

One health national programme across species on zoonoses: a call to the developing world

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Zoonoses constitute 868 (61%) of all known infectious diseases, 75% of the infections considered 'emerging' are zoonoses. Developed nations have national programmes, adjoining "One Health" concept to combat zoonoses, whereas inadequacies exist in developing nations. As a case study, role of national programmes in India, a developing nation with a large human and animal population, was explored, as we did have acquaintance of it. Data from PubMed was extracted using keywords "Zoonoses AND Prevalence/Incidence AND India AND Human OR Animal" till 2009. Additionally, some individual disease keywords were used for extraction, which were missed by the above comprehensive search terms. On appraisal, the health sector in India has only a few national programme on zoonoses where as none exists in animal husbandry sector. In the struggle against zoonoses -a major constituent of emerging infections, a system approach based, one national programme is urgently required for the developing world.

Keywords: *Zoonoses; Epidemiology; Prevalence; Incidence; Program Evaluation*

Received: 18 July 2011; Revised: 14 September 2011; Accepted: 28 September 2011; Published: 24 October 2011

The World Health Organisation (1) estimates that 25% of the total 57 million annual deaths that occur globally are caused by microbes with a major proportion occurring in the developing world. A database (2) has identified 1,415 species of infectious organisms known to be pathogenic to humans, including 217 viruses and prions, 538 bacteria and rickettsia, 307 fungi, 66 protozoa and 287 helminths. Zoonoses constitute 868 (61%) of all known infectious diseases, with humans serving as the primary reservoir for only 3% of them. Of the 175 diseases considered to be emerging, 132 (75%) are zoonotic.

Zoonoses in general and food-borne zoonoses in particular have a major impact on health in the developing world, with a bulk of their source from foods of animal origin. Exposures to humans occur through meat, vegetables and water contaminated by animals in the food chain. In addition to human disease, zoonoses pose an economic burden on livestock production. Although extensive antibiotics are used in animal husbandry for growth promotion in many parts of the world, non-therapeutic use creates a potential hazard in

the emergence of antibiotic-resistant pathogens that include zoonotic agents.

The 'One Health' concept (3) is a worldwide strategy to control zoonoses by expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and environment. When planning on a national level with inter-sectoral coordination to control zoonoses, it is necessary to adopt the One Health approach. There are networked efforts adjoining One Health in certain developed nations for combating zoonoses, whereas inadequacies prevail in developing countries. This study was undertaken to evaluate the role of national programmes for zoonoses in India—a developing country with large human and animal populations and to make recommendations on the deficiencies identified.

Background of zoonoses in India

Zoonotic diseases are of great public health importance in India (4), where 68% of the workforce relies on farming that is in close contact with domestic animals and poultry with frequent exposure to sick or infected

animals. Other than causation, factors that contribute to the dissemination of zoonoses are: unhygienic living conditions, lack of education, poor personal hygiene, poverty and occupation. Wildlife has been recognised as an important reservoir of zoonoses either infecting humans directly or indirectly through domestic animals. Furthermore, several relevant zoonotic infections may be vectorborne, that is, transferred from animals to humans via, for example, arthropods or ticks.

Morbidity estimates of many zoonoses are unknown; also, the problems of food-borne zoonoses are complicated because of varied food habits. Lack of authentic data and awareness regarding the occurrence of these diseases and their true impact on public health have acted as major obstacles in commencing adequate and effective control measures.

Several national programmes are instituted by the Ministry of Health and Family Welfare to combat communicable, non-communicable and other diseases. These programmes re-inforce the delivery of primary, secondary and tertiary health care throughout the country. The programmes (5) that include zoonoses are as follows:

- (1) The national vector-borne disease control programme incorporating the Japanese Encephalitis (JE) control programme and the Kala-azar (Leishmaniasis) control programme.
- (2) The revised national tuberculosis (TB) control programme.
- (3) The national surveillance programme for communicable diseases—the core programme cluster for communicable diseases and surveillance under the division of zoonoses, with provision of guidelines for prevention and control of anthrax, dengue, JE and leptospirosis. On the contrary, there is no national programme on zoonoses managed by the Department of Animal Husbandry, Ministry of Agriculture. However, a control programme for canine rabies, coordinated by a few state governments, is in function in select cities.

