Bat and Lyssavirus Exposure among Humans in Area that Celebrates Bat Festival, Nigeria, 2010 and 2013

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Using questionnaires and serologic testing, we evaluated bat and lyssavirus exposure among persons in an area of Nigeria that celebrates a bat festival. Bats from festival caves underwent serologic testing for phylogroup II lyssaviruses (Lagos bat virus, Shimoni bat virus, Mokola virus). The enrolled households consisted of 2,112 persons, among whom 213 (10%) were reported to have ever had bat contact (having touched a bat, having been bitten by a bat, or having been scratched by a bat) and 52 (2%) to have ever been bitten by a bat. Of 203 participants with bat contact, 3 (1%) had received rabies vaccination. No participant had neutralizing antibodies to phylogroup II lyssaviruses, but ≥50% of bats had neutralizing antibodies to these lyssaviruses. Even though we found no evidence of phylogroup II lyssavirus exposure among humans, persons interacting with bats in the area could benefit from practicing bat-related health precautions.

Bats are vital to many ecosystems and provide benefits to humans (*1*). However, under certain circumstances, bats may pose a risk to human health, as they host several zoonotic pathogens (*2*). Humans should therefore avoid bat contact unless appropriate precautions are taken. Among the most concerning batborne pathogens are viruses within the genus *Lyssavirus*. Previously unimmunized humans exposed to any of the >16 currently recognized and putative lyssaviruses (typically through a bite from an infected animal) will have 1 of 3 outcomes. First is a complete lack of any lyssavirus infection, characterized by the absence of both illness and lyssavirus-neutralizing antibody production. Second is a productive lyssavirus infection, characterized by a fatal encephalitis known as rabies (*3*). A human with rabies may produce lyssavirus-neutralizing antibodies in the end stages of illness as the disease progresses, although this response is typically inadequate for viral clearance (*4*). Third is an abortive lyssavirus infection (sometimes termed an exposure) characterized by the absence of frank encephalitis but with production of lyssavirus-neutralizing antibodies. Although

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rarely documented, the prevalence of abortive lyssavirus infections among some Amazonian communities whose members experience frequent bites from vampire bats has challenged the paradigm that lyssavirus infections are nearly always productive and therefore fatal (*5*).

The various lyssaviruses sort into different phylogroups (*6*). Phylogroup I includes rabies virus, Duvenhage virus, and several others. Rabies can be prevented after exposure to phylogroup I lyssaviruses with prompt administration of postexposure prophylaxis (PEP) that includes wound cleansing, rabies vaccine, and, when indicated, rabies immune globulin (*3*,*7*,*8*). Phylogroup II includes Lagos bat virus, Shimoni bat virus, and Mokola virus. These viruses are phylogenetically and antigenically distant from phylogroup I members (*9*). West Caucasian bat virus and Ikoma lyssavirus are even more distant lyssaviruses (*10*,*11*). The rabies vaccines available for use in the previously described PEP regimen may not be effective against non–phylogroup I lyssaviruses (*10*–*12*). Evidence of abortive lyssavirus infections outside the Amazon is limited, but they could possibly occur wherever humans frequently interact with infected animals (*5*,*13*,*14*).

Twice a year in the Idanre area of Nigeria, a 1-day bat festival takes place in which boys and men enter into designated caves to capture bats, typically with their bare hands (*15*) (Figure 1). Captured bats are cooked and eaten, sold in markets, and used in cultural ceremonies. Pathogen spillover from bats to humans might occur during these festivities, given that some Nigerian bats harbor lyssaviruses such as Lagos bat virus and other pathogens such as *Bartonella rousetti* (*16*–*20*). Furthermore, the most frequently identified bat species roosting in the festival caves is the Egyptian fruit bat (*Rousettus aegyptiacus*), which is a reservoir for Marburg virus and Sosuga virus (*15*,*21*–*23*).

We evaluated bat and lyssavirus exposure among humans in the area around Idanre, Nigeria. Our objectives were to determine the prevalence of bat contact, to identify factors associated with bat contact, to assess knowledge about batborne infections and health precautions related to bats, to determine whether febrile illnesses occur following the bat festival, to determine whether abortive lyssavirus infections occur, and to identify whether lyssaviruses circulate among bats in the festival caves.

Methods

Study Design

Work with human participants was approved by the Centers for Disease Control and Prevention (CDC), Ahmadu Bello University, and the National Health Research Ethics Committee of Nigeria. All animal sampling was conducted in compliance with a protocol approved by the CDC Animal Institutional Care and Use Committee.

Persons eligible to participate were those residing in communities located near the 2 festival caves in the Idanre area (Figure 2). We recruited study participants through community surveys and through a convenience sample; some respondents participated in a follow-up survey. Before enrolling, adults (persons ≥18 years of age) and mature minors (persons 13–17 years of age who were married, had children, or provided for their own livelihood) provided consent. Persons <18 years of age who were not mature minors had to get guardian consent and provide assent if ≥7 years of age. We administered study questionnaires verbally and recorded responses electronically. After administering the study questionnaire, we collected blood specimens from participants who agreed.

We completed community surveys during September 26–28, 2010 (2010 community survey; 9–11 days after the September 17, 2010, bat festival) and March 2–March 6, 2013 (2013 community survey; 11–15 days after the February 19, 2013, bat festival) (Figure 3). We enrolled households into the survey from 9 rural villages near the festival caves and from the

Figure 1. Bat hunters and bats captured during a bat festival, Idanre area, Nigeria, 2013. A) Bat hunters with slingshots and bats captured during a bat festival. B) Bats captured during a bat festival. C) Bat hunter with a bat captured during a bat festival.

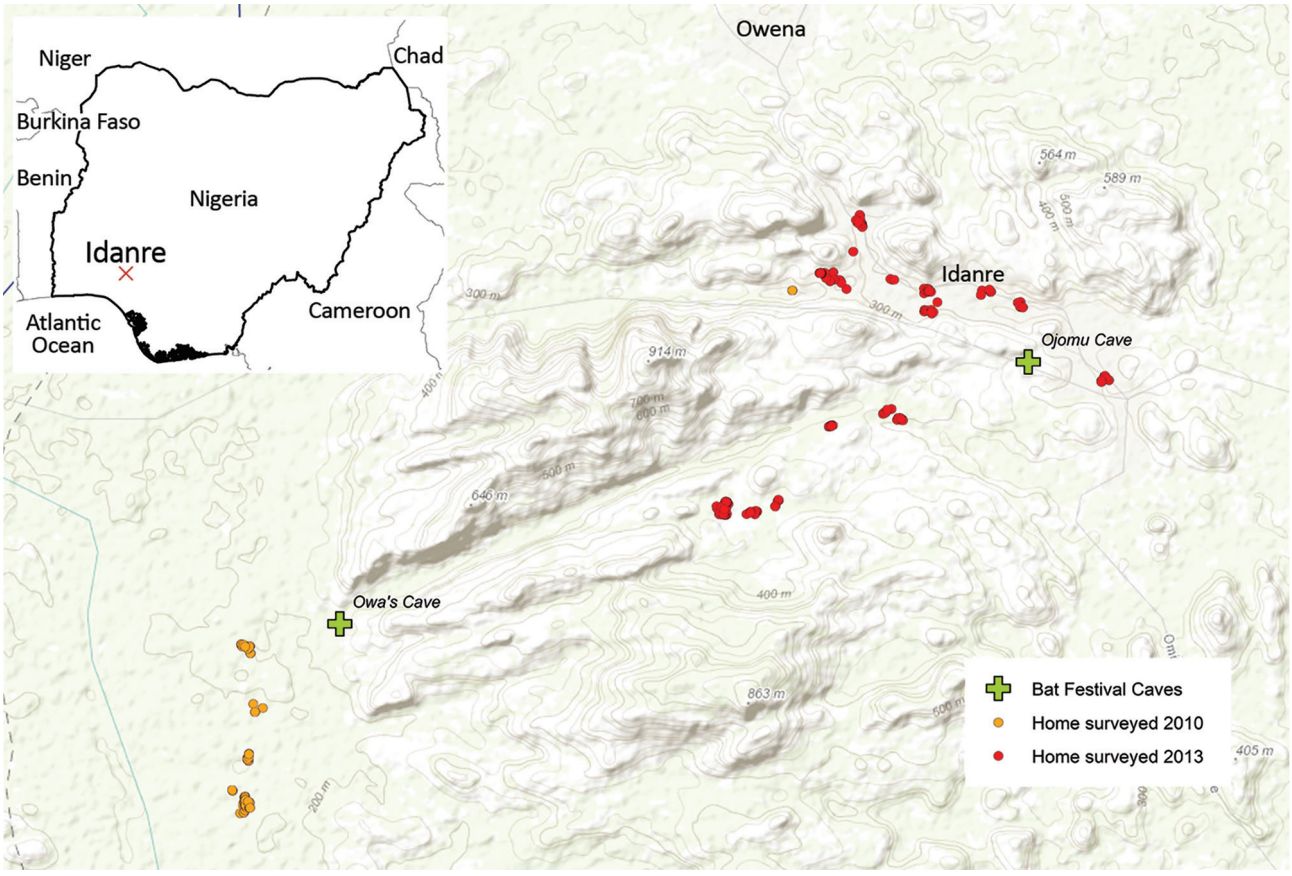

Figure 2. Locations of festival caves and households enrolled in 2 community surveys and a bat hunter survey of bat exposures, Idanre area, Nigeria, 2010 and 2013. Inset map shows location of Idanre area within Nigeria.

town of Idanre. Generally, all households within rural villages were offered enrollment in the study. In contrast, Idanre was divided into ≈100 zones, and households from 10 randomly selected zones were offered enrollment in the study. At the time of the household visit, an adult or mature minor had to be present. If consent was provided, this adult or mature minor was considered the main household respondent and was the first person of the household to whom the study questionnaire was administered (Appendix 1, https://wwwnc.cdc.gov/EID/article/26/7/19-1016-App1.pdf). We then administered a similar study questionnaire to additional household respondents, who were other consenting or assenting household members. However, to enroll as an additional household respondent, the household member had to be immediately available and either had previously had bat contact (defined as having touched a bat, having been bitten by a bat, or having been scratched by a bat) or had eaten a bat. This requirement was different than that for main household respondents, for whom having had bat contact or having eaten a bat were not requirements for enrollment.

We recruited additional participants outside the community surveys on March 6, 2013 (2013 bat hunter survey) using a convenience sample of bat hunters composed exclusively of persons who actively trapped bats during the bat festival (they may also have trapped bats at other times of the year) (Figure 3). These participants answered the same study questionnaire as main household respondents from the community survey (Appendix 1). Study participants in the community surveys may also have hunted bats (in that they actively trapped bats during and outside the bat festival), but data for these participants were analyzed with other community survey data and handled separately from the 2013 bat hunter survey. Persons who participated in the 2013 community survey or 2013 bat hunter survey and who agreed underwent a follow-up survey during May 14–19, 2013 (2013 follow-up survey; 85–90 days after the February 19, 2013, bat festival took place) (Appendix 1).

Human Serologic Testing

We stored blood specimens on ice and centrifuged them within 12 hours of collection. We stored

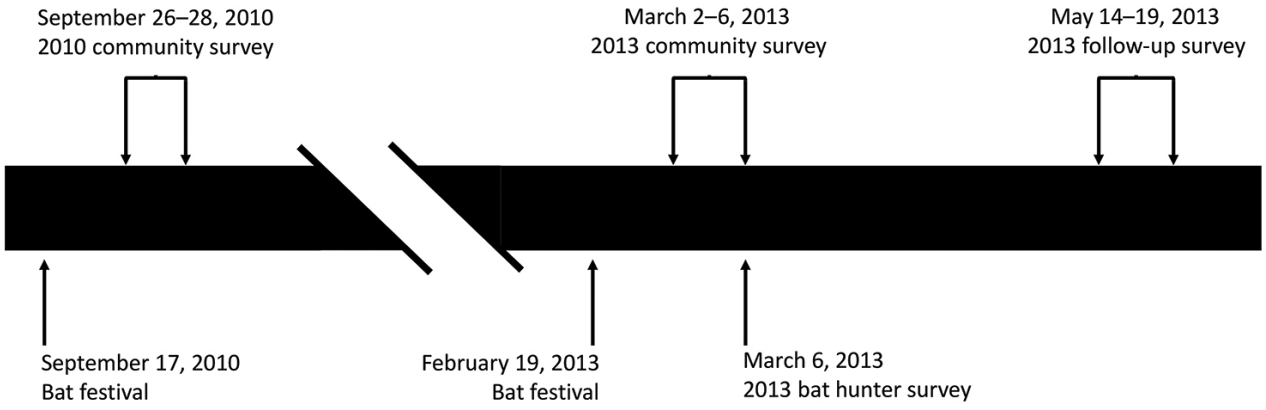

Figure 3. Timeline of events for 2 community surveys, a bat hunter survey, and a follow-up survey of bat exposures, Idanre area, Nigeria, 2010 and 2013.

serum specimens at -80°C except while in the field and during shipment to the United States, when they were stored on dry ice. We tested serum specimens for neutralizing antibodies against rabies virus, Duvenhage virus, Lagos bat virus, Shimoni bat virus, Mokola virus, and West Caucasian bat virus using a modification of the rapid fluorescent focus inhibition test (*5*,*24*–*26*). We considered serum samples that exhibited complete neutralization of challenge lyssavirus at a 1:5 serum dilution to have detectable neutralizing antibodies to that lyssavirus (*3*).

