to evaluate this impact (citation, in order to find the conclusions of the assessment) \_\_\_\_\_

**Q18.** Are you aware of any kind of impact assessment of the level of awareness/knowledge of health professionals on hantavirus in your country?

- Yes, in regular basis
- Yes, in ad hoc manners
- No
- It's been planned
- Don't know

If yes, which ones and which indicators are used to evaluate this impact (citation, in order to find the conclusions of the assessment) \_\_\_\_\_

## Annex 3. HFRS ENIVD case definition

Please refer to [38] for further details on the HFRS ENIVD case definition.

### A. Suspected case

An acute illness characterised by an abrupt onset of fever (lasting 3-8 days) and some of the following symptoms: conjunctival injection, prostration, backache, headache, acute myopia/myopic shift, myalgia, dizziness, abdominal pain, anorexia, vomiting and at least one of the following criteria:

- direct contact with possibly infected rodents during the two months before onset of illness
- within the last two months before onset of illness having had direct or indirect contact with the excreta of possibly infected rodents (e.g. in food or on surfaces such as floors or beds)
- within the last two months before onset of illness having visited an area where possibly infected rodents live
- haemorrhagic manifestations (e.g. petechial rash, conjunctival or nasal bleeding, excess bleeding at sites of injury) after a few days of onset of illness
- impaired renal function
- hypotension
- shock
- death during the hypotensive and anuric phase
- at least two of the following laboratory findings: proteinuria, leukocytosis, thrombocytopenia, elevated blood urea nitrogen

### B. Probable case

A suspected case with at least one of the following criteria:

- within the last two months before onset of illness having been in a location with probable or confirmed cases of HFRS at that time
- detection of hantavirus antibodies in blood or other body fluid (by immunofluorescence, ELISA, HI, immunoblot or neutralisation test)
- positive RT-PCR from serum or tissue

### C. Confirmed case

A HFRS case is confirmed with one of the following laboratory diagnosis:

- detection of specific IgM or low-avidity IgG antibodies
- detection of  $\geq$  fourfold rise in specific antibody titre
- detection of hantavirus nucleic acid in a sequenced RT-PCR from blood or tissues

