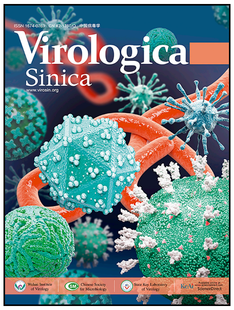

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Review

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Crimean-Congo hemorrhagic fever: An emerging threat in Europe

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Highlights

- Crimean-Congo hemorrhagic fever (CCHF) epidemiology and epizootiology was poorly defined in Europe.
- A total of 2,746 CCHF cases occurred from 1944 to 2024 in (non-Russian) Europe.
- Occasional or frequent outbreaks were recorded in 17 European countries, and CCHFV is likely present in 16 additional European countries.

Abstract

Crimean-Congo hemorrhagic fever (CCHF), caused by Crimean-Congo hemorrhagic fever virus (CCHFV), is endemic in Africa, Asia, and Europe. However, CCHF epidemiology and epizootiology have been poorly defined in Europe. Here, we summarize the current knowledge of CCHFV distribution in (non-Russian) Europe, including countries previously not considered to be at risk. We collected data on CCHF cases, human/vertebrate animal anti-CCHFV seroprevalence, CCHFV vector (*Hyalomma* tick), and CCHFV isolation from ticks and classified countries into five risk levels using a One Health approach. From 1944 through Feb 2025, more than 2,000 recorded CCHF cases were identified in Europe, mostly from southern/eastern countries/regions, primarily Bulgaria (at least 1,623), Kosovo (at least 339), Ukraine (at least 336), Croatia (at least 200), Albania (at least 146), and Republic of Moldova (at least 60). Albania, Bulgaria, Greece, Kosovo, and Spain were categorized as level 1 (reported CCHF cases, presence of robust surveillance systems). North Macedonia, Portugal, and Ukraine/Crimea were assigned to level 2 (reported CCHF cases in the absence of robust established surveillance). Bosnia and Herzegovina, Croatia, France, Hungary, Italy, Montenegro, Republic of Moldova, Romania, and Slovenia were assigned to level 3 due to evidence of CCHFV circulation in absence of recent CCHF cases. Thirty-four countries were assigned to level 4 (presence of *Hyalomma* ticks) or level 5 (no data). This work provides information on CCHFV distribution and burden with list of at-risk areas to inform international and local public health agencies to establish or strengthen surveillance systems.

Keywords

Europe, Crimean-Congo hemorrhagic fever, Crimean-Congo hemorrhagic fever virus (CCHFV), *Hyalomma*, tick, One Health

INTRODUCTION

Crimean-Congo hemorrhagic fever (CCHF) (ICD-11: 1D49; World Health Organization International Classification of Diseases 11th Revision, 2022) is an endemic (primarily *Hyalomma*) tick-borne viral disease in Africa, Asia, and Europe (Blair et al., 2019; Portillo et al., 2021; Temur et al., 2021; Bernard C. et al., 2022; Fereidouni et al., 2023). The etiologic agent of CCHF is Crimean-Congo hemorrhagic fever virus (CCHFV), a negarnaviricot bunyaviricete classified in hareaviral family *Nairoviridae* (species *Orthonairovirus haemorrhagiae*) (Kuhn J. H. et al., 2024a; Kuhn J. H. et al., 2024b). CCHF is designated by the World Health Organization (WHO) as a research and development priority disease, i.e., as a disease with greatest public health risk to be prioritized for research and development due to its pandemic potential and absence of sufficient medical countermeasures (World Health Organization, 2020). Likely circulating for many centuries (1391, حسن; Миндерер, 1825; 付滨 等, 2007; Mozafari et al., 2016), the disease was first described after a 1944–1945 outbreak on the Soviet Crimean Peninsula (Соколов и др., 1945).

Surveillance and early detection play a crucial role in managing CCHF outbreaks. Timely identification and reporting of cases enable public health authorities to promptly implement control measures, such as isolating and treating infected individuals and conducting tick vector control activities (Chinikar et al., 2010; Keshtkar-Jahromi et al., 2013; Fereidouni et al., 2023). Effective surveillance systems also help in identification of high-risk areas and populations, enabling implementation of targeted interventions (Dreshaj et al., 2016; Fereidouni et al., 2023). Regular monitoring of tick populations and viral activity is essential in predicting and preventing future outbreaks (Bartolini et al., 2019; Freitas et al., 2022).

This is the fourth article of a series focusing CCHF epidemiology and epizootiology. In the previous articles (Blair et al., 2019; Temur et al., 2021; Fereidouni et al., 2023), we outlined the distribution and expansion of CCHFV in Africa and Asia. Here, through a continuation of systematic analysis of literature that is frequently difficult to obtain and rarely indexed in common databases (Blair et al., 2019; Temur et al., 2021; Fereidouni et al., 2023), we extend this work to Europe (excluding the Russia Federation, which will be subject of a separate article).

DATABASE SEARCHING AND CRITERIA

We used the United Nations geoscheme (United Nations Statistics Division, 2020) for locational classifications: **Eastern Europe**—Belarus, Bulgaria, Czechia, Hungary, Poland, Republic of Moldova, Romania, Slovakia, and Ukraine/Crimea; **Northern Europe**—Denmark, Estonia, Faroe Islands, Finland, Guernsey, Iceland, Ireland, Isle of Man, Jersey, Latvia, Lithuania, Norway, Svalbard and Jan Mayen Islands, Sweden, United Kingdom of Great Britain and Northern Ireland, and Åland Islands; **Southern Europe**—Albania, Andorra, Bosnia and Herzegovina, Croatia, Gibraltar, Greece, Holy See (Vatican City), Italy, Kosovo, Malta, Montenegro, North Macedonia, Portugal, San Marino, Serbia, Slovenia, and Spain; **Western Europe**—Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, Netherlands, and Switzerland. Considering the Russian Federation's large geographical area and significant amount of data on CCHFV, the country was excluded here and will be evaluated separately. Note that Kosovo is considered part of Serbia by the United Nations but that virtually all CCHF cases and CCHFV isolation in Serbia were recorded in Kosovo. Hence, Kosovo is discussed separately in this article. The United Nations does not have a clear policy on Crimea. Data from Crimea will be discussed with Ukraine (Ukraine/Crimea) in this article. (The authors do not necessarily endorse or agree with the United Nations geoscheme.)

We searched Embase, GIDEON, Google Scholar, ProMED, PubMed, Scopus, and Web of Science for publications on CCHFV in Europe (1944 through Feb 2025). We also searched databases of national societies and libraries for related publications within each country. Further information was also gathered from conference presentations. We used Boolean combinations for searching, including "CCHFV", "CCHF", "CHF", "Crimean", "Crimean-Congo", "Congo-Crimean", "Congo virus", "Crimean hemorrhagic fever", "*Nairoviridae*", "nairovirus", and "orthonairovirus" or their non-English equivalents, based on each country's name (or previous names). We collected data on CCHF cases, human/vertebrate animal anti-CCHFV seroprevalence, CCHFV vector distribution, and CCHFV isolation from ticks. In regard to ticks, we concentrated on documentation of *Hyalomma* ticks, with a focus on *Hyalomma marginatum* Koch, 1844; *Hyalomma turanicum* Koch, 1844; and *Hyalomma rufipes* Koch, 1844 ticks because of their ability to transmit CCHFV transstadially, transovarially, and to vertebrates (Okely et al., 2020). In addition, we assessed whether a CCHF surveillance system is established within each country.

Our team developed and applied a One Health CCHFV evidence classification scheme, as laid out in prior publications, to each country (Blair et al., 2019; Temur et al., 2021; Fereidouni et al., 2023). Human, vertebrate animal, vector, and virus data were used in combination to identify CCHFV circulation. Countries were classified as follows: level 1—cases have been reported annually on a regular basis via a robust established surveillance system; level 2—cases have been reported intermittently in the absence of a robust established surveillance system; level 3—no recent cases have been reported and no surveillance has been conducted, but there is evidence of virus circulation (vertebrate animal/human serology or virus isolation from ticks); level 4— no CCHF cases have been reported, no surveillance system has been established, and there is no evidence of virus circulation, but *Hyalomma* ticks are present; and level 5—no data are available. For this study, we classified countries of Europe (excluding the Russian Federation) into the classification system based on the evidence acquired.

IDENTIFIED CCHF CASES AND CCHFV ENDEMIC EVIDENCE IN EUROPEAN COUNTRIES/REGIONS

The total identified CCHF cases per country are listed in **Table 1**; data grouped by type for each country can be found in **Table 2**.

Southern Europe

In Europe, most countries with CCHFV endemicity are in the South, primarily Kosovo (at least 339), Croatia (at least 200), and Albania (at least 146). The first CCHF case in Southern Europe was identified in Kosovo in 1954. Conversely, Greece, Portugal, and Spain reported their first CCHF cases within the last two decades (2008, 2024, and 2013, respectively). Despite evidence of CCHFV circulation in Bosnia and Herzegovina, Italy, Montenegro, and Slovenia, no human cases have been reported from these four countries. Considering the prevalence of *Hyalomma* ticks in Southern Europe and new CCHFV emergence in recent years, this region is at risk for future outbreaks.

Albania

The first CCHF case in Albania was recorded in 1985 (Eltari et al., 1987). During the period of 1985–2017, a total of at least 146 cases were reported in Albania. The country's CCHF surveillance system was strengthened in 2001 after an outbreak in the northern region during spring and summer (Papa A. et al., 2002). During 2002–2006, a total of 24 CCHF cases were identified, many in the municipality of Kukës, which is in the northern part of the country. Most cases were reported from northern Albania until 2010, when reemergence of CCHFV was observed near the southern border with Greece. Kukës and Has municipalities, two neighboring districts in northeast Albania, have reported outbreaks every 3–5 years. Endemic villages are located at an altitude of 600 meters above sea level with dense forests (Papa A. et al., 2009). The fact that CCHF cases have been reported in several other areas in the country suggests that CCHFV is most likely endemic throughout the country (Papa A. et al., 2002).

In Albania, any suspected case is reportable through surveillance system within 24 h. On average, three to 10 cases are reported annually (Papa A. et al., 2015). Each case is documented with demographic, clinical, and epidemiological data, as well as information about possible contacts and risk factors. During outbreak investigations, the case report and investigation forms are completed by the outbreak investigation team as part of the national database (Papa A. et al., 2015).

