

CLINICAL AND EPIDEMIOLOGICAL PROFILE OF CASES AND DEATHS DUE TO ACCIDENTAL TETANUS IN THE STATE OF MINAS GERAIS, BRAZIL

PERFIL CLÍNICO E EPIDEMIOLÓGICO DOS CASOS DE ÓBITOS POR TÉTANO ACIDENTAL NO ESTADO DE MINAS GERAIS, BRASIL

BORGES, Fernanda Vianna¹
SILVA, Bianca de Jesus e²
PEREIRA, Eduardo Henrique³
TRINDADE, Yasmim de Oliveira²
GOMES, Wytter Rodrigues Velasco¹
VIEIRA, Denilson Silva³
ROQUE, Tainá Rodrigues²
PEREIRA, Douglas Alves⁴
OLIVEIRA, Vinicius José de⁵

1 - Veterinary Medicine Undergraduate, member of the Programa de Educação Tutorial (PET) of the Veterinary Medicine course, Universidade Federal de Uberlândia, Uberlândia, Minas Gerais, Brazil.

2 - Veterinary Medicine Undergraduate, Universidade Federal de Uberlândia, Uberlândia, Minas Gerais, Brazil.

3 - Veterinarian Physician, Uberlândia, Minas Gerais, Brazil.

4 - Doctoral Student in the Post-graduation Program in Applied Immunology and Parasitology at Universidade Federal de Uberlândia, Uberlândia, Minas Gerais, Brazil.

5 - Doctoral Student in the Post-graduation Program in Applied Immunology and Parasitology at Universidade Federal de Uberlândia; Specialist in Zoonosis and Public Health; Coordinator of the Interdisciplinary Research Group on Public Health; College Professor at Faculdade Zarns (Faculdade de Medicina de Itumbiara), Itumbiara, Goiás, Brazil. dr.vinicius.oliveiras@gmail.com

ABSTRACT

Introduction: Tetanus is an acute infectious, non-contagious disease resulting from the binomial solution of skin/mucosal continuity and contamination by the bacillus *Clostridium tetani*. It is a vaccine-preventable disease and highly lethal. **Objective:** To evaluate the clinical and epidemiologic profile of confirmed cases and deaths from accidental tetanus recorded in the State of Minas Gerais, Brazil, between January 2007 and December 2022. **Methodology:** The methodological strategy involved the analysis of epidemiological bulletins provided by the Sistema de Informação de Agravos de Notificação (Sinan) and the Sistema de Informações sobre Mortalidade (SIM) from 2007 to 2022. There were 395 reported cases and 27% of deaths due to complications of this infection. Belo Horizonte, Ipatinga, Montes Claros and Juiz de Fora were the cities with the highest prevalence of the disease. **Results:** It was found that males, brown people, aged between 40 and 59 years, with a low level of education and urban dwellers were the most affected. There were 12 cases of infection in pregnant women. The profile of individuals who died was male, 50 years or older, white race, married, with less education and with an occupation related to the production of industrial goods and services. **Conclusion:** Despite the availability of effective vaccines, accidental tetanus is still a major public health problem in Minas Gerais. Epidemiologic surveillance of tetanus is essential to identify risk factors and take appropriate preventive measures, involving

collaboration between public health authorities, health care providers and the community for to reduce the burden of this infection.

KEYWORDS: Brazil; *Clostridium tetani*; Epidemiological Monitoring; One Health.

