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Managerial Epidemiology and Zoonoses: Application of Managerial Epidemiology in Control of Zoonotic Disease in Bosnia and Herzegovina

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1. Introduction

1.1 How to define managerial epidemiology?

Managerial epidemiology is rather new subdiscipline of epidemiology defined by Fos and Fine (2005) as: the use of epidemiology for designing and managing the health care of populations—the study of distribution and determinants of health and disease, including injuries and accidents, in specified populations and the application of this study to the promotion of health, prevention, and control of disease, the design of health care services to meet population needs, and the elaboration of health policy.

In order to fully understand all benefits in using management knowledge, approaches and skills merged with knowledge and practice of epidemiology let us consider several most frequently used definitions of management:

- Management is an activity performed by people for organizations (Gram, 1991),
- Management is a process of getting things done through and with people (Liebler, 1999),
- Management is the planning, organizing, leading and controlling of resources to achieve organizational goals effectively and efficiently (Jones, 1998),
- Management is a process of modelling and sustaining of environment in which individuals work together in teams efficiently to reach targeted goals. (Weinrich, 1994)

If we were to simplify this, we would say that management is a process of making and implementation of decisions through and with people.

Similar to the case of definitions of term *management*, epidemiology is described in various terms, most recently as:

- a study of the distribution and determinants of diseases and injuries in human populations (Mausner and Kramer, 1985).
- a branch of medicine which deals with incidence, distribution and possible control of diseases and other factors relating to health (Oxford English Dictionary, 2011)

- a study of the distribution and determinants of health-related states or events in specified populations and the application of this study to the control of health problems (Last, 2001).

By the Last's definition (2001), »study« includes surveillance, observation, hypothesis testing, analytic research, and the experiments; »distribution« refers to analysis by the time, place and classes of persons affected; and »determinants« are all physical, biological, social, cultural, and behavioural factors that influence health.

Management science theory is a contemporary approach to management that focuses on the use of rigorous, quantitative techniques to help managers make maximum use of all resources to produce the best from them for the benefits of a company and its stakeholders. This approach includes various quantitative approaches to decision-making processes and is characterized by an interdisciplinary systemic approach. One of the examples is managerial epidemiology, which tries to combine epidemiology, with its main focus of interest in the population health control and disease prevention and application of management quantitative approaches. This is a challenge not fully answered yet. Having in mind the development of epidemiology – from merely observing and describing interesting health-related events having the status of epidemics or just having some common characteristics among all cases (e.g. cholera in London 1854; Measles on the Faroe Islands 1846; Studies of smoking habits of Doll and Hill, 1947 and 1951) and today we can speak easily on observational and experimental studies conducted respecting all rules of applied epidemiological methods and their developments in the last 50 years, one can expect some similar development of managerial epidemiology too.

It has been an undisputed fact for more than a century that epidemiology is a main public health discipline. There is hardly any population health status assessment or strategy or a policy developed and/or changed without use of basic epidemiology principles.

2. Basics of application of epidemiological principles in the assessment of health status of populations

Many epidemiologists throughout the globe will say when explaining their daily work that they are searching for answers to 5 simple questions: who, what, where, why and how.

First step in any managerial epidemiology activity is gathering information on population. It includes measurements of morbidity and mortality rates, particularly incidence rates (both cumulative and incidence rate) and prevalence rates. Disease frequency measurement is the basic point for any health status assessment. Absence of such data would make any proper assessment difficult, if possible at all.

Starting point of any situation analysis is application of descriptive epidemiology principles and its three primary objectives in order to find a spreading pattern, as disease does not occur randomly, but rather in patterns that reflect the mode of operation of underlying factors. Description of the pattern by each of the characteristics requires a description of the three categories: person, place, time. These characteristics may directly or indirectly relate to the occurrence of a disease or event. In investigation of zoonotic disease outbreaks among humans, important facts necessary to establish would be contacts with animals or animal products, or, for some illnesses, presence in some specific area.

An analytic study immediately and inevitably follows the descriptive study. Descriptive studies are used to identify health related problems and define number of cases and distribution of the disease within a population and serve to formulate a hypothesis of disease outbreak source and way(s) of transition. Analytic studies are concerned with disease determinants, and with very special methodology used in hypothesis testing, acceptance or rejection in order to confirm or reject the source or way(s) of transmission defined by the descriptive study. Case - control and cohort studies are particularly useful in zoonotic diseases outbreaks, such as food borne outbreaks.

