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Research Article

BIOSAFETY ACTIVITIES IN FIELD WITH WILD RODENTS

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ABSTRACT

In the 1990s, with the identification of hantavirus pulmonary syndrome (HPS) and the risk of occupational transmission, conservative biosafety measures in handling rodents potentially infected with hantavirus have been established for researchers in the field. Recently, with the advanced knowledge about the biology and etiology of HPS and based on serological surveys for professionals who regularly handle rodents, it has been observed that the risk of contracting the disease is exceedingly low. Groups of professionals in the field of zoology and ecology, among others, began to question the need for an adaptation of conservative protective measures previously published. In this context, taking into account some unintended negative and undesirable consequences during fieldwork with the overprescription of preventative measures, in 2008, the American Society of Mammalogists provided revised guidelines for personnel working with rodents potentially infected with viruses that cause HPS in humans, considering that the level of HPS protection should be proportional to the level of risk exposure observed in many field activities.

Keywords: Biosafety, Rodent, Fieldwork
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INTRODUCTION

After the first description of hantavirus pulmonary syndrome (HPS) in 1993 in the United States, the number of eco-epidemiological studies with animal reservoirs, specifically, rodents, and the concern of professionals who are exposed to these animals increased, seeking greater knowledge and proper enforcement of biosafety techniques, with the aim of reducing the risk of occupational infection (Nichol et al. 1993, Mills et al. 1998, 2002).

The hantaviruses are zoonotic infections widely distributed in the world; the etiologic agents are different viral species belonging to the genus Hantavirus (family *Bunyaviridae*), particularly harbored by rodents of the families *Cricetidae* and *Muridae*. Recently, other groups of small mammals were identified as reservoirs of different hantaviruses, including shrews, moles, and even bats (Klempa et al. 2013). Human infection by hantaviruses can cause two clinical syndromes: hemorrhagic fever with renal syndrome (HFRS) described in Eurasia and Africa and HPS restricted to the American continent (Gajdusek 1962, Hjelle et al. 1994).

The HPS is an emerging zoonosis with high mortality, which has a case fatality rate ranging from 40% to 60% according to the area of incidence. Besides the United States, the HPS has been identified in Argentina, Chile, Brazil, Canada, Panama, Bolivia, Paraguay, Uruguay, and most recently in Peru.

In Brazil, where the largest number of cases has been registered, five genotypes of hantaviruses that cause human disease have been identified: Juquitiba, Araraquara, Anajatuba, Castelo dos Sonhos, and Laguna Negra (Johnson et al. 1999, Suzuki et al. 2004, Rose et al. 2005, Travassos da Rosa et al. 2011, 2012).

The disease has been reported in the states of Amazonas, Pará, Rondônia, Maranhão, Rio Grande do Norte, Bahia, Minas Gerais, and São Paulo besides the federal units in the South and Midwest regions (Brazilian Ministry of Health 2013)

In the 1990s, considering the ability of hantavirus, a virus classified as biosafety level 3, to be transmitted by the respiratory route and the lack of specific therapeutic and prevent measures, the scientific community considered at risk was alerted about the importance of the adoption of biosafety measures in handling rodents potentially infected with hantavirus and the need for a multidisciplinary team during the investigation of an outbreak or a research activity with rodents. In this context, based on clinical and epidemiological data available, a set of guidelines regarding biosafety care was formulated for professionals who would be exposed to

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rodents, especially for those who would carry out field expeditions to capture and handle wild animals, as a result of the efforts made to solve the occurrence of several outbreaks of HPS (CDC 1994, Mills et al. 1995a, 1995b, 2002).

These initial guidelines were established with a conservative target of protection, during a time when the information on the HPS were just beginning to emerge and based on the data available in the scientific literature. Therefore, studies show that the risk of occupational transmission of both hantaviruses that cause HFRS and related HPS reinforced the need for conservative biosafety measures aimed at reducing the occupational risk of hantavirus infection (Childs et al. 1993, CDC 199, Sewell 1995, Jay et al. 1996, Wong et al. 1998, Weber & Rutala 2001, Shi et al. 2003).

