50 Years of transforming lives through dairying

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ANAND
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Zoonoses and dairying- An Indian Perspective

Introduction

Zoonoses are diseases and infections that are naturally transmitted between vertebrate animals and humans.

Zoonoses constitute 61% of all known infectious diseases. It may also be noted that out of the 175 diseases considered to be emerging, 75% are zoonotic.

India has been identified as one of the 20 hotspots for highest incidence of zoonotic diseases in the world.

Around 70% of the population in India reside in rural areas. Poor hygiene, poverty, malnutrition, lack of awareness, close contact with animals etc, predispose a majority of the rural population to zoonotic diseases. Of the 200 zoonoses described, 45 are purported to be transmitted from cattle. It is implicit that the productivity, and hence, earning capacity of a farmer would be seriously dented in the event he or she is afflicted with a zoonotic disease. Given that 85% of bovines are maintained by the rural landless or marginal farmers, it is important to reach out by popularizing the concept of '*Human health through Animal Health*'. This would help create a conviction in the farmer to control the disease in his animals, thereby facilitating the control of at least a few economically important diseases in animals which are of zoonotic nature.

A list of 30 odd zoonoses present in the Indian sub-continent that can be transmitted from bovines are presented in the tables below. While some infections may be mild or self limiting in nature, others may require medication for complete recovery. A few may even prove fatal if prompt and appropriate treatment is not provided.

Controlling these zoonoses would require different approaches, primarily aimed at severing its transmission link. This could be either by implementing zoo-sanitary measures, pasteurization of milk or vector control for effective control of the disease in humans. Since it would be not be possible to cover all the zo-

S.no	Disease	Causative agent	Probable means of transmission from bovines to humans
Bacterial infections			
1	Anthrax	B.*anthracis*	Occupational exposure, ingestion and inhalation
2	Arcobacter infection	Many species of Arcobacter	Ingestion of contaminated water.
3	Brucellosis	B.*abortus*	Ingestion (esp. raw milk and dairy products), contact with mucous membrane and broken skin, strain 19 vaccine exposure.
4	Enteritis	Campylobacter *jejuni*, C. *fetus*, C.*coli* etc	Ingestion (raw milk and dairy products), water borne, contact with animals.
5	Dermatophilosis	Dermatophilus *congolensis*	Direct contact with lesions
6	Erysipeloid	Erysipelothrix *rhusiopathiae*	Contact with animal products; via skin after scratch or puncture wound.
7	E.coli infection	E.coli (O157:H7) and others	Ingestion of contaminated food /water with faeces; direct contact with faeces.
8	Leptospirosis	Various species of Leptospires	Occupational exposure- mucous membrane contact with contaminated urine, reproductive fluids.

S.no	Disease	Causative agent	Probable means of transmission from bovines to humans
Bacterial infections (continued)			
9	Listeriosis	L. *monocytogens*	Ingestion of raw milk or dairy products, contaminated water, direct contact with infected animals.
10	Tuberculosis	M. *bovis*	Ingestion (raw milk or dairy products), contamination of breaks in skin.
11	Nocardiosis	Various species of Nocardia	Environmental exposure (inhalation or wound contamination)
12	Salmonellosis	Various species of Salmonella	Faecal-oral route, occupational exposure.
13	Streptococcal infections	Various species of Streptococci	Ingestion (esp. raw milk or dairy products), direct contact through broken skin.
14	Tetanus	Clostridium *tetani*	Wound infection by soil or faeces.
15	Human granulocytic anaplasmosis	Anaplasma *phagocytophilum*	Tick bites
16	Q-fever	Coxiella *burnetii*	Airborne, exposure to placenta, birth tissues, excreta, ingestion (including raw milk)
Fungal infections			
17	Dermatophytosis	Microsporon & Trichophyton species	Direct skin/hair contact with infected animals, fomites
18	Crytosporidiosis	Cryptosporidium *parvum*	Faecal-oral , ingestion of contaminated food or water, inhalation
19	Microsporidiosis (Traveler's diarrhoea)	Microsporidia of various species	Faecal-oral , ingestion of contaminated food or water
20	Rhinosporidiosis	Rhinosporidium *seeberi*	Environmental exposure
21	Trypanosomiasis	Trypanosoma *evansi*	Probable contact with infected blood of animal
Parasitic infections			
22	Dicrocoeliasis	Dicrocoelium *dendriticum*	Ingestion of infected ants
23	Fasciolasis	Fasciola *hepatica* & F. *gigantica*	Ingestion of contaminated greens or water.
24	Echinococcosis	Echinococcus *granulosis*	Ingestion of parasitic eggs in food, water, to mouth on hand, parasitic eggs stick to fur and hands
25	Beef tapeworm disease	Taenia *saginata*	Ingestion of undercooked meat
26	Dracunculiasis (Guinea worm infection)	Dracuncula *medinensis*	Ingestion of infected cyclops
27	Trichostrongyliasis	Various species of Trichostrongylus	Ingestion of infective larvae on vegetables or in contaminated soil or water.
28	Acariasis	Mites of various genera	Contact with infected animals, fomites
Viral infections			
29	Buffalo pox	Buffalo pox virus	Skin contact with infected animals (often while milking)
30	Crimean Congo Haemorrhagic fever (CCHF)	CCHF virus	Tick bites, esp hyalomma, but also rhipicephalus, dermacentor etc; ingestion of raw milk.
31	Milker's nodules (pseudo cow pox)	Pseudo cow pox virus	Skin contact (especially broken skin)with lesions on cow's udder , fomites.

