Austral Journal of Veterinary Science

Austral J Vet Sci 56, 35-40 (2024)
https://doi.org/10.4206/ajvs.561.02

SHORT COMMUNICATION

The 2022 Crimean-Congo Hemorrhagic Fever outbreak in Iraq

Karima Akool Al Salihi[1*], Mohammed Hassan Younise[2], Zakaria Zuhair Mahmoud[3], Tanveer Hussain[4]

[1] Department of Internal and Preventive Veterinary Medicine, College of Veterinary Medicine, Al Muthanna University, Iraq.

[2] Colleague Arabian Board of Family Medicine, Polyclinic of Public Health, Al- Hussain Teaching Hospital, Al Muthanna Governorate, Iraq

[3] General Surgery, Al-Hussain Teaching Hospital, Al Muthanna Governorate, Iraq.

[4] Department of Molecular Biology & Biotechnology, Virtual University of Pakistan, Islamabad, Pakistan.

Article History
Received: 05.03.2023
Accepted: 28.08.2023
Published: 02.01.2024

Corresponding author
*Karima Akool Al Salihi
kama-akool18@mu.edu.iq
Kama_akool18@yahoo.co.uk

ABSTRACT. Crimean-Congo Hemorrhagic fever (CCHF) is an endemic, zoonotic, viral, and tick-borne disease that causes hemorrhagic symptoms. The disease has been reported in Iraq since 1979 comprising six cases between 1989 and 2009. Subsequently, 11, 3, and 33 cases were reported in 2010, 2018, and 2021, respectively. This study describes the 2022 Crimean-Congo Hemorrhagic fever virus (CCHFV) outbreak in different Iraqi governorates. In the 2022 outbreak, 212 cases of human CCHFV were reported between January 1 and May 22. These included 97 (46%) cases confirmed by reverse transcriptase polymerase chain reaction (RT-PCR) and 115 (54%) suspected cases. Most human cases have been reported for livestock breeders and butchers. Approximately half of the confirmed cases (48%) were reported in the Dhi Qar governorate, whereas the others were reported in Missan, Muthanna, Wasit, Diwaniya, Karkh/Baghdad, Rusafa/Baghdad, Kirkuk, Basra, Najaf, Nineveh, Babylon, and Karbala. Patients with CCHFV showed symptoms of the pre-hemorrhagic phase, including sudden fever, anorexia, vomiting, diarrhea, headache, nose bleeding, and abdominal and joint pain. Later, hemorrhagic symptoms started with unexplained bleeding lesions, ranging from small petechiae to large hematomas. The factors responsible for the re-emergence of CCHFV included a shortage of veterinary services during the COVID-19 pandemic and illegal slaughtering of animals outside the abattoirs. This led to massive tick infestations that acted as viral vectors.

In conclusion, this is the first report documenting the 2022 CCHFV outbreak in Iraq, with a total of 212 patients and 27 overall deaths, including 13 laboratory-confirmed cases. The authors recommend improving veterinary services provided to farmers. Additionally, future studies need to be done including the sero-epidemiology and molecular studies on local livestock and ticks to understand their roles in circulating the virus to humans.

Keywords: CCHFV; Iraq; Dhi Qar; Tick; Zoonotic

INTRODUCTION

Crimean-Congo Hemorrhagic fever (CCHF) is a severe zoonosis with a mortality rate of up to 40%. This is a tick-borne viral disease. This pathogen belongs to the *Nairoviridae* family within the Bunyavirales order, formerly Bunyaviridae. It is a single-stranded, spherical enveloped RNA virus (Kuehnert *et al.*, 2021; Hawman & Feldmann, 2018; Emmerich *et al.*, 2018). CCHF virus is commonly transmitted to humans through tick bites, tick crushing, or contact with infected human secretions, such as blood and tissues or blood from symptomatic infected animals (Moraga-Fernández *et al.*, 2021; Monsalve *et al.*, 2021; Gruber *et al.*, 2019).

