veterinary sciences

MDPI

Article

An Emerging Viral Infection in Horses in Central Europe: Suspected Shamonda Virus Seroconversion in Asymptomatic Horses in Baden-Württemberg from June to September 2026

Petra Benz [1,*], Nathalie Hafner [2], Marielle Elen Volkwein [1], Judith Köster [1], Thomas Miller [1] and Irena Blaha [1]

[1] Aulendorf State Veterinary Diagnostic Centre, Löwenbreitestraße 18/20, 88326 Aulendorf, Germany; thomas.miller@stuaau.bwl.de (T.M.)
[2] Animal Disease Fund Baden-Württemberg, Horse Health Service Aulendorf, Talstraße 17, 88326 Aulendorf, Germany
* Correspondence: petra.benz@stuaau.bwl.de

Simple Summary

The Shamonda virus, which emerged in Central Europe in the summer of 2026, appears to be associated with neurological deficits in horses. To date, the virus has been detected in the brains of several deceased horses in Central Europe. However, according to the current state of research, it is not possible to reliably detect the pathogen directly in living horses. Currently, no published studies on serological testing are available. This study aimed to determine whether seroconversion to viruses of the Simbu serogroup occurred in healthy horses. To this end, a competitive Schmallenberg virus multispecies ELISA was used to analyze blood samples from eleven healthy horses based in southern Germany at three different time points between June and September 2026. The results of the current study confirm that seroconversion occurred in healthy horses in southern Germany in August and September 2026. To date, there is no methodology available to differentiate serologically between Shamonda virus and other virus infections of the Simbu serogroup in living horses.

Abstract

The first detection of the Shamonda virus in Central Europe occurred in mid-June 2026. Direct detection of the virus in blood or cerebrospinal fluid from living horses has not yet been reliably achieved. Serological examinations could therefore be crucial for future diagnostics. This study aimed to determine whether clinically healthy horses develop antibodies against viruses of the Simbu serogroup and at what point the first positive ELISA S/N% values can be detected. To this end, blood sera from eleven clinically healthy horses based in southern Germany were examined retrospectively at three different time points between June and September 2026. Serological testing was performed using the ID Screen® Schmallenberg virus Multi-species ELISA kit; Innovative Diagnostics, Grabels, France. The results showed that all horses were seronegative or doubtful (one horse) in June (time point 1) and seronegative in July 2026 (time point 2). All eleven horses tested positive for antibodies in August or September (time point 3). There was a significant increase in antibody titers between time point 1 and time point 3, as well as between time point 2 and time point 3. The study found that even clinically healthy horses had been exposed to the pathogen and developed antibodies. Therefore, a positive S/N% value is not necessarily associated with clinical disease.

Keywords: Orthobunyavirus; horse; serology; ELISA; Shamonda

Check for updates

Academic Editor: Vittorio Sarchese

Received: 28 October 2026
Revised: 22 November 2026
Accepted: 23 November 2026
Published: 26 November 2026

Copyright: © 2026 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

1. Introduction

In mid-June 2026, a virus previously unknown in this region was detected in dairy herds in Central Europe [1–3]. Many cattle herds in southern Germany, Switzerland, and France were affected [1–4]. Farmers reported that their cattle were experiencing diarrhea, fever, and decreased milk production [1–4]. The virus was identified as the Shamonda virus (SHAV), which belongs to the Simbu serogroup and the genus *Orthobunyavirus schmallenbergense* [1,2], and is transmitted by Culicoides biting midges [1,5]. Initially, the novel infectious agent was identified solely in cattle in Germany, Switzerland and France [1,2,4]. It is now known that two genetic variants of SHAV are present in Europe [6]. The Shamonda Virus Europe 1 (SHAV-EU1), which has been detected in southern regions, has been identified not only in cattle, small ruminants, and New World camelids, but also in horses [6–11]. In postmortem examinations, SHAV-EU1 was detected in the brains of several equines that exhibited neurological symptoms in Switzerland and Germany [8–10,12]. These are the first reports of *orthobunyaviruses* in horses in Central Europe. As other common causes of encephalitis, such as West Nile virus (WNV), equine herpesvirus (EHV), Borna virus, rabies and tick-borne encephalitis virus (TBEV), have been ruled out, a link between the symptoms affecting the central nervous system (CNS) and SHAV-EU1 infection is suspected [8,9]. Shuni virus (SHUV), another member of the Simbu serogroup, was previously known to cause CNS disorders in horses in Africa [13–15].

To date, it has not been possible to confirm SHAV infection in living equids [9,10]. As it is difficult to detect the pathogen directly in living horses [9,10], serological testing could play a central role in diagnosis. However, no information has been published regarding seroconversion to SHAV in horses. Serological tests specific for SHAV have not yet been developed. Currently, serological tests for the detection of antibodies are only available for Schmallenberg virus (SBV), which is closely related to SHAV [16]. As there are cross-reactions between different viruses of the Simbu serogroup [17], the ID Screen® Schmallenberg virus Competition Multi-species ELISA can also be used to detect antibodies against SHAV [18,19].