Several studies revealed anti-CCHFV antibodies in vertebrate animals sampled in different regions of Albania. For instance, in 2013, eight out of 154 cattle in the districts of Has, Kavajë, and Gjirokastër (Lugaj Arta et al., 2014b), six out of 104 cattle in the village of Tërpan (Berat County) and the town of Ersekë (in Korçë County) (Lugaj Arta et al., 2014a), 40 out of 92 cattle, goats, and sheep in Ersekë (Lugaj Arta et al., 2017a), 57 out of 100 sheep and goats in the town of Toroviçë (in Lezhë County) (Lugaj Arta et al., 2014c), and 43 out of 102 sheep in Korçë County (the city of Pogradec and the towns of Buzaishtë, Ersekë, Libonik, and Shqitas) and Lezhë County (the settlement of Ishull-Lezhë and the towns of Kolojak, Shëngjin, and Torovicë) (Lugaj Arta et al., 2017b) tested positive for CCHFV immunoglobulin G (IgG) by enzyme-linked immunosorbent assay (ELISA). Another study from 2013 revealed 15 of 337 antibody-positive cattle in 10 regions of northeastern, northern, western, eastern, southern, and southwestern in 2013 (Lugaj A. et al., 2014d).

H. marginatum ticks, the fundamental CCHFV vectors in Europe, are present in northern Albania (Kadriaj Perparim et al., 2018b), and *Rhipicephalus bursa* Canestrini & Fanzago, 1878 ticks have been associated with virus isolations in southern Albania (Sherifi et al., 2018).

Considering widespread reported CCHF cases, vertebrate animal seroprevalence, and tick distribution, large-scale continuous surveillance is needed to identify hot spots and understand CCHFV ecology, transmission dynamics, potential reservoirs, and vector distribution to implement preventive measures in endemic regions and at-risk populations.

Croatia

In 1993, The Armed Forces Management Board reported 200 CCHF cases in 1988 near Dubrovnik (10 fatalities; case-fatality rate of 5%) (Defense Pest Management Information Analysis Center, 1993). *H. marginatum* ticks are present in Croatia (European Centre for Disease Prevention and Control, 2021a). However, there are no additional data. Thus, the current CCHF status in Croatia is unclear. Establishment of a robust surveillance system for CCHF cases, vertebrate animal/human seroprevalence studies, and tick sampling for virus isolations is highly recommended for risk assessment.

Greece

Despite positive human serological data obtained in 1980 (Antoniadis and Casals, 1982), the first and only CCHF case was reported in 2008 in Alexandroupoli, located in north-eastern Greece (Papa A. et al., 2008b). At the same time, a cluster of CCHF cases occurred in Bulgaria near Alexandroupoli.

There is a wide range of anti-CCHFV antibody seroprevalence in Greece. A 1% positive human seroprevalence was measured during 1981–1988 in 27 regional units of Greece (15 in northern Greece, five in central Greece, four in southern Greece, one on the island of Corfu, and two on the island of Crete) (Antoniadis et al., 1990). In a seroprevalence study conducted just after the reporting of the CCHF case in 2008, a total of 1,178 residents from five regional units in northern Greece (Drama, Evros, Kavala, Rodopi, and Xanthi) were tested for anti-CCHFV IgG; 37 (3.14%) tested positive. Evros and Rodopi (where the CCHF case occurred) had the highest seroprevalence rates (4.95% and 4.49%, respectively), while Drama and Xanthi had the lowest (1.34% and 1.09%, respectively); no positive samples were found in Kavala (Papa A. et al., 2011c). Compared to prior study (1981–1988) (Antoniadis et al., 1990), this study indicated a significant increase in seroprevalence, suggesting that CCHFV might have been introduced or increased its circulation in various regions of Greece during recent decades. A combination of climatic and environmental changes, along with livestock movements leading to increased tick populations, could have contributed to this result (Maltezou et al., 2009). In 2010–2012, a 14.4% anti-CCHFV antibody seroprevalence in Thesprotia (a regional unit in northwestern Greece) was measured, the highest seroprevalence reported thus far. Thesprotia is well known for livestock (sheep, goats, and cattle) breeding. Shrubbery and herbaceous vegetation cover approximately one third of Thesprotia, providing a habitat for ticks and contributing to the spread of CCHFV (Papa A. et al., 2013). An additional study in the regional units of Imathia and Pella in 2010–2011 showed seroprevalence rates of 1.7% and 2.9%, respectively, mostly among farmers (Sidira et al., 2013). A spatial cluster analysis revealed an overall seroprevalence in Greece of 3.8% (range, 0–14.4%), with significant differences in the eastern and western areas of the country and showed that the seroprevalence was significantly affected by factors, such as elevation, vegetation type, proportion of woodlands and shrublands per person, and livestock density (Papa A. et al., 2016b).

To determine the anti-CCHFV antibody seroprevalence of CCHFV in livestock, samples were collected in Central Macedonia (Chalkidiki, Imathia, Kilkis, Pella, and Thessaloniki regional units) and Western Macedonia (Grevena, Florina, Kastoria, and Kozani regional units) in 2013. In Central Macedonia, 7% of cattle were seropositive (28 out of 396; 95% confidence interval [CI], 5%–10%); Chalkidiki presented the highest seroprevalence (38%; 95% CI, 23%–56%), while in Western Macedonia, 2% of cattle tested seropositive (3 out of 142; 95% CI, 1%–7%) (Schuster et al., 2017).

Although several human and vertebrate animal seroprevalence studies have suggested increased CCHFV activity in Greece, many cases with a CCHF-compatible clinical presentation have tested negative. It has been hypothesized that a low-virulence orthonairovirus strain might cause the IgG-seropositivity (Antoniadis and Casals, 1982; Maltezou et al., 2010; Papa A. et al., 2011c; Papa A. et al., 2016b).

During a 2012–2014 study, 2,000 ticks collected from livestock in Greece were tested for CCHFV (Papa A. et al., 2017a). Of the 1,290 tick pools (1–5 ticks per pool), 36 (2.8%) contained CCHFV; sequencing clustered into two genotypes, V (Europe 1) and VI (Europe 2). Genotype VI was recently reclassified as a distinct virus, Aigai virus (AIGV) (Kuhn Jens H. et al., 2021; Papa Anna et al., 2022). All CCHFV-positive ticks were *Rhipicephalus* spp. ticks; most genotype V sequences were obtained from *Rh. sanguineus sensu lato* ticks, while sequences of genotype VI were recovered from *Rh. bursa* ticks. Among all collected ticks, the *H. marginatum* population accounted for only 0.5%, and none of them harbored CCHFV. In contrast, *Rhipicephalus* spp. ticks accounted for 94.7%, and genotype VI was detected in *R. bursa* ticks. It is unclear whether *Rhipicephalus* ticks can or do serve as CCHFV vectors, thus further studies are needed to determine their role in the maintenance and transmission of CCHFV in Greece (Papa A. et al., 2017a).

Based on evidence, CCHFV is circulating in Greece, though clinical cases have not been reported in the numbers expected from prevalence data, perhaps due to the circulation of low-virulence virus strains (probably AIGV), low *H. marginatum* population and risk of exposure, and/or possibly varied human–environment interactions. Thus, increased CCHFV surveillance in humans, vertebrate animals, and ticks is highly recommended (Papa A. et al., 2011c; Sidira et al., 2013; Papa Anna et al., 2022).

North Macedonia

CCHFV circulation in North Macedonia is expected because of the country’s neighbors, i.e., Albania, Bulgaria, Greece, and Kosovo, where numerous CCHF cases are reported each year. The history of CCHF in North Macedonia goes back to the 1970s, when the first human cases were described (Hoogstraal, 1979; Defense Pest

Management Information Analysis Center, 1993). CCHFV strains Ciflik 1, 6, and 11 were isolated in 1973 from two *H. marginatum* ticks and one castor bean tick (*Ixodes ricinus* (Linnaeus, 1758)) near Tetovo, Polog Region (Gligić et al., 1977). Other than that, data were lacking until 2009, when an anti-CCHFV antibody seroprevalence of 80% in sheep and 75% in goats in the country's southeastern region were determined (Schuster et al., 2016). In 2011, 80% seroprevalence was found in cattle screened in North Macedonia's Northeastern Statistical Region (Mertens et al., 2015). CCHFV endemicity in North Macedonia is poorly studied. Nevertheless, at least 21 reported cases (three fatalities) were geographically distributed in the municipalities of Tetovo (1970s), Karbinci village (2010 and 2023), Skopje (2023), Veles (2023), Arachinovo, Kriva Palanka, and Delchevo (2024) (**Table 2**).

In 1960, North Macedonia (then as part of Yugoslavia) established a human surveillance system for reporting suspected cases of "hemorrhagic fever". In 2009, this system was refined for reporting suspected cases of CCHF, orthohantavirus infection and other hemorrhagic illnesses. Since 2011, the Institute of Public Health of the Republic of North Macedonia has strengthened its capacity to include detection of human CCHF infection via molecular and serological tests (personal communication). Recent CCHF cases have prompted national awareness and a need to strengthen the surveillance system, including early recognition of suspected cases by first-line clinicians and increasing awareness among the general population. It is highly recommended that human, vertebrate animal, and tick surveillance activities be intensified. Furthermore, preventative measures should be implemented or intensified to reduce risk of human infection in North Macedonia.

Kosovo

The first possible CCHF cases in Kosovo were reported from Nishor, in the District of Prizren, in 1954 (Heneberg Đorđe et al., 1968; Avšič-Županc, 2007). Since 1989, there have been CCHF outbreaks every 4 to 5 years (Humolli Isme, 2003; Ahmeti and Raka, 2006; Jameson et al., 2012b; Papa A. et al., 2015). CCHF is endemic in Kosovo's central and southwest regions, which are at low altitudes with higher temperatures and land mostly covered by bushes and farmed vegetation (Sherifi et al., 2014). Human seroprevalence of 4.0% (range 0–9.3%) (with the highest seroprevalence in the municipalities of Klina [9.3%], Rahovec, Gjakovë [9.0%], and Malisheve [7.1%]) was measured in 2012. Consistent with these data, vertebrate animal seroprevalence (cows [18.4%], goats [20%], and sheep [10%]) was reported in 2014 to be highest Malisheve and Rahovec (Fajs et al., 2014). In 2018, another study revealed high seroprevalence in vertebrate animals in Malisheve (24.7%) and Vushtrri (4.8%) municipalities, where CCHFV was not documented before (Zhabari Z. and Xhekaj, 2022).