Descriptive studies or both descriptive and analytic studies are used as a basis for any planning, monitoring and evaluation of a prevention and/or control activity.

In management of infectious diseases probably the most important epidemiological principle to observe is surveillance. It is an ongoing systematic collection, analysis and interpretation of outcome-specific data for use in planning, implementation and evaluation of public health practice (Thacker, 2000). All health care systems worldwide have established some kind of surveillance system for communicable diseases as structured systems for disease data collection. In order to meet its objectives, public health surveillance system, particularly surveillance of communicable diseases, should be legislated. It is very important to differentiate between monitoring and surveillance: unlike monitoring process, data obtained from surveillance system is considered information for action. Only with undertaking actions based on surveillance system findings of an event, such event can be modified. Modification usually means the end of disease transmission and outbreak or epidemic is called off.

Strict observance of all the above mentioned basic epidemiological principles not only that makes health managers daily life easier, but also contributes significantly to population health status. If managers use modern management techniques, practice and skills, they will help health care system in making the best use of its resources to fulfil goals, objectives and/or targets in disease prevention and/or control.

Having said this, we can also define managerial epidemiology application of basic epidemiological principles using modern management techniques, practices and skills in a disease prevention and/or control.

3. Application of managerial epidemiology in control of zoonotic disease in Bosnia and Herzegovina

3.1 Surveillance of communicable disease in Bosnia and Herzegovina

To understand the communicable diseases surveillance system in Bosnia and Herzegovina (B&H), the enduring consequences of the 1992-1995 war and of the Dayton peace agreement must be taken into account. These consequences include a substantial decrease in human population, massive outward migration and widespread social problems. B&H is also a country still in transition from a communist regime and suffers substantial weaknesses in public administration, taxation system, public services funding and general economy. The Dayton peace agreement provided neither the legal framework for constitution of the ministry of health or agriculture at the state level and instead delegated the responsibilities for most of governmental functions related to health, food safety and agriculture to the three

state entities, the Federation of Bosnia and Herzegovina (FB&H) and Republic of Srpska (RS) and the independent district of Brčko (DB). This, coupled with a distinct lack of coordination between all involved stakeholders, has presented a major handicap to the country's overall development during the post war period (Čavaljuga et al, 2009a).

In addition, communicable disease surveillance, and/or public health surveillance in general, in developing countries such as B&H is marked by some specific issues:

- human health care system organization is as an integral part of government services,
- communicable diseases surveillance systems are independent for two branches- veterinary and human health medicine.

As described in that 2009 paper on the development of communicable diseases surveillance in Bosnia and Herzegovina through one health approach regarding reporting of communicable diseases in B&H nothing has been changed significantly until present days: communicable disease reporting has been legislated throughout entire B&H for all administrative part: District of Brčko (DB), Federation of Bosnia and Herzegovina (FB&H) and Republic of Srpska (RS). In FB&H according to the Law on population protection against communicable diseases total of 84 diseases are mandatory for reporting; out of that almost 50% are zoonotic (Legislation FB&H 2005). In RS reporting of communicable diseases has been legislated by the Law on population protection against communicable diseases from 2010 (Legislation RS, 2010) – a total of 57 diseases and syndromes or diseases groups are mandatory for reporting. At the national – B&H level – there is no unified legislation or common list of communicable diseases required for reporting. Surveillance system is not based on case definition – there is no case definition standards implemented in the country, but case defining and reporting is done based on the clinical signs and symptoms according to the ICD 10th revision and is highly dependent on physician/clinician personal assessment and therefore variable. There is no laboratory-based surveillance and reporting to epidemiological departments; microbiological laboratories send their clinical results to the referral physicians only. This brings the question whether system of surveillance of communicable diseases exists at all. That is the reason why in this paper we discuss reporting of a disease more than surveillance of diseases.

When in the second half of the last century a decrease in number of communicable diseases was reported in B&H as well as in the rest of the world, particularly „classic“ zoonoses such as anthrax and rabies, an opinion was formed that prevention, treatment and, of course, control of communicable diseases, were not important or necessary anymore. However, such opinions were proved wrong when in Bosnia, like in the rest of the world, an increase in number of cases of unknown or hardly known diseases with no previous reports or sporadic reports has been recorded.

