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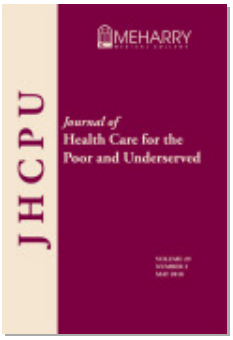

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Self-reported Animal and Ectoparasite Exposure among Urban Homeless People

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Abstract: Homeless people in the United States may experience poor hygiene and spend extended periods of time outdoors, which increases exposure to animal and insect vectors of disease. Despite these risks, efforts to understand frequency and risk factors for zoonotic and vector-borne infections among homeless people have been limited. We queried homeless people in Boston, Massachusetts (n=194) to evaluate exposure to urban wildlife and ectoparasites associated with infection. Thirty percent of participants reported seeing rodents daily, and 25% reported daily sightings of cats. Body lice and fleas were reported by 4% and 11% of participants, respectively. Sleeping outdoors and heavy drinking were positively associated with rodent and ectoparasite exposure. Frequent sightings of rodents and rodent feces among homeless people in particular areas may indicate human exposure risk to urban rodent-borne pathogens, including *Leptospira* spp, Seoul hantavirus, and *Rickettsia akari*. Epidemiologic studies of zoonotic and vector-borne infections in this population are warranted.

Key words: Parasite, zoonoses, animal, homeless, vector-borne infection, zoonotic infection.

More than half a million people in the United States experience homelessness each year, and the majority reside in urban areas.[1] While HIV, hepatitis C, and tuberculosis among homeless individuals are well-established infectious disease concerns in the United States,[2] research into other infections experienced by this population, including zoonotic and vector-borne infections, remains very limited. In particular, the nature and frequency of contact between homeless people and animal hosts and insect vectors of disease in the urban environment is understudied.

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Exposure to rodent-borne infections are of particular concern for people experiencing homelessness.[3] Urban rodents are known to carry pathogens harmful to human health, including *Leptospira* species, lymphocytic choriomeningitis virus (LCMV), Seoul hantavirus (SEOV), *Yersinia pestis*, and *Rickettsia akari*.[4–10] Studies have documented elevated incidence of rodent-borne zoonotic infection among homeless and marginalized individuals, notably people who use injection drugs.[8,10–17] Reports of wild rodents in urban areas from animal surveillance studies document additional pathogens harmful to human health in the rodent reservoir, including influenza viruses, methicillin-resistant *Staphylococcus aureus*, and other emerging infections.[18–21] Extended periods of time spent outdoors also increases exposure to other animals that may carry pathogens in addition to rodents, including cats (*Bartonella henselae* and *Rickettsia typhi),* raccoons (*Baylisascaris procyonis*) and birds (influenza viruses).[22–25]

Crowded living conditions and poor hygiene increase prevalence of ectoparasitic infestation among homeless individuals.[26] The human body louse (*Pediculus humanus humanus*) is responsible for human-to-human transmission of *Bartonella quintana*, known as "trench fever," the most prevalent identified vector-borne infection among homeless people in the United States, as well as the more severe relapsing fever (*Borellia recurrentis)* and epidemic typhus (*Rickettsia prowasekii*).[27–29] Bites from the mouse mite *Liponyssoides sanguineus* transmit *R. akari* between mice and humans.[10] Fleas carry the agent of cat scratch fever, *Bartonella henselae*.[30]

Health effects associated with these infections may be compounded by comorbidities associated with homelessness, specifically elevated stress and substance use, and may result in long-term health consequences.[2] HIV positive individuals are at heightened risk of severe sequaelae of infection with *B. quintana*, including endocarditis, pericardial effusion, and bacillary angiomatosis-peliosis.[31–33] Studies indicate an association between rodent-borne hantavirus seropositivity and hypertensive renal disease among urban, marginalized people, highlighting long-term health risks to this population.[15,16]

Despite these risks, research evaluating animal and ectoparasite exposures among homeless people in the United States is scant. In this study, we surveyed homeless people in Boston, Massachusetts to assess the type and frequency of contact with wild and domesticated animals and ectoparasites to identify the scope of the problem, establish whether further epidemiological research on zoonotic and vector-borne infections was warranted in this population, and identify risk factors for infection in order to aid clinical diagnosis and treatment.