A continental air mass influences the climate in Kosovo, resulting in comparatively cold winters, hot and dry summers, and transitional springs and autumns. These circumstances are favorable for *Hyalomma* ticks, and hence it is no surprise that *H. marginatum* ticks have been reported in Kosovo since at least 1967 (Heneberg Nada et al., 1967; Hoogstraal, 1979). During May and June 2012, ixodid ticks from seven species were collected from eight Kosovo municipalities (endemic and non-endemic). *H. marginatum* ticks were the majority (56.7%), followed by *I. ricinus* (30%), and *Rh. bursa* (10.7%). In the endemic municipalities, *H. marginatum* predominated (90.2%);

however, in the non-endemic regions, it accounted for only 24.3% of the collected ticks. Only 40 (3.6%) out of 1,102 ticks tested positive for CCHFV (all *H. marginatum*, *R. bursa*, and *I. ricinus*). The municipalities of Malisheve and Klina had the highest number of positive ticks (Sherifi et al., 2014). In another study, performed 2013–19, a total of 2,875 ticks were collected from livestock (cattle, goats, and sheep), and real-time reverse transcription polymerase chain reaction (RT-qPCR) tests detected CCHFV in 15 *R. bursa* ticks and four *H. marginatum* (19 total; 0.66%) (MBDC2023-Team, 2023).

In Kosovo, over the time period of 1954–2023, at least 339 CCHF cases have been documented with a very high case-fatality rate (25.5%) (Humolli I. et al., 2010; MBDC2023-Team, 2023), which might be explained by undiagnosed asymptomatic and mild cases confounding the case count, a circulating high-virulence CCHFV lineage, and/or genetics in the local human population (Fajs et al., 2014). Considering these data, Kosovo is a significant CCHFV hotspot and a contender for thorough study of virus ecology and potential conduct of vaccine and therapeutic trials (Fajs et al., 2014).

Since 1996, a WHO collaborating center in Ljubljana, Slovenia, has been supporting CCHFV surveillance in Kosovo (Duh et al., 2006). Also, Kosovo has a CCHF national advisory board and national laboratory for CCHFV surveillance (Fletcher et al., 2017). As of 2010, the Bernhard Nocht Institute of Tropical Medicine in Hamburg, Germany, has supported studies at the National Institute of Public Health in Prishtina using RT-qPCR and serology techniques (MBDC2023-Team, 2023) (personal communication). In 2013, the Inter-Ministerial Committee, led by the Ministry of Health in Kosovo, was established to raise public awareness about tick bite prevention, treat farm animals with acaricides to reduce tick populations, improve diagnostic capabilities, and strengthen biosecurity. Furthermore, under the German Biosecurity Programme (2013–2019), Kosovo public institutions implemented an action plan for preparedness and surveillance (MBDC2023-Team, 2023) (personal communication). Its main activities included the provision of equipment and training in biosecurity and biosafety, fieldwork, tick monitoring, and laboratory support [presented at the 2023 Medical Biodefense Conference (MBDC2023-Team, 2023)]. As an example, the municipality of Malisheve implemented a program in 2014 to treat farm animals with acaricides and educate the public about tick bite prevention and risks related to CCHFV infection (Zhabari Z. and Xhekaj, 2022). This program resulted in a significant reduction in CCHFV seroprevalence (20% in treated vs. 83% in untreated vertebrate animals) in Malisheve municipality (Zhabari Zenel, 2018). To control and prevent CCHFV's spread on a broader scale, health and veterinary institutions should establish an integrated surveillance program, including regular monitoring of ticks and domestic vertebrate animals for CCHFV infection in endemic and non-endemic areas.

Spain

In 2010, CCHFV was detected in *Hyalomma lusitanicum* Koch, 1844 ticks sampled in Province of Cáceres, Spain, marking the first isolation of the virus in this country (Estrada-Peña et al., 2012). In October 2011, a report by the Health Alert and Emergency Coordination Center (CCAES) from the Ministry of Health, Social Policy, and

Equality of Spain suggested the implementation of a multidisciplinary approach to monitor and contain CCHFV while indicating that the probability of human infection in Spain was low (Suárez et al., 2011). In August 2016, Spain's first CCHF case was reported in Province of Ávila, followed by a nosocomial transmission of the virus to a nurse taking care of the index patient (García Rada, 2016; Negredo et al., 2017). In 2018, a case was confirmed in Province of Badajoz, in western Spain (Negredo et al., 2021a). A total of 17 CCHF cases have been identified in Spain (2013–2024). Interestingly, viruses detected in ticks or causing human infection belong to different genotypes (I, III, IV, and V) (Monsalve Arteaga et al., 2021; Negredo et al., 2021a; Sánchez-Seco et al., 2022), indicating multiple introduction events.

CCHFV circulation in healthy people was first discovered in northwestern Spain in a serological investigation using samples from 516 randomly selected asymptomatic individuals during 2017–2018. Approximately one in five positive participants had occupations that placed at the risk for CCHFV exposure. Overall, 15.3% of the participants had a history of tick bite(s). In autonomous community Castilla and León, anti-CCHFV antibody seroprevalence had a range of 0.58%–1.16% (Monsalve Arteaga et al., 2020). In Province of Ávila, vertebrate animal seroprevalence was 58% in wildlife and 33% in domestic vertebrate animals in 2016. In autonomous communities Andalusia, Castile-La Mancha, Castilla and León, and Extremadura, as well as the city of Madrid, vertebrate animal seroprevalence was 2%–79% in wildlife and 4%–16% in domestic vertebrate animals in 2018. (Sierra et al., 2019). Vertebrate animal seroprevalence was 14% in the autonomous community of Catalonia (2014–2020) (Espunyes et al., 2021). In a 2022 wildlife vertebrate animal serology study in the Mediterranean forest ecosystem, anti-CCHFV antibody seroprevalence was close to 100% despite the absence of CCHF cases in the area (Welch et al., 2024). Active multidisciplinary tick surveillance confirmed CCHFV presence predominantly in *H. lusitanicum* ticks in most areas of Spain (Gargili et al., 2017; Mora-Rillo et al., 2018; Sánchez-Seco et al., 2022). The low number of reported CCHF cases suggests a low zoonotic risk despite widespread distribution of CCHFV. This discrepancy could be due to limited interaction of the human population with wildlife and their ticks but ultimately remains to be explained (Moraga-Fernández et al., 2021).

CCHFV may spread through the geographical movement of established vectors or introduction of new vectors adapted to cool and dry climates (López-Vélez and Molina Moreno, 2005; Gargili et al., 2017). Spain's proximity to Africa, potential as a rest stop for migrating birds, climate conditions, and livestock trading from non-European endemic regions likely contributed to the repeated introduction of CCHFV into the country (López-Vélez and Molina Moreno, 2005; England et al., 2016). CCHF awareness within the healthcare system and among frontline practitioners is crucial to improving CCHFV surveillance in Spain but remains limited (Negredo et al., 2021a), suggesting that many, if not most, CCHFV infections are undiagnosed.

Portugal

CCHF epidemiology and epizoology in Portugal have not been well-studied, despite the prevalence of CCHF in neighboring Spain and two human seropositivity reports in 1985 in southern Portugal (Filipe et al., 1985). In

2024, human cases revealed the susceptibility of Portugal to CCHF outbreaks and called for establishment of a robust CCHF surveillance system. The 2024 index case occurred in a rural area in the district of Braganca (central). At the time of admission, the 83-year-old patient was diagnosed with Mediterranean spotted fever and discharged with antibiotics. However, four days later, symptoms deteriorated, and the individual was readmitted to the hospital and IgG against Rickettsia was detected; the patient died six days later. Post-mortem serum samples were sent to the reference laboratory of the Portuguese National Institute of Health, where CCHFV infection was confirmed with PCR (Zé-Zé et al., 2024). This case illuminates a considerable threat to public health in Portugal posed by CCHFV.

Vertebrate animal seroprevalence investigations revealed positive results in domestic and wild animals in Portugal (Mesquita et al., 2022; Baz-Flores et al., 2024). In 2014, a nationwide seroprevalence survey of sentinel sheep (*n* = 459) from five regions of Portugal (north, center, Lisboa and Vale do Tejo, Alentejo, and Algarve) revealed two positive results in Alentejo, the southern region of Portugal, and a 0.4% overall seroprevalence (Mesquita et al., 2022). Another study also identified seropositive vertebrate animals in the northern and east-central regions of Portugal during the period 2006–2022. This cross-sectional study of wild boar (*Sus scrofa* Linnaeus, 1758) populations (each called a sounder) in Spain and Portugal tested 5,291 serum samples from 90 sounders using a specific double-antigen ELISA. The results revealed a total of 1,026 positive samples (from 57 sounders) across Spain and Portugal (Baz-Flores et al., 2024). Collectively, the recent CCHF case, positive vertebrate animal serology, and wide distribution of *Hyalomma* ticks highlight the need for surveillance and preventive measures to monitor and mitigate this risk in Portugal.

Eastern Europe

In Eastern Europe, Bulgaria has reported the most CCHF cases through a well-established surveillance system. Despite evidence of CCHFV circulation in Hungary, Republic of Moldova, and Romania, no recent human cases have been reported in these countries. *Hyalomma* ticks circulate in Czechia and Romania, but there is no evidence of CCHFV endemicity.

Bulgaria

In Eastern Bulgaria, the first likely CCHF outbreak on occurred in Razgrad and Kolarovgrad in 1944, possibly after introduction of tick-infested horses imported by Soviet forces during World War II (Иванов, 1960). Overall, a total of at least 1,623 cases have been identified in Bulgaria 1946–2023; most were reported from the southern (Plovdiv, Pazardzhik, Haskovo, and Kardzhali) and eastern (Shumen and Burgas) regions (Papa A. et al., 2004).

The first definitive case of CCHF in Bulgaria was recorded in 1951 near Stara Zagora (Неклюдов М., 1952; Митов, 1953; Дончев и др., 1965; Papa A. et al., 2004), followed by retrospective recognition of at least 10 possible cases from three areas during 1946–1952 (Миронов, 1953). CCHFV was first isolated in 1968 from the blood of two patients (Vasilenko, 1973; Hoogstraal, 1979). The Bulgarian Ministry of Health reported 1,105 cases during 1953–1974 (case-fatality rate of 17%) including 20 nosocomial infections (case-fatality rate of 52%) (Papa A. et al., 2004). After implementing a vaccination program in 1974, CCHF cases dropped to 279 during 1975–1996 (case-fatality rate of 11.4%) (Papa A. et al., 2004).