The aims of the study were threefold. One, to search for morbidity data: prevalence, incidence/outbreak data for acute zoonotic diseases in India to compare humans and animals; two, to identify the corresponding national programmes in human and animal health sectors in India, for the presented morbidity data on zoonoses; and three, to identify the gaps in the data or national programme and make recommendations.

Methods

The information in Table 1 was compiled by extracting data from PubMed (6) using keywords 'zoonoses AND prevalence/incidence AND India AND human

OR animal'. Additionally, some individual disease keywords were used for extraction, which were missed by the abovementioned search terms. The search returns on zoonotic diseases were classified as bacterial, viral, protozoan and helminths that included vector-borne diseases. Incidence, prevalence data with numerator and denominator for each of the diseases were separately gathered for humans and animals. Also, high endemicity and high-risk population were noted. In parallel, the official health and animal health websites of the government were searched for identifying the existence or absence of the national programmes.

Results

The search returned some studies with prevalence/incidence data on zoonoses in India; however, data were missing for some common prevailing zoonoses in both human and animal health sectors; such commonly known zoonoses had only case reports. Incidence/outbreak data were identified for only two diseases: JE and rabies. Also, some studies reported non-normal prevalence/incidence rates that were hospital based and not community based.

Existing national programmes on humans and animals are presented in Table 1. Notably, there are only a few national programmes on zoonoses in the human health sector, with the exception of the unique programme for TB control. JE, Kala-azar and leptospirosis are grouped under communicable diseases programme as a cluster.

Discussion

The medical and veterinary professions have distinct responsibilities, but in zoonoses, they have parallel stakes and similar challenges. Epidemiological transition has moved from mere risk factors identification to the next level of focusing on the underlying interactions within the whole system, which is the system's approach that is suited for the management of zoonotic diseases. In the context of the recent swine-origin influenza A H1N1 pandemic, Smith and co-workers (42) concluded that 'the lack of systematic swine surveillance allowed for the undetected persistence and evolution of this potentially pandemic strain for many years'.

The burgeoning Indian population encroach animal life by extending its areas of habitation into the cultivable land and forest, thereby stepping up the interactions between humans and animals substantially. Moreover, ever-increasing needs for foods from animal origin for the growing population compel a surge in domestic animal population. Indiscriminate and unregulated use of antibiotics in the livestock farming practices resonates in anti-microbial resistance in humans (43). Additionally, environmental degradation, global warming and other disasters—which are more or less caused by human

activities—contribute immensely on emergence and re-emergence of zoonoses.

Zoonoses prevention and control is an area of major concern in most developing countries and particularly in India with high population densities of humans and animals. Identifying and comparing zoonoses' prevalence/incidence data with the existence of the national programme on both human and animal health sectors in India (Table 1) revealed limited data on many diseases, missing data for some diseases in both sectors, higher estimates on high risk population/regional endemicity and select estimates from hospital-based studies. National programmes in the health sector of India are very few and the animal health sector had

virtually none on zoonoses, except for select states implementing rabies control programmes.

We have collected data using India as a case study because we are familiar with the structure and functioning of the health systems as well as having access to the data. Also, India has one of the largest, uncontrolled human and animal populations in the world with a majority of humans being agrarian and living in proximity to animals. We didn't tabulate zoonoses based on the range of animal species affected or specific to regions/states in India because India's geography and culture are so diverse. To circumvent this diversity, a common national programme on zoonoses is needed. Also, the zoonoses data compiled and reported in this study have

Table 1. Zoonoses' prevalence/incidence and corresponding national programme in India