The disease was first reported in Crimea in the 1940s by Soviet military workers after occupying Crimea (Casals, 1969). Then, an antigenically identical virus was diagnosed in the Belgian Congo (currently named the Democratic Republic of Congo) in the 1960s. Hence, the disease was named Crimean–Congo Hemorrhagic fever. Until the Autumn of 1979, Iraq was free from CCHF, but it has been endemic for approximately 50 years. The first CCHF case was recorded on September 3, 1979, and subsequently nine patients were reported (Al-Tikriti *et al.*, 1981; Al Salihi *et al.*, 2023).

The causative agent was isolated from the patient's blood and *post mortem* liver samples and was antigenically closely related to other members of the CCHF virus group (Tantawi *et al.*, 1980). Since the fourth quarter of 1979, Iraq has been considered a CCHF endemic country, as it is located at the heart of eastern Mediterranean countries. Since then, multiple outbreaks of CCHF have been reported between 1989 and 2009. Additionally, 11 cases, 3 fatal cases, and 33 confirmed cases (including 13 deaths and 39% fatalities) were reported in 2010, 2018, and 2021, respectively. Sixteen cases have been reported in the Dhi Qar governorate, resulting in seven deaths in 2021 (Aamir, 2022).

In 2015, Iraq had an enormous population of large and small ruminants, estimated at 16.432, 1.885, 3.172, 0.395, and 0.11 million heads of sheep, goats, cattle, buffalo, and camels, respectively, according to the Food and Agriculture Organization (FAO) Statistics Division (FAOSTAT, 2015). Annually, the products of these animals, such as milk, meat, wool, and skin, contribute to approximately 50% of Iraq's agricultural gross domestic product (Al-Salihi, 2012). Ticks are important vectors or pathogenic agents

and have also led to health problems in Iraqi livestock, such as stress, tick-borne diseases, tick paralysis, dermatitis, anemia, and secondary infections (Al-Salihi *et al.*, 2018). According to Hoogstraal & Kaiser (1958), there are 21 ticks from several genera in Iraq, including *Argas*, *Ornithodoros*, *Haemaphysalis*, *Hyalomma*, *Ixodes*, and *Rhipicephalus*. Many researchers have reported heavy tick infestations in livestock during various seasons; however, higher infestations were reported in July and lower in May, according to previous studies (Hassan & Simpson, 1981; Shamsuddin & Mohammad, 1988).

Previous studies have acknowledged that ticks, mainly Hyalomma species, which is the principal vector of CCHF, and *Rhipicephalus* and *Haemaphysalis* (Hasson & Al-Zubaidi, 2014; Mohammad, 2016; Mallah & Rahif, 2016), commonly infest animals in Iraq. A literature review of various Medline platforms including PubMed, ProQuest, EBSCOhost, Web of Science, and Ovid regarding the distribution of tick species showed a scarcity of publications on CCHF outbreaks, especially in Iraq. This suggests that limited research has been conducted on CCHF outbreaks in Iraq, highlighting the need for further investigation and surveillance.

Therefore, this study was designed to study the occurrence of the 2022 CCHF Crimean-Congo Hemorrhagic fever outbreak in Iraq, based on its relation to heavy tick infestation in livestock and hospital records.

MATERIALS AND METHODS

In early January 2022, suspected human CCHF cases were reported to the World Health Organization (WHO) by the authorities of the Iraqi Ministry of Health. A cross-sectional study was conducted on 212 human CCHFV cases reported in various Iraqi Governorates. Data on this outbreak, including information on all patients, were extracted from their medical records and analyzed. The number and percentage of infected humans are reported for each governorate. Based on the World Health Organization's resources, the standard definition of a CCHF-suspected case is, "An individual with a quick onset of illness, with high grade fever of > 38.5 ºC, for more than 72 hours, for < 10 days, in a CCHF endemic region, who was in contact with livestock." During this outbreak, numerous criteria were considered to diagnose the suspected cases of CCHF. These included sudden fever accompanied by thrombocytopenia (< 50.000 / mm3), hemorrhagic symptoms, including nosebleeds (epistaxis), gum bleeding, petechial or purpuric rashes, hematemesis, hemoptysis, melena, ecchymosis, hematuria, and other hemorrhagic manifestations.

