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Research article

SANITARY-EDUCATIONAL ACTIVITIES AS AN EFFECTIVE METHOD OF NONSPECIFIC PLAGUE PREVENTION IN THE NATURAL PLAGUE FOCUS IN THE KOSH-AGACH DISTRICT OF THE REPUBLIC OF ALTAI

S.V. Balakhonov[1], E.S. Kulikova[1], A.I. Mishchenko[2], V.M. Korzun[1], A.V. Rogaleva[1], S.M. Lyashenko[1], A.A. Itashev[2], S.L. Sarikova[3], N.B. Kalybayeva[4], N.M. Madinova[4]

[1] Irkutsk Anti-Plague Research Institute, 78 Trilissera St., Irkutsk, 664047, Russian Federation
[2]Altai Anti-Plague Station, 2 Zavodskaya, Gorno-Altaisk, 649002, Russian Federation
[3] Federal Service for Surveillance over Consumer Rights Protection and Human Wellbeing, Altai Republic Regional Office, 173 Kommunisticheskii Av., Gorno-Altaisk, 649002, Russian Federation
[4]Kosh-Agach district hospital, 3 Meditsinskaya, Kosh-Agach, 649780, Republic of Altai, Russian Federation

The Altai Mountains are an area of ecological tourism with high potential for further development. At the same time, intensive epizootics of plague are typical for the region including those registered in close proximity to settlements and shepherds' camps raising likelihood of potential contacts between people and plague vectors and carriers. Potential hazard of plague cases among the population persists in this area and this can result in serious epidemiological complications. From 2010 to 2024, 397 plague microbe strains, 182 Yersinia pestis ssp. pestis and 215 Y. pestis ssp. central asiatica bv. Altaica, were isolated and investigated in the Gorno-Altaisk high-mountain natural plague focus. After cases of the infection were identified in humans (2014–2016), the coverage of the sanitary-educational work increased considerably. Overall, 282 lectures were delivered to the population, more than 15 thousand leaflets and booklets were handed out, and more than 6630 talks were organized over 2016–2022. Annually, sanitary-educational activities are organized for an audience between 20 and 63 thousand people.

The aim of this study was to assess effectiveness of sanitary-educational activities aimed at informing people about risk factors associated with living in a natural plague focus.

The study method was a survey conducted among the regional population using a specifically designed questionnaire. Totally, 1650 residents of the Kosh-Agach districts, including 135 shepherds and their family members, took part in the survey; the district was selected as a plague-endemic area.

According to the survey results, people from the Kosh-Agach district of the Altai Republic (more than 90 % of the respondents) were established to be well aware about risk factors associated with living in a natural plague focus as well as the infection sources, namely, plague vectors and carriers. Most people who lived in this endemic area had means of communication and transportation necessary for applying for medical aid and were ready to inform healthcare workers in case plague was suspected or the first plague signs were manifested in them or their friends or acquaintances

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Sergey V. Balakhonov – Doctor of Medical Sciences, Professor, director (e-mail: adm@chumin.irkutsk.ru; tel.: +7 (395) 222-01-35; ORCID: https://orcid.org/0000-0003-4201-5828).

Elena S. Kulikalova – Candidate of Medical Sciences, Head of the Department of Epidemiology (e-mail: adm@chumin.irkutsk.ru; tel.: +7 (395) 222-01-35; ORCID: https://orcid.org/0000-0001-7034-5125).

Aleksandr I. Mishchenko – doctor of Epidemiology Department (e-mail: chumagorny@mail.ru; tel.: +7 (388) 226-43-19).

Vladimir M. Korzun – Doctor of Biological Sciences, Head of Zoological and Parasitological Department (e-mail: adm@chumin.irkutsk.ru; tel.: +7 (395) 222-01-35; ORCID: https://orcid.org/0000-0003-1947-5252).

Anastasiya V. Rogaleva – Junior Researcher of the Department of Epidemiology (e-mail: nastyarogaleva77@gmail.com; tel.: +7 (914) 923-80-90; ORCID: https://orcid.org/0009-0009-3951-714X).

Semyon M. Lyashchenko – doctor of the Department of Epidemiology (e-mail: adm@chumin.irkutsk.ru; tel.: +7 (395) 222-01-35; ORCID: https://orcid.org/0009-0003-9778-3485).

