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Knowledge and practices related to plague in an endemic area of Uganda

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Abstract

Background—Plague is a virulent zoonosis reported most commonly from sub-Saharan Africa. Early treatment with antibiotics is important to prevent mortality. Understanding knowledge gaps and common behaviors informs development of educational efforts to reduce plague mortality.

Methods—We conducted a multi-stage cluster-sampled survey of 420 households in the plague-endemic West Nile region of Uganda to assess knowledge of symptoms and causes of plague and healthcare-seeking practices.

Results—Most (84%) respondents were able to correctly describe plague symptoms; approximately 75% linked plague with fleas and dead rats. Most respondents indicated they would seek health care at a clinic for possible plague, however plague-like symptoms were reportedly common and in practice, persons sought care for those symptoms at a health clinic infrequently.

Conclusions—Persons in the plague-endemic region of Uganda have a high level of understanding of plague, yet topics for targeted educational messages are apparent.

Keywords

Plague; *Yersinia pestis*; knowledge; practices; behaviors; Africa

INTRODUCTION

Plague is a highly virulent zoonosis caused by the bacillus *Yersinia pestis*.^{1–3} When an epizootic occurs, high mortality among rodents leaves infectious fleas searching for alternative hosts. Most human infections result from an infectious flea bite and present as

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bubonic plague, characterized by fever and a swollen, tender lymph node. Dissemination of *Y. pestis* through the bloodstream and into the lungs results in pneumonic plague, a fulminant pneumonia characterized by bloody sputum. Pneumonic plague is the only clinical form of the illness that can be directly transmitted from person to person; patients near death can infect close contacts through respiratory droplets.^{2, 4} Although mortality in untreated plague infections ranges between 50–100% depending on the clinical presentation, it can be treated successfully if appropriate antimicrobials are administered within 72 hours of symptom onset.^{1, 3, 5} Lack of early and effective treatment increases risk of death and likelihood of epidemic spread.^{5, 6}

Sub-Saharan Africa, including the Democratic Republic of Congo (DRC) and Uganda, accounts for most human cases of plague reported in recent decades.^{7, 8} In Uganda, plague is endemic in the northwestern West Nile region, bordered by the Nile River to the East, South Sudan to the North, and DRC to the West and South.^{7–9} Persons in Uganda often seek health care from both allopathic medical practitioners and traditional healers or community drug shops.¹⁰ Widespread use of traditional medicine and drug shops is attributed to accessibility, affordability, and cultural beliefs^{11, 12}, but these practices may delay seeking care and antibiotics from a health clinic, and can contribute to plague mortality.

General knowledge of plague symptoms and health care seeking practices in the West Nile region of Uganda have not been quantified. These knowledge gaps hinder effective educational and interventional efforts to reduce plague mortality in the region. We performed a survey of household caregivers in the two districts of the plague-endemic West Nile region to 1) determine the level of knowledge regarding the causes and symptoms of plague; 2) assess the frequency of possible behavioral risk factors for human plague; 3) estimate the background frequency of symptoms consistent with bubonic and pneumonic plague; and 4) describe health care seeking behavior of persons with plague-like symptoms.

METHODS

In June 2013, a cross-sectional, stratified, multi-stage cluster-sampled household survey was performed in West Nile, Uganda as part of an ongoing collaboration between the Uganda Virus Research Institute (UVRI) Plague Program and the U.S. Centers for Disease Control and Prevention (CDC). This region is composed of two districts (Arua and Zombo) with two predominant tribes, with corresponding languages (Lugbara and Alur, respectively) and customs. First, all villages within Arua and Zombo districts as of 2009 were stratified according to district and categorized according to whether suspect or confirmed human plague cases had or had not occurred among residents during 1999 to 2012. All villages were then classified according to parish (the next larger administrative unit). Sampling was restricted to parishes in which 50% of villages had a history of plague. A random number generator was used to select 30 eligible villages from each district, for a total of 60 villages. One re-selection was necessary because the village initially was determined to be too inaccessible for survey administrators. The median number of census-enumerated households per selected village was 72 (range: 31–108). Per design similar to that recommended by the World Health Organization for immunization coverage surveys¹³, seven households in each of the 60 selected villages were surveyed, for a total of 420

households. The corresponding sampling rate of villages in the restricted sampling area used for weighted calculations was 37.5% in Arua District, and 12% for Zombo District.