All CCHFV-suspected patients who showed these symptoms were hospitalized in separate CCHFV wards and Intensive Care Units. Blood samples were collected from all (212) cases reported during the outbreak. The samples were sent immediately to the Central Public Health Laboratory (Baghdad) and handled under maximum biological containment conditions because the CCHF patient samples present an extreme biohazard risk. Active CCHFV infection was detected by amplification of CCHFV 5RNA or by capturing CCHFV-specific IgM or IgG titrations following the acute phase of infection (WHO, 2019; WHO, 2018; Gupta *et al.*, 2017; Drosten *et al.*, 2003).

In Iraq, Scenario 1 was used to detect CCHF cases. This protocol was established by the WHO R&D Blueprint, a roadmap priority to serve as a bridge to target the product profile (TPP) for diagnosing CCHF. These scenarios were established for acute and early detection of the disease during outbreaks. The WHO and CCHF Roadmap strategic priorities were updated and validated in 2018 and 2019 for rapid, simple-to-use, and easily accessible diagnostics to enable effective medical intervention and reduce deaths and morbidity from CCHF.

Serum samples were inactivated prior to nucleic acid extraction and amplification to ensure specimen handling safety. Viral RNA was extracted from the serum samples according to the manufacturer's instructions (Geneaid, South Korea). The RT-PCR oligonucleotide sequences and primers for the detection of CCHFV genes were performed according to the WHO-validated kit (CCHFV RNA, validated for Eurasian clades IV-VII). The RT-PCR test provides the maximum detection sensitivity for active infection at the earliest possible time (WHO, 2019; WHO, 2018; Gupta *et al.*, 2017; Yilmaz *et al.*, 2008; Drosten *et al.*, 2003).

Multiple field visits were conducted during the CCHFV outbreak to examine tick distribution, especially in areas where disease cases were reported.

RESULTS AND DISCUSSION

The total number of cases was 212, of which 165 (80%) were reported during April and May 2022. Among the 212 cases, 115 were suspected and 97 were laboratory-confirmed. Additionally, there were 27 deaths, of which 13 were laboratory-confirmed cases, with a case fatality ratio (CFR) of 13% (13/97). The history of these cases showed that most were people who had direct contact with animals, such as livestock, breeders, and butchers. Additionally, more than half of the confirmed patients were 15–44 years old (n = 52; 54%) and male (n = 60; 62%).

The results of RT-PCR showed that approximately 50% of the confirmed cases (n = 47; 48%) were reported in Dhi Qar, including eight deaths. The rest of the cases were reported from Missan (13), Muthanna (7), Wassit (6), Diwaniya (4), Karkh/Baghdad (4), Kirkuk (3), Basra (3), Najaf (3), Nineveh (3), Rusafa/Baghdad (2), Babylon (1), and Karbala (1) (Figure 1).

Most patients experience a sudden onset of fever and bleeding from the nose accompanied by anorexia, vomiting, diarrhea, headache, abdominal pain, and joint pain during the first stage. Later, the patient had a sudden onset

of hemorrhagic manifestation, starting with unexplained bleeding and lesions ranging from small petechiae to large hematomas. Bleeding in the uterus and gastrointestinal, respiratory, and urinary tracts has also been observed in some patients. Additionally, the deadliest CCHFV cases suffered from multifunctional failure, including hepatitis, rapid kidney deterioration, and sudden liver or respiratory failure that led to death.