Bat Capture, Species Identification, Specimen Collection, and Testing

We captured bats from the 2 festival caves (Figure 2) using nets. Taxonomic identification of bat species was based on morphology. We anesthetized bats by intramuscular injection of ketamine and then euthanized them via cardiac exsanguination. We centrifuged blood specimens within 4 hours of collection. We also collected bat brains. We stored serum and brain specimens at -80°C except while in the field and during shipment to the United States, when they were stored on dry ice.

We tested serum samples for neutralizing antibodies against Duvenhage virus, Lagos bat virus, Shimoni bat virus, Mokola virus, and Ikoma lyssavirus using a microneutralization test (*27*). We considered serum samples that exhibited >50% neutralization of challenge lyssavirus at 1:10 serum dilution to have detectable neutralizing antibodies to that lyssavirus. We tested brains for lyssavirus antigens with the direct fluorescent antibody test using a FITC-labeled monoclonal antibody kit (Fujirebio Diagnostics, https://www.fujirebio.com) (*28*) (Appendix 2, https://wwwnc.cdc.gov/EID/article/26/7/19-1016-App2.pdf).

Data Analysis

We analyzed data using SAS software (https://www.sas.com) (details in Appendix 2). A p value <0.05 was considered statistically significant.

Results

Through the community surveys in 2010 and 2013, we enrolled 264 households (254 unique households and 10 that participated in both years) (Table 1). Each enrolled household had a main household respondent; 87 persons from enrolled households participated as additional household respondents. Most of the 2013 respondents also participated in the 2013 follow-up survey (172/217 [79%] from the 2013 community survey and 18/21 [86%] from the 2013 bat hunter survey).

More than one quarter of enrolled households (72/264; 27%) had ≥1 household member who had ever participated in the bat festival (Table 1). Almost two thirds of enrolled households (168; 64%) had ≥1 household member who had ever had bat contact. Nearly two thirds of enrolled households (166; 63%) had ≥1 household member who had ever touched a bat. About one fifth of households had ≥1 household member who had ever been bitten (44; 17%) or scratched (56; 21%) by a bat. Nearly three quarters of households had ≥1 household member who had ever eaten a bat (188; 71%).

The enrolled households were composed of 2,112 persons, among whom 213 (10%) were reported to have ever had bat contact, 211 (10%) to have ever touched a bat, 52 (2%) to have ever been bitten by a bat, 66 (3%) to have ever been scratched by a bat, and 265 (13%) to have ever eaten a bat (Table 2). Of 254 main household respondents, 141 (56%) reported having ever had bat contact (Table 3, https://wwwnc.cdc.gov/EID/article/26/7/19-1016-T3.htm). Factors significantly associated with bat contact included

being male (OR 2.08, 95% CI 1.24–3.49), having ever participated in the bat festival (OR 20.17, 95% CI 6.09–66.82), having ever entered a bat cave or bat refuge (OR 31.45, 95% CI 7.45–132.73), having ever prepared a bat as food (OR 9.85, 95% CI 5.37–18.07), and having ever eaten a bat (OR 8.56, 95% CI 4.57–16.03).

Although more than half of participants with bat contact in the 2010 community survey, 2013 community survey, and 2013 bat hunter survey knew that animal bites are a mechanism of rabies virus transmission or that rabies is severe, they more often attributed dogs as being a rabies source (≥60%) than bats (≤3%) (Appendix 2 Table 1). About 50% of participants with bat contact in the 2010 and 2013 community surveys and 86% of participants in the 2013 bat hunter survey stated that they would do nothing if bitten or scratched by a bat. Among participants with bat contact in the 2010 community survey, 2013 community survey, and 2013 bat hunter survey, only 1%, 2%, and 5%, respectively, had ever received rabies vaccination. Furthermore, only 3%, 7%, and 5% of these participants, respectively, were aware that bats can cause diseases other than rabies.

More main household respondents with bat contact knew that animal bites are a mechanism of rabies virus transmission and that rabies is severe compared with those without bat contact (Table 3). However, knowledge about bats as a potential rabies source was low and not different among main household respondents with and without bat contact. There was no significant difference between main household respondents with and without bat contact regarding history of rabies vaccination and awareness that bats can cause diseases other than rabies. Study participants with bat contact in the 2010 community survey, 2013 community survey, and 2013 bat hunter survey infrequently reported knowledge of any illness as a result of bats or being in a bat cave (1%, 3%, and 0%, respectively) (Appendix 2 Table 1).

Among 170 main household respondents and additional household respondents in the 2013 community survey who participated in the 2013 follow-up survey, 23 (14%) had experienced a febrile illness within

Table 1. Characteristics of households enrolled in 2 community surveys of bat exposures, Idanre area, Nigeria, 2010 and 2013

Characteristic	2010 community survey, no. (%)	2013 community survey, no. (%)	Total, no. (%)
Households visited	90	183	273
Households enrolled	90 (100)	174 (95)	264 (97)
Total participants enrolled	134	217	351
Main household respondents*	90 (67)	174 (80)	264 (75)
Additional household respondents*	44 (33)	43 (20)	87 (25)
Mean participants enrolled per household (SD)	1.5 (0.9)	1.2 (0.6)	1.3 (0.7)
Main household respondents*	1.0 (0)	1.0 (0)	1.0 (0)
Additional household respondents*	0.5 (0.9)	0.2 (0.6)	0.3 (0.7)
Mean persons per household (SD)	7.6 (4.7)	8.2 (5.7)	8.0 (5.4)
Persons living within enrolled households	688	1,424	2,112
Male	372 (54)	734 (52)	1,106 (52)
Female	316 (46)	690 (48)	1,006 (48)
Age distribution of persons represented among enrolled households	n = 688	n = 1,424	n = 2,112
<6 y	115 (17)	278 (20)	393 (19)
6–17 y	162 (24)	419 (29)	581 (28)
≥18 y	411 (60)	727 (51)	1,138 (54)
Main material used to build house	n = 90	n = 174	n = 264
Adobe/mud	56 (62)	82 (47)	138 (52)
Cement/brick	33 (37)	92 (53)	125 (47)
Wood	1 (1)	0	1 (0.4)
Openings in house that could allow bats to enter	56 (62)	106 (61)	162 (61)
Households with animals (pets or livestock) (%)	52 (58)	90 (52)	142 (54)
Households with ≥1 animal (pet or livestock) that had been vaccinated against rabies	0 (0)	7 (8)	7 (5)
Households with ≥1 member who had ever participated in bat festival†	22 (24)	50 (29)	72 (27)
Households with ≥1 member who had ever had bat contact‡	51 (57)	117 (67)	168 (64)
Households with ≥1 member who had ever touched a bat	50 (56)	116 (67)	166 (63)
Households with ≥1 member who had ever been bitten by a bat	14 (16)	30 (17)	44 (17)
Households with ≥1 member who had ever been scratched by a bat	19 (21)	37 (21)	56 (21)
Households with ≥1 member who had ever eaten a bat	64 (71)	124 (71)	188 (71)

*Main household respondents are adults or mature minors (persons aged 13–17 y who were married, had children, or provided for their own livelihood) present at the time of household visit who provided consent to participate in the survey; the main household respondent was the first person of the household to whom the study questionnaire was administered. Additional household respondents are other consenting or assenting household members who were immediately available to answer the study questionnaire and either had previously had bat contact or had previously eaten a bat.
†This may be an underestimate, as only main and additional household respondents were asked if they had participated in the bat festival. We did not ask if other members of the household had ever participated in the bat festival.
‡Bat contact was defined as having touched a bat, having been bitten by a bat, or having been scratched by a bat.

Table 2. Types of bat exposure among persons living within households enrolled in 2 community surveys of bat exposures, Idanre area, Nigeria, 2010 and 2013

Type of bat exposure	No. (%), n = 2,112
Ever had bat contact*	213 (10)
Ever touched a bat	211
Ever bitten by a bat	52
Ever scratched by a bat	66
Ever eaten a bat	265 (13)

*Bat contact was defined as having touched a bat, having been bitten by a bat, or having been scratched by a bat.

90 days of the February 19, 2013, bat festival (Table 4). Factors such as having had any bat contact within the past 90 days, having touched a bat within the past 90 days, having been bitten by a bat within the past 90 days, having been scratched by a bat within the past 90 days, having participated in the bat festival within the past 90 days, and having entered a bat cave or bat refuge within the past 90 days were not significantly different between those with a febrile illness and those without.

Among 18 participants from the 2013 bat hunter survey who participated in the 2013 follow-up survey, 7 (39%) had experienced a febrile illness within 90 days of the February 19, 2013, bat festival. Mean age was significantly higher among those with a febrile illness compared with those without (61 years vs. 49 years; p = 0.048). The odds of having entered a bat cave or bat refuge within the past 90 days was significantly higher among those without a febrile illness compared with those with a febrile illness (p = 0.03). There were no other significant differences between those with a febrile illness and those without when analyzing the same characteristics (Table 4).

Of all study participants who underwent serologic testing, only 2 had lyssavirus neutralizing antibodies, both against rabies virus (Appendix 2 Table 2). Both denied recent encephalitis-like illness or having ever received rabies vaccine, but 1 reported prior bat contact. One of these respondents underwent repeat serologic testing for rabies virus neutralizing antibodies during the 2013 follow-up survey, and rabies virus neutralizing antibodies were still detectable.

We sampled 211 bats: 120 bats during September 2010 (112 *Rousettus aegyptiacus*, 8 *Hipposideros gigas*) and 91 during February 2013 (all *R. aegyptiacus*); none demonstrated clinical illness at time of capture. No *R. aegyptiacus* bats had neutralizing antibodies to Duvenhage virus; ≥50% had neutralizing antibodies to Lagos bat virus, Shimoni bat virus, and Mokola virus; and 1 had neutralizing antibodies to Ikoma lyssavirus (Table 5; Appendix 2 Table 3). Lyssavirus antigens were not detected in brain specimens from any of the 211 bats.

Discussion

The occurrence of purposeful human interactions with bats, such as hunting for food (e.g., bushmeat), has been identified in several parts of the world and can pose a risk to human health through spillover of zoonotic pathogens from bats to humans (*29*–*31*). We therefore investigated bat and lyssavirus exposures among humans in an area of Nigeria that celebrates a biannual bat festival. Overall, we found that persons who interact with bats in this area are likely at risk for phylogroup II lyssavirus exposures, and public health precautions are warranted.

Although nearly two thirds of households enrolled in our study had ≥1 household members who had ever had bat contact, only about one quarter of households reported having ≥1 household members who had ever participated in the bat festival. This finding strongly suggests that a sizable proportion of the human population in the area has had bat exposures unrelated to the bat festival. Furthermore, 10% of persons living within households enrolled in our community surveys had previously had bat contact and 2% had been bitten by a bat. We do not know whether the bat contact and bat bites among these persons are related to participation in the bat festival or to interactions with bats from the festival caves. Because entry into the festival caves is allowed only during the bat festivals, we suspect that many of these persons have had interactions with bats that are not from the festival caves. Regardless, these person-level data on the prevalence of bat contact and bat bites are likely an underestimate of the true prevalence of bat contact and bat bites in the area; persons with a history of bat interactions might not have been available or were not referred by other household members so they were not enrolled in the study, or persons who have had such bat interactions might have failed to report them when responding to the survey.

We also found strong serologic evidence that lyssaviruses circulate among bats in the festival caves. We found neutralizing antibodies to Lagos bat virus, Shimoni bat virus, and Mokola virus in ≥50% of bats, which is higher than in some prior reports (*17*,*32*–*34*). All 3 of these lyssaviruses belong to phylogroup II. We did not detect lyssavirus antigen in brains of any seropositive bat that we captured, suggesting that these bats survived past exposure to a phylogroup II lyssavirus. We cannot be sure which phylogroup II lyssavirus predominantly circulates in this bat population, given potential serologic cross reactivity and because we did not isolate any lyssavirus from bats. However, we suspect Lagos bat virus because it has

been documented in *R. aegyptiacus* bats before and because it was first isolated in a fruit bat in Nigeria, although we cannot rule out the possibility that a yet uncharacterized phylogroup II lyssavirus circulates among these bats (*18*,*35*).

