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Original Research Article

Large Country Screening to Discover all Domestic Animal Herds Affected by Selected Zoonoses

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Abstract

Effective country-wide preventive, control and eradication programmes require full knowledge of specific epizootiological situation. A description is given of a three-year international programme aimed at control of animal glanders, tuberculosis and brucellosis that was carried out simultaneously in all 16 Mongolian provinces by expeditions of veterinary staff of five countries. The objective was to discover all domestic animal herds affected by these infections transmissible to humans and to initiate particular control programmes. A total of 37,608,253 specific tests were carried out. Ratios of the investigations to population average (I/P) were as follows: tests for glanders in horses 2.43 and in camels 0.53; tests for brucellosis in cattle 1.42, in camels 0.69, in sheep 1.53, and in goats 1.37; tests for tuberculosis in cattle 1.53. The following results of testing were obtained: for glanders, from 5,046,070 allergic tests in horses 241,157 were positive, i.e. 4.78%; from 332,684 allergic tests in camels 380 were positive, i.e. 0.11%; from 126,960 serological tests in horses 24,760 were positive, i.e. 19.50%. Results of serological testing for brucellosis, from 2,892,658 tests in cattle 192,601 were positive, i.e. 6.66%, from 432,919 tests in camels 9,987 were positive, i.e. 2.31%, from 19,533,637 tests in sheep 320,709 were positive, i.e. 1.64% and from 5,834,450 tests in goats 136,222 were positive, i.e. 2.33%. From 677,402 allergic tests for tuberculosis in cattle in two provinces 427 were positive, i.e. 0.06%. This programme required an estimated 120,000 expedition person-working days and about twice as many assisting person-working days. Apart from local effects during these expeditions, the results created a basis for national long-term follow-up and preventive, control and eradication measures for these diseases.

Keywords: all outbreaks detection; anti-zoonotic expedition; anti-zoonotic management; country-wide testing; investigations/population ratio; glanders control; multi-zoonoses investigations; person-working days.

INTRODUCTION

Historical experience shows that any effective national infection control/eradication programme must be based on discovering all outbreaks of a specific disease requiring mass screening of the susceptible population. On 30 May 1964 this author, when heading the Czechoslovak veterinary expedition to combat foot and mouth disease in Mongolia, was asked by Dr B. Baldziniam, the Mongolian Minister of Agriculture, cognizant of successful eradications of zoonoses in Czechoslovakia[1], to prepare such country-wide programme against animal glanders (*Burkholderia mallei*), brucellosis (*Brucella abortus* and *Brucella melitensis*), and tuberculosis (*Mycobacterium bovis*). These diseases were causing considerable losses in livestock husbandry and production of food of animal origin, and affecting human population health. However, such desired programme was only possible after the eradication of foot and mouth disease in the whole country. This goal was achieved by the end of 1964, mainly thanks to Czechoslovak expedition strategy and own vaccine which proved to be compatible with local strains of virus (see *http://vaclavkouba.byl.cz/fmdmongolia.htm*).

Preparation of this article was made possible thanks to statistical data kindly provided by Prof. Dr. Z. Batzukh, Mongolian State Agriculture University in Ulaanbaatar who was able to find them in Mongolian State Veterinary Archive. The paper is also based on the protocol of the "International scientific-methodological conference preparing project against zoonoses in Mongolia" (1965), on publications of Černovský and Ševčík (1965); Jeřábek, Ládr and Boháč (1969), Kouba