As opposed to the veterinary sector, there is no national mandate for human communicable diseases reporting and control in B&H. Consequently, there is no unified system of surveillance for communicable diseases for the country. Health care finance, management and organization are the responsibilities of each of the state entities and each of them operates a separate health care system under their own authority. Accordingly, B&H has thirteen ministries of health for an estimated population of slightly more than four million people (B&H Agency for Statistics, 2010).

3.2 A brief overview of the situation with zoonosis in Bosnia and Herzegovina

World Health Organisation (WHO) defines zoonosis as any disease and/or infection which is naturally "transmissible from vertebrate animals to man" (WHO, 1959), and emerging zoonosis as "a zoonosis that is newly recognized or newly evolved, or that has occurred previously but shows an increase in incidence or expansion in geographical, host or vector range" (WHO/FAO/OIE, 2004a). In paper of Čavaljuga (2008) the current situation on zoonotic diseases in Bosnia and Herzegovina was analysed with reflection to up-to-date knowledge on human pathogens and zoonosis.

There are many research publications discussing known number of human pathogens, their structure and level of emergence. The range of the total number of human pathogens, according to such publications (Taylor et al., 2001, Hart; 2008, Woolhouse and Gowtage-Sequeria, 2005) varies from 1,407 to 1,870 with similar percentage of zoonosis within: 58-69%. Publication on the research conducted 2005 by Woolhouse and Gowtage-Sequeria met all criteria Čavaljuga was researching in 2008 in order to study the spread in Bosnia and Herzegovina of diseases with known human pathogens – pathogens that can infect more than one host, matching the WHO definition of emerging diseases; human pathogens with taxonomic classifications, defined by the WHO and the Centers for Disease Control and Prevention (CDC) criteria. The study survey identified 1,407 recognized species of human pathogens (Woolhouse and Gowtage-Sequeria, 2005). Out of them, according to the same research, 816 – 58% - were proved to be zoonotic; with the interesting fact that of the total 177 were regarded as emerging or reemerging and 130 or 77% of them were found to be zoonotic.

The list of emerging diseases is massive and all predictions say it will continue to increase in the future. About 600 human pathogens were found in the last 30 years (Hart, 2008), as a result of science improvement and technological achievements. The grow this partly due to some other factors such as jumping from one species to another – like in the case of bovine spongiform encephalopathy (BSE) or Sin Nombre virus. Factors leading to such results are also mutations, natural selection and evolution processes, environmental changes, climate changes, increase in travel and transportation, but the role of the host factors cannot be neglected, particularly with behavioural and practice changes leading to immunity changes. It is not disputable that, regarding the growth of zoonotic diseases, growth in animal population for human consumption resulted in increase of animal zoonosis cases. Adaptability of microorganisms to various and changeable environmental factors should be taken into account as other contributing factor. The novel influenza strain virus – Influenza A(H1N1) 2009 pandemic should be seen as event already proving such hypothesis.

3.3 Zoonotic diseases in humans

Major animal diseases with zoonotic potential in B&H by Čavaljuga et al in 2009 and based in greater part on her previous researches (Čavaljuga, 2008, 2009a) according to the both human and animal health reports are: Anthrax, Brucellosis, Leptospirosis, Rabies, Q fever, Tuberculosis, and Trichinellosis, while consequent human cases were reported for Leptospirosis, Q fever, Brucellosis and Trichinellosis, with substantial number of contact/exposure to Rabies but without recorded clinical cases in humans. In addition several zoonotic diseases that are not covered by the national animal diseases reporting

systems are occurring in human population in B&H (e.g., Hemorrhagic fever with renal syndrome (HFRS)). Many of these diseases may be considered as emerging according to the above given definitions since no or few cases of these diseases were reported for the area of B&H in period before 1995.

Table 1 contains reported frequency of human cases of zoonotic diseases for the period 2001-2010.

As the figures given in the Table 1 demonstrate, an increasing trend in case frequency is present for contact and exposure to rabies and Brucellosis, while the number of cases of Leptospirosis, Q fever, Trichinellosis and HFRS vary without presenting an obvious trend.

