

## **Veterinary public health in India: current status and future needs**

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### **Summary**

Veterinary public health (VPH) assumes huge significance in developing countries such as India. However, the implementation of VPH services throughout the country is still in its infancy. From 1970 onwards, many institutes, national and international organisations, professional societies, policies and personalities have contributed towards the development of VPH in India. However, there is an urgent need to develop VPH still further as there are many issues, such as high population density, the re-emergence of zoonotic pathogens, environmental pollution and antimicrobial resistance, that require attention. The time has surely come to involve all stakeholders, ranging from primary producers (e.g. farmers) to policy-makers, so as to garner support for the holistic implementation of VPH services in India. To improve VPH activities and services, there is an urgent need to develop sound, science-based strategies enforced through stringent regulation to improve human, animal and environmental health. The emergence of the 'One Health' concept has ushered in new hopes for the resurrection of VPH in India. Applying tools such as the World Organisation for Animal Health (OIE) Day One Competencies and the

OIE Tool for the Evaluation of Performance of Veterinary Services (PVS Tool) is essential to improve the quality of national Veterinary Services and to identify gaps and weaknesses in service provision, which can be remedied to comply with the OIE international standards. VPH initiatives started modestly but they continue to grow. The present review is focused on the current status and future needs of VPH in India.

### **Keywords**

Current status – Developing country – Future needs – India – One Health – Veterinary public health.

### **Introduction**

In 1999, the World Health Organization (WHO) defined veterinary public health (VPH) as: ‘the sum of all contributions to the physical, mental and social well-being of humans through an understanding and application of veterinary science’ (1). Although VPH is recognised as an important component of public health in various international forums, especially in the developed world, most developing countries, such as India, still lack the capacity, capability and expertise required for integrating VPH into overall public health activities (2, 3, 4). This is despite the fact that zoonotic pathogens have been a problem in India since the very early days (4, 5, 6, 7).

Veterinary public health as a defined structural element in public administration is virtually non-existent in India, as it is in the other developing nations of the region, i.e. Pakistan, Bangladesh, Nepal and Bhutan (8). Nevertheless, from time to time, attempts have been made to integrate VPH activities into government policies. In this regard, it is particularly important to mention the 12th ‘Five-year Plan’ because India’s ‘Five-year Plans’ are central to government planning (9) and VPH has gained substantial consideration in the current plan from both the Ministry of Agriculture and the Ministry of Health. The intensification of animal production started in the 1970s in India (2), prompting a need for proactive measures on zoonosis control and other VPH activities (2, 10). At present, India is faced with many

challenges, such as environmental pollutants, food safety hazards (especially microbial contamination and chemical residues), and the emergence and re-emergence of zoonotic pathogens (e.g. rabies, influenza and *Brucella* species). All of these elements have contributed to the necessity for the present review, which focuses on the current scenario, future needs and importance of VPH in India.

## **The present status of veterinary public health in India**

The status of VPH in India is discussed by examining developments in education, research and practice (Fig. 1).

### **Veterinary public health in education**

The Indian Veterinary Council Act, which was published in the Extraordinary Gazette of India on 21 August 1984, was enacted to regulate veterinary practice and to establish the Veterinary Council of India and State Veterinary Councils (11). At present, in India, there are 11 veterinary universities and 53 established veterinary colleges (most of which are affiliated to those 11 universities) (12, 13). As per the instructions of the Veterinary Council of India, each college has a separate Department of Veterinary Public Health and Epidemiology to teach VPH at undergraduate level to Bachelor of Veterinary Science and Animal Husbandry (BVSc & AH) students. Courses are stipulated by the Veterinary Council of India in the Minimum Standards of Veterinary Education – Degree Course (BVSc & AH) Regulations, 2008. The courses relate to zoonoses, epidemiology, milk and meat hygiene, food safety and environmental hygiene.