1 Example in *http://vaclavkouba.byl.cz/brucelosis.htm.*

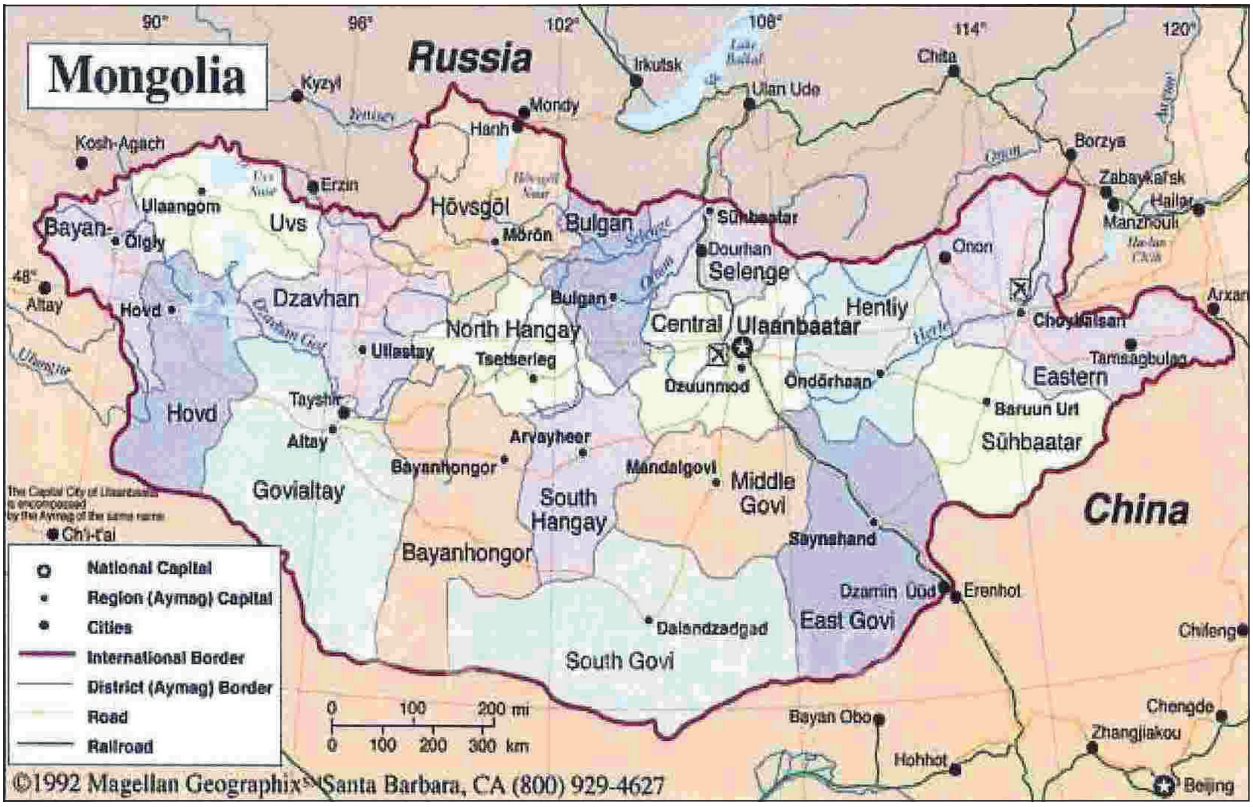

Figure 1. Mongolia is a landlocked country in Central Asia and East Asia, located between China and Russia. Much of its area is covered by steppes, with mountains to the north and west and the Gobi Desert to the south. The total land area is 1,564,116 km2. At that time approximately 80 % of the population (1,249,000 inhabitants) was nomadic. The following numbers of domestic animals were reported: 2,250,000 horses, 630,000 camels, 2,030,000 cattle, 12,800,000 sheep and 4,270,000 goats.

(1964, 2009, 2010), and on personal information kindly provided by several participants such as Rademacher (2015), Rothbauer (2007) and Sugaaradza (2007).

MATERIAL AND METHODS

The draft of the project was elaborated by a working group of specialists under the chairmanship of V. Kouba. Prof. Dr. Yarympyl and Dr. Celendash (Mongolia), Prof. Dr. Tsentsev (Bulgaria), Prof. Dr. Karpishov (Soviet Union) and Dr. T. Sugaaradza, Mongolian Chief Veterinary Officer were its members. The Czechoslovak epizootiological strategy, principles and methods were accepted. They consisted of mass screening of all herds of susceptible animal species in all provinces in order to identify specific disease occurrence in the whole country through discovering all affected herds.

A complex of diagnostic methods was applied (serological, allergic, clinical and epizootiological) using international standards for their procedures and interpretation of results. The following methods were selected: allergic test and complement fixation test for glanders, serum agglutination test and complement fixation test for brucellosis (animals were not vaccinated) and allergic test for tuberculosis. Glanders allergic test was based on mallein applied by eye-drop; eyelid swelling and a discharge from the eye within 1–2 days were considered as positive. The brucellosis agglutination test with a titre of 1:80 and 1:40 in exposed or suspect animals was considered positive. For TB allergic test we used intradermal injection dose of 0.2 ml PPD tuberculin (with potency of at least 2,000 International Units); the skin-fold thickness re-measured after 72 hrs was considered in so far TB-free herds to be positive with thickness increase of 3.6 mm and more; in other herds the interpretation was stricter. The proposed methodology required: to mark visibly and permanently all positive animals (e.g. triangle holes in left auricles in case of tuberculosis and in right auricles in case of brucellosis), to isolate them without any following retesting and to cull them as soon as possible (special attention being given to them at slaughter); to recommend measures for specific health protection of humans and of non-positive herds and animals, always considering local conditions.