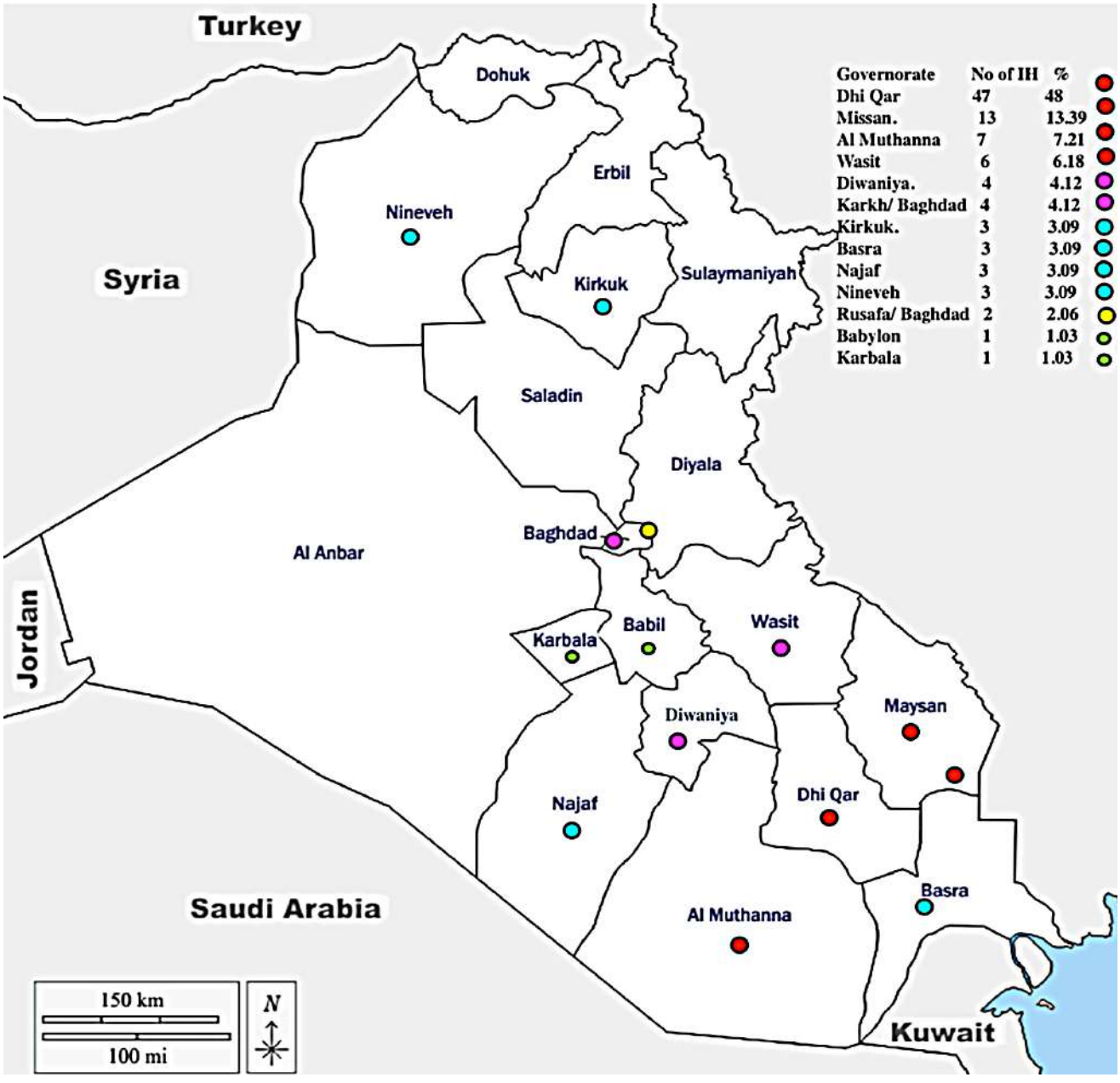

Figure 1.
Map of Iraq with the number of Infected Human (N° of IH) of CCHF and the percentage of infection in different Iraqi governorates during the 2022 outbreak.

Field visits to farmers during the CCHFV outbreak have revealed an enormous number of ticks. Most animals suffered from heavy tick infestations, which promoted the distribution of tick-borne diseases (Figure 2). Acaricide campaigns were initiated in villages, rural areas, and areas where farm animals were sold from May 1, 2022, to May 31, 2022, to control tick multiplication by all veterinary hospitals in the Iraqi governorates. Despite these procedures, CCHFV cases continued in different regions of Iraq, especially the DhiQar Governorate.

Figure 2.
A heavily infested calf with ticks from an area where a patient with CCHF was reported.

The current outbreak created fear in the people, especially those who worked with the livestock, and they called it "the deadly nose-bleed fever disease," because most patients showed bleeding from the nose.

