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BRUCELLOSIS: NEED OF PUBLIC HEALTH INTERVENTION IN RURAL INDIA

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A b s t r a c t: *Aim:* To present the epidemiology of brucellosis and to assess and suggest public health intervention strategies to control brucellosis in rural India.

Methods: The paper is based on a review of various serological and other studies and evidence on brucellosis in India.

Results: Brucellosis is present in all livestock systems. Although the true incidence for human brucellosis is not available, various state specific studies and extrapolated incidence (321 cases annually) have shown that it is a serious disease present in the population. The studies also show that there is a conducive condition and environment for wide-spread human infection on account of unhygienic conditions and poverty in rural areas which need public health attention and intervention.

Conclusion: The paper suggests that brucellosis needs to be included in public health education and public awareness programmes, particularly in the rural areas of India. It also suggests promoting safe livestock practices, active co-operation between health and veterinary services and a paradigm shift from the current 'biomedical model' to a 'sociocultural model' for the elimination of brucellosis in India.

Key words: brucellosis, zoonoses, control/eradication strategy, health education.

Country Overview

India is located in Southern Asia, bordering the Arabian Sea, the Bay of Bengal, Pakistan, Bangladesh, Bhutan, China, and Nepal, covering an area of 3,287,263 sq km. According to the 2001 census, the country's population was

1,028,737,436. The constitutional name of the country is the Republic of India. It is world's largest democracy and second most populous country after China. It emerged as a major power in the 1990s with its fast-growing economy, with changing socio-political, demographic and morbidity patterns, which are drawing global attention in recent years. Despite having several growth-orientated policies and programmes, the widening economic, regional and gender disparities are major challenges for the country and particularly for the health sector.

About 75 percent of the health infrastructure, medical manpower and other health resources are concentrated in urban areas while 72.2 percent of the population live in rural areas. Communicable and infectious diseases dominate the morbidity pattern, especially in rural areas. However, non-communicable diseases are also on the rise. The health status of the population is still a cause for grave concern, especially the rural population. This is reflected in many indicators of the health status of the population in India, i.e. the life expectancy at birth (63.7 years), infant mortality rate (57/1000 live births), and maternal mortality ratio (254/100,000 live births). Despite the National Rural Health Mission programme, the differences in urban-rural health indicators are wide where the infant mortality rate is 62 per thousand live births for rural areas as compared to 39 per thousand live births for urban areas [1]. Only 31.9 percent of all government hospital beds are available in rural areas as compared to 68.1 percent for the urban population. At a national level the current bed-population ratio for Government hospital beds for urban areas (1.1 beds/1000 population) is almost five times the ratio in rural areas (0.2 beds/1000 population) [2-4]. Apart from this shortfall in infrastructure, a shortfall in trained medical practitioners who are willing to work in rural areas is also one of the factors responsible for poor health care delivery systems in rural areas. The number of trained medical practitioners in the country is as high as 1.4 million, including 0.7 million graduate allopaths [3]. Nevertheless, the rural areas are still unable to access the services of the qualified doctors. There is shortfall of 8% of doctors in Primary Health Centres (PHC), 65% for specialist at Community Health Centres (CHC), 55.3% for male health workers, and 12.6% for female health workers [4]. Basic demographic and socioeconomic indicators as well as some health care system indicators for India are presented in Box 1.

Box 1 – Преграда 1

Demographic, socio-economic aspects and health care system indicators for India
Демографски, социо-економски аспекти и индикатори на системот на здравствената заштита во Индија

Land area (2001 Census)	3,287,263 sq km
Population (2001 Census)	1,028,737,436
Rural population (2001 Census)	742,490,639 (72.2 %)
Population density	325
Population Growth (2001–07)	1.4%
GDP growth (2007–08)	9.0%
Gross national income per capita	2,460 (PPP international $)
Literacy rate	64.8 (Rural 58.7)
Life expectancy at birth	Male – 63.7 years, Female – 66.9 years
Fertility rate	2.5 birth per woman
Maternal Mortality Ratio (MMR)	254/100,000 births
Sex ratio	933/1000 (Rural: 946/1000)
Access to improved sanitation	33%
Total expenditure on health per capita	109 (Intl $, 2006)
Total expenditure on health [as % of GDP (2006)]	4.9
Doctors per thousand	0.47
Hospital Beds per thousand	0.8 (Rural – 0.19)