Similarly, postgraduate curricula with advanced courses on VPH are taught to Master's and doctoral students, although postgraduate teaching and research is not available in all veterinary colleges in India (Fig. 2). Apart from the state government universities and/or state colleges that offer postgraduate training, two central government institutions also offer Master's and doctoral degrees in VPH, i.e. the Indian Veterinary Research Institute (IVRI), Izatnagar, and the All-India Institute of Hygiene and Public Health, Kolkata (14, 15).

Although the Veterinary Council of India routinely monitors and regulates veterinary education in India, there is still a need to apply such tools as the World Organisation for Animal Health (OIE) Day One Competencies and the OIE Tool for the Evaluation of Performance of Veterinary Services (PVS Tool) to improve the quality of national Veterinary Services and to identify gaps and weaknesses in their ability to comply with the OIE international standards. The application of these tools will also help to build capacity so that national Veterinary Services can mount a prompt response to animal health emergencies in India. To date, these tools have not yet been employed to assess the national Veterinary Services of India.

### **Veterinary public health in research**

The important institutes involved in research into VPH, including their research mandates, are discussed in this section of the review.

#### **National Centre for Disease Control, Delhi**

A key institute in early VPH initiatives in India was the National Institute of Communicable Diseases in Delhi, which is now known as the National Centre for Disease Control (NCDC). This is an important institute which operates as part of the Ministry of Health and Family Welfare and provides a platform for veterinary–medical interaction (4). The Division of Zoonoses was established at the NCDC in 1964. Many valuable documents pertaining to VPH in India, such as conference proceedings, status papers and manuals (e.g. the *Manual on Zoonoses*), have been published by the NCDC (16).

#### **Indian Veterinary Research Institute, Izatnagar**

The Indian Veterinary Research Institute, the oldest biological research institute in the country, was established in Poona in 1889 as the Imperial Bacteriological Laboratory, upon the recommendation of the Indian Plague Commission (17). The Brucellosis Laboratory of IVRI was one of the earliest centres of VPH activities (18). The IVRI Division of Veterinary Public Health was established in 1971 on the

Izatnagar campus (19). In 1954, the Brucellosis Laboratory of IVRI was recognised as a Food and Agriculture Organization of the United Nations (FAO)/WHO Reference Centre for the Southeast Asia region (6).

#### Haffkine Institute for Training, Research and Testing, Mumbai

The Haffkine Institute was established in Mumbai (formerly known as Bombay) in 1899 (20). The first ever phase-one clinical trial in India was conducted by the founder of the institute, Dr Haffkine, in 1899. Since the institute pursued research on many bacterial zoonotic diseases, VPH research has indirectly benefited from its activities (8).

#### National Institute of Virology, Pune

The Virus Research Center (VRC), Pune, came into existence in 1952 as part of a global programme of investigations into the arthropod-borne group of viruses (21). In 1978, the VRC was redesignated as the National Institute of Virology (NIV). Today, the NIV is a WHO Collaborating Centre for Arboviruses and Haemorrhagic Fever Reference and Research and a National Monitoring Centre for several diseases, namely, influenza, Japanese encephalitis, rotavirus, measles and hepatitis (21). Since the beginning, the NIV has focused its research on many zoonotic viruses, thus indirectly contributing to broad areas of VPH.

#### All-India Institute of Hygiene and Public Health, Kolkata

The All-India Institute of Hygiene and Public Health (AIHH&PH) was established in Calcutta (now Kolkata) on 30 December 1932 and is now the oldest school of public health in Southeast Asia (22). The institute, which is governed by the Director General of Health Services, offers a Master's course in VPH and conducts research in areas of VPH (15, 22).

#### School of Public Health and Zoonoses, Ludhiana

The School of Public Health and Zoonoses was established by Guru Angad Dev Veterinary and Animal Sciences University (GADVASU),

Punjab, in 2012 (23). The fact that GADVASU has established a separate School of Public Health and Zoonoses, by upgrading its Department of Veterinary Public Health, is extraordinary, because in general VPH and zoonoses are still low-key issues for both veterinary and medical institutions in India. The school is mandated to address issues such as environmental pollution, control of zoonotic diseases and food safety, through research and collaboration with national and international agencies (23).