Although some respondents reported a febrile illness after the 2013 bat festival, this finding was not associated with having recent bat contact or recent participation in the bat festival. We recommend caution in interpreting these findings. A variety of

Table 4. Characteristics associated with experiencing a febrile illness within 90 days of the bat festival in a community survey of bat exposures, Idanre area, Nigeria, 2013*

Characteristic	Febrile illness within 90 d of bat festival, no. (%), n = 23	No febrile illness within 90 d of bat festival, no. (%), n = 147	p value	OR (95% CI)
Demographics				
Mean age (SD)	47 (18)	43 (17)	0.39	NA
Age range, min–max	18–80	18–89	NA	NA
Median age (interquartile range)	47 (32–65)	38 (30–55)	NA	NA
Age <25 y	2 (9)	18 (12)	0.63	0.68 (0.14–3.27)
Male sex	13 (57)	80 (54)	0.85	1.09 (0.45–2.65)
Education				
Some secondary or above	11 (48)	65 (44)	0.73	1.16 (0.51–2.61)
Completed secondary or above	9 (39)	40 (27)	0.21	1.72 (0.74–4.00)
Household characteristics				
Persons in household				
<5 persons	7 (30)	38 (26)	0.66	1.25 (0.46–3.41)
<10 persons	18 (78)	97 (66)	0.31	1.86 (0.56–6.15)
Main material used to build house				
Adobe/mud	14 (61)	71 (48)	0.29	1.67 (0.65–4.24)
Cement/brick	9 (39)	76 (52)	Referent	Referent
Wood	0	0	NP	NP
Openings present in house that could allow bats to enter	14 (61)	91 (62)	0.93	0.96 (0.38–2.44)
Household with animals†	12 (52)	68 (46)	0.62	1.27 (0.50–3.24)
Household with ≥1 animal† that has been vaccinated against rabies	2 (17)	6 (9)	0.43	2.07 (0.34–12.64)
Bat contact within past 90 d‡				
Any bat contact	3 (13)	40 (27)	0.15	0.40 (0.11–1.40)
Touched a bat with skin uncovered	3 (13)	40 (27)	0.15	0.40 (0.11–1.40)
Bitten by bat	1 (4)	10 (7)	0.66	0.62 (0.07–5.21)
Scratched by bat	1 (4)	15 (10)	0.39	0.40 (0.05–3.22)
Other bat-related activities within past 90 d				
Participated in bat festival	1 (4)	34 (23)	0.07	0.15 (0.02–1.17)
Entered a bat cave or bat refuge	1 (4)	18 (12)	0.29	0.33 (0.04–2.61)
Prepared a bat as food	7 (30)	57 (39)	0.45	0.69 (0.26–1.82)
Eaten a bat	7 (30)	56 (38)	0.49	0.71 (0.27–1.87)
Knowledge				
Indicated animal bites as mechanism of rabies transmission	13 (57)	78 (53)	0.74	1.15 (0.51–2.62)
Described rabies as severe	13 (57)	84 (57)	0.95	0.98 (0.43–2.23)
Identified bats as a rabies source	1 (4)	3 (2)	0.49	2.18 (0.24–20.11)
Identified dogs as a rabies source	16 (70)	84 (57)	0.26	1.71 (0.67–4.36)
If bitten or scratched by a bat				
Wash wound with soap and water	0	5 (3)	NP	NP
Seek medical care	9 (39)	52 (35)	0.70	1.17 (0.51–2.69)
Seek a traditional healer or pray	2 (9)	5 (3)	0.24	2.70 (0.52–13.97)
Do nothing	9 (39)	69 (47)	0.50	0.73 (0.28–1.85)
If bitten by a potentially rabid animal				
Wash wound with soap and water	0	1 (1)	NP	NP
Seek medical care	16 (70)	92 (63)	0.53	1.37 (0.51–3.64)
Seek a traditional healer or pray	3 (13)	4 (3)	0.03	5.36 (1.17–24.48)
Do nothing	3 (13)	33 (22)	0.32	0.52 (0.14–1.89)
History of rabies vaccination	1 (4)	1 (1)	0.19	6.64 (0.39–111.64)
Aware that bats can cause disease other than rabies	3 (13)	6 (4)	0.08	3.53 (0.86–14.40)
Know of reports of illness as a result of bats or being in bat cave	2 (9)	1 (1)	0.03	13.90 (1.25–154.63)

*NA, not applicable or not calculated; NP, logistic regression could not be performed due to zero cells; OR, odds ratio.
†Pet or livestock.
‡Bat contact was defined as having touched a bat, having been bitten by a bat, or having been scratched by a bat.

Table 5. Summary of serologic testing results for lyssavirus antibodies among *Rousettus aegyptiacus* bats roosting in caves used in a bat festival, Idanre area, Nigeria, 2010 and 2013*

Lyssavirus type (species)	Duvenhage virus (South Africa, 1970)	Lagos bat virus (lineage B, Nigeria, 1956)	Shimoni bat virus (Kenya, 2009)	Mokola virus (South Africa, 1998)	Ikoma lyssavirus (Tanzania, 2009)
Lyssavirus phylogroup	I	II	II	II	Undetermined
Year	2013	2010, 2013	2013	2013	2013
No. bats tested	67	169	60	62	64
No. (%) bats with detectable neutralizing antibodies	0	89 (53)	30 (50)	37 (60)	1 (2)

*A total of 211 bats were collected: 120 bats during September 2010 (112 *Rousettus aegyptiacus*, 8 *Hipposideros gigas*) and 91 during February 2013 (all *R. aegyptiacus*). This table displays only data on serologic testing for lyssaviruses among *R. aegyptiacus* bats; serum specimens were not available for all *R. aegyptiacus* bats.

bat species, including *R. aegyptiacus*, which we identified in the festival caves, are known reservoirs for a range of potential pathogens, including filoviruses and coronaviruses (*18*,*22*,*36*,*37*). It is therefore plausible that at least some zoonotic pathogens are present in bats residing in the festival caves and that these pathogens can spill over into humans (*16*). Furthermore, the data we present on febrile illness are a snapshot from 2013, and given that excretion of virus in bats can be episodic, the risk of batborne infections may vary over time (*23*).

We did not find neutralizing antibodies to lyssaviruses in any person in the study, other than 2 persons who had neutralizing antibodies to rabies virus, perhaps reflecting prior rabies vaccination that was not recalled during the survey or abortive infection from bites of rabid dogs (*5*). Thus, we found no evidence of abortive phylogroup II lyssavirus infections among humans in this study, despite the high prevalence of neutralizing antibodies to phylogroup II lyssaviruses among bats in the festival caves and that many persons in the area frequently interact with bats. This result is perhaps not surprising. First, as previously explained, we suspect that many interactions with bats among the population are unrelated to the bat festival and unrelated to bats from the festival caves (although bat hunters who participated in the 2013 bat hunter survey, by definition, would have had interaction with bats from the festival caves). The data we present on the prevalence of neutralizing antibodies to phylogroup II lyssaviruses among bats are specific to bats from the festival caves and cannot be generalized to other bat populations in the area; the prevalence of these antibodies in other bat populations with which humans also interact might be lower than that for bats from the festival caves. Second, in the Amazon, where abortive lyssavirus infections have been documented, humans likely experience bat bites on a more continuous basis because of the predatory nature of vampire bats (*5*). In contrast, the bat festival in this part of Nigeria occurs at discrete times, leading to a lower frequency of bat bites and thus lower risk of lyssavirus exposure. Finally, the dates of the bat festivals vary each year and are determined based on traditional wisdom. Whether the bat festival timing, as determined by cultural leaders, implicitly accounts for periods of lower risk of batborne infections to festival participants warrants further investigation by an interdisciplinary team of biologists and anthropologists (*23*).

Our study has limitations. Accurate information on the distribution of communities in the area was limited, making it unclear whether persons we enrolled are representative of the area. We did not use a strict definition for febrile illness, nor could we verify the occurrence of a febrile illness; rather, we relied on retrospective, subjective reports. Our study did not have a robust method of identifying encephalitis-like illness and deaths that occurred between the initial data collection in 2013 and the 2013 follow-up survey, and we do not know what happened to participants who could not be located for the follow-up survey. Thus, we cannot draw conclusions on the ability of the predominant phylogroup II lyssavirus that circulates among bats in the festival caves to cause productive lyssavirus infections (rabies) in humans.

Emerging infectious diseases are on the rise around the world; most originate from animals (*38*). Although the source of the 2014–2016 Ebola outbreak remains unknown, it may have begun with a single spillover event involving initial bat contact (*39*), which underscores the health risks of interacting with bats without appropriate precautions. If we assume that the households we enrolled are representative of the Idanre area, then this part of Nigeria has high rates of bat contact and is at high risk for bat-related zoonoses. We therefore recommend that officials strengthen health security in the Idanre area, recognizing that an approach that bans hunting and consumption of bats is unlikely to be effective. Rather, a more productive approach will focus on harm reduction and community engagement. Specific recommendations include educating the population, particularly persons who participate in high-risk bat-related activities, about the health risks associated with bats and the ecosystem

benefits provided by bats; providing preexposure prophylaxis for rabies and possibly other batborne disease (potentially even Ebola) for persons who participate in high-risk bat-related activities; and developing surveillance and outbreak response capacity in the area for syndromes such as febrile illness, encephalitis, and hemorrhagic fevers.

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Bat and Lyssavirus Exposure among Humans in Area that Celebrates Bat Festival, Nigeria, 2010 and 2013

Appendix 1

Questionnaires Used for Surveys about Bat Exposure

The following pages show a set of questionnaires used to survey community members and bat hunters regarding bat exposures in Idanre, Nigeria, in 2010 and 2013:

- Two community surveys conducted during September 26–28, 2010 (9–11 days after the September 17, 2010, bat festival took place), and March 2–March 6, 2013 (11–15 days after the February 19, 2013, bat festival took place);
- A survey of bat hunters conducted on March 6, 2013;
- A follow-up survey of subjects who participated in the 2013 community survey or 2013 bat hunter survey, conducted during May 14–19, 2013 (85–90 days after the February 19, 2013, bat festival took place).

1. Questionnaire used in two community surveys and a bat hunter survey of bat exposures — Idanre, Nigeria, 2010 and 2013

A. HOUSEHOLD INFORMATION

1) Household ID Number

2) GPS

3) Municipality

4) Community

[Section A. Administer to adult (18 years and older) present that attended door call (main responder).

Hello. My name is _____ and I am working with the <insert appropriate agency affiliation>.

We are conducting a survey to improve our understanding of the knowledge, attitudes, and practices of people in Idanre local government of Ondo State, who come in close contact with bats or places where bats live, like caves. We would like to ask for a few minutes of your time, around 40 minutes, to ask you about your experiences with bats and your knowledge about certain diseases. Your answers to the following questions are completely voluntary and will be kept confidential. Do you have time now? (If NO, "Thank you for your time.")

5) Is there someone in the house that can respond to the interview?

Yes

No

Not applicable, because interview is being conducted on a person returning from a cave

6)

6.1) Consent obtained?

Yes

No

6.2) If consent was NOT obtained

6.2.1) Reason for declining

Not interested

No time

Fear of participating

Not capable of consenting

Language barrier

Other

6.2.2) If the reason is "other"
6.2.2.1) Specify the reason for denying consent

6.2.3) Interviewer name: (First Name, First Family Name, Second Family name)

6.3) If consent obtained

Please think carefully about each question, and answer as well as you can. You can choose not to answer any of the questions.

NOTE to INTERVIEWER: Do not read the answer choices, unless otherwise indicated. Circle the choice that best represents the interviewee's answer.

6.3.1) How many people live in this home?

6.3.2) How many are females living in this home?

6.3.3) How many children of ages 0-5 live in this house?

6.3.4) How many children of ages 6-12 live in this house?

6.3.5) How many children of ages 13-17 live in this house?

6.3.6) About the house, which is the main material used to build the house?
Brick
Adobe
Wood
Canes
Cement Block
Cement / Concrete
Other

6.3.7) If the house is made of another material
6.3.7.1) Specify the other housing material

6.3.8) Does the house have windows/doors that close and prevent bat entry? (Check all that apply)
There are open windows
Windows can close completely
Doors can close completely
There are windows or doors that close incompletely and allow entry of bats
There are large openings in the walls for ventilation never closed

No openings
Other: _____
Don’t know
Declined to answer

6.3.9) Do you own animals as either pets or livestock?