onoses related to dairying here, the focus would be on a few zoonotic diseases that have the potential to severely impact our dairy farmers.

Human brucellosis

Human brucellosis is a significant public health problem in India. Persistence of animal reservoir, low physician awareness etc, contribute towards the perpetuation of this zoonosis in India. It is reported that fewer than 10% of the human cases of brucellosis may be clinically recognized and treated or reported. The disease exists in the general population in India and, high clinical suspicion must be made in patients especially when there is history of animal contact or consumption of unpasteurized milk. There is no vaccine for humans. Brucellosis is often unsuspected because of its varied clinical manifestations and may be a more important cause of fever than previously considered.

An overlap between brucellosis and tuberculosis has been reported both in terms of clinical presentation and laboratory parameters. It is therefore essential to carefully rule out tuberculosis in all cases of suspected or proven brucellosis before initiating antimicrobial therapy in order to forestall development of drug-resistant tuberculosis, since Rifampicin and Streptomycin are used for both the diseases. Drug resistant tu-

berculosis is rising in India and is a major public health concern.

NDDB's efforts in holistic brucellosis control

NDDB has been trying to popularize the concept of '*Human Health through Animal Health*' in 140 villages of India. While awareness creation, vaccination, ear-tagging, disinfection, proper disposal of placenta or aborted material are the mainstay of the programme, identification of farmers with clinical manifestations of brucellosis through use of point of care tests, linkages with local medical physicians are also important components that facilitate the affected farmers to be cured and lead a normal and healthy life. The apprehension that the condition is zoonotic becomes a plausible reason for the farmer to follow the control measures. Till date, 7% (4/60) people who have been associated with animals showing some suspicion of the disease have tested positive in the project area and have been treated successfully. These people would be the best suited messengers for propagation of the concept to other farmers. One such success story can be viewed in the following YouTube link: https://youtu.be/0DwovGUugwU

Various manifestations of human Brucellosis reported in India
Nervous system
1. Meningoencephalitis 2. Spastic paraparesis 3. Polyradiculoneuropathy@ 4. Polyneuroradiculomyeloencep -halopathy 5.Chorea# peripheral neuritis & meningitis @ Not a specific condition, but rather a description of a problem in which one or more nerves are affected and do not work properly. #An abnormal involuntary movement disorder causing quick movements of the feet or hands.
Musculo-skeletal system
1. Spondylitis Sacroiliitis 2. Joint pain (mainly knee) 3. Back ache 4. Involuntary movements of limbs. 5. Acute polyarthritis 6. Burning sensation of feet. 7. Arthritis /Septic arthritis 8. Myalgia 9. Arthralgia
Circulatory system
1. Carditis 2. Endocarditis
Integumentary system
1. Pityriasis alba $ 2. Skin lesions $ A common skin condition mostly occurring in children and usually seen as dry, fine scaled, pale patches on their faces.
Uro-genital system
1. Genito- urinary infection 2. Abortion
Respiratory system
1. Pneumonia
General
1. Persistent low fever 2. Fatigue 3. Malaise 4. Chills 5. Sweating 6.Headaches 7. Weight loss

Incidence range (%) of brucellosis reported in human populations in India (literature review)						
Veterinarians	Paravets	Abattoir workers	Patients with fever of unknown origin	Patients with fever and other symptoms	Occupationally exposed	General population
12-40%	6-51%	1-69%	1-12%	7-92%	1-45%	0.5-6%