### Veterinary colleges and universities

As mentioned above, postgraduate and doctoral training is offered by a number of state colleges and/or universities. These institutions, along with two central government institutions (i.e. IVRI and AIIHPH), are also engaged in research work on various aspects of VPH.

### Intersectoral collaboration among research agencies

Of late, there has been increasing collaboration among government research agencies in the area of VPH. Two major national research agencies, the Indian Council of Medical Research (ICMR) and the Indian Council of Agricultural Research (ICAR), have formed a 'Joint Working Group on Zoonoses', with the aim of jointly funding zoonosis research by involving researchers from both medical and veterinary backgrounds (24). Recently, an initiative to form a similar group, the 'Joint Working Group on Food Safety', has also been taken up by the two councils (25).

### **Veterinary public health in practice**

Despite India's pressing need for VPH services, it has not been possible to implement VPH programmes to the extent required, due to a whole host of reasons. In this section, the authors discuss the current state of VPH in practice in India.

## Central government bodies

Several initiatives have been taken at the central government level to deal with issues related to VPH in India. For example, the Ministry of Health and Family Welfare and the Ministry of Agriculture formulated a National Committee on Zoonoses in 1978 (8, 16). With active support from WHO, these Ministries also formed a Joint Monitoring Group on Avian Influenza in 2004 (26) and a National Influenza Pandemic Committee (27) for the prevention and control of avian influenza in 2005.

## Veterinary public health activities at the state government level

Agriculture and animal husbandry in India are, by and large, controlled by the state government, and most states have a well-established animal husbandry and animal health sector. However, intersectoral collaboration on VPH issues is largely missing in most Indian states. Two notable exceptions are the north-eastern state of Mizoram, which formed a state-level 'Standing Committee on Zoonoses' (28), and the western state of Goa, which has a stated mandate on public health (29). Nevertheless, almost all the states of India have laboratories for disease diagnosis. These laboratories issue animal health certificates for food export purposes, certifying that certain categories of food items/ingredients are fit for human consumption (30). Some laboratories of ICAR and state agricultural/veterinary universities occasionally serve the same purpose (31).

## Veterinary public health activities at the municipal level

At the local government level, municipalities, especially the larger ones, play an important role in VPH activities in the form of meat inspection in the slaughterhouses under their jurisdiction (8). Even privately owned and operated slaughterhouses engage veterinarians (to a limited extent) to meet export inspection requirements. However, at the municipal level, broad-based modern programmes are lacking, and veterinary supervision of most abattoirs is hampered by inadequate financial support and outdated facilities (8).

Municipalities in many Indian cities are involved in controlling stray dog populations, chiefly for rabies control (32). The earlier practice of capturing and poisoning stray dogs (8) is now being replaced by animal birth control programmes (32, 33, 34).

#### Role of professional associations and non-governmental organisations in veterinary public health activities

A number of professional organisations are involved in promoting VPH in India. Prominent professional associations engaged in VPH activities include the Indian Association for Veterinary Public Health Specialists (35), the Veterinary Public Health Association of India (36), the Association of Public Health Veterinarians (37), the Association for the Prevention and Control of Rabies in India (38) and the Public Health Foundation of India (PHFI) (39). The recent Roadmap to Combat Zoonoses in India (RCZI) initiative of the PHFI aims to create a broad-based collaborative platform integrating professionals from various sectors to combat zoonoses through a 'One Health' approach (40). However, this organisation mainly focuses on the academic aspects of VPH.