<div>year</div> <div>Disease</div>	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010*
Leptospirosis	26	40	15	11	79	56	32	41	22	9
Q fever	18	250	29	314	60	71	69	30	30	15
Contact and exposure to rabies	59	16	173	151	141	140	140	151	145	156
Brucellosis	5	14	48	90	137	156	513	994	460	25
Trichinellosis	41	110	75	68	82	23	47	17	32	0
HFRS	8	143	9	6	17	10	10	16	5	2

Table 1. Reported frequency of human cases of Leptospirosis, Q fever, Brucellosis and Trichinellosis along with frequency for contact/exposure to rabies for period 2001 - 2010 (source: SFOR/EUFOR Communicable diseases bulletins, 2001 - 2010)

3.4 Zoonotic diseases in animals

B&H did not have the central level administration and national disease control and surveillance plan during the period from 1995 to 2003. This created a negative influence on the animal health situation and isolated the country from regional and international markets for animals and animal products. Reliable animal disease data were almost non-existent during the immediate post-war period (Cornwell et al, 2000). Initially, disease information was passively acquired. Collection was sporadic and most commonly initiated in response to public pressure. The usual response to a disease outbreak was implemented through a policy of test and removal of positive animals. This was hampered by a lack of sufficient funding for farmer's compensation resulting in limited reporting of disease suspicion by animal caretakers. The following zoonotic diseases were reported by sources from entity's and DB veterinary sectors: Anthrax, Brucellosis, Leptospirosis, Rabies, Q fever, Tuberculosis, and Trichinellosis; as shown in Table 2. The most remarkable are the figures on brucellosis cases both in large and small ruminant population, but also steady presence of rabies in domestic and wild animals (predominantly foxes). Other diseases listed in the table were present in animal population in B&H on sporadic or endemic levels. It is very important to point to the decline in number of Brucellosis cases among animals as well as in humans as direct result of all the prevention and control measure used by respecting application of both the epidemiological and management principles by all sectors and levels.

<div>year</div> <div>Disease</div>	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Anthrax	-	3	1	-	3	-	-	2	-	11
Brucellosis-small ruminants	16	11	168	787	838	2.263	6.830	22.122	2.426	294
Brucellosis- cattle	28	47	4	28	48	32	76	260	214	99
Leptospirosis	106	93	18	34	10	15	24	1	1	1
Rabies - wild animals	68	55	60	39	35	64	51	85	44	36
Rabies - domestic animals	26	15	15	17	5	13	9	20	28	11
Q fever	448	98	220	184	122	166	11	21	2	411
Tuberculosis	3	1	4	2	1	-	-	2	45	4
Trichinellosis	180	158	164	156	146	146	202	91	58	66

Table 2. Data on frequency of zoonotic diseases in animal population in B&H from 2001 to 2010 (animal health data base, State Veterinary Office of B&H)

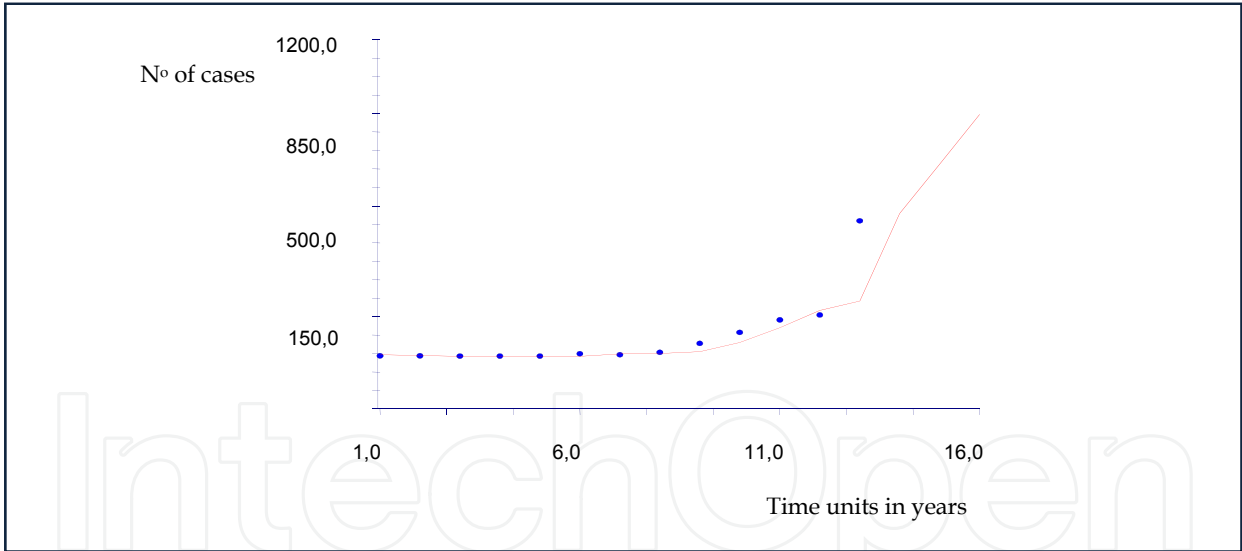
3.5 A common–one health–approach to the prevention and control of zoonoses in B&H