Methods

A cross-sectional, volunteer-based study was conducted at the Boston Health Care for Homeless Program's (BHCHP) main primary care facility in July 2015. Current BHCHP patients who were aged 18 years or older, were currently homeless or experienced homelessness in the previous three months, and English-speaking were eligible. In-person interviews were conducted in screened areas in the clinic lobby, lasting approximately 30 minutes. Questions included medical history, drug use history, hygiene behaviors, and demographic characteristics. All aspects of study design and conduct were approved by the institutional review board at the Boston University Medical Center.

Participants were asked whether they had been bitten or infested with the following insects while homeless: body lice, head lice, fleas, and ticks. Participants were queried regarding frequency of seeing rats or mice, rodent droppings, cats, dead birds, and dead wild animals, such as raccoons, squirrels, or skunks, in the last three months. Options for response were *never*, *rarely*, *sometimes*, and *every day*.

Prevalence of self-reported exposure to ectoparasites and animals during homelessness was calculated. Responses to questions regarding contact with animals were described descriptively as categorical variables using the categories from the questionnaire and also dichotomized for regression analysis. Responses of *never* and *rarely* were aggregated into one variable depicting low frequency of exposure. Responses of *every day* and *sometimes* were aggregated into one variable depicting elevated frequency of exposure. Multivariable logistic regression models were fitted using backward stepwise selection with this dichotomous outcome to identify significant risk factors at the 5% level, considering covariates of gender, street sleeping, shelter sleeping, heavy drinking (defined as more than five days drinking to intoxication in the last 30 days), injection drug use in the last year age, and HIV positive status.[34] An Index variable (*yes/no*) was created to account for self-report of infestation or bites with any of fleas, head lice, ticks, and body lice during period(s) of homelessness. Fisher's exact tests were used to assess the association between the index variable and other predictors. All statistical analyses were conducted using StataSE 13.1 (College Park, TX).

Results

In total, 194 people were enrolled in the study. An additional 11 individuals volunteered but were ineligible for enrollment due to not being English-speaking (n=7) or homeless in the last three months (n=4). Mean age was 48 years old, 55.7% were women and 41.8% were African American. Key behavioral and demographic data are presented in Table 1.

Nearly 29% percent of subjects (n=56) reported seeing rats or mice daily and 9.3% saw rodent feces daily (Table 2). Approximately 25% of participants saw cats daily. A smaller number of participants saw dead birds (5.2%; n=10) and dead wild mammals (1.6%; n=3) daily.

Approximately 21% of participants (n=41) reported bites or infestation by at least one of the following during periods of homelessness: fleas, head lice, body lice, and ticks (Table 2). Flea bites were reported by approximately 11% (n=22) of participants, and 4.1% (n=8) reported body lice. Heavy drinking was positively associated with having ever experienced a parasite infestation during periods of homelessness (p=.03).

Parasite infestation was positively associated with frequent reports of rodent feces (p=.008) and marginally with frequent rodent sightings (p=.08) (data not shown). There were no significant associations between parasite infestation and frequency of wild birds, dead animals, cats or dogs.

People who slept outdoors had more than 13 times the odds of reporting greater frequency of rodent sightings in the last three months compared with people who did not sleep on the street (OR: 13.3; p=.001; 95% CI: 2.7, 65.3) (Table 3). Sleeping outdoors or in homeless shelters was positively associated with greater frequency of

Table 1.