The current CCHFV outbreak in Iraq between January 2022 and June 2022 was primarily associated with tick bites. According to WHO's representative in Iraq (https://www.al-monitor.com/originals, 2022), huge tick multiplication was one of the postulations for the current attack. The heavy spread of ticks occurred because of the absence of livestock spraying campaigns during the coronavirus pandemic in 2020 and 2021.

The heavy tick population is a well-recognized risk factor, and its features are similar to those of previous CCHFV outbreaks scrutinized in Iraq (Ali, 2020) and worldwide (Sánchez-Seco *et al.*, 2021; Yagci-Caglayik *et al.*, 2014; Mertens *et al.*, 2013; Ozkurt *et al.*, 2006; Karti *et al.*, 2004; Chapman *et al.*, 1991). However, global warming has also extended the period of tick multiplication. Geographically, Iraq is an eastern Mediterranean country where CCHFV

is endemic, and outbreaks are becoming more frequent. Several CCHFV outbreaks were reported between 1989 and 2009. Furthermore, 11 and 33 confirmed cases, including 13 deaths (39% fatalities), were reported in 2010, 2018, and 2021. Additionally, 16 cases were reported in the DhiQar governorate, resulting in seven deaths in 2021. There are similarities between the 2022 and 2021 CCHF outbreaks. In 2021, the disease was reported in week 19, with 45 cases resulted in nine deaths, including five laboratory-confirmed deaths. The 2021 outbreak revealed that the number of cases peaked at weeks 27 (four cases) and 38 (four cases). Nonetheless, most of the 2021 cases were from DhiQar (10), Ninewa (2), Erbil (3), Baghdad (3), Babel (2), Diyala (1), and Anbar (1). Regarding sex, the ratio of males to females was 1.2:1, indicating that more males than females were affected by the disease. However, no cases have been reported among healthcare workers. The 2021 outbreak was recorded in the southern governorates during the summer months, from July to November. However, the authorities mentioned that the illegal slaughtering of animals outside the abattoirs contributed to the spread of the disease.

The clinical signs reported in the current outbreak were similar to those reported by other researchers (Appannanavar & Mishra, 2011; Yilmaz *et al*., 2008; Ergonul, 2006). Most cases have an incubation period ranging from three to seven days, and they develop severe early clinical signs, followed by various hemorrhagic lesions (Avšič-Županc, 2007; Golden *et al*., 2022). The current outbreak is a recurrent remerging of CCHFV infection in Iraq. However, the number of recorded cases was unprecedented. The high number of infected individuals is attributed to several factors including the lack of veterinary services during the COVID-19 pandemic. Additionally, a new retirement law at the age of 60 ended the jobs of many veterinarians, which led to reduced veterinary services provided to farmers by government sectors. This adversely affects livestock health. Furthermore, since 1989, the Iraqi government has stopped employing graduate veterinarians in different sectors, especially in the Ministry of Agriculture. These actions have created vacant places and an apparent lack of veterinary services for farmers in most Iraqi governorates.

CONCLUSION

A new outbreak of CCHF was reported in Iraq in 2022 with 212 patients, including 115 suspected and 97 laboratory-confirmed cases, with 27 overall deaths, including 13 laboratory-confirmed cases (case fatality ratio, 13%; 13/97). RT-PCR was performed to confirm the diagnosis. Authorities must provide veterinary services to control ticks, the CCHFV vector, and regulate the illegal slaughtering of animals outside abattoirs. Seroepidemiological and molecular studies must be conducted in livestock to understand their role in circulating the virus in humans. More studies are needed on ticks, which are viral vectors.

DECLARATIONS

Competing interest statement

The authors declare that they have no conflicts of interest.

Ethics statement

This study was approved by the Research and Animal Ethics Committee of the College of Veterinary Medicine, Al Muthanna University, 2022.

Author contributions

Karima provided the concepts, data analysis, and writing of the manuscript; Mohammed worked with data collection and analysis; Zakaria worked with data collection and analysis; and Hussain revised the manuscript and analyzed the data.

Funding

This study was funded by the authors and was not supported by any other funding sources.