RESUMO

Introdução: O tétano é uma doença infecciosa aguda, não contagiosa, resultante do binômio continuidade de pele/mucosas e contaminação pelo bacilo *Clostridium tetani*. É uma doença prevenível por vacina e de alta letalidade. **Objetivo:** Avaliar o perfil clínico-epidemiológico dos casos confirmados e dos óbitos por tétano acidental registrados no estado brasileiro de Minas Gerais no período de janeiro de 2007 a dezembro de 2022. **Metodologia:** Trata-se de um estudo epidemiológico transversal, descritivo e quantitativo. A estratégia metodológica envolveu a análise dos boletins epidemiológicos disponibilizados pelo Sistema de Informação de Agravos de Notificação (Sinan) e pelo Sistema de Informações sobre Mortalidade (SIM), no período de 2007 a 2022. Foram notificados 395 casos e 27% de óbitos por complicações dessa infecção. Belo Horizonte, Ipatinga, Montes Claros e Juiz de Fora foram as cidades com maior prevalência da doença. **Resultados:** Verificou-se que os homens, pardos, com idade entre 40 e 59 anos, com baixo nível de escolaridade e moradores da zona urbana foram os mais acometidos. Houve 12 casos de infecção em gestantes. O perfil dos indivíduos que foram a óbito foi do sexo masculino, com 50 anos ou mais, raça branca, casado, com menor escolaridade e com ocupação relacionada à produção de bens e serviços industriais. **Conclusão:** Apesar da disponibilidade de vacinas eficazes, o tétano acidental ainda é um grande problema de saúde pública em Minas Gerais. A vigilância epidemiológica do tétano é essencial para identificar os fatores de risco e tomar medidas preventivas adequadas, envolvendo a colaboração entre as autoridades de saúde pública, os profissionais de saúde e a comunidade para reduzir a carga dessa infecção.

PALAVRAS-CHAVE: Brasil; *Clostridium tetani*; Vigilância Epidemiológica; Saúde Única.

INTRODUCTION

Tetanus is a vaccine-preventable, non-contagious, acute infectious disease caused by the action of exotoxins, such as tetanospasmin, produced by *Clostridium tetani* bacteria¹. *C. tetani* is a gram-positive sporulated bacillus, anaerobic, able to survive in the environment for years, and widespread in urban areas. The major reservoirs described for the bacteria are the soil, dust, intestinal tract and animal feces, on the surface of rusty objects such as nails, screws nails, screws, barbed wire, etc.^{1,2}.

The infection is characterized by persistent muscular hypertonia, deep hyperreflexia, and paroxysmal spasms or contractures triggered by tactile, auditory, or visual stimulation of

the patient. The evolution of accidental tetanus is directly related to the severity of the clinical form of the disease, the patient's age, preexisting comorbidities, the type of bacillary entry wound, the duration of the incubation period (14 days on average, but can range from 3 to 21 days), the level of complexity of the patient's treatment, and the quality-of-care provided^{1,3-4}.

In 2015, a total of 6.750 cases of accidental tetanus were reported through the WHO/UNICEF Joint Reporting Form, considering the low sensitivity of tetanus case reporting and uncertainty about the true incidence of the disease on the planet⁵. In developed countries, the incidence of infection has decreased significantly over the years since 1940 due to national vaccination campaigns⁶. In Brazil, in the last decade, the state of Minas Gerais had the highest number of tetanus notifications representing 10.42% of the total⁷.

Knowing that the data provided by the Epidemiological Surveillance Directorate of the Brazilian Ministry of Health indicate that the State of Minas Gerais has an incidence above the national average⁷, the objective of this study was to evaluate the clinical and epidemiologic profile of confirmed cases and deaths from accidental tetanus recorded in the State of Minas Gerais, Brazil, between January 2007 and December 2022.

METHODOLOGY

This is a cross-sectional, ecological, descriptive and quantitative epidemiologic study. Its subject is the notification of accidental tetanus cases and deaths in the State of Minas Gerais individuals during the period 2007 to 2022.

The methodological strategy involved the analysis of epidemiological bulletins provided by the Sistema de Informação de Agravos de Notificação (Sinan)⁸ and the Sistema de Informações sobre Mortalidade (SIM)⁹. Research with this profile, involving only publicly available data that does not identify research participants, does not require approval by human research ethics committees associated with the Comissão Nacional de Ética em Pesquisa from Brazil.

Data collection occurred in April 2023. The secondary data are presented in descriptive tables, and a map of its spatial distribution. The elements studied were stratified according to the information available in the notification forms, such as the distribution of notifications and their annual prevalence, such as sex (male and female), race (white, black, yellow, mixed race, and indigenous), education level (illiterate, 1st to 4th grade incomplete elementary school, 4th complete grade of elementary school, 5th to 8th grade incomplete elementary school, complete elementary school, incomplete high school, complete high school, complete higher education, and incomplete higher education), age group (< 1, 1-4, 5-9, 10-14, 15-19, 20-39, 40-59, 60-64, 65-69, 70-79, and ≥ 80 years old), and area of residence (urban, rural, and peri-urban).