CCHF infection was considered rare in southwestern Bulgaria (Blagoevgrad Province) until 2008, when a cluster of cases were reported in early spring (Christova I. et al., 2009). Since then, this province has been reporting a substantial number of cases (Christova I. et al., 2013a). Recently, nearly all CCHF cases have been reported from five districts near the borders with Turkey and Greece: Burgas, Haskovo, Kardzhali, Yambol, and Blagoevgrad (Komitova et al., 2020). From 1997–2009, the incidence of CCHF increased significantly with increasing mean temperatures, vegetation density, savannah-type land coverage, and habitat fragmentation (Vescio et al., 2012). Most of Bulgaria, however, has a favorable ecological environment for CCHFV circulation (Hoogstraal, 1979; Christova I. S. et al., 2017b).

A nationwide human population study including 1,500 residents showed 3.7% anti-CCHFV antibody seropositivity in 20 out of 28 provinces in Bulgaria (Christova I. et al., 2017a). A history of tick bites, exposure to livestock, age over 40 years, and residing in Haskovo were found to be risk factors. In general, measured human seropositivity rates are directly related to the number of recorded CCHF cases in the surveyed areas.

Vertebrate animal seroprevalence and tick surveillance was performed in endemic and non-endemic areas of Bulgaria from 2006–2012. Overall, anti-CCHFV antibody seroprevalence was noted to be 7.89% (140 out of 1,775) for vertebrate animals (Gergova and Kamarinchev, 2013). CCHFV was found in 1.46% of ticks (9 out of 617), belonging to species *H. marginatum*, *Rhipicephalus sanguineus* (Latreille, 1806), and *I. ricinus*. Vertebrate animal seroprevalence was not significantly different between endemic and non-endemic districts. In all surveyed locations, the virus dispersed mosaically without significant variation over the years (Gergova and Kamarinchev, 2013). Even in districts without human cases, vertebrate animal seroprevalence had a range of 22.5%–55%, suggesting that CCHFV has spread far beyond the known endemic areas in Bulgaria and is circulating throughout most of the country (Christova I. et al., 2018). In another tick surveillance study, 2.01% of sampled ticks in Kardzhali, 4.83% in Haskovo, and 1.46% in Stara Zagora tested positive for CCHFV (Gergova et al., 2012). The National Center for Infectious and Parasitic Diseases of Bulgaria confirmed tick infestation of birds in non-endemic areas; *H. marginatum* was the second most common type of ticks found on migratory birds (Aleksandrova et al., 2021).

Bulgarian CCHFV surveillance is supported by the national reference laboratory in Bulgaria (Fletcher et al., 2017). During a CCHF outbreak in Gotse Delchev Municipality, Blagoevgrad Province, in 2008, a coordinated investigation was conducted by a team of epidemiologists, virologists, veterinarians, and clinicians from local health authorities, Ministry of Health, National Center for Infectious and Parasitic Diseases, and Sofia Hospital. Public and media attention in Bulgaria played a major role during the outbreak, and intense public training was implemented after the outbreak to prevent transmission. Numerous local meetings were held to educate staff and veterinary authorities. Public tick exposure was reduced by massive tick control measures applied to vertebrate animals and the environment (Kunchev and Kojouharova, 2008).

As part of preventive measures, an inactivated CCHFV vaccine has been used for military personnel, medical staff, and residents of endemic areas in Bulgaria since 1974 (Тодоров С. и др., 2001; Keshtkar-Jahromi et al., 2011). This vaccine was developed by the Soviet Union in suckling mouse brain cultures in the 1970s (Keshtkar-Jahromi et al., 2011). Initially, two doses were given (one on day 0 and one on day 30); a third dose was administered one year later, followed by a fourth dose five years later (Papa A. et al., 2004). Since vaccination program implementation, the number of cases has decreased, with no cases reported among military personnel who had received the vaccine (Papa A. et al., 2004; Keshtkar-Jahromi et al., 2011; Papa A. et al., 2011b). This decline might not be solely due to vaccination, because other factors (e.g., changes in ecology and epidemiology) may have also contributed (Papa A. et al., 2011b). The effectiveness of the vaccine remains disputed, and it is not licensed for use outside of Bulgaria.

Hungary

A human seroprevalence study conducted during 2008–2017 in Hungary revealed a 0.37% anti-CCHFV antibody seropositivity rate (10 out of 2,700) in healthy blood donors, with most positive samples coming from Hungary's western and central regions (Magyar et al., 2021). Wild rodent screening performed in 2011 and 2013 revealed that 20 out of 2,085 (0.96%) vertebrate animals had antibodies against CCHFV (Földes et al., 2019). In another study, CCHFV was detected in 12 out of 198 (6%) sampled European hares (Németh et al., 2013). A 2017 investigation identified 11 (8 out of 1,391 cattle and 3 out of 514 sheep) anti-CCHFV antibody-positive livestock of a total of 1,905 (0.58%) (cattle and sheep). Bács–Kiskun County was most affected with a seropositivity of 1.8% (3 out of 72 cattle and 3 out of 262 sheep) (Deézsi-Magyar et al., 2024).

In the 1970s, during a national survey for arbovirus foci in Hungary, two isolates of CCHFV were obtained from *I. ricinus* ticks (Molnár, 1982). There is limited published information about the occurrence and distribution of *Hyalomma* ticks in Hungary. However, *H. marginatum* nymphs were found engorged on a northern white-breasted hedgehog (*Erinaceus roumanicus* Barrett-Hamilton, 1900) in a Budapest city park (Földvári G. et al., 2011) and on European robins (*Erithacus rubecula* (Linnaeus, 1758)) in Duna-Ipoly National Park (Hornok et al., 2013). In September 2011, two *H. rufipes* ticks were found on two cows within eight days (Hornok and Horváth, 2012). In another study, in 2021, citizen scientists from all over the country submitted 137 specimens and several hundred photos of ixodid ticks within seven months. A specimen from a dog and another from a cow were morphologically identified as *H. marginatum* and *H. rufipes*, respectively (Földvári Gábor et al., 2022), indicated that *Hyalomma* ticks are broadly present in the country.

Together, these data indicate that CCHFV is endemic in Hungary, but that the circulating virus is not significantly virulent (possibly causing only subclinical infections) or that human exposure to CCHFV does not occur frequently (Németh et al., 2013).

Large-scale active surveillance is needed in Hungary to identify the public health risks associated with CCHFV. It is also recommended that genomic studies of the virus be conducted on a national level to determine the genetic diversity of CCHFV in the country. Surveillance must be conducted in an appropriate and effective manner to gain a better understanding of virus ecology, dynamics of transmission, potential reservoir hosts, and vectors (Földes et al., 2019). A continuous tick surveillance program would be beneficial, particularly in regions where CCHFV carrier ticks are more likely to be present (Braks et al., 2011).

Ukraine/Crimea

CCHFV was first identified in Crimea in 1944 (Grashchenkov, 1945; Колачев, 1945; Соколов и др., 1945; Чумаков М. П., 1946; Hoogstraal, 1979). Morbidity data from 1944 vary across reports, depending on whether the focus was solely on military cases or included both military and civilian cases (Hoogstraal, 1979). Nevertheless, estimates encompass remote rural areas lacking medical facilities, particularly in parts of the Kerch Peninsula, with at least 200 cases in 1944 (Чумаков М. П. и др., 1974a; Hoogstraal, 1979). The 1944 outbreak was attributed to environmental disturbances caused by disrupted agricultural activities and the prevalence of *H. marginatum* ticks on European hares and cattle (Домрачев, 1949; Hoogstraal, 1979). Approximately 100 CCHF cases were reported in the summer of 1945. The densities of hares, rodents, and *H. marginatum* ticks significantly decreased in 1945 (Гробов, 1946; Петрова-Пянтковская, 1947), leading to a decline in CCHF cases. Consequently, single and scattered cases were reported in Crimea during 1946–1969 (Чумаков М. П. и др., 1974a). The epizootiological study of the natural CCHF focus in Crimea in 1968–1969 revealed 14.8% positive agar gel diffusion precipitation test results of cattle and horse sera (unknown numbers) collected at breeding farms on the Kerch Peninsula (Александров and Кудрявцев, 1970). Later, during 1972–1973, a total of 33 CCHFV strains were isolated from five tick species from cattle in 11 areas (in central and eastern Kerch, the area in and around Sevastopol, and southern coastal areas) covering most of the Crimean territory (Чумаков М. П. и др., 1974a). A total of 33 isolates were obtained from 1,663 *H. marginatum* (28 positives; 57 pools), 33 *I. ricinus* (2 out of 3), 46 *Haemaphysalis punctata* Canestrini & Fanzago, 1878 (1 out of 4), 97 *Rh. bursa* (1 out of 2), and 132 *R. sanguineus* (1 out of 2) ticks. More recently, in 2015, a PCR test on a blood sample from a patient and 506 ixodid ticks from six administrative regions of the Crimean federal district (Alushta, Bakhchisarai, Belogorsk, Sudak, Yalta, and Simferopol regions) identified a new Crimea genetic subgroup (Vd) of the Europe 1 genotype for the first time. The positive ticks belonged to *H. marginatum* (6 samples) and *R. bursa* (4 samples) species collected from horses and cattle in the vicinity of the town of Luchistoe in the Alushta region (Куличенко и др., 2016).

The presence of CCHFV vectors or reservoirs in Ukraine suggests that human cases of febrile illnesses may be caused by CCHFV (Lozynskyi et al., 2020). In 1969, at least three CCHF cases were confirmed serologically in the Luhansk Oblast in eastern Ukraine (Примаков, 1971; Hoogstraal, 1979). One human serology study in the Lviv revealed 1.7% positive seroprevalence (Lozynskyi et al., 2020). CCHFV has been detected in ticks and small mammals (white-toothed shrews, voles, and other mouse-like rodents) in eastern, southern and central Ukraine

(Cherkasy, Donetsk, Ivano-Frankivsk, Kyiv, Luhansk, and Zaporizhzhia Oblasts) (Коваленко и др., 2006). In several oblasts, including Zakarpattia and Lviv (in the northwest, bordering Poland), CCHFV antigen has been detected in *Ixodes* ticks (Lozynskyi et al., 2020). Other regions of Ukraine are also prone to CCHF endemicity and future outbreaks. Despite the absence of systematic surveillance studies in Ukraine, historical investigations support the notion that CCHFV is widespread.