To evaluate seroconversion to SHAV in horses, we examined the blood serum of eleven healthy horses in southern Germany at three different time points between June and September 2026.

2. Materials and Methods

2.1. Study Population

The retrospective study included blood sera from eleven healthy horses based in Baden-Württemberg, southern Germany (Table S1). Blood samples were collected from all eleven horses at three time points between June and September 2026. All of the horses belong to a stud farm in Baden-Württemberg, and they are all housed in the same area. The inclusion criteria required the horses to be clinically healthy both at the time of blood sampling and for two months thereafter. The horses included in the study had to be at least three years of age. No restrictions regarding breed were applied. All eleven horses included are breeding stallions. The equine health professionals employed by the stud farm undertake regular health assessments of the stallions through clinical examinations. Due to national and international regulations, they must be tested for various pathogens at prescribed intervals. For this reason, blood samples are collected regularly at approximately 30-day intervals during the breeding season. The blood samples are then sent to the state testing laboratory for analysis.

2.2. ELISA

In total, 33 serum samples from eleven horses were examined. The blood samples were sent to the Aulendorf State Veterinary Diagnostic Centre for routine diagnostics and were analyzed retrospectively for the current study. The first measurement time point (T1) included blood samples taken on 24 June 2026; the second measurement time point (T2), samples taken on 13 July 2026; and the third measurement time point (T3), samples taken on 31 August 2026 (horses 1–4) and 10 September 2026 (horses 5–11). The blood samples were centrifuged at 3000 rpm for three minutes. Serum was separated and stored at −20 °C until further analysis. To detect antibodies against SHAV, the N-protein-based ID Screen® Schmallenberg virus Competition Multi-species ELISA (Innovative Diagnostics, Grabels, France) was used. The test was conducted according to the manufacturer's instructions. The ID Screen® Schmallenberg virus Competition Multi-species ELISA has not been validated for the use in horse sera. The optical density was measured using a Tecan Sunrise microplate reader (Sunrise™, Tecan, Switzerland). The results were expressed as competition percentage (S/N%). In accordance with the manufacturer's instructions, samples with S/N% $\leq$ 40 were classified as positive, those with S/N% $\geq$ 50 as negative and those with values between 40 and 50 as doubtful. A negative and a positive control, both provided by the manufacturer, were included in each run. All doubtful and positive test results were confirmed by repeated measurements.

2.3. Statistical Analysis

Statistical analysis was performed using R version 4.6.1 [20–25]. The statistical analysis only considered the 11 horses recorded in Section 2.1 that were permanently stationed in Baden-Württemberg. Firstly, the normal distribution of all results was tested using the Shapiro–Wilk test. As the data were repeated measures, the Friedman test was used to compare all three measurements. A Wilcoxon signed-rank test for paired samples was performed as a post hoc test. *P*-values were adjusted for multiple comparisons using the Holm correction. Results with a p-value less than 0.05 were considered statistically significant.

2.4. Additional Data

Additionally, blood serum samples from two healthy horses that had recently been relocated to south Germany (Baden-Württemberg) were submitted for routine diagnostic testing. Horse 12 originated from north Germany (Berlin) and Horse 13 originated from Austria (Vorarlberg). Both horses originated from private ownership and were imported into Baden-Württemberg independently of one another. The repeated blood sampling was carried out as part of quarantine examinations. In addition, both horses underwent daily clinical examinations during the two-week quarantine period.

Horse 12 was imported from Berlin to Baden-Württemberg on 30 August. Blood samples were collected on 3 September and 16 September.

Horse 13 was imported from Austria to Baden-Württemberg on 14 September. Blood samples were collected on 17 September and 5 October.

The sera were processed and analyzed as described in Section 2.2. "ELISA".

3. Results

3.1. Study Population

A total of eleven healthy male horses were included in the study. The mean age was 8 years (range 3 to 18 years). The breeds included Black Forest Horse (3), German Sport Horse (2), Trakehner (1), Arabian Horse (2), Württemberg Horse (2) and Westphalian Horse (1). All eleven horses were based in the district of Reutlingen, Baden-Württemberg.

3.2. ELISA

The SBV competition ELISA was carried out on 33 serum samples from eleven individual horses. At the first measurement (T1) from blood samples taken in June 2026, ten samples tested negative in the ID Screen® Schmallenberg virus Competition Multi-species ELISA (S/N% ≥ 50), and one sample yielded a doubtful result (S/N% 49.1). At T2, all eleven samples tested negative (S/N% ≥ 50). All eleven sera collected at T3 tested positive (S/N% ≤ 40). The results of all eleven horses at all three time points are shown in Table 1 and Figure 1.

Table 1. Comparison of S/N% at three different time points in eleven horses with corresponding *p*-values (*p*).