The reports in pregnant women were studied according to the gestational period (1st, 2nd, and 3rd trimester). The evolution of the cases was stratified according to clinical cure and death from accidental tetanus.

The variables were transferred and analyzed using Excel® and GraphPad Prism 6®. The map of the spatial distribution of cases was generated using TabWin 4.15®.

To calculate the annual prevalence rate, the number of notifications in each year was used as the numerator and the Brazilian population by year, according to the Brazilian Demographic Census projection¹⁰, as the denominator. The result of the division was multiplied by hundred thousand inhabitants, adapted from Oliveira & collaborators¹¹.

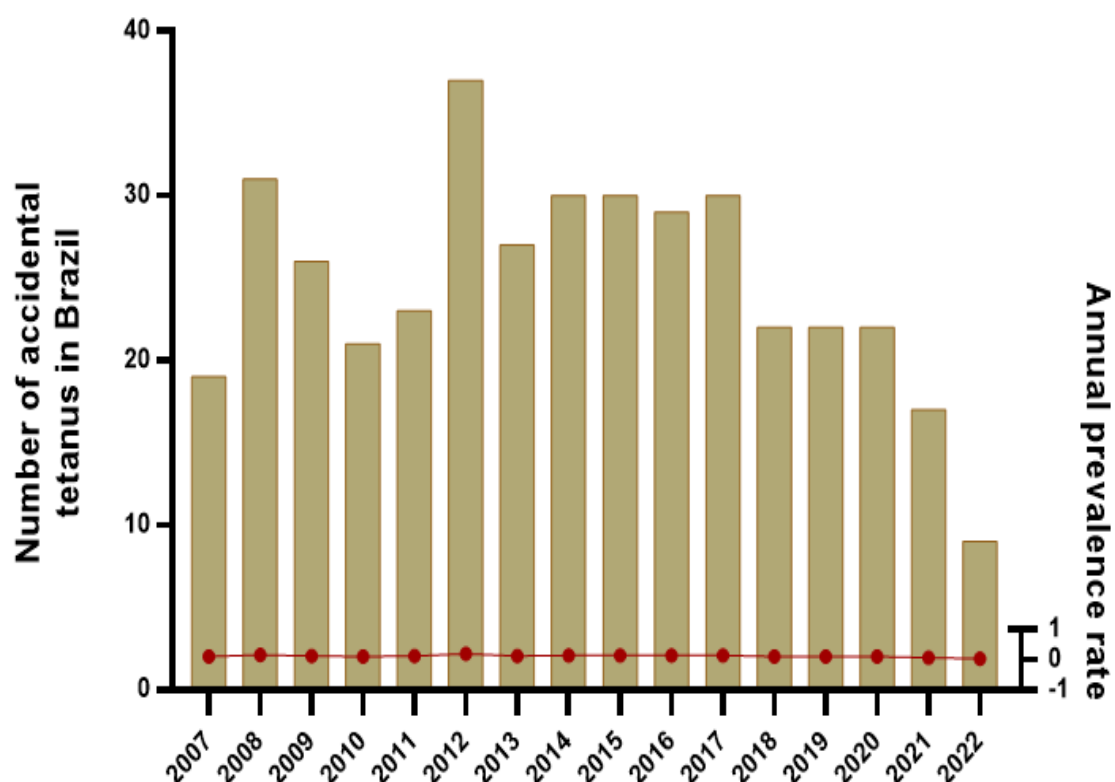
Statistical analysis was performed using GraphPad Prism 6®. The normality of the number of reports in the study period was assessed by the Kolmogorov-Smirnov test, which found a non-parametric distribution of the data. Data were subjected to Kruskal-Wallis's test and Dunn's multiple comparison test for comparison between groups. P-values <0.05 were considered significant.

RESULTS

According to the data collected in the Sinan database, between 2007 and 2022, 395 cases of accidental tetanus were identified in the State of Minas Gerais.

The number of notifications per year and their annual prevalence rate are shown in Figure 1. The bar graph represents the number of cases and should be analyzed with the Y-axis on the left. The line graph with circular symbols refers to the annual prevalence rate in the period studied and should be analyzed with the Y-axis on the right of the figure.

Figure 1 - Accidental tetanus cases and annual prevalence in Minas Gerais (2007-2022).