SELECT PARTICIPANT DEMOGRAPHICS (N=194)

Characteristic	Prevalence % (n)
Gender	
Female	55.7 (108)
Male	43.8 (85)
Race/ethnicity	
Black	41.8 (81)
White	38.1 (74)
Hispanic	18.6 (36)
Most frequent location for sleep in the last week	
Homeless shelter	53.6 (104)
Street/unsheltered outdoors	7.2 (14)
Supportive or transitional housing	11.3 (22)
With a friend or family member	13.9 (27)
Housing without support services	8.8 (17)
Other	5.2 (10)
Self-reported medical history	
HIV positive	11.3 (22)
Ever diagnosed with endocarditis	3.1 (6)
Currently on hemodialysis for renal failure	2.1 (4)
Injection drug use in last year	27.8 (54)
Heavy drinker[a]	15.5 (30)

Notes
[a]Defined as drinking to intoxication 5+ days in the last month.

dead bird sightings (sleeping outdoors: OR: 3.2; p=.06; 95%CI: 0.9, 10.9; sleeping in shelters: OR: 2.6, p=.02; 95%CI: 1.2, 5.5). Heavy drinking was associated with greater frequency of sightings of rodents and rodent feces, cats, dogs, dead birds and dead mammals (Table 3). No associations were identified between HIV status, gender, and age and animal exposure.

Discussion

Self-reported data on animal and parasite exposure among people experiencing homelessness in Boston suggests that epidemiologic research into human infection with zoonotic and vector-borne disease in this population is warranted. Notably, approximately half of the participants in our study reported frequent sightings of rodents and/or rodent feces on a daily basis. These findings indicate that homeless people in Boston may be at particularly elevated risk of exposure to rodent-borne infections. While an imperfect metric of exposure, self-reports provide insight into personal experience and observation in a way that can guide future research and interventions, and are

Table 2.

ECTOPARASITE AND ANIMAL EXPOSURE REPORTED BY STUDY PARTICIPANTS[a]

		Select risk factors for any ectoparasite exposure (p-value)[b]		
Infestation during homelessness	**Prevalence % (n)**	**Injection drug use**	**Heavy drinking**	**Shelter sleeping**
Any ectoparasite	21% (8)	p=.12	p=.03	p=.08
Body lice	4.1 (8)			
Head lice	5.2 (10)			
Fleas	11.3 (22)			
Ticks	2.6 (5)			
Frequency of sighting in the last three months	**Every day**	**Sometimes**	**Rarely**	**Never**
Rats or mice	28.9 (56)	22.2 (43)	18.6 (36)	30.4 (59)
Rodent feces	9.3 (18)	15.5 (30)	12.4 (24)	62.7 (121)
Cats	24.9 (48)	23.3 (45)	17.1 (33)	34.7 (67)
Dogs	37.0 (71)	26.0 (50)	11.0 (21)	26.0 (50)
Dead birds	5.2 (10)	20.8 (40)	26.0 (50)	48.0 (92)
Dead wild mammals	1.6 (3)	13.0 (25)	16.7 (32)	68.7 (132)

Notes
[a]Columns do not sum to 100% due to missing data.
[b]Calculated using Fisher's exact test due to small numbers.

especially useful in contexts where more nuanced exposure metrics may be difficult or expensive to ascertain, or where very limited data exist.

Homeless individuals who slept in a variety of housed arrangements, including transitional and supportive housing, did not encounter rodents as frequently as those sleeping in shelters and on the street. These results imply that housing programs to transition and support individuals from homelessness may be effective in reducing risk of these infections, suggesting additional public health benefit of such programs. Rodent control in homeless shelters is an established problem, and our findings reflect the continued relevance of these public health efforts.[35–37]

Infestation with body lice (*P. humanus humanus*) may transmit *B. quintana*, for which elevated seroprevalence has been identified in prior studies of homeless people.[38] *B. quintana* typically causes mild febrile illness or may be asymptomatic, but long-term consequences, including endocarditis and chronic bacteremia may result, especially for HIV-positive individuals.[27] A low proportion of study participants (4%) reported body lice infestation during their experience of homelessness, which reflects lower infestation

Table 3.