Horse	Unit	T1	T2	T3	*p*-Value	*p*-Value T1–T2	*p*-Value T2–T3	*p*-Value T1–T3
1		80.3	95.1	4.2				
2		94.5	94.9	22.0				
3		90.0	91.1	21.3				
4		49.1	54.2	5.4				
5		50.3	51.2	4.1				
6	S/N%	87.0	88.0	4.4	**<0.001**	1.00	**0.003**	**0.003**
7		96.4	87.5	6.8				
8		97.2	88.3	3.6				
9		83.8	81.1	3.8				
10		97.2	85.8	5.1				
11		90.2	92.3	12.4				

Values shown in bold indicate $p < 0.05$. Fourth last column "*p*-value" indicates *p*-value over all three time points. The corrected values between different time points are shown in the last three columns.

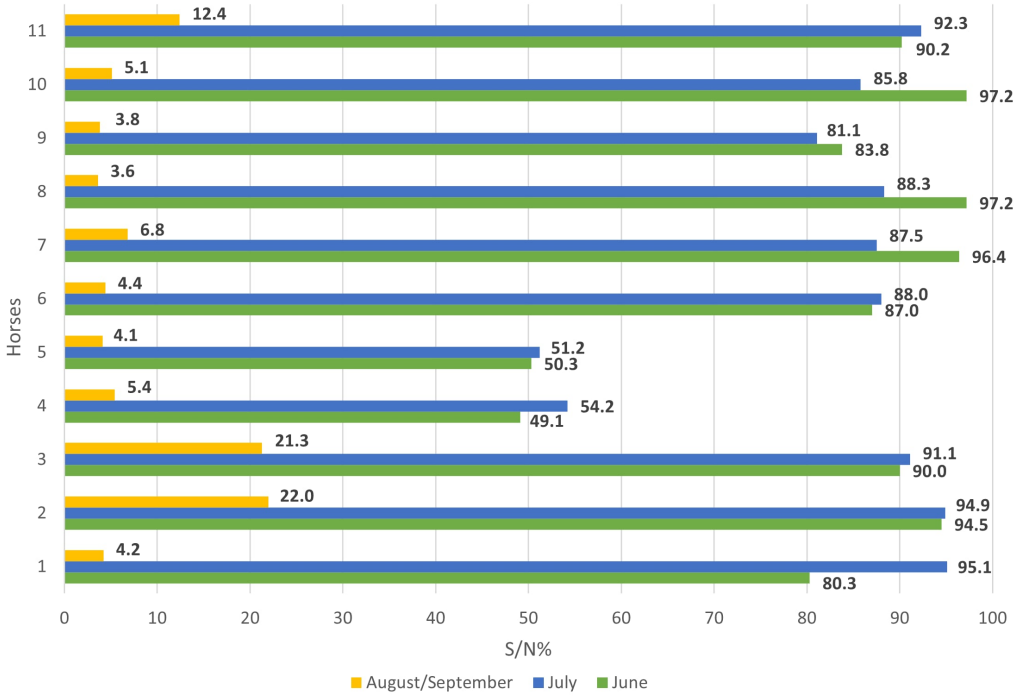

Figure 1. S/N% values for each horse at all three time points.

Figure 2 shows a comparison of the S/N% at all three measurement time points. S/N% decreased significantly between T1 and T3 ($p = 0.003$) and between T2 and T3 ($p = 0.003$). No significant change was observed between T1 and T2 ($p = 1.0$).

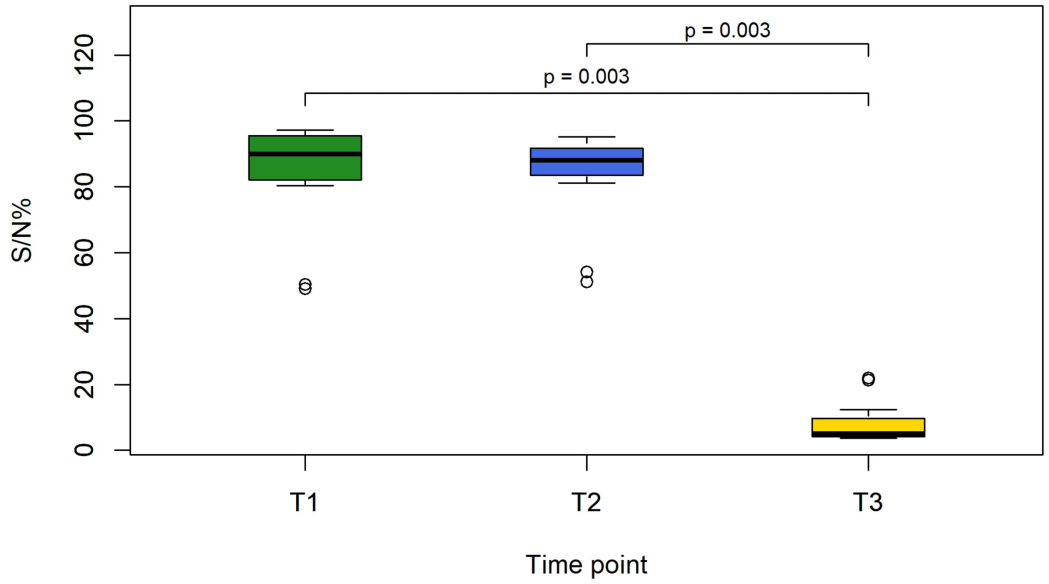

Figure 2. Comparison of S/N% at all three time points, tested with Friedman test and Wilcoxon post hoc test. The brackets indicate statistically significant changes ($p < 0.05$). Outliers are indicated by circles.