The project draft was sent to all participating countries for study and comments. A particular international scientific-methodological conference to finalize the project was held in Ulaanbaatar (4–12 March 1965) attended by national specialists (epizootiologists and diagnosticians) from Bulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, Soviet Union

Figure 2. International scientific-methodological conference held in Ulaanbaatar, 4–12 March 1965, to finalize the project document for international expeditions against glanders, brucellosis and, tuberculosis in Mongolia.

and Mongolia as the host country. The conference finalized the details of diagnostic methods and procedures for specific disease control. All activity norms, lists of necessary equipment for international expeditions as well as the principles for their performance and management were elaborated in great detail. Due to harsh weather conditions it was agreed to limit the annual working period during 1966, 1967 and 1968 to six months, namely from April to September. It was suggested ands agreed that the expeditions work simultaneously in all 16 aimaks (provinces) covering the entire Mongolian territory divided as indicated in Table 1.

Table 1. Mongolian aimaks (provinces) assigned to international veterinary anti-zoonotic expeditions according to participating countries (Mongolian State Veterinary Archive)

Country	Aimak (province)
Bulgaria	Dornod
Hungary	Khentii, Dornogobi
Germany	Selenge
Poland	Tuv and Dundgobi
USSR	Arkhangai, Bayanulgii, Bayankhongor, Gobialtai, Zavkhan, Khovd, Uvs, Khuvsgul
Czechoslovakia	Bulgan, Uvurkhangai

PROJECT OBJECTIVE, PREPARATION AND IMPLEMENTATION

The main project objective was to discover and verify the specific epizootiological situation in the entire Mongolia as the basis for: improving animal and human population specific health related to animal glanders, brucellosis and tuberculosis through reducing their focality, morbidity and mortality; improving protection of human (nomadic herders and consumers) and animal populations against selected zoonoses; reducing losses in livestock husbandry; improving animal production in quantity and sanitary quality and facilitating animal commodity exports.

The Mongolian preparatory measures consisted in: introducing a particular legislation and instructions as well as a specific information system for collecting and processing data on screening activities and their results (incl. questionnaires and statistical forms); introducing a centralized planning system of vertical management (incl. concrete objectives in time and place; responsibilities) and a system of periodic project evaluations; organizing an intensive publicity campaign targeted at rural populations to convince them about the need of the project. Mongolian authorities had also to assure: bilateral international agreements with all participating countries; staff to assist international expeditions (interpreting; catching, fixing and marking animals, etc.); transport, accommodation and catering, communication and medical care; maintenance and repair of transport means; vertical and horizontal project coordination; training courses for national staff; administrative support; necessary funds for national staff, material and activities etc. Mongolian veterinary

Figure 3. Czechoslovak mobile veterinary diagnostic laboratory with electric generator in Bulgan aimak (province) steppe.

service was at that time relatively well staffed and organized, and enjoying a respected authority.

The preparatory activities of international expeditions were also very demanding. It was necessary to select veterinarians – volunteers having practical experience with specific zoonoses diagnosis and measures and being in good physical condition. The expedition members had to pass vaccinations according to expected sanitary risks (e.g. against typhus abdominalis, viral hepatitis A and B, tetanus, diphtheria, plague – *Yersinia pestis* etc.). It was necessary to assure funds for the expedition staff (home country salary, travel expenses, "pocket" money, etc.), material and project executing activities. Among the material supplies belonged laboratory diagnostic facilities (preferably mobile ones), transport means, human and veterinary medicaments, antisera against Mongolian venomous snakes, repellents, sanitary facilities, cleansing and disinfection means, maintenance material, tents and other requirements

Table 2. Staff of international anti-zoonotic expeditionsaccording to participating countries (Mongolian State Veterinary Archive)