Yes
No
Don't know
Declined to answer

6.3.10) If you own animals as either pets or livestock

6.3.10.1) Do you know or have you seen if your domestic animals (pets/cattle/pigs) have been bitten by bats?

Yes
No

6.3.10.2) If your domestic animals have been bitten by bats

6.3.10.2.1) Which of your animals have been bitten by bats? (Select all that apply?)

Cows
Goats
Sheep
Pigs
Horses
Dogs
Cats
Chicken
Other

6.3.10.2.2) If the bitten animal is "Other"

6.3.10.2.2.1) Specify the animals that have been bitten by bats

6.3.10.3) Do you do anything to avoid your animals/pets being bitten by bats?

Nothing
Lights on where animals sleep
Barriers (nets, close doors)
Burn herbs
Apply oil/chemicals to animals
Hunt bats
Blankets
Garlic

Other

6.3.10.4) If answered OTHER as something that is done to avoid your animals/pets being bitten by bats

6.3.10.4.1) Specify what other thing is done to avoid your animals/pets being bitten by bats

6.3.10.5) Are one or more of your animals vaccinated against rabies?

Yes
No
Don't know
Declined to answer

6.3.10.6) Have any of your animals been sick or died due to bats?

Yes
No
Don't know
Declined to answer

6.3.10.7) If any of your animals have been sick or died due to an illness that you believe may have been caused by bats?

Complete for each species:	**Questions about animal sickness**	**What were their signs? (tick all that apply)**	**Questions about animal death**
A) Goats	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+

	b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change (more quiet/more aggressive)	☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they

		☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	were slaughtered or sold? (yes, no, some, unsure, declined)
B) Sheep	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+	c) What were their signs? (tick all that apply)	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+

	☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching	☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they

		☐ Behavior change (more quiet/more aggressive) ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	were slaughtered or sold? (yes, no, some, unsure, declined)

C) Cows	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold

	symptoms? (yes, no, unsure, declined)	☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change (more quiet/more aggressive) ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died	for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)

		☐ Other (specify):	
D) Pigs	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined

	b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change (more quiet/more aggressive) ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions	e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold?

		☐ Still birth ☐ Suddenly died ☐ Other (specify):	(yes, no, some, unsure, declined)
E) H orses	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined

	b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change (more quiet/more aggressive) ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)
F) Dogs	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change (more quiet/more aggressive) ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)

7) Are there any dogs in your house?
Yes
No

7.1) If there are dogs in the house

7.1.1) How many dogs:_____

7.1.2) How many female dogs: _____

7.1.3) How many male dogs: _____

7.1.4) What is the age of the oldest dog in years?: ___

7.1.5) What is the age of the youngest dog?:_____

7.1.6) Are the dogs in your house vaccinated against rabies?:
Yes, all of them
Yes, but only some of them
No, none of them are vaccinated
Don't know
Decline to answer

7.1.6.1) If yes, when was the last vaccination:
Date: _____

7.1.7) Have any of the dogs in the house bitten anybody?

Yes
No
Don't know
Decline to answer

7.1.8) Have any of the dogs in the house bitten any of your other animals?

Yes
No
Don't know
Decline to answer

B. HOUSEHOLD RESPONDENT INFORMATION

1A) Sample ID

1B) Name: First name, First Family name, Second Family name

1B.1) What is your home address?

1B.2) What is your mobile phone number? (if no mobile phone, get home phone instead)

1C) Where do you live when this bat festival does not take place?

Idanre local government, Ondo State, Nigeria
Ondo state (but not Idanre local government), Nigeria
A state other than Ondo State, but in Nigeria
An African country other than Nigeria
A country outside of Africa

1D) If you do not live in Ondo State, what brought you to Ondo State at this time? (circle all that apply)

To participate in the bat festival
For vacation but not specifically for the bat festival
To see family and friends
For work/to make money
Other

1D.1) If other, please specify why:

1E) Did you participate in a survey like this about bats and the bat festival nearly three years ago?

Yes
No
Declined to answer

2) How old are you?

3) Gender

Male
Female

4) What is the last level of schooling you have completed? (Note to interviewer: Read all but last two options to participant.)

None
Started primary
Completed primary
Started basic/Junior Secondary School (JSS)
Completed basic/Junior Secondary School (JSS)
Started secondary/Senior Secondary School (SSS)
Completed secondary/Senior Secondary School (SSS)
Started higher education
Completed higher education
Not sure
Declined to answer

5) How many years have you lived in this house?
Less than one year
One year
More than one year

6) If you have lived in this house more than one year
6.1) how many years

7) How many years of experience do you have working/living with or near bats?
None
5 or less
6-15
16-25
> 25
Don't know
Declined to answer

8) What activities do you engage in that regularly puts you in contact with bats? (check all that applies) (Note to interviewer: Read all but last two options to participant.)

Bat hunting
Participation in bat festival
Preparing bats for consumption
Farming
Hunting
Nightwatchman
Other

None
Declined to answer

9) If the activity is Other
9.1)

9.2) Have you ever participated in the bat festival (if yes, go to the next question, and if no, skip to question 10)

Yes
No
Declined to answer

9.2.1) How many times or often do you participate in the bat festival?

Once a year
Twice a year
Don't know
Declined to answer

9.2.2) How many years have you participated in the bat festival?

Less than 2 years
2 years to less than 5 years
5 years to less than 20 years
20 years and more
Do not know
Declined to answer

9.2.3) what role do you play during the bat festival? (tick all that concerns)

Bat hunting
Selling of bats
Preparation of bats for food/consumption
Dancer, singer
Spiritual activities
Standby watcher
Don't know
Decline to answer
Other _____

10) Have you been inside of a bat cave or bat refuge (trees, abandoned house, bridge, etc.)?

Yes
No
Don't know
Declined to answer

---

11) If you have been inside of a bat cave or refuge

11.1) How often do you enter bat caves or bat refuge? (Note to interviewer: Read all but last two options to participant.)

once per year or less
2-4 times per year
5 times or more per year
Don't know
Declined to answer

11.2) When was the last time you entered a bat cave or bat refuge? (Note to interviewer: Read all but last two options to participant.)

< 1 month ago
1 to 6 months ago
6-12 months ago
More than 12 months ago
Don't know
Declined to answer

12) Have you ever touched a live bat with your skin uncovered?

Yes
No
Don't know
Declined to answer

13) If you have ever touched a live bat with your skin uncovered

13.1) How often do you touch bats? (Note to interviewer: Read all but last two options to participant.)

once per year or less
2-4 times per year
5 times or more per year
Don't know
Declined to answer

13.2) When was the last time you touched a bat with your skin uncovered? (Note to interviewer: Read all but last two options to participant.)

< 1 month ago
1 to 6 months ago
6-12 months ago
More than 12 months ago
Don't know

Declined to answer

14) Have you ever been scratched by a bat, to your knowledge?
Yes
No
Don't know
Declined to answer

15) If has been scratched by a bat
15.1) How often are you scratched by bats? (Note to interviewer: Read all but last two options to participant.)

once per year or less
2-4 times per year
5 times or more per year
Don’t know
Declined to answer

15.2) When was the last time you were scratched by a bat? (Note to interviewer: Read all but last two options to participant.)

< 1 month ago
1 to 6 months ago
6-12 months ago
More than 12 months ago
Don’t know
Declined to answer

16) Have you ever been bitten by a bat, to your knowledge?
Yes
No
Don't know
Declined to answer

17) If you have been bitten by a bat
17.1) How often are you bitten by bats? (Note to interviewer: Read all but last two options to participant.)

once per year or less
2-4 times per year
5 times or more per year
Don’t know
Declined to answer

17.2) When was the last time you were bitten by a bat? (Note to interviewer: Read all but last two options to participant.)

< 1 month ago
1 to 6 months ago
6-12 months ago
More than 12 months ago
Don't know
Declined to answer

18) Have you ever prepared a bat as food?
Yes
No
Don't know
Declined to answer

19) If you ever prepared a bat as food
19.1) How often do you prepare them for eating (Note to interviewer: Read all but last two options to participant.)

once per year or less
2-4 times per year
5 times or more per year
Don't know
Declined to answer

19.2) When was the last time you prepared one for eating? (Note to interviewer: Read all but last two options to participant.)

< 1 month ago
1 to 6 months ago
6-12 months ago
More than 12 months ago
Don't know
Declined to answer

20) Have you ever eaten a bat?

Yes
No
Don't know
Declined to answer

21) If you have ever eaten a bat
21.1) How often do you eat bats? (Note to interviewer: Read all but last two options to participant.) (Note to interviewer: Read all but last two options to participant.)

once per year or less
2-4 times per year
5 times or more per year
Don't know
Declined to answer

21.2) When was the last time you ate a bat? (Note to interviewer: Read all but last two options to participant.)

< 1 month ago
1 to 6 months ago
6-12 months ago
More than 12 months ago
Don't know
Declined to answer

22) What kinds of bats do you most frequently observe or have had contact with? (Note to interviewer: Read all but last two options to participant.)

Fruit-eating bats
Insect-eating bats
Vampire bats
Multiple types
Other
Don't know
Declined to answer

23) If the kind of bat is "Other"
23.1) Specify the other type of bat

24) Do you or your family do something to avoid bat bites in the house?
Nothing
Use mosquito net
Prevent entry of bat in the house
Increase number of cats
Increase the number of cattle/pigs to be bitten
Destroy bat refuges/kill bats
Pray/consult the gods
Declined to answer
Other

25) If answered OTHER as the type of action taken to avoid bites in the house
25.1) Specify what you and your family does to avoid bat bites in the house

26) How much do you know about rabies? (Note to interviewer: Read all but last two options to participant.)

Little to none
Basic
Extensive
Declined to answer

27) How dangerous is rabies?
Very Severe
Mild or moderate
Don't know
Declined to answer

28) How do people get infected with rabies? (Note to interviewer: Read all but last two options to participant.)

Animal bite
Animal scratch or lick
Touching an animal
Eating an animal
Other
Don't know
Declined to answer

29) If the way people are infected with rabies is "Other"
29.1) Specify the way people are infected by rabies

30) What animals can be infected with rabies? (check all that apply) (Note to interviewer: Read all but last two options to participant.)

Bats
Dogs
Cats
Horses
Livestock
Wild mammals (not bats)
Other
Don't know
Declined to answer

31) If the animals are potentially infected with rabies are "Other"
31.1) Specify which other animals could be infected with rabies

32) What would you do if you were bitten or scratched by a bat? (Note to interviewer: Read all but last two options to participant. Select all that apply.)

Nothing

Wash wound with soap and water
Call a doctor for advice
Call or visit a traditional healer
Seek medical care at a hospital, clinic or health post
Seek rabies PEP (rabies vaccines)
Have bat tested for rabies (or other diseases)
Other
Don't know
Declined to answer

33) If the action that you would take is Other
33.1) Specify the other action that would be taken

34) Do you think there is any time of the year in which bats attack more animals or people?
No, it is the same all year round
Yes, rainy season (April-October)
Yes, dry season (November-April)
Don't know
Declined to answer

35) If someone has been bitten by an animal potentially infected with rabies what should that person do? (Check all that apply)
Nothing
Wash wound with soap and water
Call a doctor for advice
Call or visit a traditional healer
Seek medical care at a hospital or clinic
Seek rabies post-exposure prophylaxis (rabies vaccines)
Check animal's vaccination history
Observe animal for a period of time to see if it becomes rabid
Have animal tested for rabies
Kill animal
Other
Don't know
Declined to answer

36) If the action is "Other"
36.1) Specify the other action that should be done if someone has been bitten by an animal that might be infected by rabies

37) Have you ever been vaccinated against rabies?
Yes
No
Don't know

Declined to answer

38) If you have ever been vaccinated against rabies

38.1) What was the reason you were vaccinated against rabies?

Post-exposure prophylaxis
Pre-exposure prophylaxis
Have received PreP and PEP
Don't know
Declined to answer

38.2) If you have received rabies vaccination after being bitten or scratched by an animal bite, what animal or animals were responsible for the incident? (check all that apply)

Bats
Dogs
Cats
Horses
Livestock
Wild mammals (not bats)
Others
Don't know
Declined to answer
Did not receive PEP

38.3) If received a vaccination after being bitten by an OTHER animal

38.3.1) Specify the other animal that bit you

39) Are you aware if there are any other diseases that humans can get from bats? (NOTE: any disease mentioned means "yes')

Yes
No
Don't know
Declined to answer

40) Have you or anyone you know ever experienced an illness that you believe may have been caused by bats or being in a bat cave?