3.3. Additional Data

Horse 12 is an eight-year-old Polo Argentino mare, Horse 13 a three-year-old Icelandic gelding. The results of Horse 12 and 13 are shown in Table 2. Both horses tested negative in the initial screening conducted after they were imported to Baden-Württemberg (S/N% $\geq$ 50). However, in the second screening about two weeks later, both horses tested positive for antibodies using the SBV competition ELISA (S/N% $\leq$ 40).

Table 2. Comparison of S/N% of Horse 12 and 13 at two different time points.

Unit	Horse 12		Horse 13	
	3 September 4 Days After Arrival	**16 September 17 Days After Arrival**	**17 September 3 Days After Arrival**	**05 October 21 Days After Arrival**
S/N%	80.3	30.7	84.4	36.7

4. Discussion

This is the first published study to detect antibodies against viruses of the Simbu serogroup in clinically healthy horses in Central Europe. The study confirmed that all eleven clinically healthy adult horses in southern Germany developed antibodies against Simbu serogroup viruses by August or September 2026. The seroconversion occurred just weeks after the first documented cases of SHAV infection in horses in Switzerland and Germany [8,9,11]. At the same time, it was confirmed that SHAV was circulating among cattle herds in Central Europe [4,26,27].

The present study describes the development of antibodies in clinically healthy horses over a period of three months. The results show that ten horses were seronegative for Simbu serogroup viruses in June 2026, while one horse yielded a doubtful result (S/N% = 49.1). In July 2026, all eleven horses tested negative in the ELISA. The doubtful result for horse 4 may have been caused by a nonspecific reaction. As the same horse tested negative in July, it is unlikely that it had already come into contact with SHAV or other simbuviruses in June. Therefore, we consider the doubtful result of Horse 4 at T1 to be negative. In this

context, the results confirm that none of the eleven horses had been exposed to Simbu serogroup viruses by early July 2026. Accordingly, no significant change in S/N% was observed between T1 and T2 ($p = 1.0$). The Friedman test revealed a significant reduction in S/N% between measurement time points T1 and T3, as well as between T2 and T3, corresponding to a significant increase in antibody titer. It is known that antibodies against simbuviruses develop just 7 to 21 days after infection [28–32]. Therefore, it can be suspected that the horses had been exposed to the simbuvirus at least one to three weeks before the last blood draw. This coincided with the emergence of the first reports of horses displaying neurological abnormalities in late July [10]. However, the time of infection of the horses in the present study cannot be confirmed. The positive S/N% values in August and September demonstrate that all eleven horses in this study seroconverted to viruses of the Simbu serogroup at this time. The seroconversion confirmed in our study occurred simultaneously with the first detections of SHAV in dead horses [8,9,11] and cattle [2,3].

To the best of the authors' knowledge, no SHAV-specific ELISA is available for horses. The study therefore used the ID Screen® Schmallenberg virus Competition Multi-species ELISA for serological testing. In this context, it is important to note that viruses belonging to the Simbu serogroup are genetically very similar to one another [1,16]. Of the three genome segments, the L and S segments are particularly similar [1]. The S segment encodes the nucleocapsid protein (N-protein) [16], which triggers a strong serological response [33–35]. Therefore, ELISA tests based on the N-protein tend to produce cross-reactions [18,19,36]. For this reason, the ID Screen® Schmallenberg virus Competition Multi-species ELISA can also be used to detect SHAV antibodies. The same ELISA was also used to detect SHAV antibodies in cattle [3]. The competitive multispecies ELISA has previously been shown to be effective in non-ruminants, including dogs [37,38], pigs [39] and elephants [40]. It is important to note that the competitive SBV ELISA is not validated for use in horses. However, a recently published study successfully applied the competitive SBV ELISA to the blood serum of a deceased horse [8]. The deceased horse in this study also had a positive SHAV Polymerase chain reaction (PCR) result, and the infection with SBV could be excluded by PCR. In other studies, an indirect SBV ELISA test was used in horses [9,41,42]. Other serological test systems, such as an SNT, that can differentiate between SBV and SHAV in horses are not yet available. PCR tests of blood or cerebrospinal fluid from living horses are predominantly negative for SHAV [9,10], presumably due to the very short duration of viremia [10]. As it is currently impossible to validate the results using an SNT or SHAV-specific ELISA test, it is important to discuss the diagnostic accuracy of the test used in this study. Several studies have evaluated the specificity and sensitivity of the ID Screen® competitive SBV ELISA [43–45]. As shown in the Innovative Diagnostics Internal Validation Report, the competitive ELISA has a specificity of 100% and a sensitivity of 97.6% [46]. This is consistent with studies evaluating different serological testing methods in cattle [45], sheep [43,45] and New World camelids [44]. The ID Screen® competitive SBV ELISA was found to correctly identify all positive sera as positive and all negative sera as negative in cattle and sheep [45]. This result was replicated in various laboratories [45]. Furthermore, the ID Screen Competitive SBV ELISA was found to yield results that are almost identical to those of the SNT, particularly at low seroprevalence [43]. The test results from the cited studies suggest that false-positive or false-negative results are also unlikely in the present study, given that it used the same ELISA test. However, the diagnostic accuracy of the competitive SBV ELISA has not been evaluated in horses, nor for the detection of antibodies against SHAV.