Local teachers, community development officers, and health care providers trained by study personnel in interview techniques and fluent in one of the two primary languages of the region served as survey administrators. Upon arrival in selected villages, survey administrators approached village leaders to explain the study and seek permission to conduct surveys of seven primary caregivers in each village. The primary caregiver of the household was defined as the person who usually makes health care choices for members of the household. Household members were defined as all persons who ate from the same cooking pot daily. To select households, the survey administrator dropped a writing implement on the ground in the center of the village, and proceeded to the nearest house in the direction indicated by the implement. Nearest neighboring households were subsequently selected until the total number of households surveyed reached seven. Two attempts at reaching the primary caregiver of a household were made; if unsuccessful, the nearest neighboring household was approached. Following documented informed consent, a 41-question survey was administered to each caregiver in Lugbara or Alur. Responses that indicated a history of plague in the village were cross-referenced to historical passive and active clinic surveillance records in the region from 1999 through June 2013.

Hard copy survey forms were entered into Epi Info v.7 (Centers for Disease Control and Prevention, Atlanta, GA, USA). Survey data were analyzed using sample survey analytic procedures within SAS (SAS Institute, Cary, NC, USA). The inverse of the sampling fraction for each household observation within each village cluster was assigned as the sampling weight. Weighted percentages are presented unless otherwise indicated. Rao-Scott χ^2 tests were used for comparison between respondents in Arua and Zombo districts, where appropriate. This study was approved by Institutional Review Boards at UVRI, the Uganda National Council for Science and Technology, and CDC.

RESULTS

Study population and general health care seeking practices

Among the 420 respondents, 210 were from Vurra County in northern Arua District and 210 were from Zombo County in Zombo District (formerly Okoro County of Nebbi District) (Figure 1). Median age of respondents was 40 years (range 12–82 years); 224 (55%, unweighted) were male.

When asked about overall utilization of different health care options during the prior year, most respondents (n=359; 84%) indicated that someone in their household had sought care from a health clinic; the percentage was slightly higher in Arua District (91%) compared to Zombo (81%) (p=0.018). Overall, 377 (87%) reported seeking care from drug shops; frequency of drug shop usage was similar between the two districts. Fewer respondents (17%) indicated that household members utilized traditional healers, but reported usage was higher in Arua District (28%) than in Zombo District (12%) (p=0.0003). Travel time of less than two hours to a health clinic was reported by 283 (82%) households, to a chemist/drug stores by 328 (87%) households, and to a traditional healer for 65 (78%) households.

Discrete factors why respondents chose not to seek care from a health clinic were rarely reported. Length of the wait, cost, the type of illness, and personal preference were reported reasons for fewer than 3% of respondents.

Knowledge about plague

Nearly all caregivers (n=400; 95%) had heard of plague. Most caregivers (n=328; 84%) were able to describe plague as a febrile illness with a painful swelling in the groin or armpit; 5% believed the primary symptoms were headache and confusion, 8% did not identify any symptoms of plague, and fewer thought it to be a diarrheal illness (2%) or a febrile illness with rash (1%).

Most respondents also understood that plague was an illness transmitted by fleas (330; 76%) and was associated with rats dying in large numbers (314; 72%). Nevertheless, 19% indicated that people got plague from drinking bad water, and 12% believed that plague could be transmitted by mosquitoes. The frequency of these responses did not differ by district. Almost half of surveyed caregivers (49%) reported that plague could be transmitted from touching a person who is sick with, or has died from, plague. This response was more common in Zombo district (57% vs. 28%; p=0.001). Only four respondents indicated that they believed plague to be the result of a curse specifically, yet 20 (6%) believed plague occurred when there was discord among village or family members. Roughly half of respondents (55%) regardless of district, were aware that risk of plague was linked to the rainy season.