Yes
No
Don't know
Declined to answer

41) If you or anyone you know ever experienced an illness that you believe may have been caused by bats or being in a bat cave

41.1) What were the symptoms? (Check all that apply) (Note to interviewer: If respondent doesn't indicate that the person(s) recovered, ask if they died from illness. If answer is yes, circle death as a symptom. If respondent knows of more than one person affected—

including but necessarily themselves—and symptoms mentioned are a composite, circle "multiple persons".)

Skin rash/discoloration/ infection
Unusual bleeding (e.g. from nose/mouth)
Fever
Cough
Sneezing
Runny nose
Chest congestion
Muscle pain
Difficulty breathing
Headache
Convulsions
Altered mental state (dementia)
Unconsciousness/coma
Muscle weakness/paralysis
Vomiting or diarrhea or stomach cramps
Miscarriage/stillbirth
Death
Multiple persons
Other
Don't know
Declined to answer

41.2) If the symptoms is "Other"
41.2.1) Specify the other symptom

41.2.2) Are you or the person you know that presented symptoms caused by a bat recovered?

Yes
No
Don't know
Decline to answer

42) We would like to take a sample of your blood. Will you allow us to take a sample?

Yes
No

42.2 Was blood sampled obtained?
Yes
No

42.3. IF blood sample was not obtained, why not?
Did not consent for blood
Was not able to get blood

Other:_____

42.4) Will you allow us to return in 6-8 weeks to ask you some more questions? YES/ NO

43) Has anyone from your family or living here had been in contact, bitten, scratched, eaten, or had touched a bat?

Yes
No

_____

C. PARTICIPANTS WITH BAT EXPOSURE (ADDITIONAL TO RESPONDENT)
Additional Participant

Interviewer name: (First Name, First Family Name, Second Family name)_

1A) Sample ID
1B) Name: First name, first family name, second family name
1C) Household ID: _____

2) How old are you?

3) If at least 18 years old or mature minors
3.1) Consent obtained? (If yes, go to question 3.2)
Yes
No

3.2) What is your mobile phone number? (if no mobile phone, get home phone instead)

4) If less than 18 years old
4.1) Parental permission obtained?
Yes
No

4.2) Children between 7 and 17 years [Interviewer: parents will answer the survey when child < 9 years of age but child age 9 years and older will answer survey directly]
4.2.1) Child assent obtained?
Yes
No

5) If consent obtained (and assent if applicable)
5.1) Interviewer: who is being interviewed:
O Self
O Parent/guardian

5.2) Gender

Male
Female

5.2.1) Did you participate in a survey like this about bats and the bat festival nearly three years ago?

Yes
No
Declined to answer

5.3) What is the last level of schooling you have completed?

None
Started primary
Completed primary
Started basic/Junior Secondary School (JSS)
Completed basic/Junior Secondary School (JSS)
Started secondary/Senior Secondary School (SSS)
Completed secondary/Senior Secondary School (SSS)
Started higher education
Completed higher education
Not sure
Declined to answer

5.4) How many years have you lived in this house?

Less than one year
One year
More than one year

5.4.1) Where do you live when this bat festival does not take place?

Idanre local government, Ondo State, Nigeria
Ondo state (but not Idanre local government), Nigeria
A state other than Ondo State, but in Nigeria
An African country other than Nigeria
A country outside of Africa

5.4.2) If you do not live in Ondo State, what brought you to Ondo State at this time? (circle all that apply)

To participate in the bat festival
For vacation but not specifically for the bat festival
To see family and friends
For work/to make money
Other

5.4.2.1) If other, please specify why:

_____

5.5) If you have lived in this house more than one year

5.5.1) how many years

5.6) How many years of experience do you have working/living with or near bats? (Note to interviewer: Read all but last two options to participant.)

None
5 or less
6-15
16-25
> 25
Don't know
Declined to answer

5.7) What activities do you engage in that regularly puts you in contact with bats? (check all that applies) (Note to interviewer: Read all but last option to participant.)

Bat hunting
Participation in bat festival
Preparing bats for consumption
Farming
Hunting
Nightwatchman
Other
None
Declined to answer

5.8) If the activity is Other

5.8.1)

5.8.2) Have you ever participated in the bat festival (if yes, go to the next question, and if no, skip to question 5.9)

Yes
No
Declined to answer

5.8.3) How many times or often do you participate in the bat festival?

Once a year
Twice a year
Don't know
Declined to answer

5.8.4) How many years have you participated in the bat festival?

Less than 2 years
2 years to less than 5 years
5 years to less than 20 years
20 years and more
Do not know
Declined to answer

5.8.5) what role do you play during the bat festival? (tick all that concerns)

Bat hunting
Selling of bats
Preparation of bats for food/consumption
Dancer, singer
Spiritual activities
Standby watcher
Don't know
Decline to answer
Other _____

5.9) Have you been inside of a bat cave or bat refuge (trees, abandoned house, bridge, etc.)?

Yes
No
Don't know
Declined to answer

5.10) If you have been inside of a bat cave or refuge

5.10.1) How often do you enter bat caves or bat refuge? (Note to interviewer: Read all but last two options to participant.)

once per year or less
2-4 times per year
5 times or more per year
Don't know
Declined to answer

5.10.2) When was the last time you entered a bat cave or bat refuge? (Note to interviewer: Read all but last two options to participant.)

< 1 month ago
1 to 6 months ago
6-12 months ago
More than 12 months ago
Don't know

Declined to answer

5.11) Have you ever touched a live bat with your skin uncovered?
Yes
No
Don't know
Declined to answer

5.12) If you have ever touched a live bat with your skin uncovered
5.12.1) How often do you touch bats? (Note to interviewer: Read all but last two options to participant.)
once per year or less
2-4 times per year
5 times or more per year
Don't know
Declined to answer

5.12.2) When was the last time you touched a bat?
< 1 month ago
1 to 6 months ago
6-12 months ago
More than 12 months ago
Don't know
Declined to answer

5.13) Have you ever been scratched by a bat, to your knowledge?
Yes
No
Don't know
Declined to answer

5.14) If has been scratched by a bat
5.14.1) How often are you scratched by bats? (Note to interviewer: Read all but last two options to participant.)
once per year or less
2-4 times per year
5 times or more per year
Don't know
Declined to answer

5.14.2) When was the last time you were scratched by a bat?
< 1 month ago
1 to 6 months ago
6-12 months ago
More than 12 months ago

Don’t know
Declined to answer

5.15) Have you ever been bitten by a bat, to your knowledge?
Yes
No
Don't know
Declined to answer

5.16) If you have been bitten by a bat
5.16.1) How often are you bitten by bats? (Note to interviewer: Read all but last two options to participant.)
once per year or less
2-4 times per year
5 times or more per year
Don’t know
Declined to answer

5.16.2) When was the last time you were bitten by a bat? (Note to interviewer: Read all but last two options to participant.)

< 1 month ago
1 to 6 months ago
6-12 months ago
More than 12 months ago
Don’t know
Declined to answer

5.17) Have you ever prepared a bat as food?
Yes
No
Don't know
Declined to answer

5.18) If you have ever prepared a bat as food
5.18.1) How often do you prepare them for eating? (Note to interviewer: Read all but last two options to participant.)
once per year or less
2-4 times per year
5 times or more per year
Don’t know
Declined to answer

5.18.2) When was the last time you prepared a bat for eating? (Note to interviewer: Read all but last two options to participant.)

< 1 month ago
1 to 6 months ago
6-12 months ago
More than 12 months ago
Don’t know
Declined to answer

5.19) Have you ever eaten a bat?
Yes
No
Don't know
Declined to answer

5.20) If you ever eaten a bat
5.20.1) How often do you eat bats? (Note to interviewer: Read all but last two options to participant.)
once per year or less
2-4 times per year
5 times or more per year
Don’t know
Declined to answer

5.20.2) When was the last time you ate a bat?
< 1 month ago
1 to 6 months ago
6-12 months ago
More than 12 months ago
Don’t know
Declined to answer

5.21) What kinds of bats do you most frequently observe or have had contact with? (Note to interviewer: Read all but last two options to participant.)

Fruit-eating bats
Insect-eating bats
Vampire bats
Multiple types
Other
Don’t know
Declined to answer

5.22) If the kind of bat is "Other"
5.22.1) Specify the other type of bat

5.23) Do you or your family do something to avoid bat bites in the house?
- Nothing
- Use mosquito net
- Prevent entry of bat in the house
- Increase number of cats
- Increase the number of cattle/pigs to be bitten
- Destroy bat refuges/kill bats
- Pray
- Declined to answer
- Other

5.24) If answered OTHER as the type of action taken to avoid bites in the house
5.24.1) Specify what you and your family does to avoid bat bites in the house

5.25) How much do you know about rabies? (Note to interviewer: Read all but last two options to participant.)
- Little to none
- Basic
- Extensive
- Declined to answer

5.26) How dangerous is rabies?
- Very Severe
- Mild or moderate
- Don't know
- Declined to answer

5.27) How do people get infected with rabies?
- Animal bite
- Animal scratch or lick
- Touching an animal
- Eating an animal
- Other
- Don't know
- Declined to answer

5.28) If the way people are infected with rabies is "Other"
5.28.1) Specify the way people are infected by rabies

5.29) What animals can be infected with rabies? (check all that apply)
- Bats
- Dogs
- Cats
- Horses
- Livestock

Wild mammals (not bats)
Other
Don't know
Declined to answer

5.30) If the animals are potentially infected with rabies are "Other"
5.30.1) Specify which other animals could be infected with rabies

5.31) What would you do if you were bitten or scratched by a bat?
Nothing
Wash wound with soap and water
Call a doctor for advice
Call or visit a traditional healer
Seek medical care at a hospital, clinic or health post
Seek rabies PEP (rabies vaccine)
Have bat tested for rabies (or other diseases)
Other
Don’t know
Declined to answer

5.32) If the action that you would take is Other
5.32.1) Specify the other action that would be taken

5.33) Do you think there is any time of the year in which bats attack more animals or people?
No, it is the same all year round
Yes, rainy season (April-October)
Yes, dry season (November-April)
Don't know
Declined to answer

5.34) If someone has been bitten by an animal potentially infected with rabies what should that person do? (Check all that apply)
Nothing
Wash wound with soap and water
Call a doctor for advice
Call or visit a traditional healer
Seek medical care at a hospital or clinic
Seek rabies PEP (rabies vaccines)
Check animal’s vaccination history
Observe animal for a period of time to see if it becomes rabid
Have animal tested for rabies
Kill animal
Other
Don't know

Declined to answer

5.35) If the action is "Other"

5.35.1) Specify the other action that should be done if someone has been bitten by an animal that might be infected by rabies

5.36) Have you ever been vaccinated against rabies?

Yes
No
Don't know
Declined to answer

5.37) If you have ever been vaccinated against rabies

5.37.1) What was the reason you were vaccinated against rabies?

Post-exposure prophylaxis
Pre-exposure prophylaxis
Have received PreP and PEP
Don’t know
Declined to answer

5.37.2) If you have received rabies vaccination after being bitten or scratched by an animal bite, what animal or animals were responsible for the incident? (check all that apply)

Bats
Dogs
Cats
Horses
Livestock
Wild mammals (not bats)
Others
Don't know
Declined to answer
Did not receive PEP

5.37.3) If received a vaccination after being bitten by an OTHER animal

5.37.3.1) Specify the other animal that bit you

5.38) Are you aware if there are any other diseases that humans can get from bats?

Yes
No
Don't know
Declined to answer

5.39) Have you or anyone you know ever experienced an illness that you believe may have been caused by bats or being in a bat cave?

Yes
No
Don't know
Declined to answer

5.40) If you or anyone you know ever experienced an illness that you believe may have been caused by bats or being in a bat cave

5.40.1) What were the symptoms?

Skin rash/discoloration/ infection
Unusual bleeding (e.g. from nose/mouth)
Fever
Cough
Sneezing
Runny nose
Chest congestion
Muscle pain
Difficulty breathing
Headache
Convulsions
Altered mental state (dementia)
Unconsciousness/coma
Muscle weakness/paralysis
Vomiting or diarrhea or stomach cramps
Miscarriage/stillbirth
Death
Multiple persons
Other
Don't know
Declined to answer

5.40.2) If the symptoms is "Other"

5.40.2.1) Specify the other symptom

5.40.2.2) Are you or the person you know that presented symptoms caused by a bat recovered?

Yes
No
Don’t know
Decline to answer

5.41) We would like to take a sample of your blood. Will you allow us to take a sample?