Arzhan A. Itashev – Deputy Director for Epidemiological Work (e-mail: chumagorny@mail.ru; tel.: +7 (388) 226-43-19; ORCID: https://orcid.org/0009-0002-1183-9728).

Svetlana L. Sarikova – Deputy Head (e-mail: Tagizova_SL@04.rospotrebnadzor.ru; tel.: +7 (923) 664-62-72).

Nataliya B. Kalybaeva – chief physician (e-mail: kosh-agach@med04.ru; tel.: +7 (388) 422-26-55).

Natal'ya M. Madinova – Head of the Infectious Diseases Department (e-mail: kosh-agach@med04.ru; tel.: +7 (388) 422-26-55).

The trans-border Sailyugemskii natural plague focus is located in the north border area of the vast Central Asia zone with natural foci of the infection and covers territories in two countries, Russia and Mongolia. Its northern Russian part (Gorno-Altaisk high-mountain natural plague focus) is located in the South-Eastern Altai Mountains or, according to administrative division, in the Kosh-Agach district of the Altai Republic [1]. The Altai Mountains are becoming more and more popular as an area for environmental tourism and this area is being visited by multiple Russian and foreign tourists. At the same time, it is endemic per plague and potential zoonotic plague foci are often located in close proximity to settlements and shepherds' camps as well as to major transport routes with high shares of trans-border trips. All this raises likelihood of potential contacts between people and plague vectors and carriers.

A considerable part of the Kosh-Agach district of the Altai Republic has been characterized with high epizootic activity per plague for a long time (since early 1990ties) [2]. All three plague cases among people (2014–2016) were caused by hunting marmots and eating their meat [3–6]. For Altai people, marmot meat is a traditional delicacy and is often given as a present to esteemed guests; this can cause the infection. Thus, when an epidemiological investigation was conducted after the epidemic situation per plague became complicated in 2014, three marmot carcasses were found in a fridge that belonged to the plague patient A. in Mukhor-Tarkhata settlement. One of them was infected with plague. Those marmots had been hunted on purpose to be served as a delicacy during a holiday feast. In 2015, two marmot carcasses (plague microbe strains of the basic sub-species were isolated from both during microbiological testing) were taken from a fridge in the house of the patient M. in Kyzyl-Tash settlement; they had been prepared for a New Year feast [3]. Therefore, there is a risk that the epidemiological situation per plague can get complicated in a season not typical for the disease and that the plague agent can spread far beyond the boundaries of an area enzootic per plague, marmot meat contaminated with the plague microbe acting as an infection source [3–6].

High epizootic activity that persists in the Gorno-Altaisk high-mountain natural plague focus determines its highest epidemic significance in Russia. Here, over the period between 2010 and 2014, 397 plague microbe strains were isolated from field materials; of them, *Yersinia pestis* ssp. *pestis,* 182; *Y. pestis* ssp. *central asiatica* bv. *Altaica,* 215.

Given high epizootic activity in the natural plague focus, sanitary education provided for the population becomes a significant component of preventive activities together with immune prevention of the infection and timely disinsection measures. This sanitary education should be aimed at informing people about health risk factors associated with living and performing economic and other activities in a plague-enzootic area. These activities are accomplished in accordance with the Complex Plan of Scheduled Activities by Rospotrebnadzor Aimed at Improving the Situation in the Gorno-Altaisk High-Mountain Natural Plague Focus located in the Kosh-Agach district of the Altai Republic; the plan is annually approved and prolonged by the Head of Rospotrebnadzor. Basic activities aimed at plague prevention, which were accomplished to localize and eliminate plague cases as well as annually taken measures, were described in works published in 2018 [7, 8]. It seems very important to have a feedback as solid grounds for improving preventive activities, sanitary education included, which involve local population. Use of medical investigative questionnaires for surveys is a powerful tool for getting such a feedback. Surveys allow reaching the maximum number of respondents and obtain large enough samples, which are representative for using proved statistical models [9, 10].

The aim of this study was to assess effectiveness of sanitary-educational activities aimed at informing people about risk factors associated with living in a natural plague focus.

