Epidemiological and epizootological monitoring of echinococcosis and biological safety

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Abstract. Anthropozoohelmintiases (helminthozoonoses) - helminthoses which excitant are capable to parasitize on human and animals. These diseases actuality is testified by the fact that pig echinococcosis and cysticercosis are included in OIE list. Aim is to work out a model of risk-oriented animal and human echinococcosis monitoring on the basis of geoinformatics systems. The article considers geoinformatics systems (GIS) as an epidemiology and epizootology method for the risk-oriented monitoring of zoonotic cestodiasises, a model of multilevel geoinformatics system is offered for to elucidate a wide range of tasks in the sphere of struggle with these diseases. GIS usage allows to study fuller the regularities of epizootic process and the geography of zoonotic cestodiasises and to perfect epizootological analysis methodology in either deep long-term perspective and short timeframes.

1. Introduction
Socially important helminthoses – zoonosises, which agents are conveyed from animals to human and induce health harm and employability loss, constitute and important healthcare and veterinary medicine task. According to World Health Organization (WHO) data, humanity is threatened by more than 500 kinds of parasitical worms. More than 150 illnesses are registered in the world that are passed from animals to human. These diseases claim more than 15 million human lives annually.

Echinococcosis – one of the most significant and widely spread helminthoses in the world representing a serious problem not only for a veterinary but also for a medicine. Excitant - Echinococcus granulosus – is localized in liver, lungs, in brain sometimes, eyes and bones. Larvacysts represent single and multiple water bubbles (hydatids) with from 1.5…2 mm to 15 cm diameter [1, 2, 3, 4, 5, 6].

Reproductive echinococcus – is a very small cestode of Taeniidae family Taeniata suborder of 2 to 6 mm length, consists of scolex armed with 28…40 hooks and 3…4 joints. Mature one is the joint filled with a pouchlike uterus which 500…800 mature eggs are in. (with oncoshpere inside). Adult cestodes parasitize in intestinal of carnivorous animals.

Disease excitant source for ruminants, pigs and other animals — dogs, wolves, foxes, jackals, polar foxes that are wormy with adult stage and emitting mature joint of this parasite with feces, and among carnivorous animals – ruminants and pigs, effected by echinococcus larvae (hydatids).
Excitant transfer factors – grass. Various fodders and water kinds contaminated with echinococcus joints and eggs, emitted by dogs, wolves and other carnivores with feces and swallowed by ruminants and omnivorous animals. Echinococcus transfer factors by definitive hosts are parasite effected organs (liver, lings and others) of intermediary hosts.

Man is infested via dirty hands, water and food as well as immediately during the contact with dog or via different objects (sheep hair, carnivores animal fell, skim and others), contaminated by feces of the diseased dog.

Due to Rospotrebnadzor (Russia Federal Service for Monitoring in the Sphere of Consumer Rights and Human Prosperity) data, more than 400 cases of human echinococcus is registered in Russian Federation annually, wherein, 14.5% of patients are children. During 32-year period, from 1995 to 2018, echinococcus morbidity increased more than 3 times (in 2018 – 0.33 in 100 thousand of population).

Northern Caucasus, Black Mould, Volga River basin and Ural Industrial regions of Russian Federation are unfortunate in terms of animal echinococcus where synanthropic focuses prevail, as well as Siberia and Far East which natural focuses dominate in.

In a whole across Russia, rather jazzy picture of echinococcus spread is observed. Sheep taint level constitutes 8.7…10.7 %, heavy beasts – 3.9…4.5 %, pigs – 3.8…4.3 %. Echinococcus actively functioning cycles prevail on the Northern Caucasus (sheep and pig variants), at Black Mould Zone and Volga River basin (pig, sheep and bovine variants), at Urals Industrial Zone (sheep variant predominantly).

Agricultural animals, effected by echinococcus larva stage, are the potential source for the excitant transfer into carnivores population, therefore measures on exclusion of dog access to condemned material during processing of slaughter animals is rather important term in actions complex aimed on excitant source of echinococcus invasion.

Carnivores echinococcus is not taken into account by veterinary statistics. For last 30 years, general dog taint with cestodes constituted 5…15 %, stray dogs — 70…80 %, and on the Northern Caucasus and Volga River basin reaches 100 %.

The actuality of given disease is testified by the fact that echinococcus is included in OIE listed diseases which 119 most dangerous and commercially significant diseases of animals are included in.

2. Scope
The scope is to elaborate a model of risk-oriented monitoring of animals and human echinococcus on the basis of geoinformatics systems.

3. GIS application for epizootological and epidemiological monitoring
To monitor animals and human illnesses the cartographic method is widely applied for, which allows to study the regularities of research objects spatial location and individual aspects of illness epizootic on particular territory by the way of maps creation and nosological maps using. that can be considered as a research approach applying for a retrospective and for a forecasting.

Thanks to GIS the major drawbacks of regular maps are overcome (data static character and paper content limitation as for an information carrier), scale expansion and data specification are provided.

Epizootological GIS – is an informatics system enabling to pursue epizoototological information collection, storage and analysis with possibility for its reflection on geographical maps and report performance according to indicated parameters. GIS usage allows to learn fuller the epizootic process and animals and human illness geography and, on its basis, to perfect epizootic analysis methodology in either deep long-term perspective or small time ranges. GIS databases allow on the basis of veterinary and medicinal organization final reports and supervisory organizations to hold current and retrospective monitoring of epizootic and epidemiological situation.

GIS is an ideal instrument for risk analysis and monitoring of natural-focus parasitic diseases of animals and human. Unlike usual epizootic maps with limited possibilities to fill in legends with data and to reflect process dynamics in space and time, GIS enable to collect, process, model and analyze
data of unlimited volume depending on task being settled as well as to show it on monitor screen or paper carrier. Wherein, maps reflection is possible in different scales and as separate parts (from whole country map to small local biotope) and of different map layers (for example, diseases focuses and their loimopotential).