With the advancement of knowledge of the biology and etiology of HPS in the last two decades and based on the results of new serological surveys for professionals whose activities involve capture and handling of wild rodents, it has been possible to estimate that the risk of professionals, who handle rodents regularly, contracting the disease is exceedingly low (Zeitz et al. 1997, Fulhorst et al. 2007, Poeppl et al. 2012). However, reinforcing the concept of conservative measures, Torres-Perez and colleagues demonstrated two cases of Sin Nombre hantavirus infection in professionals who had worked in the field and probably contracted the infection by rodent bites (Perez-Torres et al. 2010).

In this scenario, despite the lack of consensus on the adoption of conservative measures for biosafety, new guidelines in the field will be considered, taking into account the actual risks of infection and exposure of professionals that perform field activities associated not only with research outbreaks of zoonotic pathogens but also with ecological, behavioral, and taxonomic research, among others, that is not associated with disease-related studies.

Therefore, from a greater knowledge of HPS, also taking into account the high cost of personal protective equipment (PPE), specifically motorized respirators autonomous with positive pressure that operates with mechanical filters of high efficiency, groups of professionals, such as those in the field of zoology and ecology, began to question the need for an adaptation of conservative biosafety measures previously established. With the overprescription of HPS preventative measures during the fieldwork, some unintended negative and undesirable consequences, including heat prostration from extra layers of protective gear, especially in the tropics; difficulty breathing when using negative pressure respirators at high elevation; and snake bites, falling, and other physical injuries due to restricted visibility when using full-coverage face masks, have been argued by some professionals that endorses the need for adjustments in the level of protection established in the capture of wild animals (Hafner 2007, Kelt et al. 2010).

According to these considerations, in 2008, the American Society of Mammalogists presented new biosafety revised guidelines for handling wild rodents potentially infected with hantavirus (updated guideline for HPS) in response to the belief that the level of protection against HPS should match the level of risk exposure associated with the different field activities and for focusing on researchers who work with rodent species known to transmit hantaviruses that cause HPS (Kelt et al. 2010).

Despite the lack of consensus among professionals who handling rodents, due the possibility of transfer of other viruses transmitted by these animals, such as arenaviruses causing hemorrhagic fever (e.g. Sabia virus in Brazil), it is strongly recommended that field researchers who working with wild rodents strictly follow the CDC guidelines previously stated; the researcher should be protected by PPE according to the activities of higher risk, such as necropsy and taxidermy (Mills et al. 1995a, 1995b, 2002).

Therefore, the selection and definition of protective equipment to be used by members of the field team should take into consideration the location, staff, and activities to be developed. For example, during the capture of wild animals, where assembly, transportation, and subsequent cleaning and disinfection of traps are necessary, the use of thick rubber gloves; long-sleeved shirts (light colored); thick trousers to prevent arthropod bites and scratches; cap or hat to avoid sunstroke; and comfortable shoes and leggings that protect against potentially harmful animals like spiders, snakes, and ticks is recommended. Additionally, because of the risk of inhalation of potentially infectious excretions of the animals during capture and transport of traps, the use of respirators, such as full face, which protect the entire face, allowing a better seal associated with a filter, is also suggested (Torloni 2002).

One of the most hazardous phases of field activity involves the manipulation of live rodents in the laboratory field, which preferably should be handled in an open environment. In this case, the appropriate respiratory protection is a powered respirator with positive pressure that operates with high-efficiency mechanical filters (Figure). Air enters the filter unit (which is generally attached to a waist belt operator) and is pumped to the top of the head and subsequently distributed around the face and neck. Respirators are used with a headgear, which can be a cap or hood system being powered by batteries (Mills et al. 1995a, Mills et al. 1995b, 2002). At this stage, the use of disposable surgical gowns with open back or overalls with front closure (zipper up to chin height) with elastic wrists and ankles is also recommended.