SELECT RISK FACTORS FOR ELEVATED FREQUENCY OF SELF-REPORTED EXPOSURE TO URBAN ANIMALS

	Odds ratio[a] (95% CI); p-value		
Greater frequency exposure[b]	**Sleeping outdoors**	**Sleeping in homeless shelters**	**Heavy drinking**
Rodents	13.3 (2.7, 65.3); p=.001[c]	3.5 (1.8, 6.9); p=.05[c]	2.5 (1.0, 6.4); p=.05[c]
Rodent feces	2.8 (0.8, 10.2); 0.1	5.7 (1.9, 17.3); 0.002[c]	2.5 (1.0, 6.2); 0.04[c]
Cats	0.34 (0.1, 1.1); p=.08	0.45 (0.2, 0.9); p=.01[c]	4.5 (1.8, 11.5); p=.002[c]
Dead birds	3.2 (0.9, 10.9); p=.06	2.6 (1.2, 5.5); p=.02[c]	3.3 (1.4, 7.9); p=.007[c]
Dead wild mammals	1.5 (0.2, 3.7); p=.9	1.0 (0.4, 2.5); p=.9	5.3 (1.9, 14.6); p=.001[c]

Notes
[a]Odds ratios generated from multivariable logistic regression models using backwards stepwise selection and including the following covariates: HIV positive status, street sleeping, heavy drinking, injection drug use in the last year, shelter sleeping, age and gender.
[b]Greater frequency exposure refers to responses of either daily or sometimes in regard to frequency of sighting the following during the last 30 days.
[c]Significant at the 5% level

rate than identified in other studies of homeless people.[39–43] It is possible that incidence of body lice infestation is lower in this population due to active medical care provided by the Boston Health Care for the Homeless Program or that other factors, such as improved or proactive sanitation practices in shelters, are responsible. Epidemiologic studies would improve understanding of the distribution of *B. quintana* in this population. Clinicians treating homeless people, especially HIV-positive individuals, should be trained to recognize and treat rodent-borne infections to reduce risk of complications for vulnerable groups.

Cats are the reservoir for *Bartonella henselae*, which has been identified previously in studies of homeless individuals.[44] Fleas are also known to carry *B. henselae*, and can transmit the bacteria to cats and potentially humans through a blood meal or through deposition of contaminated feces onto abraded skin.[45] Approximately half of study participants identified frequent contact with cats, and half of these individuals said the cats were pets. Contact with cats among homeless people warrants further attention to identify whether disease transmission occurs along this pathway.

Contact with dead wild mammals and their effluvia, especially raccoons and raccoon fecal material, may increase risk of exposure to pathogens such as *Baylisascaris procyonis*, which can cause neural larva migrans in humans.[46] Similarly, contact with

dead birds poses a risk for human transmission of pathogens in the avian reservoir, including influenza viruses and psittacosis.[47,48]

Heavy drinking was positively associated with frequent exposure to urban wildlife, dead animals, and ectoparasites in our study. This finding is concordant with other studies that identified heavy drinking as a risk factor for urban zoonotic and vector-borne disease among homeless people.[11,49–52] Heavy drinking may occur in environments with limited sanitation, such as city alleys, with a greater preponderance of urban wildlife. It is also possible that individuals who drink heavily may spend more time outdoors, due to no-alcohol policies at many shelters and day centers, increasing opportunities for contact with wildlife. While injection drug use has been associated with rodent-borne infections in multiple studies, we did not observe an association here.[11–13,51,53] Since study participants were recruited at a health clinic, it is possible that our subjects were less likely to use illegal substances, or that drug use was underreported. It is also possible that given the small size of our study, we were underpowered to see such associations.