## Annex 4. List of national websites sources on prevention measures for hantavirus in Europe

Country	Title of document	Website
<b>Albania</b>		<a href="http://www.ishp.gov.al">www.ishp.gov.al</a>
<b>Austria</b>	Informationen zur Vermeidung von Hantavirus-Infektionen	<a href="http://www.rki.de/DE/Content/InfAZ/H/Hantavirus/Merkblatt_PDF.pdf">http://www.rki.de/DE/Content/InfAZ/H/Hantavirus/Merkblatt_PDF.pdf</a>
<b>Belgium</b>	Informatie over hantavirose Knaagdieren en hantavirose Les maladies transmises par les animaux. Ce qu'il est bon de savoir. Service d'écologie sociale	<a href="https://www.wiv-isp.be/epidemie/epinl/plabnl/indexha.htm">https://www.wiv-isp.be/epidemie/epinl/plabnl/indexha.htm</a> <a href="http://www.zorg-en-gezondheid.be/hantavirose.aspx">http://www.zorg-en-gezondheid.be/hantavirose.aspx</a> <a href="http://www.ulb.ac.be/sciences/use/documents/dobly/ziekten_dieren_ulb.pdf">http://www.ulb.ac.be/sciences/use/documents/dobly/ziekten_dieren_ulb.pdf</a>
<b>Bosnia-Herzegovina</b>		<a href="http://www.nalaz.org/wp/misija-groznica/">http://www.nalaz.org/wp/misija-groznica/</a> <a href="http://www.nalaz.org/wp/hemoragijska-groznica-sa-bubreznim-sindromom-u-bosni-i-hercegovini/">http://www.nalaz.org/wp/hemoragijska-groznica-sa-bubreznim-sindromom-u-bosni-i-hercegovini/</a>
<b>Bulgaria</b>		No link available
<b>Croatia</b>	Mišja groznica - kako se zaštititi Informacija o grupiranju hemoragijske groznice s bubrežnim sindromom  HVBS_letak (za zdravstvene djelatnike)  HVBS_brošura (za građane)  HVBS_plakat (za građane)	<a href="http://www.hzjz.hr/epidemiologija/mis.htm">http://www.hzjz.hr/epidemiologija/mis.htm</a>  <a href="http://www.hzjz.hr/epidemiologija/ghbs.htm">http://www.hzjz.hr/epidemiologija/ghbs.htm</a>  <a href="http://www.bfm.hr/uploads/HVBS_letak.pdf">http://www.bfm.hr/uploads/HVBS_letak.pdf</a> <a href="http://www.bfm.hr/uploads/HVBS_brosura2.pdf">http://www.bfm.hr/uploads/HVBS_brosura2.pdf</a> <a href="http://www.bfm.hr/uploads/HVBS_poster.pdf">http://www.bfm.hr/uploads/HVBS_poster.pdf</a>
<b>Czech Republic</b>	Not applicable	
<b>Estonia</b>	Hantaviirused  Neerusündroomiga hemorraagiline palavik	<a href="http://www.terviseamet.ee/nakkushaiused/nakkushaiused-a-ue/h.html">http://www.terviseamet.ee/nakkushaiused/nakkushaiused-a-ue/h.html</a> <a href="http://www.terviseamet.ee/fileadmin/dok/Nakkushaiused/nakkused/Neerusundr_hemorr_palavik.pdf">http://www.terviseamet.ee/fileadmin/dok/Nakkushaiused/nakkused/Neerusundr_hemorr_palavik.pdf</a>
<b>Finland</b>	Myyräkuumeen aika  Puumalavirus  Myyräkuume	<a href="http://www.metla.fi/hanke/3071/myyrakuume.htm">http://www.metla.fi/hanke/3071/myyrakuume.htm</a>  <a href="http://www.thl.fi/fi_FI/web/infektiaudit-fi/puumalavirus">http://www.thl.fi/fi_FI/web/infektiaudit-fi/puumalavirus</a>  <a href="http://www.ttl.fi/fi/tyoturvallisuus_ja_riskien_hallinta/henkilonsuojaimet/suojainratkaisuja/myyrakuume/Sivut/default.aspx">http://www.ttl.fi/fi/tyoturvallisuus_ja_riskien_hallinta/henkilonsuojaimet/suojainratkaisuja/myyrakuume/Sivut/default.aspx</a>
<b>France</b>	Fièvre hémorragique avec syndrome renal  Hantavirus	<a href="http://www.sante.gouv.fr/fievre-hemorragique-avec-syndrome-renal,348.html">http://www.sante.gouv.fr/fievre-hemorragique-avec-syndrome-renal,348.html</a> <a href="http://www.invs.sante.fr/Dossiers-thematiques/Maladies-infectieuses/Zoonoses/Hantavirus">http://www.invs.sante.fr/Dossiers-thematiques/Maladies-infectieuses/Zoonoses/Hantavirus</a>
<b>Germany</b>	Informationen zur Vermeidung von Hantavirus-Infektionen  Hantavirus-Erkrankungen. RKI-Ratgeber für Ärzte.	<a href="http://www.rki.de/DE/Content/InfAZ/H/Hantavirus/Merkblatt_PDF.pdf">http://www.rki.de/DE/Content/InfAZ/H/Hantavirus/Merkblatt_PDF.pdf</a> <a href="http://www.fli.bund.de/fileadmin/dam_uploads/tierseuchen/Hantaviren/Merkblatt_Hantavirus_Information_2010.pdf">http://www.fli.bund.de/fileadmin/dam_uploads/tierseuchen/Hantaviren/Merkblatt_Hantavirus_Information_2010.pdf</a> <a href="http://www.rki.de/DE/Content/Infekt/EpidBull/Merkblaetter/Ratgeber_Hantaviren.html?nn=2374512">http://www.rki.de/DE/Content/Infekt/EpidBull/Merkblaetter/Ratgeber_Hantaviren.html?nn=2374512</a>
<b>Greece</b>	Information about viral haemorrhagic fevers	<a href="http://www.keelpno.gr">http://www.keelpno.gr</a>
<b>Hungary</b>		No link available
<b>Kosovo</b>		No link available
<b>Latvia</b>	Hemorāģiskais drudzis ar nieru sindromu	<a href="http://www.spkc.gov.lv/file_download/612/Hemoragiskais_drudzis_ar_nieru_sindromu.pdf">http://www.spkc.gov.lv/file_download/612/Hemoragiskais_drudzis_ar_nieru_sindromu.pdf</a>
<b>Luxembourg</b>	Infection par le Hantavirus au Luxembourg.	<a href="http://www.stm.lu/wp-content/uploads/2012/06/infection_par_le_hantavirus_au_luxembourg_05_06_2012.pdf">http://www.stm.lu/wp-content/uploads/2012/06/infection_par_le_hantavirus_au_luxembourg_05_06_2012.pdf</a>
<b>Netherlands</b>	LCI-richtlijn Hantavirusinfectie	<a href="http://www.rivm.nl/Bibliotheek/Professioneel_Praktisch/Richtlijnen/Infectieziekten/LCI_richtlijnen/LCI_richtlijn_Hantavirusinfectie">http://www.rivm.nl/Bibliotheek/Professioneel_Praktisch/Richtlijnen/Infectieziekten/LCI_richtlijnen/LCI_richtlijn_Hantavirusinfectie</a>