It should be noted that a positive SBV ELISA test result does not confirm SHAV infection in horses, as cross-reactions between simbuviruses occur [16,17]. To the best of the authors' knowledge, there are no documented cases of confirmed SBV infection in horses. Other

viruses of the Simbu serogroup, such as SHUV or Akabane virus, have not yet been reported in Europe. In addition, there have been no documented cases of SBV infection in cattle in Germany in 2026. Furthermore, the horses included in the present study tested negative by ELISA in June and July, suggesting that they had not been exposed to simbuviruses at these time points. Therefore, we consider it unlikely that horses in Europe had previously been exposed to SBV or other simbuviruses. However, two studies on the seroprevalence of SBV in horses in Iran have been published: one in northern and northeastern Iran [42] and one in Kurdistan Province [41]. These studies found that 14.68% of horses in Kurdistan Province tested positive for antibodies against SBV [41], compared to 5% in northern and northeastern Iran [42]. However, these results were not confirmed by a serum neutralization test (SNT) or similar tests that differentiate between simbuviruses. As there have been reports of SHUV infections in the Middle East [47,48], it is possible that the horses in both studies were exposed to SHUV rather than SBV. In contrast, the current epidemiological evidence strongly suggests that the horses in the present study developed positive ELISA S/N% values as a result of exposure to SHAV. This is consistent with the fact that SHAV is also circulating in cattle herds in Central Europe [4,26,27]. During this vector season, no samples returned positive SBV PCR results, supporting the conclusion that SBV is not circulating in Central Europe presently. However, the lack of evidence for the presence of viruses of the Simbu serogroup in Europe does not confirm their absence or exclude their circulation. Therefore, it cannot be ruled out that seroconversion occurred following exposure to other simbuviruses.

In this study, all eleven horses were clinically healthy at all three blood draws. Consistent with the findings of other studies, a positive antibody titer against viruses of the Simbu serogroup is not directly associated with clinical disease [16]. Nonetheless, the sample size in the present study is insufficient to confirm this hypothesis.

The present study also examined blood sera from two horses imported to Baden-Württemberg from Berlin (northern Germany) and Vorarlberg (Austria) in late August and September of 2026. The first blood sample was collected from Horse 12 just three days after its arrival in Baden-Württemberg, southern Germany. At that time, the horse tested negative for antibodies via SBV ELISA. However, a positive ELISA S/N% value was detected during the second blood draw on 16 September. This result suggests that the horse had not been exposed to SHAV or other simbuviruses in Berlin, northern Germany. This finding supports the assumption that Shamonda virus Europe 2 (SHAV-EU2), which primarily occurs in northern Germany, does not infect horses [6]. Nevertheless, the duration of immunity following SHAV infection remains unknown, and the possibility that a previous infection may not have resulted in the development of antibodies cannot be excluded. Therefore, the possibility that the horse had been previously infected with SHAV or other simbuviruses in Berlin cannot be ruled out. Shortly after arriving from Vorarlberg (Austria), Horse 13 also tested negative in the SBV-ELISA. The horse had been kept in the mountains at high elevations. It is reasonable to assume that the Culicoides biting midges are not active at these elevations. Since SHAV is transmitted by Culicoides biting midges [1,5], and since temperatures were warm in Baden-Württemberg in early September, it is reasonable to assume that Horse 12 and 13 became infected shortly after arriving from Berlin/Austria. Thus, both horses developed antibodies against viruses of the Simbu serogroup within 10–14 days after being imported to southern Germany. This finding is consistent with the results of other studies on antibody production against simbuviruses [28–32].

The study has several limitations. Due to the retrospective design and the brief viremic outbreak, only a limited number of blood sera could be examined. Furthermore, it is currently impossible to distinguish serologically between SHAV and other virus infections of the Simbu serogroup in living horses, as no specific ELISAs or SNTs are available. Con-

sequently, it cannot be stated with absolute certainty that the antibodies detected in the present study were directed against SHAV.

5. Conclusions

This study showed that healthy horses in southern Germany developed antibodies against Simbu serogroup viruses in the summer of 2026. As there is no specific serological test for SHAV, it could not be confirmed whether the seroconversion was caused by exposure to this particular virus or by cross-reactions with other simbuviruses. The timing of seroconversion coincided with reports of horses exhibiting neurological symptoms and positive pathogen detections. The current epidemiological situation in Central Europe may therefore provide a possible explanation for the development of antibodies against SHAV. However, the development of SHAV-specific serological tests, such as ELISA or SNT, is necessary to enable serological differentiation between various viruses of the Simbu serogroup in the future.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/vetsci13121286/s1, Table S1: Data of all eleven horses included in the study.