Overall, friends and family were the most commonly reported source of information on plague (53%). The radio (37%), health clinics (32%), and village health workers (32%) were slightly less common sources of information, followed by drug shops (10%), posters (3%), and traditional healers (1%). Persons in Arua District reported more varied sources of plague information than those in Zombo District. Radio was much more commonly reported as a source of plague information in Arua District (73% vs. 22%; p<0.0001), as were drug shops (30% vs. 2%; p<0.0001), and traditional healers 4% vs 1%; p=0.008).

Frequency of potential plague risk factors

In both districts, most respondents (n=328; 80%) reported seeing live rats in their village >5 times in the past month. People commonly reported taking measures to eliminate rats: 79% used either chemicals or poison; 52% used traps, and 25% reported “catching” rats in other ways. Overall, 27% of respondents indicated that they try to store food in a way that rats cannot access. Most respondents noticed dead rats infrequently; 10% indicated they had seen dead rats 1–2 times during the prior month.

Most households report someone sleeping on the floor; however, this was more common in Zombo District (93%) than in Arua District (83%), p=0.003). In 20% of households, everyone sleeps on the floor. Among those households where some but not all family members sleep on the floor, children were the most common (65%), and slightly more frequently in Zombo (71%) compared to Arua District (52%) (p=0.008). Women sleep on the floor in 35% of households, also more frequently in Zombo (42%) than in Arua (16%) (p<0.0001). Men reportedly sleep on the floor in only 9 (2%) households. More than half of

surveyed households (n=269; 68%) reported that people sleep in huts where food is stored and 149 (38%) reported that people sleep in huts where food is prepared.

Frequency of plague like-symptoms and associated health care seeking practices

Nearly all caregivers (n=383; 94%) reported that they would go to a health clinic first if they had plague, and similarly 366 (84%) caregivers reported that they would go to a health clinic first if they were sick with fever and painful swelling in their groin area. There were no significant differences by district. A similar proportion of respondents indicated they would visit a health clinic first for other illnesses: headache and confusion, fever and rash, and diarrhea and vomiting. Approximately 13% reported that they would seek care from a community drug shop first for these symptoms.

When asked about frequency of plague-like symptoms, 29 (8%) reported that someone in their household had been sick with fever and a swelling in their groin, neck, or armpit in the prior year; 14 (5%) reported that someone in their household had been sick with fever and had coughed up blood during the same time period. Of the 29 respondents that indicated fever and lymph node swelling in the prior year, 20 (69%, unweighted) reportedly sought care in a health clinic, but only 12 (41%, unweighted) sought care at a health clinic first. Similarly, among the 14 respondents who indicated that someone had been sick with bloody cough, most (n=11; unweighted 79%) sought care from a health clinic for treatment but only 1 (7%, unweighted) of these patients went to the health clinic first.

DISCUSSION

Based on survey responses, caregivers in the plague-endemic West Nile region of Uganda have a strong understanding of the clinical features and epidemiology of plague. Most understood plague as a disease characterized by fever and lymph node swellings associated with fleas and rats requiring treatment at a health clinic. Nevertheless, there appears to be some discrepancy between caregivers' theoretical care-seeking practices and what they report doing when household members were recently sick with plague-like symptoms. Reasons for this discrepancy should be further pursued, as they will affect the success of plague educational messages in the region. Given the relatively high frequency of fever and lymph node swelling in the population as revealed by this survey, it is possible that caregivers are able to distinguish severity of illness due to plague from other, less virulent etiologies. Messages that urge immediate assessment at the health clinic for fever and swelling may require modification to increase specificity for plague. Regardless, village health volunteers should be reminded of the importance of plague recognition and rapid referral to reduce potential for future plague outbreaks.