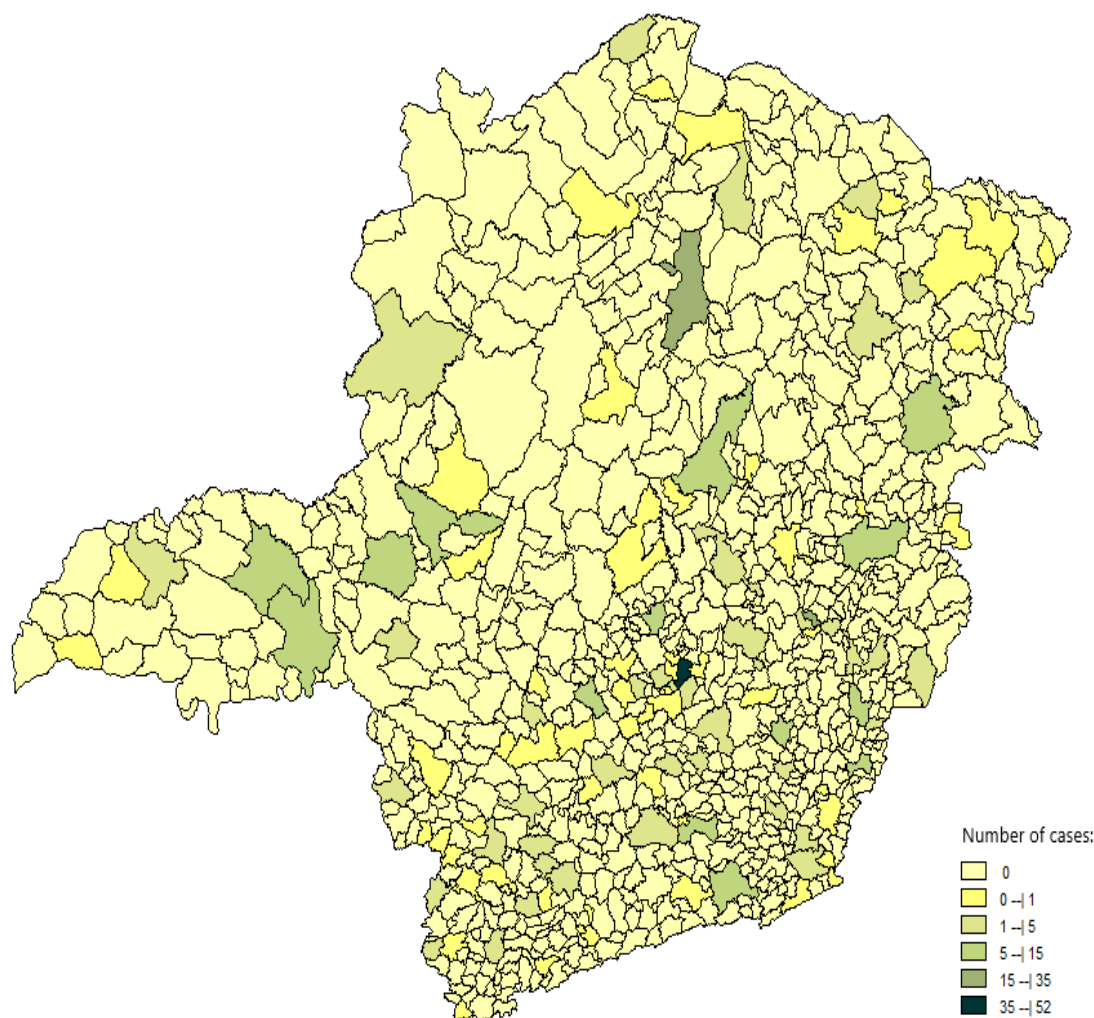


Source: Author's preparation with data from the Sinan⁸.

The statistical analysis did not identify significant differences between the notifications in the period studied.

Figure 2 shows the spatial distribution of reported cases according to the municipality of residence of the infected persons. Note that the cities with a high prevalence of notification in Minas Gerais are Belo Horizonte at 13.5%, Ipatinga at 5.4%, Montes Claros at 4.4%, and Juiz de Fora at 3.1%.

Figure 2 - Geographic distribution of accidental tetanus cases Minas Gerais (2007-2022).