Professionals that work with surveillance activities during an outbreak situation, who need to enter in dwellings that are enclosed and potentially

contaminated with rodent excreta, should necessarily use respiratory protection mask or respirator filters with high-efficiency PFF3 and rubber gloves. At the end of the work, gloves should be washed with disinfectant before removal, and then, hands should also be washed with soap and water.

Finally, although the risk of hantavirus transmission to professionals who handle wild animals, especially wild rodents, is considered very low, preventive measures in all activities should be maintained, considering the possibility of being contaminated by other infectious agents by contact of infected excreta with skin lesion or intact mucosa and transmission through ingestion or arthropod bite (fleas, ticks, and mosquitoes).

Figure. Powered air-purifying respirator fitted with high-efficiency particulate air (HEPA) filters (Gutemberg Brito/IOC)

REFERENCES

Brazilian Ministry of Health 2013. Reported on hantavirus pulmonary syndrome until May, 2013. Avaliable from: *http://portal.saude.gov.br/portal/arquivos/pdf/casos_confirmados_hantavirose.pdf.* (accessed 20.07.2013 in Portuguese).

CDC 1994. Laboratory management of agents associated with hantavirus pulmonary syndrome: interim biosafety guidelines. *MMWR Recomm. Rep.* 43: 1-7.

CDC 1993. Hantavirus infection - Southwestern United States: interim recommendations for risk reduction. *MMWR Recomm. Rep.* 42: 1-13.

Childs JE, Kaufmann AF, Peters CJ, Ehrenberg RL 1993. Hantavirus infection-southwestern United States: interim recommendations for risk reduction. Centers for Disease Control and Prevention. *MMWR Recomm. Rep.* 30: 1-13.

Fulhorst CF, Milazzo ML, Armstrong LR, Childs JE, Rollin PE, Khabbaz R, Peters CJ, Ksiazek TG 2007. Hantavirus and arenavirus antibodies in persons with occupational rodent exposure. *Emerg. Infect. Dis.* 13: 532-538.

Gajdusek DC 1962. Virus hemorrhagic fevers. Special reference to hemorrhagic fever with renal syndrome (epidemic hemorrhagic fever). *J. Pediatr.* 60: 841-857.

Hafner MS 2007. Field research in mammalogy: an enterprise in peril. *J. Mammal* 88: 1119-1128.

Hjelle B, Jenison S, Torrez-Martinez N, Yamada T, Nolte K, Zumwalt R, MacInnes K, Myers G 1994. A novel hantavirus associated with an outbreak of fatal respiratory disease in the southwestern United States: evolutionary relationships to known hantaviruses. *J. Virol.* 68: 592-596.

Jay M, Hjelle B, Davis R, Ascher M, Baylies HN, Reilly K, Vugia D 1996. Occupational exposure leading to hantavirus pulmonary syndrome in a utility company employee. *Clin. Infect. Dis.* 22: 841-844.

Johnson AM, de Souza LT, Ferreira IB, Pereira LE, Ksiazek TG et al. 1999. Genetic investigation of novel hantaviruses causing fatal HPS in Brazil. *J. Med. Virol.* 59: 527-535.

Kelt DA, Hafner MS, Mammalogists AS 2010. Updated guidelines for protection of mammalogists and wildlife researchers from hantavirus pulmonary syndrome (HPS). *J. Mammal* 91: 1524-1527.

Klempa B, Radosa L, Kruger DH 2013. The broad spectrum of hantaviruses and their hosts in Central Europe. *Acta. Virol.* 57: 130-137.

Levine JR, Fritz CL, Novak MG 2008. Occupational risk of exposure to rodent-borne hantavirus at US forest service facilities in California. *Am. J. Trop. Med. Hyg.* 78: 352-357.

Mills JN, Childs JE, Ksiazek TG, Peters CJ, Velleca WM 1995a. Methods for Trapping and Sampling Small Mammals for Virologic Testing, Department of Health and Human Services, Atlanta, CDC, 59 p.