Plague occurred in what is now Zombo District for several decades before spreading north into Arua District in the early 1990s.⁹ While overall knowledge of plague was similar in both Districts, several differences became apparent, specifically sources of plague knowledge, and the reported use of traditional healers. Persons in Arua District reported more varied sources of plague information, including radio and drug shops. Several radio stations in Arua include daily health messages run during every major news hour. In contrast, Zombo has only one primary radio station with limited geographic coverage and

fewer health message broadcasts which focus primarily on malaria and diseases other than plague (T. Apangu, personal communication). Additionally, drug shop owners in Arua District have received substantial health training and are well-connected with the district health office, whereas their counterparts in Zombo have less training and are solely business owners (T. Apangu, personal communication). Lastly, traditional healers in Arua District are most often herbalists, whereas in Zombo District, they are often considered to invoke the supernatural (T. Apangu, personal communication). Because visits to healers believed to have supernatural powers can carry some level of community stigma, respondents in Zombo may have been less likely to report that they visited traditional healers to the survey administrators. Identification of cultural or geographic differences in care seeking behavior can inform options for future dissemination of educational messages.

Despite a high level of understanding of plague in these communities, opportunities for targeted educational messages are apparent. First, improving recognition of possible plague among alternative health providers such as drug shop owners and traditional healers could serve as a means of secondary prevention. Even if the patients are initially seen outside of a health clinic, rapid recognition and referral to a health clinic could improve outcomes. Second, although overall knowledge of plague was quite high, confusion about the causes of plague (bad drinking water, community discord) remain obstacles to prompt recognition and treatment.^{12, 14} Village-specific education by village health volunteers may foster increased recognition of possible plague when dead rats are found or when persons fall ill with plague-like symptoms. Sleeping on the floor and sleeping in huts where food is stored or cooked may increase risk of plague. Increased education regarding plague risk in villages with a history of plague may additionally motivate behavioral measures to mitigate human plague risk. Additionally, this survey revealed that members of these communities are motivated to keep rats out of their dwellings, and spend some of their minimal available resources to purchase poison or traps. This suggests that an available cost-effective prevention method to reduce both rats and fleas would be used. Lastly, this survey demonstrated that in the event of a plague epidemic in the region, a ready-made message for radio distribution may be the most efficient way of public education. Emphasis of those messages should not be on plague symptoms, as there is already a high-level of associated understanding in the population, but on the importance of seeking care early from the health clinic in order to save lives.

There were several limitations to this study. First, because of vague wording that could have been misinterpreted, we were unable to adequately assess participant's understanding of transmissibility of pneumonic plague. Further surveys with more discrete wording easily translatable into both languages should be conducted, as understanding practices associated with pneumonic plague is an important component of reducing epidemic spread and decreasing plague mortality. Second, restricting sampling to parishes where at least 50% of the villages had a history of plague limits the generalizability of findings to other parts of Arua and Zombo districts where plague is less common.^{15, 16} Third, recall bias could have influenced reporting of various practices, and observer bias could have influenced respondents to answer with what they perceived to be the "correct" answer, rather than the most truthful one reflecting their actual practice. This latter bias may potentially have contributed to the observed discrepancy between theoretical health care seeking with plague versus more accurate reporting of what people did when they or a family member had fever

and a swelling. Finally, as mobile phones and internet access become more common, they could be sources of health-related information even in rural sub-Saharan Africa; however, we did not assess that as a source of information in this survey.

As with many other epidemic prone infectious diseases, plague is relatively rare and highly episodic. Even in plague-endemic regions of Uganda, the illness is sometimes absent for several years. This unpredictable pattern likely contributes to delays in recognition and poses a challenge to public health authorities seeking to anticipate and control outbreaks. The framing and dissemination of plague educational messages is further challenged by varying cultural nuance and limited communications infrastructure. Knowledge of how people living in West Nile understand plague and where opportunities exist for improving knowledge and modifying current practice should be used to inform appropriate public health interventions.