Materials and methods. The study relied on using questionnaires developed by Rospotrebnadzor experts in 2017 and updated in 2024. The questionnaires were made of three blocks: general information (9 questions), social and household conditions (12 questions), and types of contacts between people and the natural plague focus (21 questions). People who were exposed to high risks of plague infection took part in the survey; they lived in a plague-endemic area located in the Kosh-Agach district. Experts of the Altai Anti-plague Station distributed the questionnaires through paramedic and obstetric stations. The respondents were asked to give detailed answers or select the most suitable options. All 132 questionnaires filled by shepherds and their family members who lived in summer camps were put into a database created in Microsoft Excel. The survey results were analyzed using conventional variation statistics with calculating the extensive indicator and 95 % confidence intervals (CI)[1]:

$$CL = \overline{x} \pm Z \cdot \frac{S}{\sqrt{n}},$$

where *CL* is confidence interval;

$\overline{x}$ is the sample mean;

Z is the confidence level value for calculating 95 % likelihood = 1.96;

S is the sample standard deviation;

N is the sample size.

Conclusions on effectiveness of sanitary-educational activities performed in the natural plague focus were made based on the survey results; in addition, relevant recommendations were developed.

Results and discussion. High epizootic activity of the natural plague focus in the Kosh-Agach district indicates how significant it is to inform people about risk factors able to cause plague. Overall, 282 lectures were delivered to the population in the area over 2016–2022 (on average, approximately 40 lectures a year); 15,263 leaflets and booklets were handed out and more than 6630 talks were held. The total number of people involved in sanitary education every year grew from 20,000 in 2016–2020 to 64,580 in 2022 [1]. Effectiveness of activities performed in 2016–2017 is confirmed by the survey conducted by an epidemiologic group among locals June to September 2017. Overall, 1650 people who lived in the Kosh-Agach district took part in it. The survey established that people knew there was a threat of getting infected with plague and about basic signs of the disease; they had positive attitudes towards vaccination, disinsection, and deratization. Most respondents (91 %) were aware what role marmots had in plague transmission to humans. Fleas as the infection vectors were mentioned by 77 % of the respondents; 89 % knew it was prohibited to hunt marmots but only 61 % of them were ready to cooperate with law enforcement agencies in fighting against poachers who hunted grey (Altai) marmots. These data indicate it is necessary to intensify sanitary-educational work with people as regards responsibility for violating prohibitions and limitations imposed on marmot hunting; preventive activities are also advisable [1].

In 2024, 17 lectures were delivered in the Gorno-Altaisk High-Mountain Natural Plague Focus, 730 healthcare workers and 57 veterinaries were consulted on plague prevention methods; 816 healthcare workers took part in workshops with their focus on clinical mani-

[1] Rokitskii P.F. Biologicheskaya statistika [Biological statistics], 3rd ed., revised. Minsk, Vysheish. shkola Publ., 1973, 320 p. (in Russian); Glantz S. Mediko-biologicheskaya statistika [Biomedical statistics], translated from English. Moscow, Praktika Publ., 1998, 459 p. (in Russian).

festation and prevention of the disease. Overall, 18,966 people living in the area were involved in all types of sanitary-educational work with its focus on plague.

In 2024, the screening group of the respondents who took part in the survey was made of men and women in approximately equal proportions (men accounted for 54.1 % and women 45.9 %) (Figure 1).

It is noteworthy that not all respondents gave answers to each question in the questionnaire; therefore, the sum of all answers does not equal 100 percent everywhere. The age structure of the population in settlements and shepherd camps in the natural plague focus was as follows: people aged 30–49 years accounted for 37.1 %; 50–64 years, 27.2 %; older than 65 years, 3.0 %; the smallest group was people aged 18–29 years, 1.5 %. Altai people were the prevailing nationality accounting for 58.3 %; they were followed by Kazakhs, 30.3 %, and Telengits, 1.5 %. The remaining 9.9 % were mixed families consisting of people with these nationalities. Two-person families lived in a summer camp in almost half of the cases (43.2 %), but sometimes families who lived there were made of more people. Eighty-one point one percent of the respondents did not have children or their children did not live in these camps.