Improvements in functioning of the animal health sector became apparent after the State Veterinary Office of B&H was established in December 2000, under the Ministry of foreign trade and economic relations of the national government. Since then, measurable efforts have been implemented within country’s veterinary administration with the aim to fulfil the requirements for accession to the World Trade Organization (WTO) and harmonization with animal health standards of the European Union (EU). However, one of the main goals still remains to reassess the current animal disease information system and adjust it to prevailing surveillance requirements.

Simultaneously, but independently, work has been done to strengthen surveillance of communicable diseases systems in the human health sector in accordance with WHO and EU standards. Even superficial comparisons of the above zoonosis data in B&H collected independently from animal and human sectors proved the necessity of future coordination of activities between animal health and public health agencies. This has been underscored during the last decade situation with Avian Influenza and potential threat of a pandemic influenza new strains. Baring in mind that at least 61% of all human pathogens are zoonotic, and have represented 75% of all emerging pathogens during the past decade (Acha et al, 2003) prevention activities for Avian and Pandemic Influeza in B&H have shown possible that a common approach can and should be used. This is true not only for this particular disease, but also more widely on all zoonosis. This common approach fits the widely and globally propagated “one health” concept. This concept represents a more holistic approach to preventing disease for the benefit of humans and their domesticated animals.

The quoted studies Čavaljuga in 2008 and 2009 and updates until 2010 (presented in tables 1 and 2) indicate, as the most interesting, the data on brucellosis. Until 2000 only sporadic cases were reported (Gaon in 1952, described first 2 cases in BiH, and one more outbreak with about

40 cases was recorded in 1985 on mountain Manjača near Banjaluka (RS)) (Gaon et al 1989, Dautović-Krkić et al, 2006). Brucellosis outbreak investigation in 2000 proved that Brucellosis first appeared among persons who got the donated animals at the area of Zenica-Doboj Canton (Dautović-Krkić et al, 2006). Afterwards, due to mobility of small ruminants – commonly sheep as major hosts of brucellosis in B&H – outbreak slowly spread to the epidemic throughout entire B&H (FB&H & RS Bulletins, 2000-2010, CDC, 2007). Today, brucellosis in Bosnia and Herzegovina is considered endemic. In all outbreak investigations and analyses commonly made only in FB&H until 2007 and starting from 2007 in RS as well, the most dominant mode of transmission was direct contact with sick animals, found among more than 90% of cases (FB&H & RS Bulletins, 2000-2010). Number of brucellosis cases among both humans and animals was significantly increasing in the observed period, according to the findings of Čavaljuga in 2008 - particularly during 2006 and 2007, reaching their pick by the end of 2008: 994¹. Morbidity rates (such as incidence) cannot yet not be calculated with relevant precision, as denominator – population number - is only estimated, and the last population census in B&H was done 1991. The data on brucellosis from 1996 to 2007 were extrapolated using Holt’s linear trend method, as greater significance is given to the recent data for the most optimal period by this method, which was 4 years for all analysed diseases, based on the known data for 12 previous years. Trend for brucellosis among humans showed almost exponential growth. The original graph is presented as graph 1.



Source: Cavaljuga, 2008

Graph 1. Brucellosis human cases in B&H trend – based on data 1996-2007

Based on the presented numbers it is easy to conclude that adequate control and prevention measures were not undertaken. However, regardless of almost 500 cases in FB&H in 2007, and even more in first 6 months of 2008 (when the research was conducted and paper was submitted for publication) an outbreak/epidemic has never being called on for the

¹ This data was not included in the cited paper from 2008, as the paper was submitted for publication July 2008. Thus, 2008 number of reported cases was not included in the extrapolation.