Given our small sample size, we were not able to make inferences regarding association between exposures and some predictors. Self-reported exposure data is of incomplete accuracy in that it is limited by subjective awareness of environment, recall capability, and correct identification of exposure. Selection bias may have affected our findings, in that study participants were volunteers recruited from a medical clinic. As a result, these individuals may be healthier than other homeless people and more motivated to improve their living conditions, and therefore more likely to notice and report exposure. However, the generalizability of our findings to the entire BHCHP patient population is unclear. Exposure categories for frequency of exposure were not quantified, due to concern that such quantification may be equally imprecise as qualitative metrics. Our questionnaire tool also did not include an option for "don't know" or "don't remember" and as a result, may overestimate exposure. Future work that quantifies rodent exposure, perhaps using cameras or habitat mapping, would be valuable to verify self-reports.

Homeless people, particularly those who drink heavily, report frequent contact with animal and insect vectors of disease. Human studies are necessary to evaluate rates of zoonotic and vector-borne infections in this population.

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References

1. National Alliance to End Homelessness. The state of homelessness in America. Washington, DC: National Alliance to End Homelessness, 2016. Available at: http://endhomelessness.org/wp-content/uploads/2016/10/2016-soh.pdf.
2. Fazel S, Geddes JR, Kushel M. The health of homeless people in high-income countries:

descriptive epidemiology, health consequences, and clinical and policy recommendations. Lancet Lond Engl. 2014;384(9953):1529–40.
https://doi.org/10.1016/S0140-6736(14)61132-6
PMid: 25390578

3. Leibler JH, Zakhour CM, Gadhoke P, Gaeta JM. Zoonotic and vector-borne infections among urban homeless and marginalized people in the United States and Europe, 1990–2014. Vector Borne Zoonotic Dis Larchmt N. 2016 Jul;16(7):435–44
https://doi.org/10.1089/vbz.2015.1863
PMid: 27159039
4. Berger SA, Oliver JA, Pulini M. Urban leptospirosis. N Y State J Med. 1974 Nov;74(12):2232–3.
PMid: 4530914
5. Drancourt M, Houhamdi L, Raoult D. Yersinia pestis as a telluric, human ectoparasite-borne organism. Lancet Infect Dis. 2006 Apr;6(4):234–41.
https://doi.org/10.1016/S1473-3099(06)70438-8
PMid: 16554248
6. Feigin RD, Anderson DC. Human leptospirosis. CRC Crit Rev Clin Lab Sci. 1975 Mar;5(4):413–67.
https://doi.org/10.3109/10408367509107050
PMid: 237740
7. Haake DA, Levett PN. Leptospirosis in humans. Curr Top Microbiol Immunol. 2015;387:65–97.
https://doi.org/10.1007/978-3-662-45059-8_5.
PMid: 25388133
8. Khabbaz RF, Ksiazek TG, Caiaffa WT, Rollin PE, Taylor E, Vlahov D. Seoul hantavirus seropositivity among injecting drug users in Baltimore. J Infect Dis. 1994 Dec;170(6):1636–7.
https://doi.org/10.1093/infdis/170.6.1636
PMid:7996013
9. Laposova K, Pastorekova S, Tomaskova J. Lymphocytic choriomeningitis virus: invisible but not innocent. Acta Virol. 2013;57(2):160–70.
https://doi.org/10.4149/av_2013_02_160
PMid: 23600874
10. Paddock CD, Zaki SR, Koss T, et al. Rickettsialpox in New York City: a persistent urban zoonosis. Ann N Y Acad Sci. 2003 Jun;990:36–44.
https://doi.org/10.1111/j.1749-6632.2003.tb07334.x
PMid: 12860597
11. Comer JA, Diaz T, Vlahov D, Monterroso E, Childs JE. Evidence of rodent-associated Bartonella and Rickettsia infections among intravenous drug users from Central and East Harlem, New York City. Am J Trop Med Hyg. 2001 Dec;65(6):855–60.
https://doi.org/10.4269/ajtmh.2001.65.855
PMid: 11791987
12. Comer JA, Flynn C, Regnery RL, Vlahov D, Childs JE. Antibodies to Bartonella species in inner-city intravenous drug users in Baltimore, Md. Arch Intern Med. 1996 Nov;156(21):2491–5.
https://doi.org/10.1001/archinte.1996.00440200111014
https://doi.org/10.1001/archinte.156.21.2491
PMid: 8944742
13. Comer JA, Tzianabos T, Flynn C, Vlahov D, Childs JE. Serologic evidence of rick-

ettsialpox (Rickettsia akari) infection among intravenous drug users in inner-city Baltimore, Maryland. Am J Trop Med Hyg. 1999 Jun;60(6):894–8.
https://doi.org/10.4269/ajtmh.1999.60.894
PMid: 10403316