Acknowledgements

The authors would like to thank the Ministry of Health for providing the data on the CCHFV outbreak.

REFERENCES

Al-Mosawi, A. J. (2022). Crimean-Congo hemorrhagic fever in Iraq (2018-2022) and an educational review. *Biomedical and Biotechnological Sciences. 1*(1). http://dx.doi.org/10.5281/zenodo.6874121

Ali, H. M. (2020). Epidemiological Profile of Crimean-Congo Hemorrhagic Fever, Iraq, 2018; Epidemiology Conference. August 10-11, 2020. London, UK. *Journal of Health and Medical Research*, S(2). https://www.iomcworld.org/articles/epidemiological-profile-of-crimean-congo-hemorrhagic-fever-iraq-2018.pdf

Appannanavar, S. B., & Mishra, B. (2011). An update on Crimean Congo Hemorrhagic Fever. *Journal of global infectious diseases*, *3*(3), 285–292. https://doi.org/10.4103/0974-777X.83537

Al-Salihi, K. A. (2012). An insight into veterinary education in Iraq. *The Veterinary Record*, *171*(13), 316–317. https://doi.org/10.1136/vr.e5145

Al-Salihi, K. A., Karim. A. J., Jasim, H. J., & Kareem, F. A. (2018). Epidemiology of Ticks Fauna of Camels in Samawah Desert. *Advances in Animal and Veterinary Sciences*, *6*(8), 311-316. http://dx.doi.org/10.17582/journal.aavs/2018/6.8.311.316

Al Salihi K. A., Mahmoud Z. Z., Younise M. H., & Hussain, T. (2023). Review on Crimean-Congo Hemorrhagic fever with Special focus on Iraqi outbreaks (2022). *Mirror of research in veterinary Sciences and animals. 12*(1), 1-44. https://dx.doi.org/10.22428/mrvsa-2023-00121-01

Al-Tikriti, S. K., Al-Ani, F., Jurji, F. J., Tantawi, H., Al-Moslih, M., Al-Janabi, N., Mahmud, M. I., Al-Bana, A., Habib, H., Al-Munthri, H., Al-Janabi, S., Al-Jawahry, K., Yonan, M., Hassan, F., & Simpson, D. I. (1981). Congo/Crimean haemorrhagic fever in Iraq. *Bulletin of the World Health Organization*, *59*(1), 85–90 PMCID: PMC2396030

Avšič-Županc, T. (2007). Epidemiology of Crimean–Congo hemorrhagic fever in the Balkans. In: Ergonul O, Whitehouse CA (Eds.). *Crimean–Congo hemorrhagic fever. A global perspective* (pp. 75-88). Springer Dordrecht, Netherlands. https://doi.org/10.1007/978-1-4020-6106-6

Casals, J. (1969). Antigenic similarity between the virus causing Crimean hemorrhagic fever and Congo virus. *Proceedings of the Society for Experimental Biology and Medicine*, *131*(1), 233–236. https://doi.org/10.3181/00379727-131-33847

Chapman, L. E., Wilson, M. L., Hall, D. B., LeGuenno, B., Dykstra, E. A., Ba, K., & Fisher-Hoch, S. P. (1991). Risk factors for Crimean-Congo hemorrhagic fever in rural northern Senegal. *The Journal of Infectious Diseases*, *164*(4), 686–692. https://doi.org/10.1093/infdis/164.4.686

Niazi, A., & Al-kaabi Q. (2022). Deadly nose-bleed fever shocks Iraq as cases surge. *Al-Monitor*. https://www.al-monitor.com/originals/2022/05/deadly-nose-bleed-fever-shocks-iraq-cases-surge

Drosten, C., Kümmerer, B. M., Schmitz, H., Günther, S. (2003). Molecular diagnostics of viral hemorrhagic fevers. *Antiviral Research*, *57*, 61–87.