Yes
No

5.41.2 Was blood sampled obtained?

Yes
No
5.41.3 IF blood sample was not obtained, why not?
Did not consent for blood
Was not able to get blood
Other:_____
5.41.4) Will you allow us to return in 6-8 weeks to ask you some more questions? YES/ NO

6) Please ask again if there is anyone else living here that has been bitten, scratched or has eaten or touched any bats. If so then fill additional section C for each additional exposed person. (Follow same process for consent/assent and blood sampling than other participants.

Those are all the questions I have for you. Thank you very much for your time and cooperation. We or personnel of the MoH may need to contact you again if the survey is found to be incomplete. Results of this study will be reported to MoH representatives in your area.

Technical Appendix 2. Questionnaire used in a follow-up survey of bat exposures — Idanre, Nigeria, 2013

D	D	M	M	Y	Y	Y	Y

Date of Follow-up: Household ID Number:
(autofill)

Interviewer Name: First Name, First Family name, Second Family name

1. Municipality: autofill
2. Community: autofill
3. GPS Coordinates: autofill

Section A

[Section A. Administer to the person originally consented to the main responder of the study. If not available, ask if another adult (18 years and older) is available]

Hello. My name is _____ and I am working with the <insert appropriate agency affiliation>.

Mr./Mrs. (*name of person originally consented to the study*) participated in a survey in Feb/March of this year; is (*he/she*) in the house and available to participate in a follow-up survey at this time?

If available, interviewer to confirm that consent was obtained for participation in the Feb/March survey (Yes, No) If not available, ask if another adult who participate in the original study is available to answer follow-up questions.			

Last (Feb/March) (*you* or *name of person originally consented to the study)* agreed to participate in a survey to improve our understanding of the knowledge, attitudes, and practices of people in Idanre local government of Ondo State, who come in close contact with bats or places where bats live, like caves. We are here today to ask for a few more minutes of your time, around 20 minutes, to follow-up on your responses about any animals you've kept as pets or livestock since the festival, exposures to bats since the festival, and about your health since the bat festival. Your answers to the questions are completely voluntary and will be kept confidential. Do you have

time now? (If NO, "Thank you for your time." Ask if there is another time that would be more convenient)
Just like for the first survey, you do not have to be in this follow-up survey. It is up to you. You do not have to answer any question or give blood if you do not want to.

Do you want to be in the follow-up part of the Nigeria Bats study? (Yes, No)

Name:_____
Signature:_____

Date:_____ Right Thumbprint (if not able to read/write): _____

Please think carefully about each question, and answer as well as you can. You can choose not to answer any of the questions.

History of Animal Illness Since the Bat Festival:

1. A) At the time of the bat festival, did you have any animals as pets or livestock? (Yes, No, Don't know, Declined to answer)

   If no, go to **Section B** on page 6
   If yes, ask the following questions:

   B) Have any of the animals died since the festival? (Yes, No, Don't know, Declined to answer)
   C) Have any of the animals been sick since the festival? (Yes, No, Don't know, Declined to answer)
   D) During or since the bat festival, did any of your animals come in contact with bats – either by biting, scratching, or touching (Yes, No, Don't know, Declined to answer)
   E) If yes, please indicate which sort of the animals have been in contact with bats during or since the bat festival (Select all that apply?)

Goats	Dogs
Sheep	Cats
Cows	Chicken
Pigs	Other (Specify "other" type of animal)
Horses	

F) Now I/we are going to ask you more about the animals you had at the time of the festival and any sickness or death they've had since the festival.

Follow-up Form
(Convalescent Blood Draw Visit)

Complete for each species	Questions about animal sickness	Clinical signs? (tick all that apply)	Questions about animal death
I. Goats: How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)
II. Sheep How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)

III. Cows How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)
IV. Pigs How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)
V. Horses How many total? (number, N/A,	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+

don't know, declined, N/A)	☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)
VI. Dogs How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)

VII. Cats	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+

How many total? (number, N/A, don't know, declined, N/A)	☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined
VIII. Other (specify) How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined
IX. Other (specify) How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for

	symptoms? (yes, no, unsure, declined)	☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined

Section B: Household Respondent Information:

Now we would like to ask you and the members of your household who participated in the last study, if they would like to like to answer questions about their exposure to bats and health status since the festival. Answers to the questions are completely voluntary and will be kept confidential.

2. Patient ID: (autofill)
3. Sample ID: (autofill)

D	D	M	M	Y	Y	Y	Y

4. Date of Follow-up:

Interviewer to confirm the following information:

5. Name: First name, First Family name, Second Family name (autofill)
6. Respondent Age (autofill: age in years)
7. Confirm patient gender (autofill: male/female)
8. Contact / Mobile Number:

9. A) Respondent Status: Alive/Deceased
   B) If deceased, specify source of information:

Bat Exposure During and Since Bat Festival:

10. A) Did you participate in the last bat festival (specify dates)? (Yes (date/s), No, don't know, declined)
    If Yes, ask the following questions:
    B) What dates did you participate? (Date/s, don't know, declined)
    C) What role(s) did you play during the bat festival? (tick all that concerns)

Bat hunting	Dancer, singer	Decline to answer
Selling of bats	Spiritual activities	Other (specify) _____
Preparation of bats for food/consumption	Standby watcher	
	Don't know	

5.

11. A) Did you go inside of a bat cave or bat refuge during or after the festival (trees, abandoned house, bridge, etc.)?
    (Yes, No, Don't know, Declined to answer)
    If yes, ask the following questions:
    B) How many times did you enter a bat cave or bat refuge during the festival? (*N*, Don't' know, declined to answer)
    C) How many times did you enter a bat cave or bat refuge since the festival? (*N*, Don't' know, declined to answer)
    D) When was the last time you entered a bat cave or refuge? (Note to interviewer: Read all but last two options to participant.)
    During the festival

Since after the festival: 1-4 weeks ago (in the past 4 weeks)
Since after the festival: 5-8 weeks ago (longer than 4 weeks ago)
Don’t know
Declined to answer

12. A) During or since the bat festival, have you touched a live bat with your skin uncovered? (Yes, No, Don't know, Declined to answer)
    B) If yes, when was the last time you touched a bat?
    During the festival
    Since after the festival: 1-4 weeks ago (in the past 4 weeks)
    Since after the festival: 5-8 weeks ago
    Don’t know
    Declined to answer

13. A) During or since the bat festival, were you scratched by a bat, to your knowledge? (Yes, No, Don't know, Declined to answer)
    B) If yes, when was the last time you were scratched by a bat?
    During the festival
    Since after the festival: 1-4 weeks ago (in the past 4 weeks)
    Since after the festival: 5-8 weeks ago
    Don’t know
    Declined to answer

14. A) During or since the bat festival, were you bitten by a bat, to your knowledge? (Yes, No, Don't know, Declined to answer)
    B) If yes, when was the last time you were bitten by a bat?
        During the festival
        Since after the festival: 1-4 weeks ago (in the past 4 weeks)
        Since after the festival: 5-8 weeks ago
        Don’t know
        Declined to answer
15. A) During or since the bat festival, did you prepare bat as food? (Yes, No, Don't know, Declined to answer)
    B) If yes, when was the last time you prepared bat as food?
        During the festival
        Since after the festival: 1-4 weeks ago (in the past 4 weeks)
        Since after the festival: 5-8 weeks ago
        Don’t know
        Declined to answer
16. A) During or since the bat festival, did you eat bat? (Yes, No, Don't know, Declined to answer)
    B) If yes, when was the last time you ate bat?
        During the festival
        Since after the festival: 1-4 weeks ago (in the past 4 weeks)
        Since after the festival: 5-8 weeks ago
        Don’t know
        Declined to answer
17. What kinds of bats do you most frequently observe or have had contact with? (Note to interviewer: Read all but last two options to participant.)

Fruit-eating bats	Multiple types
Insect-eating bats	Other (specify)
Vampire bats	Don’t know

Declined to answer

Follow-up Form
(Convalescent Blood Draw Visit)

Respondent History of Illness Since Bat Festival:

18. A) Since the bat festival, have you felt sick at any time? Yes, No

B) If yes, did you go for help when you felt sick? (Y=1, N=2, Declined=99)

If yes: ask the following questions:

a) Where did you go? (nearby clinic, state hospital, private hospital/clinic, pharmacy/chemist, traditional healer, other: (specify))

b) What did the doctor/healer/chemist say was wrong? (list all, unsure=3, declined=99)

c) Did you stay at the hospital for treatment? (Y=1, N=2, declined=99)

d) If yes, how many days were you in the hospital?

e) Did the doctor/healer/chemist prescribe any medication?

i) If yes, what medication/s: (list all, unsure=3, declined=99)

19. A) Since the bat festival, have you taken any medications?

B) If yes, what medication/s: (list all, unsure=3, declined=99)

20. Now I/we would like to ask you some questions about the symptoms you had when you were sick after the bat festival

ORY OF ILLNESS	**Have you had "*name specific symptom*"** (Yes = 1, No= 2, unsure= 3, declined =99)	**How many days ago did it start?** (if started today: code=00, NA=88, declined =99)	**How many days did the symptom last?** (if continuing until today, count current day as 1; NA= 88, declined=99)	**Did you have this symptom before o during the bat fes** (Yes=1, No=2, unsure=3, NA=88, declined=99)
:				
a:				
ing:				
ea:				
minal pain:				
nctivitis/red eye:				
:				
lcers or cold sores:				
nroat:				
ulty breathing:				
pain:				
e aches:				
ain:				
ired/weak:				
che:				
_____				
ng from gums or mouth				
ORY OF ILLNESS	**Have you had "*name specific symptom*"** (Yes = 1, No= 2, unsure= 3, declined =99)	**How many days ago did it start?** (if started today: code=00, NA=88, declined =99)	**How many days did the symptom last?** (if continuing until today, count current day as 1; NA= 88, declined=99)	**Did you have this symptom before o during the bat fes** (Yes=1, No=2, unsure=3, NA=88, declined=99)
spots in eyes (sclera) or on skin				

Follow-up Form
(Convalescent Blood Draw Visit)

eck:				
anced/difficulty walking:				
ulty swallowing:				
ulty speaking:				
ulty hearing:				
ulty seeing:				
sive fear/anxiety				
ed				
rs or convulsions:				
d or loss of consciousness:				
sis:				
symptom 1, y_____				
symptom 2, y_____				

21. A) Since the last time we talked to you around 2 months ago, have you received rabies vaccination? Yes, No

B) If yes, when were you given your last rabies vaccination?"

Those are all the questions I have for you. Thank you very much for your time and cooperation. We or personnel of the state Ministry of Health may need to contact you again if the survey is found to be incomplete. Results of this study will be reported to Ministry of Health representatives in your area.

Questionnaire used in a follow-up survey of bat exposures — Idanre, Nigeria, 2013

Date of Follow-up: | | | | | | | | | D D M M Y Y Y Y

Household ID Number: (autofill) | | | | | | | | |

Interviewer Name: First Name, First Family name, Second Family name

1. Municipality: autofill
2. Community: autofill
3. GPS Coordinates: autofill

Section A

[Section A. Administer to the person originally consented to the main responder of the study. If not available, ask if another adult (18 years and older) is available]

Hello. My name is _____ and I am working with the <insert appropriate agency affiliation>.

Mr./Mrs. (*name of person originally consented to the study*) participated in a survey in Feb/March of this year; is (*he/she*) in the house and available to participate in a follow-up survey at this time?

Household ID# | | | | | | | | |

If available, interviewer to confirm that consent was obtained for participation in the Feb/March survey (Yes, No)

If not available, ask if another adult who participate in the original study is available to answer follow-up questions.

Last (Feb/March) (*you* or *name of person originally consented to the study)* agreed to participate in a survey to improve our understanding of the knowledge, attitudes, and practices of people in Idanre local government of Ondo State, who come in close contact with bats or places where bats live, like caves. We are here today to ask for a few more minutes of your time, around 20 minutes, to follow-up on your responses about any animals you've kept as pets or livestock since the festival, exposures to bats since the festival, and about your health since the bat festival. Your answers to the questions are completely voluntary and will be kept confidential. Do you have time now? (If NO, "Thank you for your time." Ask if there is another time that would be more convenient)

Just like for the first survey, you do not have to be in this follow-up survey. It is up to you. You do not have to answer any question or give blood if you do not want to.

Do you want to be in the follow-up part of the Nigeria Bats study? (Yes, No)

Name:_____ Signature:_____

Date:_____ Right Thumbprint (if not able to read/write): _____

Please think carefully about each question, and answer as well as you can. You can choose not to answer any of the questions.