Mills JN, Yates TL, Childs JE, Parmenter RR, Ksiazek TG, Rollin PE, Peters CJ 1995b. Guidelines for Working with Rodents Potentially Infected with Hantavirus. *J. Mammal.* 76: 716-722.

Mills JN, Johnson JM, Ksiazek TG, Ellis BA, Rollin PE, Yates TL, Mann MO, Johnson MR, Campbell ML, Miyashiro J, Patrick M, Zyzak M, Lavender D, Novak MG, Schmidt K, Peters CJ, Childs JE 1998. A survey of hantavirus antibody in small-mammal populations in selected United States National Parks. *Am. J. Trop. Med.. Hyg.* 58: 525-532.

Mills JN, Corneli A, Young JC, Garrison LE, Khan AS, Ksiazek TG 2002. Hantavirus pulmonary

syndrome-United States: updated recommendations for risk reduction. Centers for Disease Control and Prevention. *MMWR Recomm. Rep.* 26: 1-12.

Nichol ST, Spiropoulou CF, Morzunov S, Rollin PE, Ksiazek TG, Feldmann H, Sanchez A, Childs J, Zaki S & Peters CJ 1993. Genetic Identification of a Hantavirus Associated with an Outbreak of Acute Respiratory Illness. *Science* 262: 914-917.

Poeppl W, Tobudic S, Winkler HM, Faas A, Mooseder G, Burgmann H 2012 . Cross-sectional survey of the seroprevalence of Puumala hantavirus in Austria. *Vector Borne Zoonotic Dis.* 12: 709-711.

Rosa ES, Mills JN, Padula PJ, Elkhoury MR, Mendes WS et al. 2005. Newly recognized hantaviruses associated with hantavirus pulmonary syndrome in Northern Brazil: partial genetic characterization of viruses and serologic implication of likely reservoirs. *Vector Borne Zoonotic Dis*. 5: 11-19.

Sewell DL. Laboratory-associated infections and biosafety 1995. *Clin. Microbiol. Rev.* 8: 389-405.

Shi X, McCaughey C, Elliott RM 2003.Genetic characterisation of a Hantavirus isolated from a laboratory-acquired infection. *Med. Virol.* 71: 105-109.

Suzuki A, Bisordi I, Levis S, Garcia J, Pereira LE et al. 2004. Identifying rodent hantavirus reservoirs, Brazil. *Emerg. Infect. Dis.* 10: 2127-2134.

Torloni M 2002. Programa de proteção respiratoria. Seleção e uso de respiradores. São Paulo: *Fundacentro* 130 p.

Torres-Perez F, Wilson L, Collinge SK, Harmon H, Ray C, Medina RA, Hjelle B 2010. Sin Nombre virus infection in field workers, Colorado, USA. *Emerg. Infect. Dis.* 16: 308-310.

Travassos da Rosa ES, Medeiros DB, Nunes MR, Simith DB, de Souza Pereira A et al. 2011. Pygmy rice rat as potential host of Castelo dos Sonhos hantavirus. *Emerg. Infect. Dis.* 17: 1527-1530.

Travassos da Rosa ES, Medeiros DB, Nunes MR, Simith DB, de Souza Pereira A et al. 2012. Molecular Epidemiology of Laguna Negra Virus, Mato Grosso State, Brazil. *Emerg. Infect. Dis.* 18: 982-985.

Weber DJ, Rutala WA. Risks and prevention of nosocomial transmission of rare zoonotic diseases. Clin Infect Dis 2001 32:446-456. Wong TW, Chan YC, Yap EH, Joo YG, Lee HW, Lee PW, Yanagihara R, Gibbs CJ Jr, Gajdusek DC 1988. Serological evidence of hantavirus infection in laboratory rats and personnel. *Int. J. Epidemiol.* 17: 887-890.

Zeitz PS, Graber JM, Voorhees RA, Kioski C, Shands LA, Ksiazek TG, Jenison S, Khabbaz RF 1997. Assessment of occupational risk for hantavirus infection in Arizona and New Mexico. *J. Occup. Environ. Med.* 39: 463-467.