Source: Census of India 2001, Sample Registration System April 2009, World Development Indicators 2008, National family Health Survey-III (2006-06), World Bank's 'India at a glance', World Health Statistics 2008

Introduction

Brucellosis is an important but neglected emerging endemic zoonotic communicable disease in India. It remains a significant threat to human health in India, especially to the rural population. The population residing in rural areas are primarily engaged in agriculture, including animal husbandry, and thus having close contact with domestic animals and the wildlife population [5]. The increasing demand for dairy products accompanied with changing and intensified farming practices have raised concern about the increased transmission

of brucellosis in rural areas. Brucellosis is a serious public health problem in many developing countries and in regions of high endemicity such as Africa, the Mediterranean, the Middle East, parts of Asia and Latin America [6]. Though brucellosis has been eradicated in many developed countries [7], it remains largely an uncontrolled and neglected [8, 9] disease in India.

In India, 742 million people live in rural areas in 638,588 villages and thousands of small towns. About five million households in the country are engaged in the rearing of small ruminants (sheep and goats), rabbits and other allied activities. These populations live in close contact with domestic and wild animals because of their dependence on animals for power, milk and other animal products which make the population at a greater risk of acquiring a zoonosis, including brucellosis. The disease has added importance considering that animal husbandry and dairy development play a prominent role in the rural economy in supplementing the income of rural households, particularly the landless, small and marginal farmers. It also provides subsidiary occupation in semi-urban areas and more so for people living in hilly, tribal and drought-prone areas where crop output may not sustain the family. Coupled with these are conducive environments for the spread of the disease on account of poor socio-economic status, poor sanitation and hygiene, poor health infrastructure and services, illiteracy, and lack of awareness which makes the rural people more vulnerable to brucellosis than those in urban areas.

India has the largest livestock population in the world. It accounts for 57 percent of the world's buffalo population and 14 percent of the cattle population. According to the Livestock Census (2003), the country has about 185 million cattle, 98 million buffaloes, 61.47 million sheep, 124.36 million goats and 13.91 million pigs of which 2.18 million are cross-bred/exotic pigs. Considering the damage done by the infection in animals in terms of decreased milk production, abortions, weak offspring, weight loss, infertility and lameness, brucellosis is one of the most serious diseases of livestock. It is also a major impedement for the trade [10].

In humans, brucellosis often occurs through contact with infected animals or materials and through skin abrasions. Symptoms in human brucellosis can be highly variable, ranging from non-specific, flu-like symptoms (acute form) to undulant fever, arthritis, orchitis, epididymitis, fatigue, malaise, chills, sweats, headaches, myalgia, arthralgia, and weight loss [11, 12]. Human brucellosis was once thought to be predominantly transmitted through animal contact. However, it is now being increasingly realized that animal products such as milk and meat products are frequently the source of disease transmission [11]. Dairy products prepared from unpasteurized milk such as soft cheeses, yoghurts, and ice-cream may contain a high concentration of the bacteria and consumption of these is an important cause of brucellosis. It is the commonest mode of transmission in

case of *B.melitensis* and *B.abortus* infections in the general population [9, 12]. Skinning stillborn lambs and kids and aborted foetuses, which may be heavily contaminated with *Brucella spp.*, also presents a high risk of brucellosis [13]. Other means of infection include inhalation of airborne animal manure particles. Inhalation is often responsible for a significant number of cases in abattoir employees [14]. In addition, laboratory-acquired *Brucella* infection due to accidental ingestion, inhalation and mucosal or skin contact is a major health hazard for laboratory workers handling cultures of the virulent or attenuated strains. The disease has been recognized as one of the common laboratory-transmitted infections and has been reported to occur in clinical, research, and production laboratories [15, 16]. Another issue of concern is the use of *Brucellae* as a biological weapon. Although there is no reported case of bio-terrorism using *Brucella spp.* [17], nevertheless, *Brucellae* are not difficult to grow and disperse (the American military weaponized *Brucella suis* in 1954). The transmission to humans may result in prolonged illness and long-term sequelae [18].