14. Glass GE, Watson AJ, LeDuc JW, Kelen GD, Quinn TC, Childs JE. Infection with a ratborne hantavirus in US residents is consistently associated with hypertensive renal disease. J Infect Dis. 1993 Mar;167(3):614–20.
https://doi.org/10.1093/infdis/167.3.614
PMid: 8095060
15. Glass GE, Childs J, Watson A, LeDuc J. Association of chronic renal disease, hypertension, and infection with a rat-borne hantavirus. Arch Virol Suppl 1. 1990 Jan:69–80.
https://doi.org/10.1007/978-3-7091-9091-3_9
16. Glass GE, Watson AJ, LeDuc JW, Childs JE. Domestic cases of hemorrhagic fever with renal syndrome in the United States. Nephron. 1994;68(1):48–51.
https://doi.org/10.1159/000188086
PMid: 7991040
17. Reeves WK, Murray KO, Meyer TE, et al. Serological evidence of typhus group rickettsia in a homeless population in Houston, Texas. J Vector Ecol J Soc Vector Ecol. 2008 Jun;33(1):205–7.
https://doi.org/10.3376/1081-1710(2008)33[205:SEOTGR]2.0.CO;2
PMid: 18697325
18. Firth C, Bhat M, Firth MA, et al. Detection of zoonotic pathogens and characterization of novel viruses carried by commensal Rattus norvegicus in New York City. MBio. 2014 Oct 14;5(5):e01933–14.
https://doi.org/10.1128/mBio.01933-14
PMid: 25316698
19. Frye MJ, Firth C, Bhat M, et al. Preliminary survey of ectoparasites and associated pathogens from Norway rats in New York City. J Med Entomol. 2015 Mar;52(2):253–9.
https://doi.org/10.1093/jme/tjv014
PMid: 26336309
20. Himsworth CG, Miller RR, Montoya V, et al. Carriage of methicillin-resistant Staphylococcus aureus by wild urban Norway rats (Rattus norvegicus). PloS One. 2014 Feb3;9(2):e87983.
https://doi.org/10.1371/journal.pone.0087983
PMid: 24498421
21. Himsworth CG, Zabek E, Desruisseau A, et al. Prevalence and characteristics of Escherichia coli and Salmonella spp. in the feces of wild urban Norway and black rats (Rattus norvegicus and Rattus rattus) from an inner-city neighborhood of Vancouver, Canada. J Wildl Dis. 2015 Jul;51(3):589–600.
https://doi.org/10.7589/2014-09-242
PMid: 25932669
22. Webby RJ, Webster RG, Richt JA. Influenza viruses in animal wildlife populations. Curr Top Microbiol Immunol. 2007;315:67–83.
https://doi.org/10.1007/978-3-540-70962-6_4
PMid: 17848061
23. Boulouis H-J, Chang C-C, Henn JB, Kasten RW, Chomel BB. Factors associated with the rapid emergence of zoonotic Bartonella infections. Vet Res. 2005 May–Jun;36(3):383–410.