Considering information about Crimea (located in the south), Luhansk Oblast (in the east), and human seropositivity in the northwest, it can be hypothesized that CCHFV is widespread in all oblasts of Ukraine. There have been no recent CCHF cases, but there is no robust surveillance system and hence the absence of cases needs to be seen with caution. Robust seroprevalence and tick surveillance is needed to identify endemic areas within country. Diagnostic capabilities are needed to identify human cases.

Western Europe: France

Most CCHFV investigations in France focused on Corsica, an island in the southern part of the country, due to its suitable environment with agriculture, hunting, and hiking activities that increase the risk of exposure through human interaction with livestock and wildlife (Grech-Angelini et al., 2016b). Additionally, this area lies along a migratory bird route that creates a link between Africa and Europe by which infected ticks are transported (Hoffman et al., 2018). In 2014–2016, a seroprevalence study in cattle, goats, and sheep revealed a 9.1% anti-CCHFV antibody seropositivity rate (Grech-Angelini et al., 2020). Another study, conducted in 2022–2023, revealed 0.1% and 1% seropositivity in general and high-risk human populations, respectively. Among vertebrate animals (wild boar, roe deer, red deer, mouflon, and cattle), only cattle tested positive [No ticks tested positive for CCHFV (Welch et al., 2024)]. Furthermore, CCHFV circulation was detected in vertebrate animals in mainland France (Bernard Célia et al., 2025). A serosurvey of 8,609 cattle (2018–2022) and 2,182 wildlife (wild boar, mouflons, red deer, European roes, red foxes) (2008–2022) using ELISA and pseudo-plaque reduction neutralization (PPRN) in south-eastern France, spanning areas from Spain to Italy, with confirmed or potential *H. marginatum* presence, revealed seropositivity in both cattle (2.04%) and wildlife (2.25%). The highest cattle seroprevalence rates were found in the departments of Alpes-Maritimes (7.18%) and Pyrénées-Orientales (9.09%). Among wildlife, positive samples were detected in wild boar (*n* = 14), red deer (*n* = 18), roe deer (*n* = 13), and mouflon (*n* = 1). Notably, most positive wildlife (including wild boar, roe deer, and red deer) were hunted in Hautes-Prénées (Bernard Célia et al., 2025).

H. marginatum ticks in France were long thought to be limited to Corsica but were recently confirmed on the mainland (Grech-Angelini et al., 2016b; Vial et al., 2016). In 2022, an average of 30 ticks per location were collected from horses in four Mediterranean departments on the French mainland near Spain and, in 2023, ticks were collected from cattle in Pyrénées-Orientales. An RT-qPCR test was used to identify the tick species and detect the presence of CCHFV. In 2022, a total of 997 *H. marginatum* ticks were identified; 13 (1.3%) tested positive for CCHFV. In 2023, a total of 1,001 *H. marginatum* ticks were identified; 142 (14.2%) tested positive for CCHFV

(Bernard C. et al., 2024). In 2022 and 2023, CCHFV was detected in ticks collected from cattle in the southeast and central-western areas of Corsica (Kiwan et al., 2024).

The French Agency for Food, Environmental and Occupational Health & Safety (ANSES) called for nationwide surveillance of *Hyalomma* ticks as part of vector control measures. This scheme prioritizes at-risk geographical areas, early detection of *Hyalomma* ticks, and early detection of CCHFV in ticks, enabling risk prevention and management measures. In addition, healthcare professionals on the frontline of identifying indigenous human cases are being educated about CCHF (The French Agency for Food, 2023). Also, the program emphasizes the importance of research programs to improve understanding of *Hyalomma* tick epidemiology and spatial-temporal dynamics (The French Agency for Food, 2023). As part of the plan to control tick-borne diseases, the citizens making an invaluable contribution (CiTIQUE) program was created to conduct surveillance, which could be extended to include *Hyalomma* ticks. In this program, users record tick bites via a software application, can send ticks to a laboratory for further analysis, and populate a database that informs users about potential viral or bacterial infections (CiTIQUE, 2024).

In light of the fact that CCHFV is clearly present across France (Fanelli et al., 2023; Bernard C. et al., 2024; Bernard Célia et al., 2025), the absence of CCHF cases remains puzzling. Consequently, more investigations are needed in ticks and vertebrate animals, including humans, to clarify CCHFV circulation and biological properties, such as virulence.

Other countries

No other European countries reported autochthonous CCHF cases, and data on CCHFV for other countries are limited. However, there is some evidence of CCHFV circulation in Bosnia and Herzegovina, Italy, Montenegro, Republic of Moldova, Romania, and Slovenia (Table 2).

A total of 16 European countries have documented presence of *Hyalomma* ticks without CCHFV circulation (Austria, Belgium, Czechia, Finland, Germany, Luxembourg, Malta, Netherlands, Norway, Poland, San Marino, Serbia, Slovakia, Sweden, Switzerland, and United Kingdom of Great Britain and Northern Ireland). The environments of these countries are favorable for *Hyalomma* ticks and hence for CCHFV introduction or maintenance. Thus, accurate surveillance is needed to monitor tick populations.

There are 18 European countries that appear not to have studied distribution of *Hyalomma* ticks and/or circulation of CCHFV; the establishment of a systematic approach to studying the CCHF risk is strongly recommended for these countries.

DISCUSSION

This study is the fourth of our global CCHF mapping publication series (Blair et al., 2019; Temur et al., 2021; Fereidouni et al., 2023). In comparison to Asia and Africa, where CCHFV is a rather well-known endemic pathogen, it is only considered as an emerging and "exotic" pathogen in Europe. We have identified at least 2,746 CCHF reported cases from 1944 through September of 2024 in Europe (**Table 1**). Historically, most cases were reported in southern and eastern Europe, but CCHFV has apparently emerged in additional countries (Bosnia and Herzegovina, France, Italy, Portugal, Romania, Slovenia, and Spain) within the last decade. In all three examined regions of Europe (eastern, southern, and western), evidence of CCHFV circulation either by serology or virus isolation was found years before the first CCHF case was reported. Southern France escalated to a high risk level after CCHFV was isolated from ticks in April 2023, and vertebrate animal and human serology identified the virus in 2014. Consequently, the French public health system implemented measures to identify additional human infections. CCHFV endemicity in Portugal is not well studied. However, the potential for the virus to spread in Portugal has been demonstrated by a recent fatal autochthonous CCHF human case (Zé-Zé et al., 2024) as well as positive serology in vertebrate animal samples and the presence of competent tick vectors (**Table 2**). Many other countries in Europe (level 3) have been identified as at risk due to evidence of CCHFV circulation in absence of recent CCHF cases. Some countries (e.g., Croatia and Republic of Moldova) have records of CCHF cases decades ago but none since, and serological evidence of CCHFV circulation in Montenegro dates (only) to the 1970s (**Table 2**). It is unclear whether this lack of detection in recent decades is due to lack of diagnostic and/or surveillance capabilities or whether the virus has truly disappeared from these areas.

Several factors could have contributed to the spread of CCHFV in Europe. Suitable habitat expansion, likely due to climate change, for tick vectors, particularly *Hyalomma* ticks, is a major factor for increased CCHFV distribution (Gale et al., 2012; Hekimoglu et al., 2023). *Hyalomma* ticks have the potential to transmit CCHFV transstadially and transovarially to future tick generations in the area, thereby contributing to "silent" persistence of CCHFV in nature in the absence of suitable host and habitat and eventually leading to local reemergence or emergence in new areas. Additionally, movement of infected mammals (domestic and wild) and migratory birds contributes to the spread of ticks and virus (Spengler et al., 2016). The pivotal role of tick-infested migratory birds in importing CCHFV from Africa has been shown in Italy (De Liberato et al., 2018; Mancuso et al., 2022) and is a likely explanation for recent CCHFV discoveries in France and Spain. A niche modelling approach using occurrence data from the Global Biodiversity Information Facility (GBIF) to assess the ecological suitability of *H. marginatum* across Europe predicted a broad potential distribution spanning Western, Southern, Central, and Eastern Europe, extending as far north as the southern parts of Scandinavia, including Central European countries where these ticks are currently not thought to be native (Celina et al., 2023).

CCHF is also considered a threat to non-endemic and low-risk European countries via imported cases and is exacerbated due to ease of travel among countries within the Schengen Area. For instance, Germany reported two nosocomial CCHFV infections in 2009 due to an imported CCHF case (Conger et al., 2015), and, in 2012, 2014, and 2022, CCHF cases were imported into the United Kingdom from Afghanistan, Bulgaria, and Central Asia, respectively (Barr et al., 2013; Public Health England, 2014; UK Health Security Agency, 2022). The examples of imported cases highlight importance of healthcare education and diagnostic capacities even in non-endemic countries due to CCHFV's potential for human-to-human and nosocomial spread.