FAOSTAT. FAO Statistics Division. (2015). Available online: http//www.fao.

org/faostat/en/#data (Accessed on 04 June 2022).
Emmerich, P., Jakupi, X., von Possel, R., Berisha, L., Halili, B., Günther, S., Cadar, D., Ahmeti, S., & Schmidt-Chanasit, J. (2018). Viral metagenomics, genetic and volutionary characteristics of Crimean-Congo hemorrhagic fever orthonairovirus in humans, Kosovo. Infection, genetics and evolution. *Journal of Molecular Epidemiology and Evolutionary Genetics in Infectious Diseases*, *65*, 6–11. https://doi.org/10.1016/j.meegid.2018.07.010
Ergonul, O. (2006). Crimean–Congo haemorrhagic fever. *The Lancet. Infectious Diseases. 6*(4), 203-14.
Gruber, C. E. M, Bartolini, B., Castilletti, C., Mirazimi, A., Hewson, R., Christova, I., Avš ič, T., Grunow, R., Papa, A., Sánchez-Seco, M. P., Kopmans, M., Ippolito, G., Capobianchi, M. R., Reusken, C. B. E. M., & Di Caro, A. (2019). Variability affects CCHFV detection by RT-PCR: a tool for in-silico evaluation of molecular assays. *Viruses*, *11*, 953. https://doi.org/10.3390/v11100953
Gupta, E., Agarwala, P., Kumar, G., Maiwall, R., & Sarin, S.K. (2017). Point -of -care testing (POCT) in molecular diagnostics: Performance evaluation of GeneXpert HCV RNA test in diagnosing and monitoring of HCV infection. *Journal of clinical virology: the official publication of the Pan American Society for Clinical Virology*, *88*, 46–51. https://doi.org/10.1016/j.jcv.2017.01.006
Golden, J. W., Zeng, X., Cline, C. R., Smith, J. M., Daye, S. P., Carey, B. D., Blancett, C. D., Shoemaker, C. J., Liu, J., Fitzpatrick, C. J., Stefan, C. P., & Garrison, A. R. (2022). The host inflammatory response contributes to disease severity in Crimean-Congo hemorrhagic fever virus infected mice. *PLOS Pathogens.* https://doi.org/10.1371/journal.ppat.1010485
Hassan, F., & Simpson, D. I. (1981). Congo/Crimean haemorrhagic fever in Iraq. *Bulletin of the World Health Organization*, *59*(1), 85–90.
Hasson, R. H., Al-Zubaidi, H. H. (2014). Cattle and buffaloes tick' s infestation in Wasit province districts, Iraq. *Kufa Journal for Veterinary Medical Sciences*, *5*, 31–40.
Hawman, D. W., & Feldmann, H. (2018). Recent advances in understanding Crimean-Congo hemorrhagic fever virus. F1000Research, 7, (F1000 Faculty Rev-1715). https://doi.org/10.12688/f1000research.16189.1
Hoogstraal, H., & Kaiser, M. N. (1958). The Ticks (Ixodoidea) of Iraq: Keys, Hosts, and Distribution. Distrib. *Journal of Iraqi Medical Professions. 6*, (2-3), 58-84.
Kuehnert, P. A., Stefan, C. P., Badger, C. V., & Ricks, K. M. (2021). Crimean-Congo Hemorrhagic Fever Virus (CCHFV): A Silent but Widespread Threat. *Current tropical Medicine Reports. 8*(2), 141–147. https://doi.org/10.1007/s40475-021-00235-4
Karti, S. S., Odabasi, Z., Korten, V., Yilmaz, M., Sonmez, M., Caylan, R., Akdogan, E., Eren, N., Koksal, I., Ovali, E., Erickson, B. R., Vincent, M. J., Nichol, S. T., Comer, J. A., Rollin, P. E., & Ksiazek, T. G. (2004). Crimean-Congo hemorrhagic fever in Turkey. *Emerging Infectious Diseases*, *10*(8), 1379–1384. https://doi.org/10.3201/eid1008.030928
Mallah, M. O., & Rahif, R. H. (2016). Epidemiological study for tick infestation in cattle in Baghdad city-Iraq. *Al-Qadisiyah. Journal. Veterinary. Medicine. Sciences. 15*, 45–51.