Epidemiology of brucellosis in India

Brucellosis is the most common zoonosis accounting more than 500,000 cases in the world annually [19] and remains a worldwide problem, predominantly in developing countries including India. Epidemiological evidence shows that in India brucellosis is present in different species of mammalian farm animals including cattle, goats, buffalo, yaks, camels, horses and pigs [20]. Five percent of cattle and 3 percent of buffaloes are infected with brucellosis [21]. Ten of the 28 states of India indicated the cumulative incidence in sheep 7.9 percent as compared to 2.2 percent in goats [21]. Species of main concern in India are *B. melitensis*, and *B. abortus*. *Brucella melitensis* is widespread and is the major cause of abortion in sheep and goats in India. *B. melitensis* is the most virulent and common strain for man and it causes severe and prolonged disease with a risk of disability. *B. abortus* is the dominant species in cattle. Bovine brucellosis is widespread in India and appears to be on the increase in recent times, perhaps due to increased trade and rapid movement of livestock [21].

Brucellosis has been reported from almost all the states of India [22]. Although the situation varies widely between states, extrapolated incidence (321 human cases annually) has shown the presence of human brucellosis in the population [23]. Despite the fact that the true incidence of human brucellosis is unknown and no data are available for India [10], it has been estimated that the incidence of brucellosis may be 25 times higher than the reported incidence due to misdiagnosis and underreporting [24]. One of the reasons for misdiagnosis and underreporting is because in many cases patients have pyrexia of unknown origin or the symptoms and signs are confused with those of other diseases such

as typhoid fever, rheumatic fever, spinal tuberculosis, pyelitis, cholecystitis, thrombophlebitis, autoimmune disease, and tumours [25, 26]. Brucellosis imitates a variety of clinical entities which makes it difficult and challenging to diagnose for an unaware physician. Nevertheless, several publications indicate that human brucellosis is a fairly common disease in India [27]. Table 1 shows some of the studies reporting the incidence and prevalence of brucellosis in India.

Table 1 – Табела 1

Study reports for prevalence of brucellosis in India
Извештаи од студии за преваленца на бруцелозата во Индија

Authors	**Study findings**
Mathur, 1964 [27]	Reported 8.5% sero-prevalence of brucellosis among dairy personnel in contact with infected animals.
Chahota *et al*., 2003 [28]	Reported a severe outbreak of brucellosis in an organized dairy farm leading to abortions, retained placenta and stillbirth in cows.
Panjarathinam *et al*., 1986 [29]	Reported 8.5% prevalence of *Brucella* agglutinins recorded in human cases in Gujarat.
Thakur & Thapliyal, 2002 [30]	Reported a prevalence rate of 4.97% in samples obtained from persons exposed to animals.
Barbuddhe *et al*., 2000 [31], Chadda *et al*., 2004 [32]	Reported much higher seroprevalence rate in specific risk groups such as abattoir workers.
Sen *et al*., 2002 (33)	Reported 28 (6.8%) seropositive cases in a group of 414 patients with patients with pyrexia of unknown origin.
Kadri *et al*., 2000 [34]	Reported 28(0.8%) seropositive cases in a group of 3,532 patients with patients with pyrexia of unknown origin.
Mantur *et al*., 2006 [35]	Reported 495 adult patients in Bijapur with the prevalence of 1.8%.
Koshi *et al*., 1971 [36]	Reported 10 cases of brucellosis diagnosed by serology or by isolation in a study at Vellore.

The studies indicate that the presence of brucellosis in animals, with a potential for continuous transfer to humans is an important epidemiological issue [37]. Although the situation is not alarming, it is important to include brucellosis in public health education and awareness programmes considering the conducive condition and environment for wide-spread human infection in rural areas on account of unhygienic conditions and poverty.