	Veterinarians			Laboratory technicians and animal health assistants			Technical employers and drivers			Total		
	1966	1967	1968	1966	1967	1968	1966	1967	1968	1966	1967	1968
Bulgaria	10	10	-	4	4	-	1	1	-	15	15	-
Hungary	6	11	20	4	9	9	-	-	-	10	20	29
Germany	4	4	4	3	3	3	1	1	1	8	8	8
Poland	26	26	26	24	12	12	1	2	2	51	40	40
USSR	97	97	99	86	43	43	22	9	5	205	149	147
Czechoslovakia	6	22	23	1	-	-	1	2	2	8	24	25
Total	149	170	172	122	71	67	26	15	10	297	256	249

Table 3. Numbers of international teams, groups, cars and laboratory facilities taking part in the anti-zoonotic programme in Mongolia during 1966–1968 (Mongolian State Veterinary Archive)

Countries	Number of teams	Number of groups	Cars		Laboratory facilities
			Trucks	Off-roaders	
Bulgaria	1	1	2	4	1
Hungary	2	9	9	18	9
Germany	1	2	2	5	2
Poland	2	12	-	38	19
USSR	8	43	55	112	54
Czechoslovakia	2	7	5	12	7
Total	16	74	73	189	92

Table 4. Reported numbers of investigations carried out in Mongolia during 1966–1968 (Mongolian State Veterinary Archive) and ratios investigations/population (I/P)

Disease	Method	Species	Investigations	Population	Ratio I/P
Glanders					
	Allergic	Horses	5 460070	2 250000	2.43
	Serological	Horses	126960	2 250000	0.06
	Allergic	Camels	332684	630000	0.53
Brucellosis					
	Serological	Camels	432919	630000	0.69
	Serological	Cattle	2 892658	2 030000	1.42
	Serological	Sheep	19 533637	12 800000	1.53
	Serological	Goats	5 834450	4 270000	1.37
Tuberculosis					
	Allergic	Cattle	3 113115	2 030000	1.53
All investigations			37 608253		
All selected species				21 980000	1.71

for expedition work and life in very difficult conditions of desert, steppe and tundra; etc. It was expected for the expeditions to be materially independent as much as possible. In Mongolia of that time the rural areas were in extreme poverty and were short of electrification, radio communication, medical service, food supply, reparation facilities, etc.

The project started in the spring of 1966 and finished in autumn 1968. When summarizing staff during all three years, then the total number of expedition personnel reached 491 veterinarians, 260 laboratory technicians/animal health assistants, 51 technical employers and drivers; all together 802 persons. For details, see Table 2.

The expeditions were divided into 16 teams with 74 working groups provided with 73 trucks and 189 off-road cars as well as 92 diagnostic laboratory facilities (including mobile laboratories with electro-generators). For details, see Table 3.

Together with hundreds of foreign veterinary experts – epizootiologists and diagnosticians – there were hundreds of Mongolian veterinarians and several hundreds of other supporting personnel with active assistance of local countrymen as well as of somon (district) and aimak (province) authorities. The work was extremely demanding (catching, fixing and marking animals of unsettled herders) and very risky in terms of injuries. The expedition members, often working and living in poor hygienic conditions, were continuously exposed to many local infectious and parasitic diseases (more information in *http://vaclavkouba.byl.cz/Mongolia5.ppt* – pages 47 and 48.

RESULTS

The numbers of allergic tests for glanders reached 5,046,070 in horses and 332,684 in camels. Additionally, 126,960 horses were followed also serologically using complement fixation test. The numbers of serological tests for brucellosis reached 432,919 in camels, 2,892,658 in cattle, 19,533,637 in sheep and 5,834,450 in goats. The number of allergic tests for tuberculosis in cattle reached 3,113,115. The total number of all reported tests reached 37,608,253. The numbers of reported tests were relatively high when expressed using a particular indicator – ratio of specific investigations to total average number of animals (I/P). For details, see Table 4.

From allergic tests for glanders in horses 241,157 were positive, i.e. 4.78%. From allergic tests for glanders in camels 380 were positive, i.e. 0.11%. From complement fixation tests for glanders in horses 24,760 were positive, i.e. 19.50 %. From serological tests for brucellosis in camels 9,987 were positive, i.e. 2.31%; in cattle 192,601 were positive, i.e. 6.66%; in sheep 320,709 were positive, i.e. 1.64%; in goats 136,222 were positive, i.e. 2.33%. In cattle, positive reactions were caused by *Brucella abortus* and in sheep and goats by *Brucella melitensis*. Results of tuberculosis testing were available only from Bulgan and Uvurkhangai aimaks (provinces) where from 677,402 tuberculin tests in cattle carried out by Czechoslovak expeditions 427 were positive, i.e. 0.06%. For details, see Table 5.