https://doi.org/10.1051/vetres:2005009
PMid: 15845231
24. Abramowicz KF, Rood MP, Krueger L, Eremeeva ME. Urban focus of Rickettsia typhi and Rickettsia felis in Los Angeles, California. Vector Borne Zoonotic Dis. 2011 Jul;11(7):979–84.
https://doi.org/10.1089/vbz.2010.0117
PMid: 21142968
25. Gavin PJ, Kazacos KR, Shulman ST. Baylisascariasis. Clin Microbiol Rev. 2005 Oct;18(4):703–18.
https://doi.org/10.1128/CMR.18.4.703-718.2005
PMid: 16223954
26. Brouqui P, Raoult D. Arthropod-borne diseases in homeless. Ann N Y Acad Sci. 2006 Oct;1078:223–35.
https://doi.org/10.1196/annals.1374.041
PMid: 17114713
27. Ohl ME, Spach DH. Bartonella quintana and urban trench fever. Clin Infect Dis. 2000 Jul;31(1):131–5.
https://doi.org/10.1086/313890
PMid: 10913410
28. Cutler SJ. Relapsing fever—a forgotten disease revealed. J Appl Microbiol. 2010 Apr;108(4):1115–22.
https://doi.org/10.1111/j.1365-2672.2009.04598.x
PMid: 19886891
29. Bechah Y, Capo C, Mege J-L, Raoult D. Epidemic typhus. Lancet Infect Dis. 2008 Jul;8(7):417–26.
https://doi.org/10.1016/S1473-3099(08)70150-6
PMid: 18582834
30. Higgins JA, Radulovic S, Jaworski DC, Azad AF. Acquisition of the cat Scratch Disease Agent Bartonella henselae by cat fleas (Siphonaptera: Pulicidae). J Med Entomol. 1996 May;33(3):490–5.
https://doi.org/10.1093/jmedent/33.3.490
PMid: 8667399
31. Koehler J. Bartonella-associated infections in HIV-infected patients. AIDS Clin Care. 1995 Dec;7(12):97–102.
PMid: 11362939
32. Koehler JE, Sanchez MA, Tye S, et al. Prevalence of Bartonella infection among human immunodeficiency virus-infected patients with fever. Clin Infect Dis. 2003 Aug 15;37(4):559–66.
https://doi.org/10.1086/375586
PMid: 12905141
33. Koehler JE, Sanchez MA, Garrido CS, et al. Molecular epidemiology of Bartonella infections in patients with bacillary angiomatosis-peliosis. N Engl J Med. 1997 Dec 25;337(26):1876–83.
https://doi.org/10.1056/NEJM199712253372603
PMid: 9407154
34. Substance Abuse and Mental Health Services Administration. Alcohol. Rockville, MD: United States Department of Health and Human Services, 2016. Available at: https://www.samhsa.gov/atod/alcohol.