Need of Public Health Intervention in Rural Areas

In rural areas, apart from agriculture, dairy, animal husbandry, free grazing, movement with frequent mixing of flocks of sheep and goats, unrestricted trade and movement of animals, use of local cattle yards and fairs for trading, and poor farm hygiene make rural people vulnerable to the spread and transmission of the infection. Increasing demand for dairy products and protein, changing agricultural methods, and increased trade and movement of animals have caused concerns that the prevalence may increase. Brucellosis is present in all livestock systems and transmitted to humans from infected domestic animals. Considering the poor health infrastructure and manpower in rural areas, the focus should be on preventive measure coupled with strengthening the curative health care services for early diagnosis and treatment. The study by Aulakh *et al*. shows that brucellosis is widespread in cattle and buffaloes and the only alternative to control and eradicate the disease is a statutory mass vaccination of livestock [10, 38, 39]. Since the treatment of animal brucellosis is very expensive and often unsuccessful and compensation for slaughter of infected animals is not available, the government should encourage the mass vaccination of livestock. Animal owners should be taught about the importance of vaccination of their animals. Learning lessons from other countries, brucellosis can be controlled. For example, many South American countries report control of brucellosis by use of RB 51 vaccine combined with serological monitoring. In many countries, the use of *B.abortus* strain vaccine in cattle and *B.melitensis* strain Rev1 vaccine in goats and sheep has resulted in the elimination or near-elimination of brucellosis in these animals. A plan for the control of bovine brucellosis has already been developed in India [24]. In spite of the clinical efficacy and cost effectiveness of vaccination of livestock, the limited availability of vaccines and lack of awareness have led to the persistence of brucellosis in rural areas of India.

The possibility of human to human transmission of Brucella infection [40–42] is another concern. Although a safe and effective vaccine for humans is not available [11], human brucellosis can be treated with a combination of antibiotics (10). Although, *Brucellae* are somewhat inaccessible to antibiotics as they are facultative intracellular pathogens, and clinical efficacy does not always correlate with *in vitro* susceptibility [41], many antimicrobials are active against *Brucella species*. Apart from curative intervention, prevention to stop the spread is very important considering its communicable nature. The lack of human vaccines and effective control measures make it necessary for doctors and other health care workers to take protective measures. Protective clothing / barriers while handling stillbirths / products of conception and cultures can reduce occupation-related brucellosis [42]. Prevention is dependent upon increasing public awareness through health education programmes and safe livestock practices and active cooperation between health and veterinary services. A control programme for human brucellosis would depend to a large extent on public health

education about the disease and its risk factors, good administrative arrangement and ensuring the maximum co-operation of the community, particularly between health and veterinary authorities. Clinicians practising in endemic areas must be familiar with this disease and develop a high degree of clinical suspicion based on epidemiological information. The absence of an effective brucellosis control programme in the country needs a public health education programme about the disease and its risk factors, along with good administrative arrangement, ensuring the maximum co-operation between line departments, particularly between health and veterinary authorities.

Framework for Public Health Intervention

The prevention and eradication of brucellosis in human beings can be accomplished in rural areas by bringing together medical and veterinary workers with combined medical, veterinary and public health approach. It could be further strengthened by establishing veterinary public-health units, usually within the organisational framework of village, block, district, state and at central level. It is hoped that this approach will gear toward improving service delivery in rural areas in the control and elimination of brucellosis and ensure access, coverage, quality of services and safety.