The follow-up consisted in marking positive animals, their isolation and premature culling simultaneously with recommended measures for outbreak elimination and for the protection of local personnel and of healthy herds.

Table 5. Results of zoonotic disease investigations carried out by international expeditions in Mongolia during 1966–1968 (Mongolian State Veterinary Archive)

Disease	Method	Investigations		Positive results		%
Glanders		Total	5505 714		241537	4.39
	Allergic	Horses		5046070	241157	4.78
	Allergic	Camels		332684	380	0.11
	Serological	Horses		126960	24760	19.50
Brucellosis	Serological	Total	28693664		660432	2.30
	e.g.	Camels		432919	9987	2.31
	e.g.	Cattle		2892658	192601	6.66
	e.g.	Sheep		19533637	320709	1.64
	e.g.	Goats		5834450	136222	2.33
Tuberculosis	Allergic	Total	3408875		?	?
	e.g.	Cattle		3113115	*)	*)
Grand Total			37 608253			

*) Positive results of 667 402 tuberculin tests in cattle in Bulgan and Uvurkhangai aimaks (provinces) were reported in 427 animals, i.e. in 0.06 %.

Assuming a total of 450 working days (3 years × 150 days), then it can be estimated that the total time spent by 802 expedition members reached about 120,000 person-working days (1966 – 44,550, 1967 – 38,400 and 1968 – 37,350). The time spent by Mongolian personnel can be roughly estimated to be of double value. Extremely demanding work was carried out when solving incalculable operational problems. The support of the programme provided by the Mongolian government authorities was exemplary.

CONCLUSION

A comparative study was not carried out due to the fact that in scientific literature no information on a similarly large and complex anti-zoonotic screening programme has been found.

The article is dealing with reported numbers of tests and not with the number of investigated animals because some animals were tested more than once (testing of previously negative animals). Moreover, some animals could not be caught and some were not found in very extensive grazing lands. Other difficulties were caused by nomadic system of animal free grazing being in permanent movement without all-year stable locality or housing. The reproduction process (herd turnover) influenced the numbers of tested animals at a particular moment; e.g. many tested animals had been eliminated by slaughter or culling as positive reactors and many others by natural death due to diseases or extreme winter frost or hunger. In spite of all these difficulties always sufficient numbers of animals were tested to discover all herds affected by the above-mentioned zoonoses. One of the major problems was missing individual animal identification. A country-wide modern system of animal identification was started only in the 21th century by Institute of Tropics and Subtropics, Czech University of Life Sciences under the leadership of Prof. Dr. D. Lukešová.

The reported number of specific tests represented at that time a record of screening to discover all animal herds affected by several dangerous diseases transmissible to humans and covering the whole territory of a large country in development. Positively responding animals were isolated and prematurely culled thus eliminating detected infection sources. Data for project economic evaluation were not available.

The project results had a multiplying effect thanks to the implementation at a country-wide level with long-term impact on the development of animal husbandry, production of meat and other products of animal origin as well as on the health of nomadic herders and city consumers throughout all Mongolia. Thanks to the project results many tens of thousands of Mongolian countrymen and consumers were protected from illness, disability or death due to the mentioned zoonoses. The results provided a solid basis for further specific control of animal glanders, brucellosis and tuberculosis in Mongolia.

In the years 1966–1968 the following veterinarians from Czechoslovakia participated in the Mongolia expedition: Augustinský Vojtěch, Benninghaus Tibor, Bíro Imrich, Brunšák František, Černovský Jan, Jeřábek Jan, Kačín Jiří, Kacovský Jiří, Kouba Václav, Koudela Josef, Krušpán Jaroslav, Ládr Jiří, Lávička Jan, Novotný Pavol, Polášek Ludvík, Rademacher Rudolf, Roháč Jaromír, Rozsíval František, Schlée Antonín, Schneeweiss Petr, Skrovný Josef, Soukup Václav, Straka Josef, Vargic Jiří, Vašák Václav, Zachoval Roman, Zapletal Jan, Žilinčár Ján.

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