Federation, but only for most attacked cantons. In order to undertake adequate control and prevention measures it was necessary to call the situation an outbreak. In her paper in 2008, Čavaljuga concluded: "...strategy of disrupting this pathogen transmission from sick animal to human with long term strategy of brucellosis elimination is something B&H still has not developed. Recommended steps for action are given, among other recommendations, in the report of the CDC team mission conducted in July 2007 (CDC, 2007): introducing standardized case definition for this (but to for the other diseases as well) implemented as recommended by WHO/EU Communicable Diseases Surveillance Guidelines (WHO, 2006); set laboratory criteria for classification of confirmed, possible and suspect cases according to the WHO and EU recommendations (WHO, 2006); introduce regular training for all physicians and all relevant health workers for a case recognition and reporting, as well as additional training in use of analytical epidemiology and laboratory techniques; and, perhaps the most important: zoonotic diseases investigation should be conducted in both human and animal sectors. Some 1,200 cases of brucellosis in 2011 is not only a result of statistical extrapolation, but reality. Severity of clinical signs and symptoms indicate that each case costs, directly or indirectly, 1,000 BAM (B&H currency, about 510 Euros) at the minimum. The question is can we afford not to do anything despite the fact that at this moment brucellosis is the only emerging zoonosis at this moment in Bosnia and Herzegovina?"

The following is the story on brucellosis in Bosnia after 2008: the outbreak was admitted but never official proclaimed by the respective entity governments as by the end of 2008 the total number of reported cases was 994, and almost all the suggested measures were undertaken. Laboratory capacities were strengthened, all professionals involved in the brucellosis investigation, treatment, prevention and control were trained using different methodologies, and veterinarian sectors increased their efforts as well as level of activities in control the disease among animals. Major activities started in 2009. With the strong funding support by the Swedish Development Agency and the Swedish Embassy that enabled purchasing animal brucellosis vaccines through public procurement procedure as well as equipment and supplies required for implementation of sheep vaccination program activities. All competent agencies from the veterinary sector in B&H were actively involved in implementation.

The result of the described implementation of relevant managerial and epidemiological principles in human health protection is easily seen from table 1: number of registered human cases in 2010 was 25 and in sheep 294.

There are other examples on implementation of various epidemiological principles with managerial approach in health status assessment or strategy/policy developed or changed in disease prevention and/or control, such as the study on flock level risk factors for ovine brucellosis in several cantons of Bosnia and Herzegovina (Šerić-Haračić et al, 2009). It also contributed to the previously mentioned successful story on fight against brucellosis epidemic in Bosnia and Herzegovina.

Brucellosis reports in recent years indicated an increase in the number of reported outbreaks in ruminants, especially sheep. The objective of such studies was to investigate risk factors associated with the brucellosis status of sheep flocks in several cantons of Bosnia and Herzegovina. A cross-sectional study was conducted on 138 sheep flocks during the period of July-September 2005. The brucellosis status of the flocks was established through

serological testing of serum samples using Rose Bengal and complement fixation tests applied in series. Data on risk factors were obtained through a study questionnaire. Risk factor analysis was performed using logistic regression analysis. The brucellosis risk factors identified were those usually associated with traditional management of small ruminant flocks in this region. It was concluded by the authors that the risk based approach to the disease surveillance would increase the overall sensitivity of the disease detection and allow more effective allocation of limited resources for disease containment. However, in order to reach comprehensive and scientifically based disease detection program, further investigation of disease epidemiology are needed. Following this study, future studies were suggested as needed to reliably establish small ruminant brucellosis prevalence and incidence in the country and investigate specific relationship between brucellosis in humans in animals. That would improve the market competitiveness of domestic sheep production by increasing consumer trust, and most importantly, help in prevention of human cases.