We applied the CCHF risk level classification we had established previously (Blair et al., 2019; Temur et al., 2021; Fereidouni et al., 2023) to (non-Russian) Europe (**Table 3**, **Fig. 1**). Accordingly:

1. Albania, Bulgaria, Greece, Kosovo, and Spain are considered level 1 due to CCHF cases and established diagnostic capabilities that enable rapid response during CCHF outbreaks. Albania, Bulgaria, and Kosovo have the highest number of cases but also have established surveillance infrastructures, which could enable the establishment of a network in the region. It would be beneficial for these countries to collaborate to improve their surveillance systems by establishing a diagnostic network and defining CCHF hotspots in eastern and southern Europe. Active surveillance for CCHFV must include tick fieldwork for improved understanding of tick distribution dynamics and serological testing of humans and vertebrate animals. In addition, improvement of health systems, education of communities about CCHF, and development of protective measures in high-risk areas should be priorities;
2. North Macedonia, Portugal, and Ukraine/Crimea are considered level 2, having reported cases intermittently, with evidence supporting CCHFV circulation. The Institute of Public Health in Skopje (North Macedonia) developed an action plan for improved surveillance of CCHF using a One Health approach in 2024. It is expected that the number of cases will gradually increase within the next couple of years. Support from international organizations, and close collaborations with neighboring countries and WHO Collaborating Centers is urgently needed to enhance data sharing and establish a diagnostic network for further improvement of CCHF surveillance. Portugal is also considered level 2 due to the recent fatal human case. Further investigation is highly recommended to determine the risks and future potential outbreaks in Portugal. Ukraine/Crimea are classified level 2 due to the 2013 and 2015 human cases in Crimea as well as CCHFV circulation in different regions. Further investigations under a robust surveillance system umbrella are highly recommended to determine human, vertebrate animal, and tick infection and implement preventive measures in high-risk areas in Ukraine/Crimea;
3. Bosnia and Herzegovina, Croatia, France, Hungary, Italy, Montenegro, Republic of Moldova, Romania, and Slovenia are considered level 3, i.e., to be at risk of experiencing CCHF cases emergence due ongoing CCHFV circulation. These countries would benefit from the establishment of robust surveillance systems to monitor and investigate human infections, as well as perform systematic studies to determine the epizootiology of CCHFV and management of likely future CCHF outbreaks;
4. Austria, Belgium, Czechia, Finland, Germany, Luxembourg, Malta, Netherlands, Norway, Poland, San Marino, Serbia, Slovakia, Sweden, Switzerland, and United Kingdom of Great Britain and Northern Ireland are considered level 4 due to presence of *Hyalomma* ticks in absence of CCHFV circulation. It would be

beneficial for these countries to conduct tick surveillance studies to validate the nonendemicity of CCHFV; and

5. Andorra, Belarus, Denmark, Estonia, Faroe Islands, Gibraltar, Guernsey, Holy See, Iceland, Ireland, Isle of Man, Jersey, Latvia, Liechtenstein, Lithuania, Monaco, Svalbard and Jan Mayen Islands, and Åland Islands are considered level 5 because of absence of data regarding CCHFV and because most of these countries are located in northern Europe, which has a cold and humid climate that is not considered a suitable habitat for *Hyalomma* ticks.

Our study has some limitations. First, we searched for articles that had been indexed in public databases. Therefore, there is a possibility that we missed data, such as those published exclusively in (potentially not publicly available) government reports or articles that are not indexed in the databases we used or those that were not retrieved using the selected keywords. Second, weights were assigned equally to all studies in each category (isolation of virus, human and other vertebrate animal serological testing). However, there is considerable variation among and within countries in the applied methods and accuracy of reported data, resulting from different diagnostic standards. Third, variations in surveillance intensity over time and across species can result in inconsistent CCHFV detection. Such inconsistencies may delay responses to emerging threats, overlook subclinical human cases, and heighten the risk of unnoticed outbreaks. Finally, artificial geographic boundaries have no impact on ecology or transmission of CCHFV; however, there may be significant differences among adjacent ecological niches and ecotypes. It is possible that CCHFV may be considered endemic in two countries, one with a uniform distribution of the virus and another with only one hotspot. Our precautionary assumption was that countries neighboring CCHFV-endemic countries would be endemic as well, but perhaps that is not the case. As a next step, our current risk assessment study could be fine-tuned via extensive ecological niche modelling, integrating diverse spatial data (e.g., climate, environment, tick, animal and human population) in collaboration with other agencies to design a comprehensive predictive niche model.

CONCLUSIONS

CCHF is an emerging public health concern in Europe with the potential to cause severe outbreaks in previously unaffected areas. Understanding the epidemiological and epizootiological trends and patterns of CCHFV and the factors contributing to its spread is essential in developing effective prevention, response, and containment strategies. High-risk countries should be prioritized for expanding diagnostic capabilities and surveillance tools. Collaborative efforts and establishing a CCHFV community network in Europe will be of paramount importance for establishment of improved surveillance systems and public awareness campaigns that are crucial to get ahead of, and possibly prevent, future catastrophes.

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Figure legends

Fig. 1. An approach based on One Health to understand CCHF burden in Europe. The circulation of CCHFV is confirmed in countries of lower levels (1 and 2), but further investigation and increased surveillance are recommended for countries of higher levels (3, 4, and 5). CCHFV distribution within a country is unlikely to be accurately reflected by its boundaries. However, given that CCHFV activity is a priority, even a single area of focus within a country requires the involvement of the entire nation (Country boundaries are not guaranteed to represent the geographical area at risk and they are not necessarily endorsed by the authors.). CCHF, Crimean-Congo hemorrhagic fever; CCHFV, Crimean-Congo hemorrhagic fever virus.

Table 1. Minimum of total identified Crimean-Congo hemorrhagic fever cases in (non-Russian) European countries (1944–2024)

Country	Total confirmed cases	Total deaths	Year(s)	References
Albania	111 + 35*	1	1985, 1986–1990*, 2001, 2003, 2002–2006, 2003–2006, 2013–2015, 2017**	(Eltari et al., 1987; Papa A. et al., 2002; Harxhi et al., 2005; Papa A. et al., 2006; Papa A. et al., 2007b; Papa A. et al., 2008a; Zehender et al., 2013; Biberaj, 2015; Dreshaj et al., 2016; Krasniqi and Bino, 2016b; Krasniqi and Bino, 2016a; Muco et al., 2018; Ndreu et al., 2018)
Bulgaria	1,623	525 (1953–2013)	1946–2023	(Hoogstraal, 1979; Papa A. et al., 2004; Christova I. et al., 2009; Christova I. et al., 2010; Kalvatchev and Christova, 2012; Vescio et al., 2012; Christova I. et al., 2013b; Lumley et al., 2014; Papa A. et al., 2016a; Петрова, 2016; Papa A. et al., 2018a; Komitova et al., 2020; European Centre for Disease Prevention and Control, 2021b; Kevorkyan et al., 2022; European Centre for Disease Prevention and Control, 2023a)
Croatia	200	10	1988	(Defense Pest Management Information Analysis Center, 1993)
Germany	1*** + 2	0	2009	(Conger et al., 2015)
Greece	1	1	2008	(International Society for Infectious Diseases, 2008; Papa A. et al., 2010)
North Macedonia	21	3	1970, 1976, 2010, 2023, 2024	(Stamatović et al., 1971; Vesenjak-Hirjan et al., 1991; Defense Pest Management Information Analysis Center, 1993; Jakimovski et al., 2023; Boshevska et al., 2024; Welch et al., 2024; Бошевска и др., 2024)
Portugal	1	1	2024	(Zé-Zé et al., 2024)
Republic of Moldova	60	?	1946–1947, 1958–1959	(Hoogstraal, 1979)
Kosovo	339	65	1954–2014, 1954–1967, 1970, 1995–2014, 2001–2011, 2013–2015, 2013–2016, 2017–2023 (personal communication)	(Hoogstraal, 1979; Papa A. et al., 2015; Sherifi et al., 2018; Ahmeti et al., 2019; Korva et al., 2019; Rackow et al., 2019)
Spain	17	4	2013–2024	(Negredo et al., 2017; International Society for Infectious Diseases, 2020b; International Society for Infectious Diseases, 2020a; International Society for Infectious Diseases, 2021; Negredo et al., 2021a; Negredo et al., 2021b; International Society for Infectious Diseases, 2022; Lorenzo Juanes et al., 2023)
Ukraine/Crimea	336	27	1944, 1945-1947, 1949, 1969, 2013, 2015	(Колачев, 1945; Домрачев, 1949; Примаков, 1971; Hoogstraal, 1979; Куличенко и др., 2016)
United Kingdom of Great Britain and Northern Ireland	3***	0	2012, 2014, 2022	(Barr et al., 2013; Public Health England, 2014; UK Health Security Agency, 2022)
Total	2,746	637	1944–2024	1944–2024

Notes: * Suspected cases. ** Year unclear. *** Imported cases, not included in total case count. CCHF, Crimean-Congo hemorrhagic fever; CCHFV, Crimean-Congo hemorrhagic fever virus.

Table 2. Evidence supporting Crimean-Congo hemorrhagic fever virus endemicity in European countries/regions.