Most respondents (97.7 %) estimated sanitary conditions in their housing as having medium quality. Among outhouses, many respondents (88.6 %; CI: 83.2–94.0 %) mentioned sheep yards. Most respondents (82.6 %; CI: 76.1–89.1 %) stated there were no rodents, fleas, ticks or lice in their homes. The respondents predominantly estimated their hygienic knowledge as medium (68.2 %; CI: 60.3–76.1 %). Dogs were kept as pets the most often; cats were a rarer occasion. Camels were kept at two camps (Ak-Kel area, Beltirkii paramedic and obstetric station and Dzudut-Zhan-Aulskii paramedic and obstetric stations). Rest in camps as a leisure activity was chosen by 47.0 % (CI: 38.5–55.5 %) of the respondents.

Most respondents, 65.9 % (CI: 57.8–74.0 %) lived between 11 and 50 km away from the nearest healthcare facility; 68.9 % (CI: 61.0–76.8 %) of the respondents applied for healthcare services once a month or more often. Absence of any communication means was mentioned by 16.7 % of the respondents (CI: 10.3–23.1 %) living in this area; this could make it difficult for them to apply for medical aid in time in case some plague signs were manifested. The emergency phone number was known to 56.1 % (CI: 47.6–64.6 %); in addition, 25.8 % (CI: 18.3–33.3 %) of the respondents said they knew a healthcare worker's personal mobile number. A long distance to healthcare facilities was to a certain extent compensated by more than a half of the respondents having a car and another 15.2 % having a bike (CI: 9.1–21.3 %).

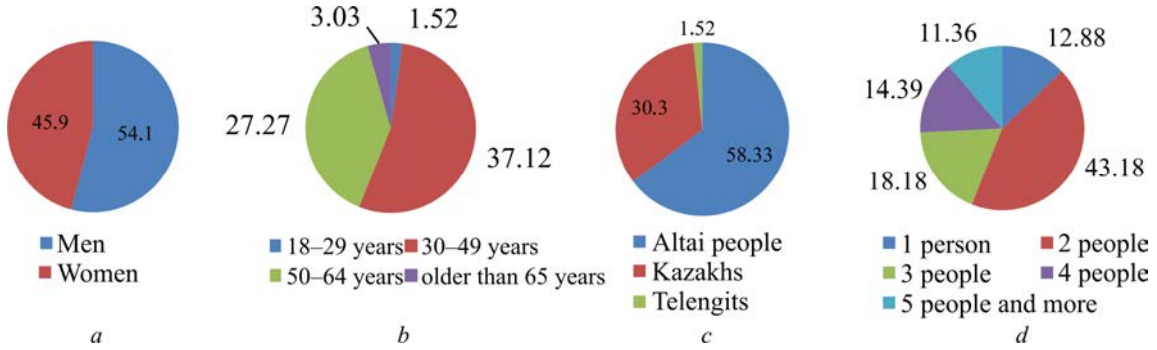

Figure 1. The profile of the screening respondent group (2024). Distribution per:
a) sex; b) age; c) nationality; d) number of family members

Most respondents were shepherds 71.2 % (CI: 63.5–78.9 %); of them, 7.6 % (CI: 3.1–12.1 %) let their sheep graze on wild pastures. Seventy-six point five percent (CI: 69.3–83.7 %) were involved in making hay: 10.6 % (CI: 5.3–15.9 %) by hand and 53.8 % (CI: 45.3–62.3 %) using mowing machines; 12.1 % (CI: 6.5–17.7 %) used both ways. Half of the respondents stocked fuel (pressed dung). Thirty-five point six percent gathered berries, mushrooms and herbs (CI: 27.4–43.8 %); 3.0 % dealt with some construction (CI: 0.1–5.9 %). Doing these works was associated with staying in camps for 60.0 % of the respondents (CI: 51.6–68.4 %); these camps were located in areas with rodents' colonies, which raised likelihood of contacts with the parasitic system of the natural plague focus.