The use of GIS as a method for risk-oriented monitoring of zoonotic cestodiasises gives a possibility to create a multilayer platform which allows to settle task wide spectrum in the sphere of struggle with this disease. Modern GIS-instruments embody geoinformatics methods using powerful software-hardware means: geographical Webservers of open access, complex multifactor spatial analysis instruments, devices for formation of the most precise electronic and for preparation of high-quality paper maps.

Fully functional GIS contain full set of geospatial processing tools including data collection, their integration, storage, automatic processing, editing, topology creation and support, spatial analysis, connection with database management system (DBMS), visualization and creation of any cartographic information solid copies [7, 8, 9, 10, 11].

4. Risk-based monitoring of zoonotic cestodiasises

Real way to rise economic indicators of animal agriculture – all-in struggle with helminthiases and other intrusive illnesses. It must be aimed not to the parasite living temporary suppression but to their full elimination – devastation.

In the case of zoonotic cestodiasises, which agents are biohelminths, the struggle with them and prophylactics must be targeted on parasite imaginal stages elimination with the help of dishelminthization of definitive hosts and lifecycle abruption and with the help of prevention of contamination of definitive as well as intermediary hosts.

Parasite lifecycle knowledge assists to forecast animals and human infection possibility. Thus, the most optimal measures of struggle and prophylactics at cystic echinococcosis are:

- Prevention of unsupervised and odd dog occurrence on animal agricultural facilities. Limitation of herd dog number (to 2…3 dogs per herd).
- Registration of dogs which represent production value.
- Bar to keep dogs at fodder storage places, sheep pens and bases.
- Planned ishelminthization of dogs four times per year. Wild predators (wolves, jackals and others) abolishment.
- To pursue slaughtering only on slaughter court, slaughter points and meat factories.
- Bar to perform slaughter on pastures, farms and yards.
- Thorough veterinary-sanitary examination of meat corpses on meat-processing factories with follow-up abolishment and reliable disinfection of contaminated organs.
- Timely clean-up and reliable utilization of agricultural animal cadavers.
- Compliance with personal prophylactics rules while communication with dogs.
- Veterinary-sanitary propaganda and awareness-building conduction among breeders and other population layers.

In some country districts, the series of antiechinococcosis measures make changes and additions depending on zonal specificities of breeding pursuing and helminthosis epizootology.

Taking into account that larva echinococcosis source for agricultural animals and human mainly are house carnivores animals (dogs) the clarification of infested animals and their highly-effective and timely dishelminthization are the priority measures in the warning of agricultural animals infection.

One of the most important information sources on the presence of echinococcosis focuses are notices of veterinary-sanitary expertise laboratories of grocery markets, meat factories and slaughters. The presence of contaminated organs in byproducts from particular region (farm, private residence) testifies the occurrence of infection origin therein – ill dog which infests natural
environment and animals and, probably, people. Wherein, the given dog will be an invasion source during 6 months (cestode lifespan). To abolish illness focus it should be held the series of diagnostics and treating measures of animals (dogs scatoscopy and their dishelminthization) and people from risk group (ultrasound investigation and computer tomography of internal organs). Together, all data on echinococcosis cases should be put in specialized database on GIS ground with referring to the location.

In the complex of anti-helminth measures, the significant role is on helminthological knowledge propaganda by scientific and veterinary personnel amongst population wide ranges and, firstly, among breeders and poultry farmers. The most spread form is a knowledge oral propaganda (lecturing, radio speech, seminars and talks and so on). Important role of helminthological knowledge propaganda belongs to print-forms (publication of popular scientific articles in newspapers and magazines, posters, brochures, leaflets issue as well as watching of movies on helminthological themes). Alike propaganda rises literacy and consciences of rural population on veterinary helminthology matters.

In city conditions, the requirements to embody echinococcosis lifecycle are rather unfortunate, because agricultural animals are almost absent (excluding single cases in private sector), meat and byproducts are sold via distributing network and pass veterinary-sanitary expertise, the essential part of dogs is fed with ready commercial fodders. These conditions tear off parasite cycle development and prevent contamination as of definitive hosts as well as of intermediary ones. Nevertheless, helminthiasis import factor on city territory can be homeless dogs and also illegal selling of meat products which did not pass veterinary-sanitary expertise or delivery of infected byproducts for personal consumption.

Especially, one should mark the necessity if risk-oriented monitoring of echinococcosis at special guarded natural territories: reserved areas, national parks and so on, which agent circulation is possible in between homeless dogs and wild carnivore animals, on the one hand, and wild ruminant one, on the other. Thus, while obduction of wild deceased elks and deers in national park “Losiny ostrov” (Moscow) territory discovered echinococcosis cystes (sterile ones) in parenchymatous organs [12]. It sais about the presence of contaminated carnivore animals which can serve as an infection origin for people. In this case, effective measures of struggle are timely clean-up of deceased animal cadavers and homeless dog elimination.

Such variants should be considered also while pursuing the risk-oriented monitoring of echinococcosis and the forecasting animals and human illness cases.

5. Conclusion
The article considers geoinformatics systems (GIS) as an epidemiology and epizootology method for the risk-oriented monitoring of zoonotic cestodiasises, a model of multilevel geoinformatics system is offered for to elucidate a wide range of tasks in the sphere of struggle with these diseases. GIS usage allows to study fuller the regularities of epizootic process and the geography of zoonotic cestodiasises and to perfect epizootological analysis methodology in either deep long-term perspective and short timeframes.

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