Tuberculosis due to bovine TB

Bovine Tuberculosis (bTB) infects many domestic and wild animals though cattle are the primary hosts. The main routes of transmission to humans are by consumption of raw milk and inhalation of infectious aerosols in dried bovine sputum. Moreover, the disease in humans caused by bTB and human TB bacteria are identical with respect to clinical symptoms and lesions and would require complex tests to distinguish them. It is interesting to note that though bTB is a zoonosis, the importance of human TB bacterium as a reverse zoonosis is also gaining prominence with reports of around 9 % and 36% of the humans and bovines respectively having mixed infections with both bTB and human TB organisms. Immuno-suppressed and malnourished people are more likely to develop active TB infection following infection with bTB bacterium.

It would be worthwhile to look at some facts on human TB in India. Around 2.85 million Indians contracted TB in 2015 and, that too with only 59% of the cases being reported. This adds to ~30% of the total cases reported globally every year, which is at ~9 million. Moreover, around 3 lakh die every year due to TB in our country.

India also has the dubious distinction of having the second highest numbers of Multi-Drug Resistant (MDR) TB with around 1,00,000 cases, only second however to China, among the 27 MDR-TB countries. Extensively Drug Resistant TB(XDR-TB) has also been reported in India.

The annual cost of TB in India has been estimated at Rs.23.7 billion. Even with only 9% infections in humans reported to be from bTB, the losses are significant.

NDDB has also been advocating TB testing of farm personnel in contact with animals on a yearly basis to avoid cross contamination and for health reasons.

Moreover, it will also avoid culling of bulls that would react positively if exposed to human TB organisms.

Rodents for cheap and reliable TB diagnosis !

Trained African giant pouched rats are being used for secondary screening of TB in Tanzania which has improved detection rates by up to 23%. A rat can screen around 1680 sputum samples a day. It takes the rat as less as 7 minutes to screen as many samples possible by a trained human laboratory technician in a day (i.e~40 samples). The bacteria produces some distinct volatile organic compounds that are detected by the superior olfactory senses of the rats.

The sensitivity of rats reported is well above the usual sensitivity of microscopy.

An African giant pouched rat testing sputum samples in a laboratory in Tanzania. A simple, cheap and highly efficient method for TB diagnosis.

Leptospirosis

It is an occupational hazard to people associated with livestock, sewer workers and veterinarians. Farmers who milk infected cows and those who are engaged in agriculture, especially in rice and cane fields contaminated with cattle, rodent or dog urine, are exposed to infection. Infection rate is also higher in monsoon months. It could also be an important cause of febrile illness in patients from urban slums during monsoon and post-monsoon season. There is no vaccine available for humans.

It may have a mortality as high as 40% in its icteric form (Weil's disease). However the presentation of non-icteric forms of leptospirosis are often non-specific and may be missed unless there is a high index of suspicion. There could be an overlap of symptoms with Dengue, Malaria and Hepatitis A or E.

The 2015 leptospirosis epidemic in Mumbai that had 19 fatalities was caused by two rare serovars of Leptospira: *Tarassovi* and *Djasmin* which was also reported to be isolated from cattle urine.

NDDB had included sections related to rodent control and prophylaxis for Leptospirosis while preparation of the 'Biosecurity and Biosafety Manual for Bovines' released by DADF in January 2016, keeping the zoonotic aspect also in view.

Tick-borne infections

Tick-borne infections have been reported from various regions of our country and are a group of zoonoses that requires attention. They may be difficult to diagnose due to their non-specific signs and symptoms. Again, with people living in close proximity with cattle, usually with moderate to high loads of ticks on them, the possibility of these infections being prevalent can-

Various manifestations of human Leptospirosis reported in India
General
1. Fever 2. Headache
Nervous system
1. Altered sensorium 2. Uveitis
Respiratory system
1. Cough 2. Acute respiratory distress syndrome
Musculo-skeletal system
1. Flaccid weakness 2. Myalgia 3. Stiffness of calf muscles
Circulatory system
1. Bleeding manifestations 3. Nasal bleeding 4. Myocarditis 5. Hypotension
Urinary system
1. Oliguria 2. Acute kidney injury 3. Haematuria
Digestive system
1. Jaundice 2. Vomiting

Incidence range (%) of Leptospirosis reported in human populations in India (literature review)		
1	Veterinarians	7-14 %
2	Farm workers	30-77 %
3	Farmers	21-32 %
4	Sewer workers	13-39 %
5	Animal handlers	21-41%
6	Butchers	30 %
7	Patients with fever of unknown origin	20-33 %
8	Clinically suspected cases	27-57 %
9	Patients with hepato-renal dysfunction of unknown origin	34-80 %
10	Patients with acute febrile illness > 7 days	82 %
11	People in flood prone areas	15-34 %
12	Common population	5-28 %

not be discounted of which Crimean Congo Haemorrhagic Fever (CCHF) could be the greatest threat.