Source: Author's preparation with data from the Sinan⁸.

Table 1 shows the socio-demographic profile of individuals who contracted accidental tetanus. It was possible to determine that males, people brown, aged between 40 and 59 years, with a low level of education, and urban residents are the most affected by the infection.

Table 1 - Social and demographic profile of accidental tetanus in Minas Gerais (2007-2022).

	n
Sex	
Male	329
Female	66
Race	n
White	142
Black	45
Yellow	4
Brown	150
Indigenous	2
Ignored/white	52
Educational levels	n
Illiterate	9
1st to 4th incomplete elementary school	44
4th complete grade of Elementary School	27
5th to 8th incomplete elementary school	23
Complete elementary school	11
Incomplete high school	15
Complete high school	19
Complete higher education	2
Incomplete higher education	2
Ignored/white	243
Age group	n
Less than 1 year	4
5-9 years	1
10-14 years old	1
15-19 years old	9
20-39 years old	74
40-59 years old	159
60-64 years old	32
65-69 years old	35
70-79 years old	60
80 years or older	20
Area of residence	n
Urban	215
Rural	72
Peri-urban	6
Ignored/white	102

Caption: “n” is the raw number of notifications related to the described feature. **Source:** Author's preparation with data from the Sinan⁸.

A number of 12 cases were reported in pregnant women and three of them were in the 1st, one in the 2nd, and five in 3rd trimester. In addition, there were 3 reports in which the gestational age was ignored by reporting.

As for the evolution of the cases, 53.4% of the cases evolved to cure, 27% died from the reported ailment and 2.8% died from another cause.

The sociodemographic profile of the deceased⁹ was 72% male, 68% 50 years or older, 47.7% white race, 46.7% married, 21.5% with less education (up to 3 years completed), and 13.1% with an occupation related to the production of industrial goods and services. 95.3% of deaths occurred in a hospital⁹.

DISCUSSION

The prevalence of tetanus in Minas Gerais in the years studied seems to be in a declining trend, like that observed in Brazil^{12,13}. Despite being immunopreventable, accidental tetanus is still an important public health problem in Minas Gerais¹⁴.

In the epidemiologic study conducted by Vieira and Santos¹⁴ in Minas Gerais between 2001 and 2006, 225 cases of infection were reported. The data described by the authors are consistent with the present study since they found a prevalence of the disease in men over 65 years of age¹⁴. On the other hand, differing from the data found in this study, the area of residence of the patients was in rural areas, other studies show a predominance of the cases related to rural residents^{14,15}.

Sarmiento et al.¹⁵, in a study conducted between 2009 and 2011, found 935 cases of accidental tetanus, 187 of which were among rural residents, with an average of 62,3 cases per year and an average lethality of 32.6%.

The male gender is the group most affected by tetanus^{14,16}, due to the failure of vaccination campaigns directed at these individuals. In the country, the vaccination strategy is aimed at the prevention of neonatal tetanus during pregnancy and, consequently, in pregnant women¹⁴. Thus, the male population is at higher risk of contracting the infection. In addition, the focus of vaccination campaigns also explains the lower prevalence of tetanus in women under 50 years of age¹⁴.

The high number of cases in individuals over 40 years of age can be explained by the fact that aging causes a reduction in reflexes, visual and auditory acuity, and motor skills¹⁷, putting these individuals at risk.

In this regard, Silva¹⁸ states that the elderly population is exposed to greater risk factors than the young population due to misconceptions about the disease, including the lack of adequate active immunization measures, as well as the natural decline of immunogenic protection against infection in this age group.

Concerning age, among those who died from the infection, there was a greater preponderance of workers in the production of industrial goods and services sectors, highlighting the impact of occupation on the risk factors for acquiring the disease and predisposing those infected to death.

This fact is explained by the occupational risk process, which is higher among agricultural and construction workers, as well as the low educational level of the population described. Considering these aspects, the impact on the health-disease process related to the low level of education of the community represents a social determinant of health risk for accidental tetanus¹³.

Among the data described are notifications of accidental tetanus in pregnant women. Tetanus in pregnant women can cause muscle stiffness and spasms, especially in the muscles of the jaw and neck. This can make it difficult for the woman to eat and breathe. In severe cases, tetanus can lead to respiratory failure and death¹⁹.