Mertens, M., Schmidt, K., Ozkul, A., & Groschup, M. H. (2013). The impact of Crimean-Congo hemorrhagic fever virus on public health. *Antiviral research*, *98*(2), 248–260. https://doi.org/10.1016/j.antiviral.2013.02.007
Mohammad, M. K. (2016). Ixodiod Tick Fauna Infesting Sheep and Goats in the Middle and South of Iraq. *Bulletin of the Iraq Natural. History. Musseum*, *14*, 43–50.
Monsalve Arteaga, L., Muñoz Bellido, J. L., Negredo, A. I., García Criado, J., Vieira Lista, M. C., Sánchez Serrano, J. Á., Vicente Santiago, M. B., López Bernús, A., de Ory Manchón, F., Sánchez Seco, M. P., Leralta, N., Alonso Sardón, M., Muro, A., & Belhassen-García, M. (2021). New circulation of genotype V of Crimean-Congo haemorrhagic fever virus in humans from Spain. *PLoS Neglected Tropical Diseases*,*15*(2), e0009197. https://doi.org/10.1371/journal.pntd.0009197
Moraga-Fernández, A., Ruiz-Fons, F., Habela, M. A., Royo-Hernández, L., Calero-Bernal R., Gortazar, C., de la Fuente, J., & Fernández de Mera, I. G. (2021). Detection of new Crimean-Congo haemorrhagic fever virus genotypes in ticks feeding on deer and wild boar, Spain. *Transboundary and emerging diseases*, *68*, 993–1000. https://doi.org/10.1111/tbed.13756
Ozkurt, Z., Kiki, I., Erol, S., Erdem, F., Yilmaz, N., Parlak, M., Gundogdu, M., & Tasyaran, M. A. (2006). Crimean-Congo hemorrhagic fever in Eastern Turkey: clinical features, risk factors and efficacy of ribavirin therapy. *The Journal of Infection*, *52*(3), 207–215. https://doi.org/10.1016/j.jinf.2005.05.003
Sánchez-Seco, M. P., Sierra, M. J., Estrada-Peña, A., Valcárcel, F., Molina, R, de Arellano, E. R., Olmeda, A. S, San Miguel, L. G, Jiménez, M., Romero, L. J., & Negredo, A. (2021). Group for CCHFv Research. Widespread Detection of Multiple Strains of Crimean-Congo Hemorrhagic Fever Virus in Ticks, Spain. *Emerg Infect Dis*, *28*(2), 394-402. https://doi.org/10.3201/eid2802.211308
Shamsuddin, M., & Mohammad, M.K. (1988). Incidence, distribution, and host relationships of some ticks (Ixodoidea) in Iraq. *Journal of the University of Kuwait. 15*, 321–329.
Tantawi, H. H., Al-Moslih, M. I., Al-Janabi, N. Y., Al-Bana, A. S., Mahmud, M. I., Jurji, F., Yonan, M. S., Al-Ani, F., & Al-Tikriti, S. K. (1980). Crimean-Congo haemorrhagic fever virus in Iraq: isolation, identification and electron microscopy. *Acta Virologica*, *24*(6), 464–467.
WHO. Crimean-Congo haemorrhagic fever (CCHF). (2019). http://www.who.int/blueprint/priority-diseases/key-action/crimean-congo-haemorrhagic-fever/en/ (accessed 18 Feb2019).
WHO (2018). Roadmap for Research and Product Development against Crimean Congo Haemorrhagic Fever (CCHF). https://www.who.int/blueprint/priority-diseases/key-action/cchf-draft-r-and-d-roadmap.pdf (accessed 18 February 2019).
Yilmaz, G. R., Buzgan, T., Torunoglu, M. A., Safran, A., Irmak, H., Com, S., Uyar, Y., Carhan, A., Ozkaya, E., Ertek, M (2008). A preliminary report on Crimean-Congo haemorrhagic fever in Turkey, *Euro Surveillance*, *13*(33), 18953. Available online: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=18953
Yagci-Caglayik, D., Korukluoglu, G., & Uyar, Y. (2014). Seroprevalence and risk factors of Crimean-Congo hemorrhagic fever in selected seven provinces in Turkey. *Journal of Medical Virology*, *86*(2), 306–314.https://doi.org/10.1002/jmv.23699