Country	CCHF cases reported (year)	Human serology year (positive%)	Nonhuman vertebrate serology year (positive%)	*Hyalomma* ticks	CCHFV isolation or detection in ticks (year)	Risk level
Albania	1985 (Eltari et al., 1987), 1986–1990* (Dreshaj et al., 2016), 2001 (Papa A. et al., 2002; Harxhi et al., 2005; Zehender et al., 2013), 2003–2010 (Papa A. et al., 2007b; Papa A. et al., 2008a; Zehender et al., 2013; Biberaj, 2015), 2013–2015 (Krasniqi and Bino, 2016b; Krasniqi and Bino, 2016a), 2017 (Muco et al., 2018; Ndreu et al., 2018)	1985–1989 (ND), (Eltari et al., 1987; Eltari et al., 1993), 2003–2006 (17.6%, 32.2%) (Papa A. et al., 2006; Papa A. et al., 2007a)	2003 (20%) (Papa A. et al., 2009), 2010–2014 (4%, 5.5%, 57%, 4.4%, 23%, 43.4%, 42.1%, 67.1%) (Lugaj Arta et al., 2014a; Lugaj Arta et al., 2014b; Lugaj Arta et al., 2014c; Lugaj A. et al., 2014d; Schuster et al., 2016; Lugaj Arta et al., 2017a; Lugaj Arta et al., 2017b; Kadriaj P. et al., 2018a)	Yes (Eltari et al., 1987; Papa A. et al., 2017b; Kadriaj Perparim et al., 2018b; Sherifi et al., 2018)	2007–2015 (Papa A. et al., 2017b; Sherifi et al., 2018)	1
Andorra	ND	ND	ND	ND	ND	5
Austria	ND	ND	ND	Yes (Duscher et al., 2018; Duscher et al., 2022)	ND	4
Belarus	ND	ND	ND	ND	ND	5
Belgium	ND	ND	ND	Yes (European Centre for Disease Prevention and Control, 2023b)	ND	4
Bosnia and Herzegovina	ND	ND	2018–2019 (14.9%, 9.65%) (Goletic et al., 2022; Satrovic et al., 2022), 2021 (14.9%) (Goletic et al., 2022)	Yes (Omeragic, 2011; Goletic et al., 2022; Omeragić et al., 2022; European Centre for Disease Prevention and Control, 2023b)	2019 (Goletic et al., 2022), 2021 (Goletic et al., 2022)	3
Bulgaria	1946–2021 (Неклюдов М., 1952; Миронов, 1953; Митов, 1953; Неклюдов М. Ю. and Бохосян, 1954; Василенко и др., 1971; Василенко и др., 1972a; Vasilenko, 1973; Hoogstraal, 1979; Монев, 1994; Papa A. et al., 2004; Christova I. et al., 2009; Комитова и др., 2010; Kalvatchev and Christova, 2012; Vescio et al., 2012; Christova I. et al., 2013b; Единакова и др., 2013; Lumley et al., 2014; Дойчева и др., 2014; Papa A. et al., 2016a; Панайотова Е. Ж., 2016; Петрова, 2016; Papa A. et al., 2018a; Komitova et al., 2020; European Centre for Disease Prevention and Control, 2021b; Kevorkyan et al., 2022; European Centre for Disease Prevention and	1954–1972 (30.7%, 10.4%, 10%, 5.1%, 5.9%, 65.7%) (Василенко и др., 1968; Василенко, 1971; Василенко и др., 1971; Василенко и др., 1972b; Vasilenko, 1973; Hoogstraal, 1979), 2008–2012 (2.7%, 2.4%, 3.1%) (Christova I. et al., 2013a; Christova I. et al., 2013b; Gergova and Kamarinchev, 2014), 2014–2015 (3.4%, 3.6%) (Панайотова Е. Ж., 2016; Christova I. et al., 2017a)	1968–1972 (50%, 36.4%, 11.4%, 29.2%) (Василенко и др., 1968; Василенко, 1971; Василенко и др., 1971; Vasilenko, 1973), 1974 (85.7%) (Mertens et al., 2016), 2006–2014 (7.8%, 71.9%, 26%) (Gergova and Kamarinchev, 2013; Barthel et al., 2014; Mertens et al., 2016), 2014–2015 (17.8%, 18.3%) (Панайотова Е. Ж., 2016; Christova I. et al., 2018), 2017** (71.9%) (Christova I. S. et al., 2017b), 2022** (23.3%) (Belij-Rammerstorfer et al., 2022)	Yes (Дренски, 1960; Тодоров Тодор и др., 1966; Чумаков М. П. и др., 1968; Леви, 1972; Леви and Василенко, 1972; Георгиева и др., 1990; Панайотова Е. and Христова, 2015; Панайотова Е. Ж., 2016)	1968–1972 (Василенко и др., 1971; Vasilenko, 1973; Hoogstraal, 1979), 1990** (Kamarinchev et al., 1991), 2006–2010 (Gergova et al., 2012; Gergova and Kamarinchev, 2013), 2010–2014 (Панайотова Е. and Христова, 2015; Panayotova et al., 2016; Hua et al., 2020), 2017** (Christova I. S. et al., 2017b),	1

	Control, 2023a), 2022–2023 (personal communications)					
Croatia	1988 (Defense Pest Management Information Analysis Center, 1993)	ND	ND	Yes (Vesenjak et al., 1975; Krčmar, 2012; Krčmar et al., 2022)	ND	3
Czechia	ND	ND	ND	Yes (Hubálek et al., 2020; Lesiczka et al., 2022; European Centre for Disease Prevention and Control, 2023b)	ND	4
Denmark	ND	ND	ND	ND	ND	5
Estonia	ND	ND	ND	ND	ND	5
Faroe Islands	ND	ND	ND	ND	ND	5
Finland	ND	ND	ND	Yes (Nuorteva and Hoogstraal, 1963; Hoogstraal, 1979; European Centre for Disease Prevention and Control, 2023b)	ND	4
France	ND	2022–2023 (0.1%) (Welch et al., 2024)	2008–2023 (9.1%, 2.3%, 2%) (Grech-Angelini et al., 2020; Welch et al., 2024; Bernard Célia et al., 2025)	Yes (Rageau, 1972; Macaigne and Perez-Eid, 1993; Morel, 2003; Grech-Angelini et al., 2016a; Vial et al., 2016; European Centre for Disease Prevention and Control, 2021a; Reynard et al., 2021; Bah et al., 2022; Bernard C. et al., 2022; Bernard C. et al., 2024; Kiwan et al., 2024)	2022–2024 (Bernard C. et al., 2024; Kiwan et al., 2024)	3
Germany	2009*** (Conger et al., 2015)	ND	ND	Yes (Kampen et al., 2007; Rumer et al., 2011; Chitimia-Dobler et al., 2016; Chitimia-Dobler et al., 2019)	ND	4
Gibraltar	ND	ND	ND	ND	ND	5
Greece*****	2008 (International Society for Infectious Diseases, 2008; Papa A. et al., 2008b; Papa A. et al., 2010)	1980–1988 (6.1%, 1%) (Antoniadis and Casals, 1982; Antoniadis et al., 1990), 2008–2012 (3.1%, 4.2%, 14.4%, 2.1%, 6%) (Papa A. et al., 2004; Sidira et al., 2012; Papa A. et al., 2013; Sidira et al., 2013; Papa A. et al., 2014)	2012–2013 (50%, 5.1%) (Papa A. et al., 2014; Schuster et al., 2017), 2015 (42.1%) (Papa A. et al., 2018b)	Yes (Pavlidou et al., 2008; Papa A. et al., 2011a; Hoffman et al., 2021)	1978 (Antoniadis and Casals, 1982), 2012–2015 (Papa A. et al., 2014; Papa A. et al., 2018b), 2017** (Fernández de Mera et al., 2017)	1
Guernsey	ND	ND	ND	ND	ND	5
Hungary	ND	1972–1975 (2.8%) (Horváth Lidia B., 1976), 2019** (0.3%) (Magyar et al., 2021)	1972–1973 (3.4%, 2.8%) (Horváth Sándorné, 1974; Хорват, 1975), 2008–2009 (6%) (Németh et al., 2013), 2011–	Yes (Hornok and Horváth, 2012; Földvári Gábor et al., 2022; Földvári G. et al., 2024)	1972 (Molnár, 1982)	3

			2013 (0.9%) (Földes et al., 2019), 2017 (0.5%) (Deézsi-Magyar et al., 2024)			
Iceland	ND	ND	ND	ND	ND	5
Ireland	ND	ND	ND	ND	ND	5
Isle of Man	ND	ND	ND	ND	ND	5
Italy	ND	ND	2021 (1.8%) (Fanelli et al., 2022)	Yes (Manilla, 1982; Mancini et al., 2013; De Liberato et al., 2018; Mancuso et al., 2019; Pascucci et al., 2019; Battisti et al., 2020; Rollins et al., 2021; Toma et al., 2021)	2017–2019 (Mancuso et al., 2019; Mancuso et al., 2022)	3
Jersey	ND	ND	ND	ND	ND	5
Kosovo	1954–2016 (Hoogstraal, 1979; Defense Pest Management Information Analysis Center, 1993; Avsic-Zupanc et al., 1999; Ђокић и др., 2000; Tegnell et al., 2001; World Health Organization, 2001; Avšič-Županc et al., 2002; Boutin et al., 2002; Drosten et al., 2002; Humolli Isme, 2003; Ahmeti and Raka, 2006; Ramadani et al., 2007; Thomas et al., 2012; Самарджич и др., 2012; Ahmeti et al., 2014; Ajazaj-Berisha et al., 2014; Papa A. et al., 2015; Ahmeti et al., 2019; Korva et al., 2019; Rackow et al., 2019; Ajazaj-Berisha et al., 2025), 2017–2023 (personal communications)	1995–2009 (6.8%, 5.3%) (Tomanović et al., 1996; Humolli I. et al., 2010), 2012–2016 (3.9%, 5%) (Fajs et al., 2014; Emmerich et al., 2021)	2008 (3.7%) (Sherifi et al., 2016), 2012 (16.2%, 10.9%) (Fajs et al., 2014; Dreshaj et al., 2016), 2018 (17.1%) (Zhabari Z. and Xhekaj, 2022)	Yes (Heneberg Nada et al., 1967; Heneberg Đorđe et al., 1968; Hoogstraal, 1979; Fajs et al., 2014; Sherifi et al., 2018; European Centre for Disease Prevention and Control, 2023c)	2001 (Duh et al., 2006), 2012–2019 (Sherifi et al., 2014; Sherifi et al., 2018; MBDC2023-Team, 2023)	1
Latvia	ND	ND	ND	ND	ND	5
Liechtenstein	ND	ND	ND	ND	ND	5
Lithuania	ND	ND	ND	ND	ND	5
Luxembourg	ND	ND	ND	Yes (European Centre for Disease Prevention and Control, 2023b)	ND	4
Malta	ND	ND	ND	Yes (European Centre for Disease Prevention and Control, 2023b)	ND	4
Monaco	ND	ND	ND	ND	ND	5
Montenegro	ND	ND	1970 (ND) (Stamatović et al., 1971)	ND	ND	3
Netherlands	ND	ND	ND	Yes (Uiterwijk et al., 2021; European Centre for Disease	ND	4