In addition, *C. tetani* infection can affect the developing fetus, increase the risk of miscarriage and stillbirth, cause premature labor and delivery, and cause low birth weight, which can increase the risk of other health problems for the newborn¹⁹. Therefore, if the pregnant woman has no history of vaccination, she should receive 3 doses of the dual adult vaccine in cases of probable exposure to the bacteria²⁰.

The lethality found in different studies ranges from 16.3% to 52.3%, being higher at the extremes of age^{16,21}. Therefore, the data from this study are in line with the global lethality rate, since the data showed that cases that progressed to death represented 27% of the notifications.

The Sistema de Informação de Agravos de Notificação (Sinan) is a fundamental tool for monitoring public health in Brazil²². However, one of the main challenges facing Sinan

is the presence of ignored and blank variables in the notifications. This can lead to underreporting of cases and, consequently, underestimation of the magnitude of certain diseases. To reduce underreporting, health authorities should provide regular training, encourage the standardization of records, and ensure the availability of resources and technology for data collection and analysis^{22,23}.

CONCLUSION

Despite the availability of effective vaccines, accidental tetanus remains a significant public health problem in the state of Minas Gerais. This potentially fatal disease can lead to prolonged hospitalization and long-term disability, so its prevention and early diagnosis are crucial. Epidemiologic surveillance of tetanus is essential to identify risk factors and implement appropriate preventive measures.

Healthcare professionals must remain vigilant in their efforts to educate the public about the importance of tetanus vaccination and wound care. It is also necessary to strengthen case reporting and investigation to ensure timely response and effective management of the disease. A comprehensive approach involving collaboration between public health authorities, health care providers and the community is essential to reduce the burden of accidental tetanus in Minas Gerais.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests to disclose.

REFERENCES

- 1- Cook TM, Protheroe RT, Handel JM. Tetanus: a review of the literature. *Br. J. Anaesth.* 2001;87(3):477-487. <https://doi.org/10.1093/bja/87.3.477>
- 2 - Larrubia ALS, Zafalon B, Bressan EMR, dos Santos HGN, Cândido KVDS, Blaszk PR, Júnior FDM. Tétano acidental: uma revisão dos aspectos clínicos, epidemiológicos e neuroquímicos. *Braz. J. Health Review.* 2021;4(3):12392-12401. <https://doi.org/10.34119/bjhrv4n3-214>
- 3 - Fan Z, Zhao Y, Wang S, Zhang F, Zhuang C. Clinical features and outcomes of tetanus: a retrospective study. *Infect. Drug Resist.* 2019;1289-1293. <https://doi.org/10.2147/IDR.S204650>