Author Contributions: Conceptualization, P.B., I.B. and N.H.; methodology, P.B., I.B., J.K. and N.H.; formal analysis, P.B. and M.E.V.; investigation, P.B., I.B. and N.H.; writing—original draft preparation, P.B.; writing—review and editing, P.B., I.B., T.M., M.E.V. and N.H.; visualization, P.B. and M.E.V.; supervision, I.B. and T.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Approval from the Animal Ethics Committee was not necessary, as only remaining horse sera from routine diagnostics procedures were used.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The original contributions presented in this study are included in the article/Supplementary Materials. Further inquiries can be directed to the corresponding author.

Acknowledgments: We would like to thank all colleagues involved for their excellent work, support and commitment. The authors would like to thank Marina Benz for proofreading the English version.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

SHAV	Shamonda virus
SHAV-EU1	Shamonda Virus Europe 1
SHAV-EU2	Shamonda virus Europe 2
WNV	West Nile virus
EHV	Equine herpesvirus
TBEV	tick-borne encephalitis virus
CNS	central nervous system
SHUV	Shuni virus
SBV	Schmallenberg virus
SNT	serum neutralization test
PCR	polymerase chain reaction

References

1. Wernike, K.; Hoffmann, B.; Link, E.K.; Rotheneder, S.; Eshak, M.; Pfaff, F.; Höper, D.; Beer, M. It happened again–emergence of a Shamonda-like orthobunyavirus in Central Europe, 2026. *bioRxiv* **2026**, bioRxiv:2006.743243.
2. Kelleci, M.; Fusade-Boyer, M.; Chrétien, D.; Durand, E.; Mircovich, M.; Sécula, A.; Linard, B.; Herman, N.; Schelcher, F.; Croville, G.; et al. Detection of a novel Shamonda *Orthobunyavirus* in dairy cattle, France, June 2026. *Eurosurveillance* **2026**, *31*, 2600689. [CrossRef] [PubMed]
3. Wernike, K.; Hoffmann, B.; Link, E.K.; Rotheneder, S.; Eshak, M.; Pfaff, F.; Höper, D.; Beer, M. Emergence of Shamonda Orthobunyavirus, Central Europe, 2026. *Emerg. Infect. Dis.* **2026**, *32*, 2031–2035. [CrossRef] [PubMed]
4. Wyler, M.; Darpel, K.; Berset, R.; Renzullo, S.; Huber, H.; Bauer, J.; Peter-Egli, J.; Bachofen, C.; Kubacki, J. First Identification, Isolation and Genomic Characterization of an Emerging Shamonda Virus Variant Associated with Bovine Disease in Switzerland. *Viruses* **2026**, *18*, 1086. [CrossRef] [PubMed]
5. Sick, F.; Beer, M.; Kampen, H.; Wernike, K. Culicoides Biting Midges-Underestimated Vectors for Arboviruses of Public Health and Veterinary Importance. *Viruses* **2019**, *11*, 376. [CrossRef] [PubMed]
6. Wernike, K.; Pfaff, F.; Zeiske, S.; Höper, D.; Beer, M. Two incursions, two viruses: Emergence of a second novel Shamonda virus clade, Germany, 2026. *Eurosurveillance* **2026**, *31*, 2600756. [CrossRef] [PubMed]
7. Wernike, K.; Zeiske, S.; Axt, H.; Bürstel, D.; Köster, J.; Link, E.K.; Miller, T.; Rotheneder, S.; Schneider, K.; Suntz, M. Shamonda virus infection in sheep and goat: First evidence from Europe. *Res. Sq.* **2026**. [CrossRef] [PubMed]
8. Volkwein, M.E.; Köster, J.; Großmann, E.; Hafner, N.; Miller, T.; Salditt, A.; Benz, P.; Beer, M.; Breithaupt, A.; Wernike, K. Detection of Shamonda Virus in Two Horses with Neurological Signs in Germany. *Viruses* **2026**, *18*, 1125. [CrossRef] [PubMed]