History of Animal Illness Since the Bat Festival:

1. A) At the time of the bat festival, did you have any animals as pets or livestock? (Yes, No, Don't know, Declined to answer)

   If no, go to **Section B** on page 6

Household ID# | | | | | | | | |

If yes, ask the following questions:

B) Have any of the animals died since the festival? (Yes, No, Don't know, Declined to answer)
C) Have any of the animals been sick since the festival? (Yes, No, Don't know, Declined to answer)
D) During or since the bat festival, did any of your animals come in contact with bats – either by biting, scratching, or touching (Yes, No, Don't know, Declined to answer)
E) If yes, please indicate which sort of the animals have been in contact with bats during or since the bat festival (Select all that apply?)

Goats	Dogs
Sheep	Cats
Cows	Chicken
Pigs	Other (Specify "other" type of animal)
Horses	

F) Now I/we are going to ask you more about the animals you had at the time of the festival and any sickness or death they've had since the festival.

Follow-up Form
(Convalescent Blood Draw Visit)

Complete for each species	Questions about animal sickness	Clinical signs? (tick all that apply)	Questions about animal death
I. Goats: How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)
II. Sheep How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)

Household ID# | | | | | | | | |

Follow-up Form
(Convalescent Blood Draw Visit)

III. Cows How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)
IV. Pigs How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)
V. Horses How many total? (number, N/A,	a) How many got sick? ☐ 0 ☐ 1	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking	d) How many died? ☐ 0 ☐ 1

Household ID# | | | | | | | | |

don't know, declined, N/A)	☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)
VI. Dogs How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined)

Follow-up Form
(Convalescent Blood Draw Visit)

VII. Cats How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined
VIII. Other (specify) How many total? (number, N/A, don't know, declined, N/A)	a) How many got sick? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	c) What were their signs? (tick all that apply) ☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	d) How many died? ☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined
IX. Other (specify)	a) How many got sick?	c) What were their signs? (tick all that apply)	d) How many died?

Household ID# | | | | | | | | |

Follow-up Form
(Convalescent Blood Draw Visit)

How many total? (number, N/A, don't know, declined, N/A)	☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined b) Is/are the animal recovered from the symptoms? (yes, no, unsure, declined)	☐ Not moving much/hiding ☐ Problems walking ☐ Not eating well ☐ Vomiting ☐ Diarrhea ☐ Foaming at mouth/salivation ☐ Bellowing/crying ☐ Trembling or twitching ☐ Behavior change – more quiet/more aggressive ☐ Coughing ☐ Sneezing ☐ Runny nose ☐ Problems breathing ☐ Convulsions ☐ Still birth ☐ Suddenly died ☐ Other (specify):	☐ 0 ☐ 1 ☐ 2 ☐ 3+ ☐ D/K ☐ Declined e) Was/were the animal(s) slaughtered and eaten or sold for food? (yes, no, some, unsure, declined) f) Was/were any of the animals sick before they were slaughtered or sold? (yes, no, some, unsure, declined

Section B: Household Respondent Information:

Now we would like to ask you and the members of your household who participated in the last study, if they would like to like to answer questions about their exposure to bats and health status since the festival. Answers to the questions are completely voluntary and will be kept confidential.

2. Patient ID: (autofill)

3. Sample ID: (autofill)

4. Date of Follow-up:

D	D	M	M	Y	Y	Y	Y

Household ID#

Interviewer to confirm the following information:

5. Name: First name, First Family name, Second Family name (autofill)
6. Respondent Age (autofill: age in years)
7. Confirm patient gender (autofill: male/female)
8. Contact / Mobile Number:

9. A) Respondent Status: Alive/Deceased
   B) If deceased, specify source of information:

Bat Exposure During and Since Bat Festival:

10. A) Did you participate in the last bat festival (specify dates)? (Yes (date/s), No, don't know, declined)
    If Yes, ask the following questions:

    B) What dates did you participate? (Date/s, don't know, declined)

    C) What role(s) did you play during the bat festival? (tick all that concerns)

Bat hunting	Dancer, singer	Don't know
Selling of bats	Spiritual activities	Decline to answer
Preparation of bats for food/consumption	Standby watcher	Other (specify) _____

11. A) Did you go inside of a bat cave or bat refuge during or after the festival (trees, abandoned house, bridge, etc.)? (Yes, No, Don't know, Declined to answer)

    If yes, ask the following questions:

B) How many times did you enter a bat cave or bat refuge during the festival? (*N*, Don't' know, declined to answer)

C) How many times did you enter a bat cave or bat refuge since the festival? (*N*, Don't' know, declined to answer)

D) When was the last time you entered a bat cave or refuge? (Note to interviewer: Read all but last two options to participant.)

During the festival

Since after the festival: 1-4 weeks ago (in the past 4 weeks)

Since after the festival: 5-8 weeks ago (longer than 4 weeks ago)

Don't know

Declined to answer

12. A) During or since the bat festival, have you touched a live bat with your skin uncovered? (Yes, No, Don't know, Declined to answer)
B) If yes, when was the last time you touched a bat?

During the festival

Since after the festival: 1-4 weeks ago (in the past 4 weeks)

Since after the festival: 5-8 weeks ago

Don't know

Declined to answer

13. A) During or since the bat festival, were you scratched by a bat, to your knowledge? (Yes, No, Don't know, Declined to answer)
B) If yes, when was the last time you were scratched by a bat?

During the festival

Since after the festival: 1-4 weeks ago (in the past 4 weeks)

Since after the festival: 5-8 weeks ago

Don’t know

Declined to answer

14. A) During or since the bat festival, were you bitten by a bat, to your knowledge? (Yes, No, Don't know, Declined to answer)
    B) If yes, when was the last time you were bitten by a bat?

    During the festival

    Since after the festival: 1-4 weeks ago (in the past 4 weeks)

    Since after the festival: 5-8 weeks ago

    Don't know

    Declined to answer

15. A) During or since the bat festival, did you prepare bat as food? (Yes, No, Don't know, Declined to answer)
    B) If yes, when was the last time you prepared bat as food?

    During the festival

    Since after the festival: 1-4 weeks ago (in the past 4 weeks)

    Since after the festival: 5-8 weeks ago

    Don't know

    Declined to answer

16. A) During or since the bat festival, did you eat bat? (Yes, No, Don't know, Declined to answer)
    B) If yes, when was the last time you ate bat?

    During the festival

    Since after the festival: 1-4 weeks ago (in the past 4 weeks)

    Since after the festival: 5-8 weeks ago

    Don't know

Declined to answer

17. What kinds of bats do you most frequently observe or have had contact with? (Note to interviewer: Read all but last two options to participant.)

    Fruit-eating bats

    Insect-eating bats

    Vampire bats

    Multiple types

    Other (specify)

    Don't know

    Declined to answer

Follow-up Form
(Convalescent Blood Draw Visit)

Respondent History of Illness Since Bat Festival:

18. A) Since the bat festival, have you felt sick at any time? Yes, No

B) If yes, did you go for help when you felt sick? (Y=1, N=2, Declined=99)

If yes: ask the following questions:

a) Where did you go? (nearby clinic, state hospital, private hospital/clinic, pharmacy/chemist, traditional healer, other: (specify))

b) What did the doctor/healer/chemist say was wrong? (list all, unsure=3, declined=99)

c) Did you stay at the hospital for treatment? (Y=1, N=2, declined=99)

d) If yes, how many days were you in the hospital?

e) Did the doctor/healer/chemist prescribe any medication?

i) If yes, what medication/s: (list all, unsure=3, declined=99)

19. A) Since the bat festival, have you taken any medications?

B) If yes, what medication/s: (list all, unsure=3, declined=99)

Follow-up Form
(Convalescent Blood Draw Visit)

20. Now I/we would like to ask you some questions about the symptoms you had when you were sick after the bat festival

HISTORY OF ILLNESS	**Have you had "*name specific symptom*"** (Yes = 1, No= 2, unsure= 3, declined =99)	**How many days ago did it start?** (if started today: code=00, NA=88, declined =99)	**How many days did the symptom last?** (if continuing until today, count current day as 1; NA= 88, declined=99)	**Did you have this symptom before or during the bat festival?** (Yes=1, No=2, unsure=3, NA=88, declined=99)
Fever:				
Chills:				
Nausea:				
Vomiting:				
Diarrhea:				
Abdominal pain:				
Cold:				
Conjunctivitis/red eye:				
Cough:				
Oral ulcers or cold sores:				
Sore throat:				
Difficulty breathing:				

Household ID# | | | | | | | | |

Follow-up Form
(Convalescent Blood Draw Visit)

Chest pain:				
Muscle aches:				
Joint pain:				
Very tired/weak:				
Headache:				
Rash: Site_____				
Bleeding from gums or mouth				
HISTORY OF ILLNESS	**Have you had "*name specific symptom*"** (Yes = 1, No= 2, unsure= 3, declined =99)	**How many days ago did it start?** (if started today: code=00, NA=88, declined =99)	**How many days did the symptom last?** (if continuing until today, count current day as 1; NA= 88, declined=99)	**Did you have this symptom before or during the bat festival?** (Yes=1, No=2, unsure=3, NA=88, declined=99)
Blood spots in eyes (sclera) or on skin				
Stiff neck:				
Unbalanced/difficulty walking:				
Difficulty swallowing:				
Difficulty speaking:				
Difficulty hearing:				
Difficulty seeing:				

Household ID# | | | | | | | | |

Follow-up Form
(Convalescent Blood Draw Visit)

Excessive fear/anxiety				
Agitated				
Tremors or convulsions:				
Altered or loss of consciousness:				
Paralysis:				
Other symptom 1, specify_____				
Other symptom 2, specify_____				

21. A) Since the last time we talked to you around 2 months ago, have you received rabies vaccination? Yes, No

B) If yes, when were you given your last rabies vaccination?"

Those are all the questions I have for you. Thank you very much for your time and cooperation. We or personnel of the state Ministry of Health may need to contact you again if the survey is found to be incomplete. Results of this study will be reported to Ministry of Health representatives in your area.

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Bat and Lyssavirus Exposure among Humans in Area that Celebrates Bat Festival, Nigeria, 2010 and 2013

Appendix 2

Data Analysis

We summarized characteristics of enrolled households and persons represented among enrolled households in the 2010 and 2013 community surveys using descriptive statistics. The number and percentage of persons who had bat contact (overall and by type of contact) and who had eaten a bat were calculated among persons represented in the enrolled households from the community surveys. We analyzed demographics; household characteristics; bat-related activities; knowledge of rabies, bats, and animal bites; and history of rabies vaccination as potential associative factors in 3 different comparisons. Analyses included main household respondents who had ever had bat contact compared with those who didn't using logistic regression, a 2-sample *t*-test and Wilcoxon rank-sum test; participants in the 2010 community survey compared with those in the 2013 community survey who reported having ever had bat contact using generalized estimating equations (GEEs) with the logit link; and participants in the 2013 community survey and 2013 bat hunter survey who experienced febrile illness within 90 days of the bat festival versus those who did not, using GEEs with the logit link. The last 2 comparisons also looked at bat contact as a potential association. Odds ratios (ORs) with 95% confidence intervals were calculated for all 3 comparisons.

Main household respondents who participated in both the 2010 community survey and the 2013 community survey were excluded from the 2013 community survey results when analyses included both surveys. A response of "don't know" was considered "no" for the purpose of analysis. We analyzed data using SAS software (https://www.sas.com). A p value <0.05 was considered statistically significant.

Appendix 2 Table 1. Personal characteristics, household characteristics, practices, and knowledge of study participants who reported having ever had bat contact* in 2 community surveys and a bat hunter survey of bat exposures, Idanre area, Nigeria, 2010 and 2013.