#### International organisations

##### *World Health Organization: South-East Asian Regional Office, New Delhi*

The South-East Asian Regional Office (SEARO) of WHO in New Delhi served as the platform for various early VPH activities in India (2). The organisation sponsored important activities, notably a WHO inter-regional seminar on 'Veterinary Public Health Manpower Development' in New Delhi in 1978 (41) and a WHO inter-country seminar on the 'Planning of National and Regional Programmes for Surveillance, Prevention and Control of Zoonoses and Related Foodborne Diseases', also held in New Delhi, in 1979 (41). At various times, SEARO has supported VPH activities in India, by, for example, funding fellowships to study zoonotic disease control programmes and organising seminars, training and workshops on the surveillance and control of zoonoses such as rabies (8).

### *Food and Agriculture Organization of the United Nations, New Delhi*

The Food and Agriculture Organization, which is a United Nations organisation, was also instrumental in the development of VPH activities in India. The organisation worked mostly with the Ministry of Agriculture (specifically the Department of Animal Husbandry, Dairying and Fisheries [DAHDF]), to manage zoonotic diseases, especially avian influenza (42). In fact, the Indian action plan for avian influenza was developed in active consultation with the New Delhi office of the FAO (42). Additionally, FAO and WHO provided a number of expert committee reports on zoonoses and VPH that have formed the basis for implementing VPH activities in India (43, 44).

### **Milk cooperatives**

In India, milk cooperatives, such as the Gujarat Cooperative Milk Marketing Federation Ltd (GCMMF, under the brand name AMUL) (45), other cooperative societies in various Indian states and some private companies also contribute towards VPH by improving their milk hygiene practices. As a result of the well-organised and supervised establishment of milk-handling, processing and marketing procedures (45) these institutions have significantly assisted in raising the quality of marketed milk and milk products in India. They have been helped in this by government support schemes and legal instruments for improving the quality of raw milk produced in villages (9), e.g. the Food Safety and Standards (Food Product Standards and Food Additive) Regulation, 2011, and the Food Safety and Standards (Prohibition and Restriction on Sales) Regulation, 2011.

### **Personalities**

In the formative years of VPH development in India, a number of expert professionals from India and abroad made significant contributions. Among them were Dr C.M. Singh, Director of IVRI and adviser to WHO (2, 17), and Dr Calvin W. Schwabe, Professor of Epidemiology (School of Veterinary Medicine, Davis) and WHO consultant. Dr Schwabe prepared the 'Assignment Report on Training

in VPH (India)' for WHO in 1968 (2). Other experts who contributed to VPH in India in the early years include D. Cohen, who compiled the 'Assignment Report on Strengthening of Health Services (Epidemiology), India' for WHO (2); James H. Steele, Assistant Surgeon General of the US Public Health Service and WHO consultant; K. Bogel, WHO virologist, VPH unit, Geneva; and B.C. Hobbs, Director of the Food Hygiene Laboratory, Public Health Laboratory Service, London (2).

### **Current issues in veterinary public health in India**

In the Indian government's 12th Five-year Plan, the Ministry of Health & Family Welfare and the Ministry of Agriculture have laid out ambitious plans to improve VPH activities, particularly in the areas of zoonoses, food safety, antimicrobial resistance and disease surveillance (13, 46). The DAHDF also proposed the Prevention and Control of Infectious and Contagious Diseases in Animals Bill, 2005 (47). This Bill has now been enacted as the Prevention and Control of Infectious and Contagious Diseases in Animals Act, 2009, with separate provisions for zoonotic diseases under Article 253 of the Indian Constitution. At present, India is confronted with multiple issues, such as the lack of public health delivery systems in villages, a shortage of qualified veterinarians and limited financial resources. Some of the key VPH issues affecting human health and the livestock sector are discussed in the following sections.