9. Bachofen, C.; Oesch, S.; Junge, H.K.; Wyler, M.; Egli, P.; Gerber, V.; Schwarzwald, C.; Matthiss, L.K.; Gurtner, C.; Decollogny, M. Newly Emerged Shamonda Virus in Europe Associated with Neurological Disease in Horses, Switzerland 2026. *Preprints* **2026**. [CrossRef]
10. Institut Suisse de Médecine Equine. U.B. Shamonda-like Virus Beim Pferd. Available online: https://isme.unibe.ch/forschung/neues_virus_beim_pferd/index_ger.html (accessed on 20 October 2026).
11. Friedrich-Loeffler Institut. Shamonda Virus: Infections Confirmed in Horses and Alpacas; Sheep and Goats Are Also Susceptible. Available online: https://www.fli.de/en/news/short-messages/short-message/shamonda-virus-infections-confirmed-in-horses-and-alpacas-sheep-and-goats-are-also-susceptible/ (accessed on 20 October 2026).
12. Lengyel, D. Das Neue Shamonda-like-Virus bei Einem Pferd Mit Zentralnervösen Störungen Nachgewiesen. Available online: https://www.ua-bw.de/pubmobil/beitrag.asp?Thema_ID=8&ID=4459&subid=1 (accessed on 20 October 2026).
13. van Eeden, C.; Williams, J.H.; Gerdes, T.G.; van Wilpe, E.; Viljoen, A.; Swanepoel, R.; Venter, M. Shuni virus as cause of neurologic disease in horses. *Emerg. Infect. Dis.* **2012**, *18*, 318–321. [CrossRef] [PubMed]
14. Motlou, T.P.; Williams, J.; Venter, M. Epidemiology of Shuni Virus in Horses in South Africa. *Viruses* **2021**, *13*, 937. [CrossRef] [PubMed]
15. Rakaki, M.E.; van der Walt, M.; Williams, J.; Venter, M. Detection of Novel Orthobunyavirus Reassortants in Fatal Neurologic Case in Horse and Culicoides Biting Midges, South Africa. *Emerg. Infect. Dis.* **2025**, *31*, 1455–1459. [CrossRef] [PubMed]
16. Wernike, K.; Aebischer, A.; Sick, F.; Szillat, K.P.; Beer, M. Differentiation of Antibodies against Selected Simbu Serogroup Viruses by a Glycoprotein Gc-Based Triplex ELISA. *Vet. Sci.* **2021**, *8*, 12. [CrossRef] [PubMed]
17. Goller, K.V.; Höper, D.; Schirrmeier, H.; Mettenleiter, T.C.; Beer, M. Schmallenberg virus as possible ancestor of Shamonda virus. *Emerg. Infect. Dis.* **2012**, *18*, 1644–1646. [CrossRef] [PubMed]
18. Wernike, K.; Beer, M.; Hoffmann, B. Schmallenberg Virus Infection Diagnosis: Results of a German Proficiency Trial. *Transbound. Emerg. Dis.* **2017**, *64*, 1405–1410. [CrossRef] [PubMed]
19. Oluwayelu, D.; Wernike, K.; Adebiyi, A.; Cadmus, S.; Beer, M. Neutralizing antibodies against Simbu serogroup viruses in cattle and sheep, Nigeria, 2012–2014. *BMC Vet. Res.* **2018**, *14*, 277. [CrossRef] [PubMed]
20. R Core Team. *R: A Language and Environment for Statistical Computing, 4.6.1*; R Foundation for Statistical Computing: Vienna, Austria, 2026.
21. Wickham, H.; Bryan, J. *readxl. Read. Excel Files*; Comprehensive R Archive Network (CRAN): Vienna, Austria, 2026.
22. Wickham, H. *ggplot2: Elegant Graphics for Data Analysis*; Springer: New York, NY, USA, 2016.
23. Revelle, W. *psych: Procedures for Psychological, Psychometric, and Personality Research*; Comprehensive R Archive Network (CRAN): Vienna, Austria, 2026.
24. Giraudoux, P. *pgirmess: Spatial Analysis and Data Mining for Field Ecologists*; Comprehensive R Archive Network (CRAN): Vienna, Austria, 2024. [CrossRef]
25. Wickham, H.; Vaughan, D.; Girlich, M. *tidyr: Tidy Messy Data*; Comprehensive R Archive Network (CRAN): Vienna, Austria, 2025.
26. Molini, U.; Berjaoui, S.; Lorusso, A. Shamonda virus in Europe: An emerging threat, the potential role of Culicoides and the need for preparedness. *Vet. Ital.* **2026**, *62*. [PubMed]