Characteristic	2010 community survey, n (%)	2013 community survey, n (%)†	p value‡	OR (95% CI)‡	2013 bat hunter survey, n (%)
Ever had bat contact	72	131	-	-	21
Study participant type					
Main household respondent§	43 (60)	98 (75)	0.03	0.50 (0.27–0.92)	NA
Additional household respondent§	29 (40)	33 (25)	Ref	Ref	NA
Demographics					
Mean age (SD)	42 (16)	45 (18)	0.19	NC	51 (17)
Age range (y; min–max)	9–83	18–89	NC	NC	20–83
Median age (y; interquartile range)	40 (32–51.5)	43 (30-–60)	NC	NC	52 (38–64)
Age <25 y	8 (11)	18 (14)	0.61	0.78 (0.31–2.01)	2 (10)
Male	51 (71)	81 (62)	0.20	1.50 (0.81–2.79)	21 (100)
Education					
Some secondary or above	28 (39)	66 (50)	0.13	0.63 (0.34–1.14)	12 (57)
Completed secondary or above	18 (25)	45 (34)	0.18	0.64 (0.33–1.24)	8 (38)
Household characteristics					
Households	51	109			21
Persons in household					
<5 persons	12 (24)	28 (26)	0.77	0.89 (0.41–1.94)	3 (16)
<10 persons	34 (67)	72 (66)	0.94	1.03 (0.51–2.08)	10 (53)
Main material used to build house					
Adobe/mud	32 (63)	44 (40)	NP	NP	1 (5)
Cement/brick	18 (35)	65 (60)	NP	NP	20 (95)
Wood	1 (2)	0 (0)	NP	NP	0 (0)
Openings present in house that could allow bats to enter	31 (61)	58 (53)	0.37	1.36 (0.69–2.68)	1 (5)
Household with animals (pets or livestock)	34 (67)	60 (55)	0.17	1.63 (0.82–3.27)	14 (67)
Household with ≥1 animal (pet or livestock) that has been vaccinated against rabies	0 (0)	6 (10)	NP	NP	5 (36)
Types of bat contact					
Touch bat					
Ever touched	71 (99)	130 (99)	0.67	0.55 (0.03–8.96)	20 (95)
Last time touched ≤6 mo ago	29 (41)	62 (48)	0.38	0.76 (0.41–1.40)	16 (80)
Touch ≥2 times/y	39 (55)	8 (6)	<0.0001	18.43 (7.04–48.27)	1 (5)
Bite from bat					
Ever bitten	17 (24)	34 (26)	0.75	0.88 (0.41–1.89)	10 (48)
Last time bitten ≤6 mo ago	4 (24)	14 (41)	0.33	0.44 (0.08–2.32)	5 (50)
Bitten ≥2 times/y	11 (65)	0 (0)	NP	NP	1 (10)
Scratch from bat					
Ever scratched	23 (32)	41 (31)	0.89	1.05 (0.53–2.09)	15 (71)
Last time scratched ≤6 mo ago	6 (26)	18 (44)	0.24	0.45 (0.12–1.70)	8 (53)
Scratch ≥2 times/y	12 (52)	2 (5)	0.001	21.27 (3.83–118.07)	1 (7)
Other bat-related activities					
Participate in bat festival					
Ever participated	21 (44)	46 (35)	0.29	1.42 (0.74–2.72)	19 (90)
First time participated ≥20 y ago	0 (0)	30 (65)	NP	NP	10 (53)
Participate 2 times/yr	14 (70)	8 (18)	0.0002	10.79 (3.13–37.21)	1 (5)
Enter a bat cave or bat refuge					
Ever entered	30 (44)	41 (31)	0.07	1.73 (0.95–3.16)	18 (86)
Last time entered ≤6 mo ago	6 (20)	17 (41)	0.09	0.35 (0.11–1.17)	14 (78)
Enter ≥2 times/y	17 (57)	4 (10)	0.0002	12.10 (3.28–44.64)	0 (0)
Prepare a bat as food					
Ever prepared	64 (89)	108 (82)	0.24	1.70 (0.70–4.16)	18 (86)
Last time prepared ≤6 mo ago	31 (50)	64 (59)	0.25	0.69 (0.36–1.30)	14 (78)
Prepare ≥2 times/y	39 (61)	8 (7)	<0.0001	19.50 (7.78–48.85)	1 (6)
Eat a bat					
Ever eaten	66 (92)	113 (86)	0.29	1.75 (0.62–4.94)	21 (100)
Last time eaten <1 mo ago	5 (8)	63 (56)	<0.0001	0.07 (0.02–0.23)	16 (76)
Eat ≥2 times/y	43 (65)	12 (11)	<0.0001	15.74 (6.43–38.48)	2 (10)
Rabies knowledge					

Characteristic	2010 community survey, n (%)	2013 community survey, n (%)†	p value‡	OR (95% CI)‡	2013 bat hunter survey, n (%)
Indicated animal bites as mechanism of rabies transmission	44 (61)	76 (58)	0.70	1.14 (0.59–2.18)	19 (90)
Described rabies as severe	46 (65)	80 (61)	0.65	1.17 (0.58–2.35)	18 (86)
Identified bats as a rabies source	2 (3)	3 (2)	0.83	1.22 (0.20–7.47)	0 (0)
Identified dogs as a rabies source	51 (71)	78 (60)	0.13	1.65 (0.87–3.14)	19 (90)
If bitten or scratched by a bat					
Wash wound with soap and water	9 (13)	7 (5)	0.07	2.55 (0.92–7.07)	1 (5)
Seek medical care	13 (18)	45 (35)	0.01	0.42 (0.22–0.83)	1 (5)
Seek a traditional healer or pray	2 (3)	5 (4)	0.77	0.72 (0.08–6.50)	1 (5)
Do nothing	38 (54)	62 (48)	0.50	1.26 (0.64–2.48)	18 (86)
If bitten by a potentially rabid animal					
Wash wound with soap and water	4 (6)	1 (1)	0.07	7.65 (0.86–68.39)	1 (5)
Seek medical care	53 (74)	85 (65)	0.20	1.51 (0.80–2.85)	9 (43)
Seek a traditional healer or pray	3 (4)	6 (5)	0.90	0.91 (0.20–4.07)	0 (0)
Do nothing	3 (4)	29 (22)	0.002	0.15 (0.05–0.51)	10 (48)
History of rabies vaccination	1 (1)	2 (2)	0.94	0.91 (0.08–9.86)	1 (5)
Aware that bats can cause disease other than rabies	2 (3)	9 (7)	0.25	0.39 (0.08–1.93)	1 (5)
Know of reports of illness as a result of bats or being in bat cave	1 (1)	4 (3)	0.48	0.45 (0.05–4.09)	0 (0)

*Bat contact was defined as having touched a bat, having been bitten by a bat, or having been scratched by a bat.
†Ten of the 264 main household respondents participated in both the 2010 community survey and the 2013 community survey. They were deleted from the 2013 community survey data.
‡NA, not applicable; NC, not calculated; NP, logistic regression could not be performed due to zero cells.
§Main household respondents are adults or mature minors (persons aged 13–17 y who were married, had children, or provided for their own livelihood) present at the time of household visit who provided consent to participate in the survey; the main household respondent was the first person of the household to whom the study questionnaire was administered. Additional household respondents are other consenting or assenting household members who were immediately available to answer the study questionnaire and either had previously had bat contact or had previously eaten a bat.

Appendix 2 Table 2. Serologic testing of humans for lyssavirus antibodies in two community surveys and a bat hunter survey of bat exposures, Idanre area, Nigeria, 2010 and 2013.

Lyssavirus type (species)	Rabies virus (CVS-11)	Rabies virus (CVS-11)	Duvenhage virus (South Africa, 1970)	Lagos bat virus (lineage B, Nigeria, 1956)	Lagos bat virus (lineage B, Nigeria, 1956)	Lagos bat virus (lineage D, isolate KE576, Kenya, 2010)	Shimoni bat virus (Kenya, 2009)	Mokola virus (South Africa, 1998)	West Caucasian bat virus (Caucasus region, 2002)
Lyssavirus phylogroup	I	I	I	II	II	II	II	II	Undetermined
Sampling scheme	2013 community survey; 2013 bat hunter survey	2013 follow-up survey	2010 community survey	2010 community survey; 2013 community survey; 2013 bat hunter survey	2013 follow-up survey	2010 community survey	2010 community survey	2010 community survey	2010 community survey
Number of study participants tested	200	130	103	301	132	101	96	92	97
Number of study participants with detectable neutralizing antibodies	2	1	0	0	0	0	0	0	0

Appendix 2 Table 3. List of serologic testing results for lyssavirus antibodies among *Rousettus aegyptiacus* bats roosting in caves used in a bat festival, Idanre area, Nigeria, 2013.*

	Lyssavirus type (species)				
Bat ID	Duvenhage virus (South Africa, 1970)	Lagos bat virus (lineage B, Nigeria, 1956)	Shimoni bat virus (Kenya, 2009)	Mokola virus (South Africa, 1998)	Ikoma lyssavirus (Tanzania, 2009)
bat006	Neg	Neg	Neg	Pos	Neg
bat007	Neg	Neg	Neg	Neg	Neg
bat009	Neg	Neg	ND	Pos	Neg
bat011	Neg	Neg	Neg	Neg	Neg
bat012	Neg	Pos	Pos	Pos	Neg
bat015	Neg	ND	Pos	Pos	Neg
bat016	Neg	ND	Neg	Neg	Neg
bat019	Neg	ND	Pos	Pos	Neg
bat021	Neg	Pos	Pos	Pos	Neg
bat022	Neg	Neg	Neg	Neg	Neg
bat026	Neg	Pos	Pos	Pos	Neg
bat027	Neg	ND	Pos	Pos	Neg
bat028	Neg	Neg	ND	Neg	Neg
bat029	Neg	Pos	Pos	Pos	Neg
bat030	Neg	Pos	Pos	Neg	Neg
bat031	Neg	Neg	Neg	Neg	Neg
bat033	Neg	ND	ND	Neg	ND
bat035	Neg	ND	ND	ND	Neg
bat036	Neg	Pos	Pos	Pos	Neg
bat037	Neg	ND	ND	ND	ND
bat038	Neg	Neg	Neg	Neg	Neg
bat039	Neg	Neg	Pos	Pos	Neg
bat040	Neg	Neg	Neg	Neg	Neg
bat044	Neg	Pos	Pos	Pos	Neg
bat045	Neg	Neg	Neg	Neg	Neg
bat046	Neg	Pos	Pos	Pos	Neg
bat047	Neg	Pos	Pos	Pos	Neg
bat048	Neg	Pos	Pos	Pos	Pos
bat049	Neg	Pos	Neg	Pos	Neg
bat051	Neg	Pos	Neg	Pos	Neg
bat054	Neg	Pos	Pos	Pos	Neg
bat059	Neg	Neg	Neg	Neg	Neg
bat060	Neg	Pos	Neg	Neg	Neg
bat061	Neg	Pos	Pos	Pos	Neg
bat062	Neg	Neg	Neg	Neg	Neg
bat063	Neg	Pos	Neg	Pos	Neg
bat064	Neg	Neg	Neg	Neg	Neg
bat065	Neg	Neg	Neg	Neg	Neg
bat066	Neg	ND	Neg	Neg	Neg
bat067	Neg	Pos	Pos	Pos	Neg
bat068	Neg	Pos	Pos	Pos	Neg
bat070	Neg	Pos	Pos	Pos	Neg
bat071	Neg	Pos	Pos	Pos	Neg
bat072	Neg	Pos	Pos	Pos	Neg
bat073	Neg	ND	Pos	ND	Neg
bat074	Neg	Pos	ND	ND	Neg
bat075	Neg	Pos	Pos	Pos	Neg
bat076	Neg	Pos	Neg	Neg	Neg
bat077	Neg	Neg	Neg	Neg	Neg
bat078	Neg	Pos	Pos	Pos	Neg
bat079	Neg	ND	ND	ND	Neg
bat080	Neg	Pos	Pos	Pos	Neg
bat081	Neg	Neg	Neg	Pos	Neg
bat083	Neg	Neg	Neg	Neg	Neg
bat084	Neg	Pos	Neg	Pos	Neg
bat085	Neg	Neg	Neg	Neg	Neg
bat086	Neg	Pos	Pos	Pos	Neg
bat087	Neg	Pos	Pos	Pos	Neg
bat088	Neg	Neg	Neg	Pos	Neg
bat089	Neg	Neg	Neg	Pos	Neg
bat090	Neg	Neg	Neg	Neg	Neg
bat091	Neg	Neg	Neg	Neg	Neg
bat092	Neg	Pos	Pos	Pos	Neg

	Lyssavirus type (species)				
Bat ID	Duvenhage virus (South Africa, 1970)	Lagos bat virus (lineage B, Nigeria, 1956)	Shimoni bat virus (Kenya, 2009)	Mokola virus (South Africa, 1998)	Ikoma lyssavirus (Tanzania, 2009)
bat097	Neg	Pos	Pos	Pos	ND
bat098	Neg	Neg	Neg	Neg	Neg
bat099	Neg	Neg	Neg	Neg	Neg
bat100	Neg	Pos	Pos	Pos	Neg

*A total of 211 bats were collected: 120 bats during September 2010 (112 *Rousettus aegyptiacus*, 8 *Hipposideros gigas*) and 91 during February 2013 (all *R. aegyptiacus*). This table displays only data on serologic testing for lyssaviruses among *R. aegyptiacus* bats in 2013; serum specimens were not available for all *R. aegyptiacus* bats. ND, not determined due to cytotoxicity or insufficient sample volume; Neg, negative for virus neutralizing antibodies (titer ≤1:10); Pos, positive for virus neutralizing antibodies (titer >1:10).