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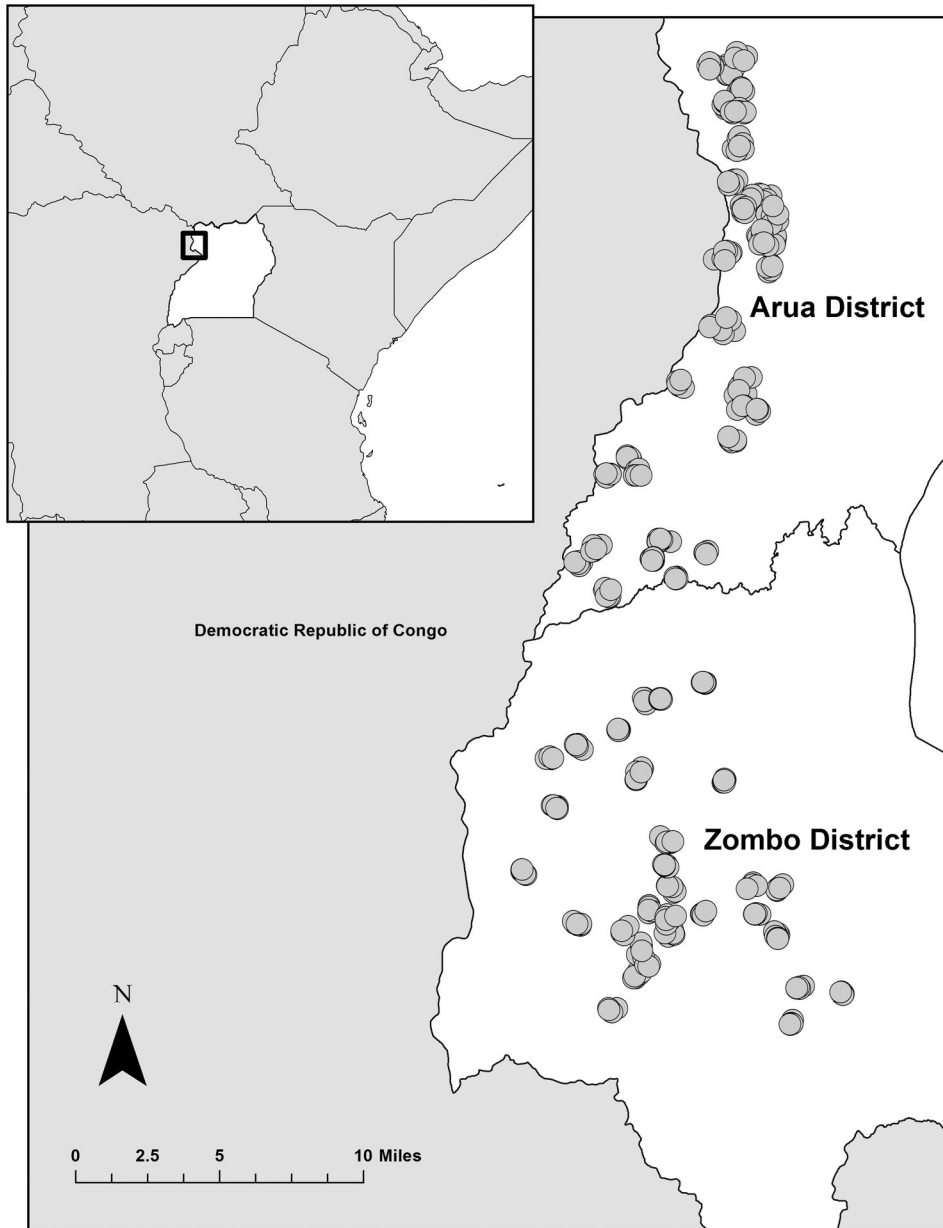


Figure 1. Location of households surveyed to assess knowledge and health care seeking practices related to plague in Arua and Zombo Districts, West Nile region, Uganda