35. Popescu G-A, Chirca I. The starry heaven and the crowded shelters: public health risks. South Med J. 2010 Jan;103(1):3–4.
https://doi.org/10.1097/SMJ.0b013e3181c38c5e
PMid: 19996839
36. Duchene M. Infection control in soup kitchens and shelters. Home Healthc Nurse. 2010 Sep;28(8):471–8.
https://doi.org/10.1097/NHH.0b013e3181ed754f
PMid: 20811182
37. The City of New York Department of Investigation. Probe of department of homeless services' shelters for families with children Finds Serious Deficiencies. New York, NY: City of New York City Department of Investigation, 2015 Mar 12. Available at: https://www1.nyc.gov/assets/doi/reports/pdf/2015/2015-03-12-Pr08dhs.pdf
38. Jackson LA, Spach DH. Emergence of Bartonella quintana infection among homeless persons. Emerg Infect Dis. 1996 Apr–Jun;2(2):141–4.
https://doi.org/10.3201/eid0202.960212
PMid: 8903217
39. Angelakis E, Rolain J-M, Raoult D, Brouqui P. Bartonella quintana in head louse nits. FEMS Immunol Med Microbiol. 2011 Jul;62(2):244–6.
https://doi.org/10.1111/j.1574-695X.2011.00804.x
PMid: 21477003
40. Bonilla DL, Kabeya H, Henn J, Kramer VL, Kosoy MY. Bartonella quintana in body lice and head lice from homeless persons, San Francisco, California, USA. Emerg Infect Dis. 2009 Jun;15(6):912–5.
https://doi.org/10.3201/eid1506.090054
PMid: 19523290
41. La Scola B, Fournier PE, Brouqui P, Raoult D. Detection and culture of Bartonella quintana, Serratia marcescens, and Acinetobacter spp. from decontaminated human body lice. J Clin Microbiol. 2001 May;39(5):1707–9.
https://doi.org/10.1128/JCM.39.5.1707-1709.2001
PMid: 11325978
42. Sasaki T, Kobayashi M, Agui N. Detection of Bartonella quintana from body lice (Anoplura: Pediculidae) infesting homeless people in Tokyo by molecular technique. J Med Entomol. 2002 May;39(3):427–9.
https://10.1603/0022-2585-39.3.427
PMid: 12061434
43. Rydkina EB, Roux V, Gagua EM, Predtechenski AB, Tarasevich IV, Raoult D. Bartonella quintana in body lice collected from homeless persons in Russia. Emerg Infect Dis. 1999 Jan–Feb;5(1):176–8.
https://doi.org/10.3201/eid0501.990126
PMid: 10081691
44. Hwang J, Gottdenker NL. Bartonella species in raccoons and feral cats, Georgia, USA. Emerg Infect Dis. 2013 Jul;19(7):1167–8.
https://doi.org/10.3201/eid1907.130010
PMid: 23764013
45. Billeter SA, Levy MG, Chomel BB, Brieitschwardt EB. Vector transmission of Bartonella species with emphasis on the potential for tick transmission. Med Vet Entomol. 2008 Mar;22(1):1–15.
https://doi.org/10.1111/j.1365-2915.2008.00713.x
PMid: 18380649

46. Wise ME, Sorvillo FJ, Shafir SC, Ash LR, Berlin OG. Severe and fatal central nervous system disease in humans caused by Baylisascaris procyonis, the common roundworm of raccoons: a review of current literature. Microbes Infect. 2005 Feb;7(2):317–23. https://doi.org/10.1016/j.micinf.2004.12.005
PMid: 15715975
47. Zambon MC. Epidemiology and pathogenesis of influenza. J Antimicrob Chemother. 1999 Nov;44 Suppl B:3–9.
https://doi.org/10.1093/jac/44.suppl_2.3
PMid: 10877456
48. Rehn M, Ringberg H, Runehagen A, et al. Unusual increase of psittacosis in southern Sweden linked to wild bird exposure, January to April 2013. Euro Surveill. 2013 May 9;18(19):20478.
PMid: 23725809
49. Brouqui P, Houpikian P, Dupont HT, et al. Survey of the seroprevalence of Bartonella quintana in homeless people. Clin Infect Dis. 1996 Oct;23(4):756–9.
https://doi.org/10.1093/clinids/23.4.756
PMid: 8909840
50. Brouqui P, Lascola B, Roux V, Raoult D. Chronic Bartonella quintana bacteremia in homeless patients. N Engl J Med. 1999 Jan 21;340(3):184–9.
https://doi.org/10.1056/NEJM199901213400303
PMid: 9895398
51. Jackson LA, Spach DH, Kippen DA, et al. Seroprevalence to Bartonella quintana among patients at a community clinic in downtown Seattle. J Infect Dis. 1996 Apr;173(4):1023–6.
https://doi.org/10.1093/infdis/173.4.1023
PMid: 8603944
52. Badiaga S, Brouqui P, Raoult D. Autochthonous epidemic typhus associated with Bartonella quintana bacteremia in a homeless person. Am J Trop Med Hyg. 2005 May;72(5):638–9.
PMid: 15891141
53. Zupan S, Poljak M, Avsic-Zupanc T. Prevalence of Bartonella infections in Slovenian intravenous drug users. Ann N Y Acad Sci. 2003 Jun;990(1):414–8.
https://doi.org/10.1111/j.1749-6632.2003.tb07403.x
PMid: 12860666