The CCHF threat

It is also known as the 'Asian Ebola' and is believed to be prevalent across the country as per the National Institute of Virology (NIV). It was first detected in Ahmedabad in 2011 and NIV has determined at least 17 outbreaks so far, affecting 50 people, many of whom have succumbed. CCHF has a mortality rate of ~40% (Ebola has an average mortality rate of 50%).

Although a number of genera of ticks can transmit CCHF, Hyalomma ticks are the principal vector. The ticks are found on cattle, buffalo, goat and sheep and these are found in almost all the States in India. The ticks act both as reservoir and vector for the virus and, bovines, sheep and goat serve as amplifying hosts for the virus. The infection in domestic animals is usually inapparent.

Humans can acquire infection either by tick bites or through exposure of CCHF infected blood, tissues or-body secretions of an infected animal. Human-to-human transmission can occur resulting from close contact with the blood, secretions, organs or other bodily fluids of infected persons. Hospital acquired infections can also occur due to improper sterilization of medical equipment and reuse of needles.

The virus could also go undetected since symptoms of dengue and CCHF may overlap. There is no vaccine available for either people or animals.

Testing of 5636 sera samples (bovine, goat and sheep) at NIV for CCHF virus specific IgG antibodies showed an overall prevalence of 5.43 % for bovine samples (260/4781) and 10.99 % (94/855) for sheep and goat samples respectively. The highest sero -positivity was seen in Odisha for bovine (31.3%) and, Himachal Pradesh for sheep and goat (53.1%) respectively.

Progression of CCHF in India

The progression of CCHF in humans since being first detected in 2011 as reported by NIV (newspaper report) is shown in the table above.

Year	State (districts)	Outbreaks/ affected no.	Mortality
2011	Gujarat (Ahmedabad)	6 cases	4 (3 were medical professionals)
2012	Gujarat	2 outbreaks	3
2013	Gujarat (Amreli, Patan, Surendranagar & Kutch)	13 cases	8
2014	Rajasthan	1case	-
2015	Rajasthan, Gujarat & UP	5 cases + 2 outbreaks	8

From the limited information presented above on the sero-prevalence in livestock and outbreaks in humans, it is apparent that the disease is slowly gaining foothold in the country and, therefore, implementing tick control measures is imperative in mitigating the threat before CCHF becomes a major public health issue.

The rampant and indiscriminate use has lead to tick-resistance developing against most of the acaricides. This also leads to its residues in milk, environmental pollution and higher costs of control. NDDB has been promoting the use of Ethno-Veterinary Medicine (EVM) and has facilitated training of veterinarians at the Trans-Disciplinary University, Bangalore on EVM for various ailments including tick and ectoparasite control. The main ingredient of the EVM formulation for tick control is *Acorus calamus,* a rhizhome, the extract of which has been reported to cause 100% mortality of ticks at 14 days post treatment in the study conducted by ICAR under the World Bank funded National Agricultural Innovation Project. This is also an eco-friendly, cost effective and sustainable option for tick control which need to be propagated widely.

Significant animal diseases reported to OIE (Oct–Dec'16)

Disease	Country
Bovine Tuberculosis	Belgium
Brucella suis	Belgium
Rabies	Belize, Kazakhstan
Foot and Mouth Disease (O, Asia1, A)	China, Guinea-Bissau, Mozambique, Saudi Arabia, Zambia
Brucella melitensis	Croatia
Blue tongue	France, Slovenia, Tunisia
Anthrax	Italy, Tanzania, Zambia
Haemorrhagic Septicaemia	Kazakhstan
Highly pathogenic avian influenza	Algeria, Bhutan, Laos , Bulgaria, China, Japan, S. Korea, Croatia, Serbia, Finland, Denmark, France, Egypt, Austria, Germany, Greece, Hungary, India, Iran, Israel, Netherlands, Nigeria, Poland, Romania, Sweden, Montenegro, Russia & Slovakia .
Low pathogenic avian influenza	France, Germany, Netherlands & S.Africa

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