#### **Stray animal population**

Although accurate estimates are lacking, India is home to a large number of stray and peridomestic animals (48). Available estimates reveal that there are approximately 2.6 million dogs in urban areas, out of an estimated total of 19 million dogs (49); more than 20,000 stray cows in the national capital of New Delhi (50); and considerable numbers of stray pigs, cats, rodents, monkeys and other feral and wild animals, some of which are pests (48). These animal populations, which live in close proximity to crowded human settlements, constitute a significant risk for the perpetuation of many zoonotic diseases and transmit infections to humans through contaminated food

and water (51, 52). Moreover, the presence of stray animals, their carcasses and excrement create an unsightly public nuisance and pollute the environment (53).

### **Unregulated markets for milk, meat and fish**

In India, there are numerous unregulated markets for milk, meat and fish and the trading practices followed in these markets are far from desirable (48). India is the largest producer of milk (49) and available estimates reveal that approximately 60% of the milk produced reaches the market, and that three-quarters of this is sold through informal chains, where compliance with safety standards is limited and the risk of contamination is high (45). These informal marketing chains are highly fragmented and include local milk vendors, wholesalers, retailers and producers (54). Dairy products are sold mostly through local sweet shops that are privately owned; these shops are currently subject to general government oversight (55), but food businesses are gradually coming under the supervision of the Food Safety and Standards Authority of India and will thus be subject to certification and registration requirements (56).

Another problem at milk markets is that adulteration of milk is not uncommon. Among the most common chemicals added are urea, neutralisers and detergents (13). Antibiotic residues from regular and off-label use also pose a further challenge to the quality of milk marketed in India (13).

The production, handling and marketing of most meat, like that of milk, is also highly unregulated, with few facilities for food animal handling, slaughter, marketing or the disposal of by-products and waste (57). Although there are 30 export-oriented modern abattoirs and 77 export-oriented meat-processing plants registered with the Agricultural and Processed Food Products Export Development Authority (exporting chilled and frozen meat to about 56 countries) (13), in general the meat-processing sector is dominated by the slaughter of animals for the direct consumption of fresh meat (45). In the poultry sector, too, most meat is sold at unregulated wet markets, which are comprised mostly of roadside vendors catering to local

populations (58, 59). Meat from other livestock species, such as goats and pigs, is also produced under similarly unregulated and insanitary conditions (59, 60). The presence of unsupervised meat markets – coupled with a tropical climate favouring microbial growth, as well as inadequate abattoir hygiene measures and the absence of surveillance of meat-borne diseases – further enhances the risk of meat-borne diseases, occupational hazards, and zoonoses such as tuberculosis, listeriosis and brucellosis (48, 61).

Fish marketing in India is also not well regulated and often presents a dismal picture (62). The physical amenities and infrastructure of most fish markets are far from satisfactory, and the fish are of variable quality (63). A previous study noted that the majority of fish retailers operate by the roadside with no quality or hygiene measures and no access to facilities such as clean drinking water, shelter, or dressing platforms (62).

The low hygiene standards at milk, meat and fish markets, together with the adulteration of food products, mean that India continues to face challenges in providing all its citizens with safe and high-quality nutrition (64).

### Unauthorised slaughter in India

There are estimated to be 25,754 unregistered slaughterhouses in India (13) and approximately 50% of animals slaughtered in urban areas come from these unauthorised slaughterhouses (65). Slaughtering and carcass-dressing are performed in open areas in highly unhygienic conditions and most of the meat is sold with little or no veterinary inspection (45, 66). The adulteration of meat is not uncommon in India (13). Common adulterants include non-meat ingredients such as blood proteins, edible offal, etc. and the addition of flour, plant proteins, starch, etc. (13).

### Problem of animal waste disposal

India houses a substantial portion of the world's livestock population (67), and approximately two million cattle and buffalo, 50 million

sheep and goats, 1.5 million pigs and 150 million poultry are slaughtered annually (13, 68). Most of India's 3,894 registered slaughterhouses have low hygiene standards, posing a health concern for the workers, and cause environmental hazards as a result of their disposal of wastes and effluent discharges (48). Registered slaughterhouses are generally under the supervision of local authorities and the majority are in a dilapidated condition, with no facilities to process or dispose of by-products, leading to air and water pollution (57, 66, 68). There is thus an urgent need to improve existing slaughterhouses and to establish plants that can process animal carcasses and by-products throughout the country.