Almost all respondents (97.0 %; CI: 94.1–99.9 %) knew about the prohibition imposed on marmot hunting. Still, 16.7 % (CI: 10.3–23.1 %) pointed out that they knew about some cases of marmot hunting involving their relatives, friends, or acquaintances. The respondents did not mention their pets brining home dead small mammals; still, rodents' carcasses were found by four respondents (3.0 %; CI: 0.1–5.9 %). More than a half of the respondents, 61.4 % (CI: 53.1–69.7 %) believed that children should be kept away from summer camps. Interestingly, 78.0 % of the respondents (CI: 79.4–88.8 %) gave a negative answer to the question about eating marmot meat but 21.2 % (CI: 14.2–28.2 %) did not give any answer at all. This is rather alerting and requires some thinking about the actual situation. Most respondents, 72.0 % (CI: 64.3–79.7 %) lived in close proximity (within 1 km) to rodent colonies.

Anti-plague vaccination was considered useful by 91.0 % (CI: 86.1–95.9 %) of the respondents whereas 9.0 % (CI: 4.1–13.9 %) of them had a negative attitude towards specific prevention; deratization was considered a useful activity by 96.2 % (CI: 92.9–99.5 %). Disease cases with inflammation in the groin or armpit areas in case history were mentioned by 0.8 % (CI: 0–2.3 %) and 80.3 % (CI: 73.5–87.1 %) of the respondents gave the negative answer to this question while the remaining were hesitant to give any.

The study conducted in 2024 established that 95.8 % (CI: 96.4–100.00 %) of the respondents knew about main risk factors associated with living in the natural plague focus, namely, marmots as carriers of the major subspecies of the plague agent; 91.7 % (CI: 87.0–96.4 %) mentioned fleas as plague vectors. Most respondents (75.8 %; CI: 68.5–83.1 %) gave the correct answer that only camels could be sick with plague among all household animals and pets. Almost all respondents (98.5 %; CI: 96.4–100 %) said they were ready to inform healthcare workers in case they suspected plague signs in themselves or people they knew (Figure 2).

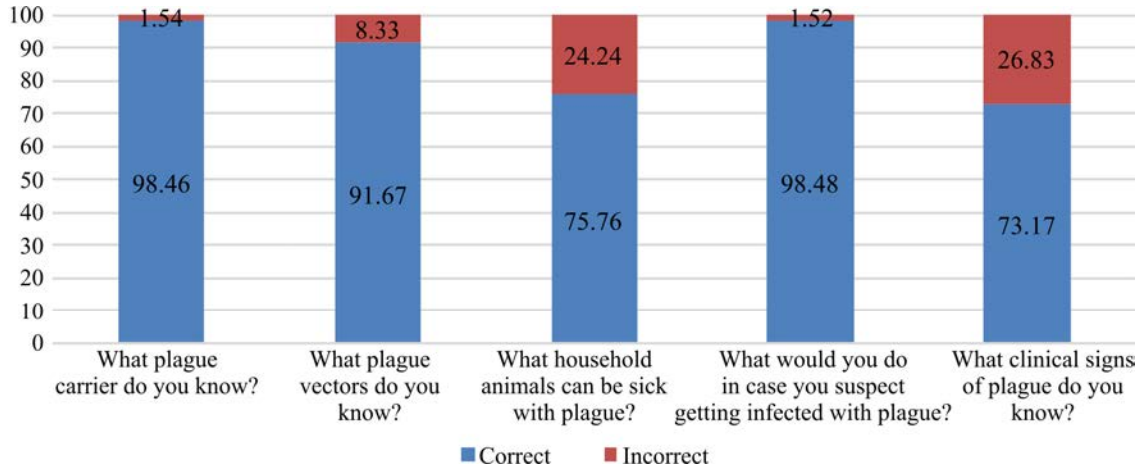

Figure 2. People's awareness about risk factors of plague infection in the Gorno-Altaisk high-mountain natural plague focus and clinical signs of the disease

Therefore, awareness is quite high among people living in the high mountain natural plague focus. The respondents are informed about major infection risk factors such as contacts with basic plague carriers and vectors in the natural plague focus. Most people who live in this plague-endemic area have communication and transport means necessary to reach a healthcare facility in case the first plague signs are manifested.

Conclusion. Endemic plague-related complications were avoided as a result of implemented activities, including sanitary education, after 2016. It is quite relevant to plan and conduct sanitary-education activities by Rospotrebnadzor organizations and healthcare institutions in the Altai Republic. They should inform about health risks and involve permanent and / or temporary residents who live and perform various economic activities in the analyzed natural plague focus.

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