- 4 - Martins MVT, Mendes GJ, Soares LC, da Silva ARL, de Oliveira SV. Análise epidemiológica e avaliação dos gastos/efetividade nas internações por tétano no Brasil. *J. Health Biol. Sci.* 2021;9(1):1-8. <https://doi.org/10.12662/2317-3076jhbs.v9i1.3594.p1-8.2021>
- 5 - World Health Organization (WHO). Tetanus vaccines: WHO position paper, February 2017—recommendations. *Vaccine.* 2018;36(25):3573-3575. <https://doi.org/10.1016/j.vaccine.2017.02.034>
- 6 - Centers for Disease Control and Prevention (CDC). Tetanus surveillance - United States, 2001-2008. USA: Georgia. 2011, pp. 365-9.
- 7 - Ministério da Saúde (BR). Diretoria de Vigilância Epidemiológica. Tétano acidental - casos confirmados notificados no Sistema de Informação de Agravos de Notificação (Sinan) – Brasil. Brasília, 2023. Available at: <http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sinanet/cnv/tetacidbr.def>. Accessed Apr 2023.
- 8 - Ministério da Saúde (BR). Sistema de Vigilância em Saúde. Sistema de Informação de Agravos de Notificação (Sinan). Brasília, 2023. Available at: <http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sinanet/cnv/esquistobr.def>. Accessed Apr 2023.
- 9 - Ministério da Saúde (BR). Sistema de Vigilância em Saúde. Sistema de Informações sobre Mortalidade (SIM). Brasília, SIM; 2023. Available at: <http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/obt10uf.def>
- 10 - Instituto Brasileiro de Geografia e Estatística (BR). Projeção da população do Brasil e das Unidades da Federação. Brasília, 2023a. Available at: <https://www.ibge.gov.br/apps/populacao/projecao/index.html>. Accessed Apr 2023.
- 11 - Oliveira VJ, Siqueira AB, Vieira CS, da Fonseca SLS, da Silva MVG, Borges FV et al. Epidemiologia da leishmaniose visceral humana no Brasil: perspectivas da atenção à saúde pública pelo prisma da Medicina Veterinária. *Res., Soc. Dev.* 2022;11(15): e202111537034-e202111537034. <https://doi.org/10.33448/rsd-v11i15.37034>
- 12 - Lima EC, Glowacki J, Barroso LF, Fonseca NC, Zancan S, da Silveira A. Tétano: Um problema de saúde pública no Brasil apesar das estratégias e medidas de prevenção. *Res., Soc. Dev.* 2021;10(5):e20010514877-e20010514877. <https://doi.org/10.33448/rsd-v10i5.14877>
- 13 - Okumoto O, Brito SMF, Schwartz AS, Abreu AL, Rohlf DB, Duarte E. Situação epidemiológica do tétano acidental no Brasil, 2007-2016. *Boletim Epidemiológico.* Secretaria de Vigilância em Saúde. Ministério da Saúde. Brasil. 2018.
- 14 - Vieira LJ, Santos LM. Aspectos epidemiológicos do tétano acidental no Estado de Minas Gerais, Brasil, 2001-2006. *Epidemiol. Serv. Saúde.* 2009;18(4):357-364. <http://dx.doi.org/10.5123/S1679-49742009000400005>
- 15 - Sarmiento RA, Moraes RM, de Viana RTP, Pessoa VM, Carneiro FF. Determinantes socioambientais e saúde: O Brasil rural versus o Brasil urbano. *Tempus—Actas de Saúde Coletiva.* 2015;9(2):221.

- 16 - Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Situação epidemiológica do tétano acidental no Brasil, 2007-2016. Brasília, 2018. Available at: <http://portalarquivos2.saude.gov.br/images/pdf/2018/junho/11/2017-041-Tetano-publicacao.pdf>. Accessed Apr 2023.
- 17 - Vieira LJ, Santos GP. Tétano acidental no idoso: situação em Minas Gerais. Revista de APS. 2011;14(2). Available at: <https://periodicos.ufjf.br/index.php/aps/article/view/14740>. Accessed May 2023.
- 18 - Silva IH. Análise de casos de tétano na população idosa no Brasil. Revista Multidisciplinar em Saúde, 2021;2(4):03. <https://doi.org/10.51161/rem/2141>
- 19 - World Health Organization (WHO). Protecting all against tetanus: guide to sustaining maternal and neonatal tetanus elimination (MNTE) and broadening tetanus protection for all populations. Switzerland, 2019. Available at: <https://apps.who.int/iris/bitstream/handle/10665/329882/9789241515610-eng.pdf>. Accessed Apr 2023.
- 20 - Ministério da Saúde (BR). Programa Nacional de Imunizações. Brasília, 2021. Available at: <https://portalarquivos.saude.gov.br/campanhas/pni/>. Accessed Apr 2023.
- 21 - Ohama VH, Bezerra AM, de Castro EF, Sprovieri SRS. Tétano acidental em adultos: uma proposta de abordagem inicial. Arq Med Hosp Fac Cienc Med Santa Casa São Paulo. 2019;120-124. <https://doi.org/10.26432/1809-3019.2019.64.2.120>
- 22 - Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Departamento de Vigilância Epidemiológica. Guia de vigilância epidemiológica. 7. ed. Brasília, 2009. Available at: https://bvsmms.saude.gov.br/bvs/publicacoes/guia_vigilancia_epidemiologica_7ed.pdf. Accessed May 2023.
- 23 - Melo MAS, Coleta MFD, Coleta JAD, Bezerra JCB, de Castro AM, de Souza Melo AL et al. Percepção dos profissionais de saúde sobre os fatores associados à subnotificação no Sistema Nacional de Agravos de Notificação (Sinan). Rev. Adm. Saúde. 2018;18(71). <http://dx.doi.org/10.23973/ras.71.104>