#### Animal welfare/ethical issues

There is increasing evidence that animal welfare issues have a direct bearing on the quality and safety of animal products and on environmental pollution (69). Since animal welfare issues get scant attention in resource-poor developing countries (70), it is reasonable to assume that animal welfare is not taken seriously in India, despite the existence of the Animal Welfare Board and other institutions, such as the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) and the National Institute of Animal Welfare. Their activities remain mainly focused on the prevention of cruelty to animals, since almost all of them work under the Prevention of Cruelty to Animals Act, 1960 (71, 72, 73). Since trade in high-welfare animal products is slowly increasing (70), this presents an opportunity to increase the trade and export potential of developing countries such as India (48, 69).

#### Zoonotic diseases

India is a hotbed of many zoonotic diseases that place a large burden on public health (74, 75). About 40 zoonotic diseases are commonly reported from India, including anthrax, brucellosis, plague, rabies, tuberculosis (zoonotic), leptospirosis, salmonellosis, campylobacteriosis, listeriosis, verotoxic *Escherichia coli* infection, Japanese encephalitis, and Kyasanur Forest disease (76). A substantial

portion of the human population in India live below the poverty line (67) and zoonotic diseases disproportionately affect these poor and marginalised communities, especially women, since they interact more closely with animals and often live far away from any available health services (75, 77). A number of zoonoses, such as avian influenza, Nipah virus infection and leptospirosis are known to be emerging or re-emerging (78, 79). Certain other zoonoses are believed to be associated with the illegal slaughter and improper disposal of animals (48). Moreover, the large numbers of stray animals in India are also considered potential sources for the spread of zoonotic infection (48, 80, 81, 82).

#### Other veterinary public health issues

There are other VPH-related issues, such as the need to upgrade preventive Veterinary Services, the quality control of veterinary drugs, and a lack of funding, which need to be addressed.

There appears to be a huge imbalance in India's Veterinary Services, with preventive activities receiving little attention, resulting in the high endemicity of many animal diseases and zoonoses. More than 60,000 veterinary institutions (including veterinary hospitals, veterinary dispensaries and veterinary aid centres) operate throughout India, under the direct control of the various states and union territories (67). However, more than 75% of staff resources are devoted to curative veterinary care and only 3.5% are engaged in preventive veterinary activities, such as disease investigation and control (77).

VPH services are perceived as a public good requiring government expenditure (10, 83), but the lack of necessary finances poses a huge challenge. It has been estimated that the funds required to modernise all slaughterhouses in India would amount to approximately 15,000 crore rupees (Rs) (approximately 2.2 billion USD or 2 billion EUR) (57); the estimated budget of the DAHDF for the year of 2011–2012, is only Rs 1,600 crore (approximately 243 million USD or 218 million EUR) (84).

Finally, the adulteration and quality control of veterinary drugs is a major area of concern, with few facilities in India available for authentication or testing (13).

### **Future needs of veterinary public health in India**

India has been tackling epidemic animal diseases since the establishment of the Cattle Plague Commission in 1868, during the British colonial era (85). The Indian veterinary and livestock sectors have made considerable progress since then, but there are certain areas where developments have been less than optimal. The Working Group on Animal Husbandry and Dairying, of the Planning Commission, Government of India (46), has identified the following as areas for improvement: access to organised markets, the provision of adequate veterinary care, organised slaughter and use of by-products, livestock extension services, the availability of trained and qualified staff, access to information on livestock, facilities for disease diagnosis, and surveillance and forecasting. Many of these areas directly relate to VPH. Since the entire range of VPH issues is very wide, judicious prioritisation is needed if we are to use resources wisely and make effective changes (86). In future, VPH needs holistic support for the following issues to expand VPH services throughout the country.