Another one is describing conducted case control study of food borne illnesses in humans in the central region of Bosnia and Herzegovina during 2006 (Čavaljuga et al, 2009b). As part of the feasibility study for the Regional center for food, agriculture and veterinary medicine, financed by the EU RED (Regional Economic Development) fund, a random survey of population sample in Srednjobosanski and Zeničko- dobojski canton, was conducted during 2006. In the overall sample of participants investigators identified cases (families with recorded cases of food borne illnesses in previous year) and controls. Cases and controls were matched one on one, according to the family size (number of adults and children), education level of adults and category of monthly income. Investigated outcome was recorded dichotomously and numerically, as well as the type and kind of the incriminated food source and severity of clinical symptoms. The study showed that nowadays, food represents much higher risk for human health despite increased attention given to the food safety by today's consumers, producers and food inspectors. The study was conducted to prove that integration and industrialization of food production chain and implementation of the surveillance system "from stable to table" has decreased frequency of outbreaks of food born diseases and concurrently increased magnitude of their consequences (number of cases, severity of clinical symptoms, antimicrobial resistance etc.). The lack of a uniform reporting system on food borne illnesses in humans, under-reporting and poor communication between veterinary and public health sectors in Bosnia and Herzegovina (B&H) additionally impair insight into the state and size of the problems in this area. Certain progress in forming and strengthening of the institutional capacities as well as recent frequent occurrences of "food poisoning" had have huge impact on reaffirmation of the needs for systematic epidemiological research in the area of food safety.

Although number of food borne illnesses cases was not quite high, there are not yet - by the end of 2011 - a uniform reporting system for both sectors - human and animals.

4. Instead of a conclusion

There are various risk factors which contribute to the emergence and spread of zoonotic diseases including social, technological, ecological and microbial. However, the greatest risk factor may be the existence of inadequately resourced and ill-prepared public and animal health systems, as well as the lack of a well-coordinated and effective global surveillance and response mechanisms (WHO/FAO/OIE, 2004b).

In B&H, the first step in overcoming any specific or general disease threat is strengthening the communicable disease surveillance systems and methodology for both human and animal sector at the national level. In addition, reliable surveillance systems in both sectors should serve simultaneously as an early epidemic warning system and provide the objective rationale for public health intervention. Early detection of communicable diseases and immediate public health intervention can curtail the numbers of communicable illnesses, deaths and negative effects on both national and international health, travel and trade (Čavaljuga et al, 2009a).

In the post-war period B&H, a country in transition has been dependent on international assistance given separately to both sectors by various international and development organizations towards meeting international standards for animal and public health. The most significant and sustainable contribution by international parties to both sectors was and still is the improvement of diagnostic capabilities and transfer of the most advanced knowledge on epidemiology principles with disease surveillance planning. In order to promote and strengthen linkages between animal and human health sectors in the country which proved by the cited publications and studies as very successful strategy to fight against zoonotic diseases, a more active role needs to be taken in learning and exploiting modern managerial techniques, knowledge, principles and skills and implementing those ones in realization of common priorities and goals.

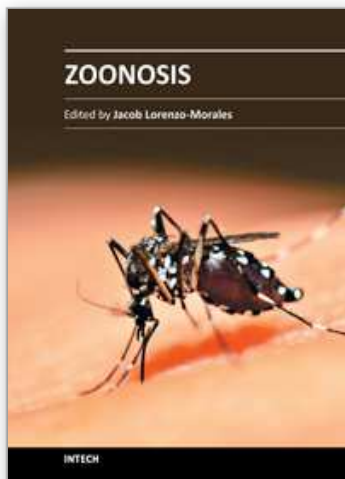
If not done through merging all available resources including knowledge and experience in humans as the most powerful as well as the cheapest resource of all - team approach and work in systemic planning and complementary actions and in development of infrastructure and expertise around public health and veterinary system – one health –control and/or prevention of any communicable disease, particularly zoonotic diseases will fail to meet its general purpose of optimal, high-quality and cost-effective protection of human health and welfare.

To be proficient in a field of science is good, but to be proficient in many fields is an accomplishment!

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Zoonotic diseases are mainly caused by bacterial, viral or parasitic agents although "unconventional agents" such as prions could also be involved in causing zoonotic diseases. Many of the zoonotic diseases are a public health concern but also affect the production of food of animal origin thus they could cause problems in international trade of animal-origin goods. A major factor contributing to the emergence of new zoonotic pathogens in human populations is increased contact between humans and animals. This book provides an insight on zoonosis and both authors and the editor hope that the work compiled in it would help to raise awareness and interest in this field. It should also help researchers, clinicians and other readers in their research and clinical usage.

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