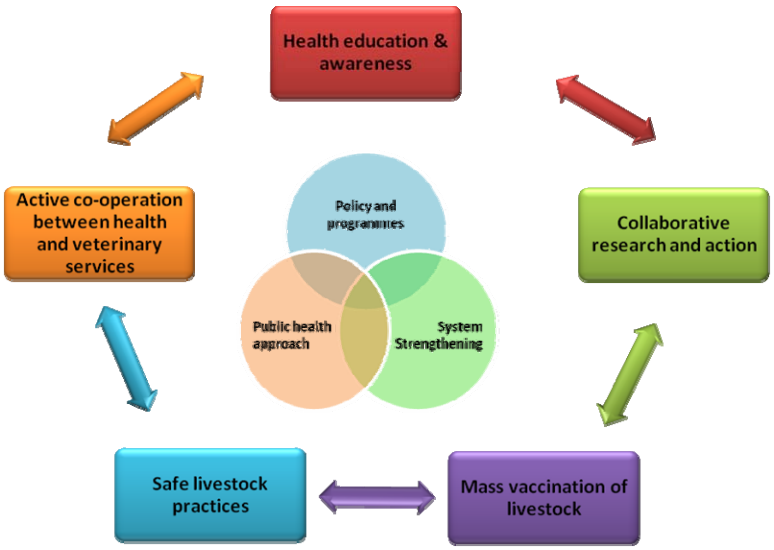

Figure 1 – Framework for public health intervention in rural areas to control Brucellosis
Слика 1 – Рамка за јавно-здравствена интервенција во руралните подрачја за контрола на бруцелозата

The framework developed above suggests that spread of brucellosis in animal and humans can be reduced and controlled through developing effective public health intervention strategies by developing an appropriate policy and programmes focussing on rural areas. At present, there is no national programme focussing on brucellosis. Little attention is given to curative services and livestock vaccination and no focus is on prevention, health education, safe livestock practices and awareness. For the eradication of brucellosis, there should be a mass vaccination programme of livestock. Most of the researches done are laboratory-based, focussing on clinical aspects of brucellosis and ignoring the socio-cultural and other determinants responsible for the spread of the disease. It is important to include brucellosis in public health education and to come out of a reductionist approach focussed only from a veterinary perspective. Brucellosis can be eliminated by promoting epidemiological investigations, health education aimed at increasing awareness of risks and the burden of human brucellosis in the affected communities, encouraging health promotion, disease prevention, intervention measures, implementation of local, regional and international standards related to food safety, enhanced regulations on the trading of animals and animal products at national and international levels.

Conclusion

Prevention of human brucellosis should be focussed mainly on the elimination of infection in animals and humans along with hygiene, vaccination and effective heating and pasteurization of dairy products. Although India has a policy for the control of brucellosis in dairy cattle, the present focus is very much towards the curative services rather than preventive. Brucellosis must be included in public health education, and public awareness programmes, particularly in the rural areas. A paradigm shift from the current 'biomedical model' to a 'sociocultural model' is imperative for the control and elimination of brucellosis in India. In conclusion, brucellosis is a serious public health challenge having socio-economic problems and an unaccounted financial burden which needs joint efforts, promotion of intersectoral action, regional and international cooperation, as well as technical and financial support.

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Резиме

БРУЦЕЛОЗА: ПОТРЕБА ОД ЈАВНО-ЗДРАВСТВЕНА НТЕРВЕНЦИЈА ВО РУРАЛНА ИНДИЈА

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Цел: Да се презентира епидемиологијата на бруцелозата и да се одредат и предложат јавно-здравствени интервенции за контрола на бруцелозата во рурална Индија.

Методи: Овој труд е базиран на преглед на различни серолошки и други студии, како и евиденцијата за бруцелоза во Индија.

Резултати: Бруцелозата е присутна кај сите видови добиток. Иако вистинската инциденца на бруцелозата кај човекот е недостапна, специфични студии од различни држави и екстраполирана инциденца (321 случај годишно), покажале дека претставува сериозно заболување присутно во популацијата. Студиите, исто така, покажале дека постојат фаворизирачки услови и околина за ширење на инфекцијата меѓу луѓето на сметка на нехигиенските состојби и сиромаштијата во руралните подрачја кои бараат јавноздравствено внимание и интервенција.

Заклучок: Овој труд предлага бруцелозата да биде вклучена во јавно-здравствената едукација и програмите за јавната свесност, особено во руралните подрачја на Индија. Исто така, препорачува промоција на безбедна работа со добитокот, активна соработка помеѓу здравствените и ветеринарните служби и промена на парадигмата од сегашниот „биомедицински модел“ во „социокултурен модел“ за елиминација на бруцелозата во Индија.

Клучни зборови: буцелоза, зооноза, стратегија за контрола/ерадикација, здравствена едукација.

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