Country	Title of document	Website
	Hantavirus	<a href="http://www.kiza.nl/node/653">http://www.kiza.nl/node/653</a>
<b>Norway</b>	Nephropathia epidemica	<a href="http://www.fhi.no/artikler/?id=82827">http://www.fhi.no/artikler/?id=82827</a>
<b>Poland</b>		No link available
<b>Portugal</b>		No link available
<b>Romania</b>	Metodologie de supraveghere a infectiei cu hantavirusuri 2012.	<a href="http://www.insp.gov.ro/cnscbt/index.php?option=com_docman&amp;task=cat_view&amp;qid=62&amp;Itemid=10">http://www.insp.gov.ro/cnscbt/index.php?option=com_docman&amp;task=cat_view&amp;qid=62&amp;Itemid=10</a>
<b>Serbia</b>	Hemoragijska groznica sa bubreznim sindromom (mišja groznica)	<a href="http://www.batut.org.rs/index.php?category_id=108&amp;month=6&amp;year=2012">http://www.batut.org.rs/index.php?category_id=108&amp;month=6&amp;year=2012</a>
<b>Slovakia</b>	Hantavírusy a hemoragická horúčka s renálnym syndrómom	<a href="http://www.uvzsr.sk/index.php?option=com_content&amp;view=article&amp;id=1563:hantavirusy-anhemoragicka-horuka-snrenalnym-syndromom&amp;catid=68:epidemiologia&amp;Itemid=76">http://www.uvzsr.sk/index.php?option=com_content&amp;view=article&amp;id=1563:hantavirusy-anhemoragicka-horuka-snrenalnym-syndromom&amp;catid=68:epidemiologia&amp;Itemid=76</a>
<b>Slovenia</b>	Mišja mrzlica oziroma Hemoragična mrzlica z renalnim sindromom (HMRS)	<a href="http://www.ivz.si/Mp.aspx?ni=78&amp;pi=6&amp;_6_id=996&amp;_6_PageIndex=0&amp;_6_groupId=-28&amp;_6_newsCategory=IVZ+kategorija&amp;_6_action&gt;ShowNewsFull&amp;pl=78-6.0">http://www.ivz.si/Mp.aspx?ni=78&amp;pi=6&amp;_6_id=996&amp;_6_PageIndex=0&amp;_6_groupId=-28&amp;_6_newsCategory=IVZ+kategorija&amp;_6_action&gt;ShowNewsFull&amp;pl=78-6.0</a>
<b>Spain</b>		No link available
<b>Sweden</b>	Sjukdomsinformation om sorkfeber	<a href="http://www.smittskyddsinstitutet.se/sjukdomar/sorkfeber/">http://www.smittskyddsinstitutet.se/sjukdomar/sorkfeber/</a>
<b>Switzerland</b>	Hanta-Virus-Infektionen	<a href="http://www.bag.admin.ch/themen/medizin/00682/00684/04983/index.html?lang=de">http://www.bag.admin.ch/themen/medizin/00682/00684/04983/index.html?lang=de</a>
<b>United Kingdom</b>	Hantavirus	<a href="http://www.hpa.org.uk/Topics/InfectiousDiseases/InfectionsAZ/Hantaviruses/">http://www.hpa.org.uk/Topics/InfectiousDiseases/InfectionsAZ/Hantaviruses/</a>

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[http://www.ulb.ac.be/sciences/use/documents/dobby/ziekten\\_dieren\\_ulb.pdf](http://www.ulb.ac.be/sciences/use/documents/dobby/ziekten_dieren_ulb.pdf).
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