Zoonotic disease	Prevalence/incidence (%)		Existence of national programme		References
	Human	Animal	Human	Animal	
<i>Bacterial</i>					
Brucellosis	2–7	3–5	X	X	(7–9)
Campylobacteriosis	13.5 ^a	5.3–39.3	X	X	(10, 11)
Leptospirosis	10–20 and 53 ^a	57	✓	X	(12, 13)
Listeriosis	40 ^a	25.3	X	X	(14, 15)
TBMTBM BovisMixed infections	0.2115.726.835.7	0.5–16	✓		(16–18)
<i>Staphylococcus aureus</i>	30.8	–	X	X	(19)
Salmonellosis	7	8–48	X	X	(20, 21)
Scrub typhus	9.2	–	X	X	(22)
VTEC	3.12	6.2	X	X	(23)
Other rickettsiae	4.6	–	X	X	(22)
<i>Viral</i>					
JE (Incidence per 10,000)	0.0003–0.0015	23.15	✓		(24)
Rabies (Incidence per 100,000)	2	–	X	✓*	(25)
Rota virus	23.4	19–27	X	X	(26–28)
<i>Protozoan</i>					
Cryptosporidiosis	1.4	12.9			(29, 30)
Giardiasis	22	–	X	X	(31)
Isospora	–	2	X	X	(32)
Leishmaniasis	13.8–26	–	✓	X	(33)
Toxoplasmosis	9.5	18–42	X	X	(34, 35)
<i>Helminths</i>					
Ascaris	11.4	31	X	X	(31, 32)
Dirofilaria	12	7	X	X	(36)
Trichuris	2.4	25	X	X	(31, 32)
Cysticercosis	15.9	26	X	X	(37, 38)
Fasciolosis	–	13–53	X	X	(39)
Hydatidosis	15–25 ^a	1–36	X	X	(40, 41)

*Denotes prevalence/incidence in high risk population/high endemicity regions.

–Denotes absence of prevalence/incidence data.

✓denotes presence of national programme.

✓*Denotes presence of national programme in select cities.

XDenotes absence of national programme.

varied denominators for incidence and prevalence; some were occupational specific; some were food specific and some were with mixed infections.

The authors searched and reported the prevalence/incidence data only from PubMed, this being the largest free access health information database, for human and veterinary disciplines. Searches on other literature bases or hand search including grey literature were not carried out. However, the status of the existing national programmes was obtained from official websites (5, 44) of the concerned health and animal husbandry ministries of India.

Some developed countries have authorities for example, CDC, USA and networks *MedVetNet* in the EU for implementing public health programmes on zoonoses. Although it appears logical to extrapolate and adopt the same for developing nations rather than conceive new ones, such simple translation of these public health programmes will be ineffectual because of the distinctly unique agricultural and cultural practices, including housing and food habits in India. However, this diversity should be taken into account when designing health programmes, and there also has to be a possibility to adjust the programmes according to local habits and practices, when necessary. Otherwise, the risk of failure in implementing the health programmes is obvious. This reasoning applies not only to India but also to most parts of the world.

A programme is defined as a plan of action to accomplish a specified end. Preventing and controlling zoonoses through a public programme in India or other developing regions requires the following strategies:

- (1) Active surveillance and estimates of zoonoses' burden across species both community and health facility based, for a selected set of diseases.
- (2) Improved diagnostics that should be rapid, specific, simple and affordable.
- (3) Effective risk communication across disciplinary and agency boundaries.
- (4) Emergency preparedness and rapid response.
- (5) Increasing risk-free disease control practices with judicious anti-microbial usage to prevent resistance.
- (6) Vector control.
- (7) Routine vaccination with an effective coverage for zoonoses across species to achieve sufficient herd immunity.
- (8) Community engagement.

To accomplish the above desired needs, a strong public health infrastructure with a 'One Health'-based national programme on zoonoses across species is required with greater community participation. Adjoining this, there could be several units on individual diseases graded for prevention, control, elimination or

eradication depending on the prevalence estimates as well as priorities. This would be facilitated by a One-Health approach, with enhanced communications across disciplinary and agency boundaries that involve complex human/animal/environmental systems in the struggle against zoonoses.

Ideally, an integrated 'One Health national programme' on zoonoses should encompass zoonoses causing most human and animal suffering and huge financial losses. To start off with at least notifiable zoonoses to control and prevent the major serious infectious diseases in India that is culturally and geographically diverse.

Conflict of interest and funding

The authors have not received any funding or benefits from industry or elsewhere to conduct this study.

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