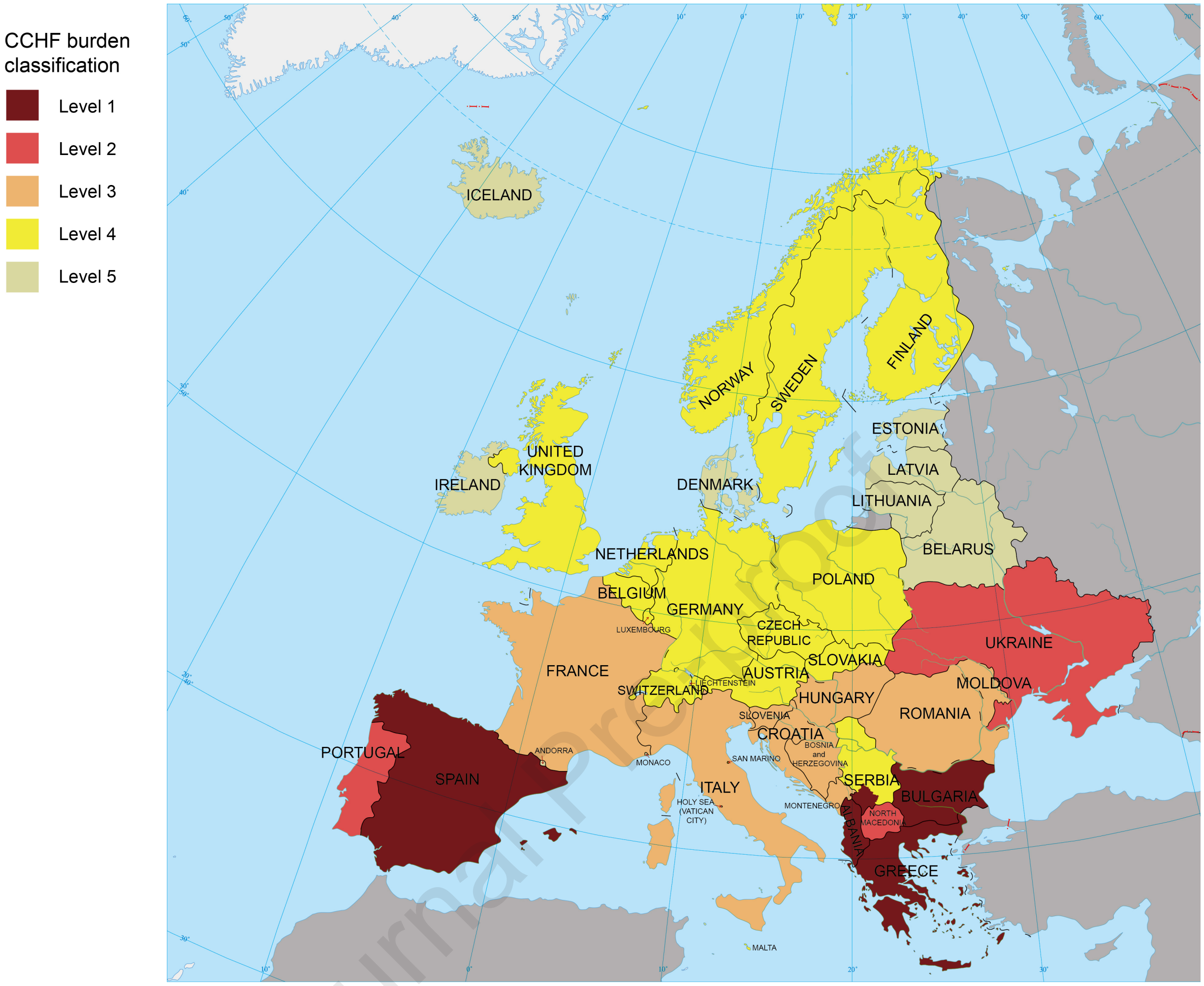
				Prevention and Control, 2023b)		
North Macedonia	1970 (Stamatović et al., 1971; Defense Pest Management Information Analysis Center, 1993), 1976 (Vesenjak-Hirjan et al., 1991), 2010 (Welch et al., 2024), 2023 (Jakimovski et al., 2023; Boshevska et al., 2024; Бошевска и др., 2024), 2024 (Jakimovski et al., 2025)	2023 (7.6%) (Jakimovski et al., 2025)	2009–2011 (14%, 14.5%, 49%) (Obradović et al., 1978; Mertens et al., 2015; Schuster et al., 2016), 2023 (58.8%) (Jakimovski et al., 2025)	Yes (Obradović, 1985; Mertens et al., 2015)	1973 (Gligić et al., 1977)	2
Norway	ND	ND	ND	Yes (European Centre for Disease Prevention and Control, 2023b)	ND	4
Poland	ND	ND	No (Bażanów et al., 2017)	Yes (Siuda, 1991; European Centre for Disease Prevention and Control, 2023b)	No(Bażanów et al., 2017)	4
Portugal	2024 (Zé-Zé et al., 2024)	1985 (0.7%) (Filipe et al., 1985)	2006–2022 (0.4%, 19.3%) (Mesquita et al., 2022; Baz-Flores et al., 2024)	Yes (European Centre for Disease Prevention and Control, 2023b)	ND	2
Republic of Moldova	ND	ND	ND	Yes (Чумаков М. П. и др., 1974b)	1973–1974 (Чумаков М. П. и др., 1974b), 1978** (Скофертца и др., 1978)	3
Romania	ND	ND	2008 (27.8%) (Ceianu et al., 2012), 2019–2020 (37.6%) (Bratuleanu et al., 2022)	Yes (European Centre for Disease Prevention and Control, 2023b)	ND	3
San Marino	ND	ND	ND	Yes (European Centre for Disease Prevention and Control, 2023b)	ND	4
Serbia	ND	ND	ND	Yes (European Centre for Disease Prevention and Control, 2023c)	ND	4
Slovakia	ND	ND	ND	Yes (Capek et al., 2014)	ND	4
Slovenia	ND	1992** (0.08%) (Avsic-Zupanc et al., 1992; Avšič-Županac et al., 1995)	Yes (Petrovec et al., 2004)	Yes (Trilar, 2014)	ND	3
Spain	2013–2022 (García Rada, 2016; International Society for Infectious Diseases, 2016a; International Society for Infectious Diseases, 2016b; International Society for Infectious Diseases, 2017a; Negredo et al., 2017; International Society for Infectious Diseases, 2018; Mora-Rillo et al., 2018; International Society for Infectious Diseases, 2020b;	2017–2018 (0%, 21.1%, 2.2%) (Latasa et al., 2020; Monsalve Arteaga et al., 2020; Monsalve Arteaga et al., 2021), 2023 (0.6%) (Lorenzo Juanes et al., 2025)	2005–2022 (1.3%, 43.4%, 59.6%, 25.4%, 19.3%, 40.9%, ND) (Sierra et al., 2019; Espunyes et al., 2021; Carrera-Faja et al., 2022; Cuadrado-Matías et al., 2022a; Cuadrado-Matías et al., 2022b; Baz-Flores et al., 2024; Welch et al., 2024)	Yes (Gale et al., 2010; Hubálek and Rudolf, 2012; Palomar et al., 2016; Hoffman et al., 2021; Castillo-Contreras et al., 2022; Cuadrado-Matías et al., 2022a; Vieira Lista et al., 2022; Cuadrado-Matías et al., 2024)	2010–2018 (International Society for Infectious Diseases, 2011; Estrada-Peña et al., 2012; Cajimat et al., 2017; International Society for Infectious Diseases, 2017b; Negredo et al., 2019; Moraga-Fernández et al., 2021; Sánchez-Seco et al., 2022)	1

	International Society for Infectious Diseases, 2020a; International Society for Infectious Diseases, 2021; Monsalve Arteaga et al., 2021; Negredo et al., 2021a; Negredo et al., 2021b; International Society for Infectious Diseases, 2022; European Centre for Disease Prevention and Control, 2023a; Lorenzo Juanes et al., 2023), 2024 (Álvarez, 2024)					
Svalbard and Jan Mayen Islands	ND	ND	ND	ND	ND	5
Sweden	ND	ND	ND	Yes (Jaenson et al., 1994; Grandi et al., 2020)	ND	4
Switzerland	ND	ND	ND	Yes (European Centre for Disease Prevention and Control, 2023b)	ND	4
Ukraine/Crimea	1944–1947 (Домрачев, 1949; Hoogstraal, 1979), 1969 (Примаков, 1971), 2013 (Куличенко и др., 2016), 2015 (Куличенко и др., 2016)	1986–1989 (0.4%) (Маркешин и др., 1992b), 2020** (1.6%) (Lozynskyi et al., 2020)	1968–1969 (ND)(Александров and Кудрявцев, 1970), 1972–1973 (1.3%) (Чумаков М. П. и др., 1974a), 1984–1992 (0.2%) (Маркешин и др., 1992a)	Yes (Hoogstraal, 1979; Akimov and Nebogatkin, 2011; Celina et al., 2023)	1945–1946 (Чумаков М. П. и др., 1974a), 1972–1973 (Чумаков М. П. и др., 1974a; Маркешин и др., 1992b), 2015 (Куличенко и др., 2016)	2
United Kingdom of Great Britain and Northern Ireland	2012*** (Barr et al., 2013), 2014*** (Public Health England, 2014), 2022*** (UK Health Security Agency, 2022)	ND	ND	Yes (Martyn, 1988; Jameson et al., 2012a; Hansford et al., 2019; McGinley et al., 2021)	ND	4
Åland Islands	ND	ND	ND	ND	ND	5

Notes: * Suspected or confirmed cases. ** Year uncertain. *** Imported CCHF cases. **** A retrospective diagnosis was made in 2020 for the patient. ***** Aigai virus, previously referred to as CCHFV genotype VI, is now classified as a distinct virus (Papa Anna et al., 2022) and is not considered here. CCHF, Crimean-Congo hemorrhagic fever; CCHFV, Crimean-Congo hemorrhagic fever virus; ND, no data available.

Table 3. Evidence-based classification of European countries/regions

Level 1	Albania, Bulgaria, Greece, Kosovo, Spain
Level 2	North Macedonia, Portugal, Ukraine/Crimea
Level 3	Bosnia and Herzegovina, Croatia, France, Hungary, Italy, Montenegro, Republic of Moldova, Romania, and Slovenia
Level 4	Austria, Belgium, Czechia, Finland, Germany, Luxembourg, Malta, Netherlands, Norway, Poland, San Marino, Serbia, Slovakia, Sweden, Switzerland, and United Kingdom of Great Britain and Northern Ireland
Level 5	Andorra, Belarus, Denmark, Estonia, Faroe Islands, Gibraltar, Guernsey, Holy See, Iceland, Ireland, Isle of Man, Jersey, Latvia, Liechtenstein, Lithuania, Monaco, Svalbard and Jan Mayen Islands, and Åland Islands


CCHF burden classification
Level 1
Level 2
Level 3
Level 4
Level 5
ICELAND
NORWAY
SWEDEN
FINLAND
ESTONIA
LATVIA
LITHUANIA
BELARUS
UNITED KINGDOM
IRELAND
DENMARK
NETHERLANDS
BELGIUM
LUXEMBOURG
GERMANY
POLAND
CZECH REPUBLIC
SLOVAKIA
UKRAINE
MOLDOVA
AUSTRIA
LIECHTENSTEIN
SWITZERLAND
FRANCE
HUNGARY
ROMANIA
SLOVENIA
CROATIA
BOSNIA and HERZEGOVINA
SERBIA
BULGARIA
MONTENEGRO
NORTH MACEDONIA
ALBANIA
GREECE
ITALY
SAN MARINO
MONACO
HOLY SEA (VATICAN CITY)
ANDORRA
PORTUGAL
SPAIN
MALTA

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