27. Ceglie, L.; Tavella, A.; Dellamaria, D.; Belfanti, I.; Rampazzo, E.; Beikircher, F.; Berasi, G.; Fustini, M.; Gasser, C.; Pallhuber, J.K. Shamonda virus EU1 in Northern Italy, August 2026. *bioRxiv* **2026**, bioRxiv:2017.752072. [CrossRef]
28. Wernike, K.; Holsteg, M.; Szillat, K.P.; Beer, M. Development of within-herd immunity and long-term persistence of antibodies against Schmallenberg virus in naturally infected cattle. *BMC Vet. Res.* **2018**, *14*, 368. [CrossRef] [PubMed]
29. Elbers, A.R.; Stockhofe, N.; van der Poel, W.H. Schmallenberg virus antibodies in adult cows and maternal antibodies in calves. *Emerg. Infect. Dis.* **2014**, *20*, 901. [CrossRef] [PubMed]
30. Elbers, A.R.; Stockhofe-Zurwieden, N.; van der Poel, W.H. Schmallenberg virus antibody persistence in adult cattle after natural infection and decay of maternal antibodies in calves. *BMC Vet. Res.* **2014**, *10*, 103. [CrossRef] [PubMed]
31. Wernike, K.; Holsteg, M.; Saßerath, M.; Beer, M. Schmallenberg virus antibody development and decline in a naturally infected dairy cattle herd in Germany, 2011–2014. *Vet. Microbiol.* **2015**, *181*, 294–297. [CrossRef] [PubMed]
32. Inaba, Y.; Matumoto, M. *Akabane Virus*; Elsevier Science Publishers: Amsterdam, The Netherlands, 1990; Volume 3.
33. Wernike, K.; Nikolin, V.M.; Hechinger, S.; Hoffmann, B.; Beer, M. Inactivated Schmallenberg virus prototype vaccines. *Vaccine* **2013**, *31*, 3558–3563. [CrossRef] [PubMed]
34. Gonzalez-Scarano, F.; Shope, R.E.; Calisher, C.E.; Nathanson, N. Characterization of monoclonal antibodies against the G1 and N proteins of LaCrosse and Tahyna, two California serogroup bunyaviruses. *Virology* **1982**, *120*, 42–53. [CrossRef] [PubMed]
35. Wernike, K.; Aebischer, A.; Roman-Sosa, G.; Beer, M. The N-terminal domain of Schmallenberg virus envelope protein Gc is highly immunogenic and can provide protection from infection. *Sci. Rep.* **2017**, *7*, 42500. [CrossRef] [PubMed]
36. Kinney, R.M.; Calisher, C.H. Antigenic relationships among Simbu serogroup (Bunyaviridae) viruses. *Am. J. Trop. Med. Hyg.* **1981**, *30*, 1307–1318. [CrossRef] [PubMed]
37. Wensman, J.J.; Blomqvist, G.; Hjort, M.; Holst, B.S. Presence of antibodies to Schmallenberg virus in a dog in Sweden. *J. Clin. Microbiol.* **2013**, *51*, 2802–2803. [CrossRef] [PubMed]
38. Sailleau, C.; Boogaerts, C.; Meyrueix, A.; Laloy, E.; Bréard, E.; Viarouge, C.; Desprat, A.; Vitour, D.; Doceul, V.; Boucher, C.; et al. Schmallenberg virus infection in dogs, France, 2012. *Emerg. Infect. Dis.* **2013**, *19*, 1896–1898. [CrossRef] [PubMed]
39. Ferrara, G.; Pagnini, U.; Improda, E.; Iovane, G.; Montagnaro, S. Pigs in southern Italy are exposed to three ruminant pathogens: An analysis of seroprevalence and risk factors analysis study. *BMC Vet. Res.* **2024**, *20*, 183. [CrossRef] [PubMed]
40. Molenaar, F.M.; La Rocca, S.A.; Khatri, M.; Lopez, J.; Steinbach, F.; Dastjerdi, A. Exposure of Asian Elephants and Other Exotic Ungulates to Schmallenberg Virus. *PLoS ONE* **2015**, *10*, e0135532. [CrossRef] [PubMed]
41. Mahdavi, S.; Salehzadeh, M.; Montazeri, M. Detection of Schmallenberg virus antibody in equine population of Kurdistan province, west of Iran. *J. Hell. Vet. Med. Soc.* **2023**, *74*, 5633–5636. [CrossRef]
42. Rasekh, M.; Sarani, A.; Hashemi, S.H. Detection of Schmallenberg virus antibody in equine population of Northern and Northeast of Iran. *Vet. World* **2018**, *11*, 30–33. [CrossRef] [PubMed]
43. Pejaković, S.; Wiggers, L.; Coupeau, D.; Kirschvink, N.; Mason, J.; Muylkens, B. Test selection for antibody detection according to the seroprevalence level of Schmallenberg virus in sheep. *PLoS ONE* **2018**, *13*, e0196532. [CrossRef] [PubMed]
44. Schulz, C.; Beer, M.; Hoffmann, B. Schmallenberg virus infection in South American camelids: Field and experimental investigations. *Vet. Microbiol.* **2015**, *180*, 171–179. [CrossRef] [PubMed]
45. Wernike, K.; Beer, M. International proficiency trial demonstrates reliable Schmallenberg virus infection diagnosis in endemic and non-affected countries. *PLoS ONE* **2019**, *14*, e0219054. [CrossRef] [PubMed]
46. Collins, Á.B.; Barrett, D.; Doherty, M.L.; Larska, M.; Mee, J.F. Post-epidemic Schmallenberg virus circulation: Parallel bovine serological and Culicoides virological surveillance studies in Ireland. *BMC Vet. Res.* **2016**, *12*, 234. [CrossRef] [PubMed]
47. Golender, N.; Bumbarov, V.; Assis, I.; Beer, M.; Khinich, Y.; Koren, O.; Edery, N.; Eldar, A.; Wernike, K. Shuni virus in Israel: Neurological disease and fatalities in cattle. *Transbound. Emerg. Dis.* **2019**, *66*, 1126–1131. [CrossRef] [PubMed]
48. Golender, N.; Bumbarov, V.Y.; Erster, O.; Beer, M.; Khinich, Y.; Wernike, K. Development and validation of a universal S-segment-based real-time RT-PCR assay for the detection of Simbu serogroup viruses. *J. Virol. Methods* **2018**, *261*, 80–85. [CrossRef] [PubMed]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.