### **Capacity, capability and expertise-building**

The ability to build capacity is considered an essential component in creating awareness and in developing a 'VPH vision and approach' (86). Though India is known to have modernised its undergraduate veterinary public health curriculum in a harmonised manner throughout the country (1), there is a need to focus more on core VPH issues, including zoonoses and food safety, as this will enable Indian livestock products to compete globally for their market share. Opportunities for in-service training in the field of VPH are also highly desirable (86). To be more specific, increased capacity, capability and expertise in the areas of zoonosis control and food safety are urgently required if VPH is to be integrated into overall public health activities.

### **Mobilising funding and resources**

In most developing countries, including India, resources for controlling zoonoses and foodborne diseases are scarce (75, 86). Therefore, funding for existing and new VPH public programmes – such as the strengthening of animal disease and zoonosis surveillance and control and the modernisation and expansion of slaughterhouses – should be allocated on a priority basis. Strong government support is essential for improving VPH services in India.

### **Prioritising research needs**

In view of India's limited resources, research priorities must be carefully defined to reap maximum benefits from the existing VPH infrastructure. In order to manage VPH risks, it is imperative for Veterinary Services and veterinary professionals to detect zoonoses and foodborne risks promptly and accurately (1). For this to take place, multidisciplinary and multisectoral research on the epidemiology of zoonoses, food contamination, environmental impacts, and disease management options should be favoured.

### **Strengthening zoonosis management**

India has the second-largest human population in the world (67), one of the most dense livestock populations, and two biodiversity hotspots (87). Its livestock keepers are poor (88) and an average of 20,000 animals are served by only one veterinarian (89). For these reasons, India is considered particularly susceptible to the emergence and re-emergence of zoonoses from wildlife and domestic animals (90, 91). Against this backdrop, strengthening zoonosis management through intersectoral collaboration and participation would be a highly effective VPH initiative.

### **National intersectoral and international collaboration**

Since modern VPH activities are essentially multidisciplinary in nature (1), collaboration between different government sectors at all levels is essential for success. In India, the problem of zoonoses in humans and animals is addressed by the Ministry of Health and

Family Welfare and the Ministry of Agriculture, while the Wildlife Institute of India focuses on zoonoses in wildlife. This represents a fragmented approach to the problem (75). Similarly, veterinarians and staff in animal husbandry departments, who are responsible for primary livestock production, are often not involved in the quality inspection of livestock products, which rests with health officials (13). Again, this reflects a disjointed approach to 'farm-to-fork' quality assurance. To address these issues, intersectoral collaboration, involvement and participation is vitally important.

In an increasingly globalised and interdependent world, political boundaries are no barrier to zoonotic diseases, food-associated health risks and environmental pollution (92). International cooperation among nations on VPH matters is encouraged by various organisations, such as the OIE, the Codex Alimentarius Commission, FAO and WHO. Therefore, it would be prudent for India to develop and foster national and international cooperation to reap benefits in managing VPH risks.

### **Public awareness and information-sharing**

Public education is crucial in creating awareness of VPH issues within the various strata of society, including policy-makers, professionals, consumers and producers (86). It has been observed that raising community awareness of VPH issues is often vital to the success of VPH programmes (1). Therefore, linking agencies that deal with VPH issues with institutions responsible for disseminating information, e.g. the mass media and the communication wings of various government and non-government organisations, will be very important in improving VPH services in India in the future.

### **Conclusions**

Though VPH does not enjoy a formal status in India, considerable efforts have been made on various fronts by diverse government and non-governmental initiatives. It is impossible to over-emphasise the need for a functional VPH service to complement the overall healthcare infrastructure in India, and so past and present attempts to

improve VPH must be further reinforced to achieve sustainable good health for all citizens. Strengthening India's national Veterinary Services, through balanced promotion of the public and private sectors, professional development, political commitment and regulations enforced within a well-developed policy framework, would all help to improve the overall VPH scenario in India.

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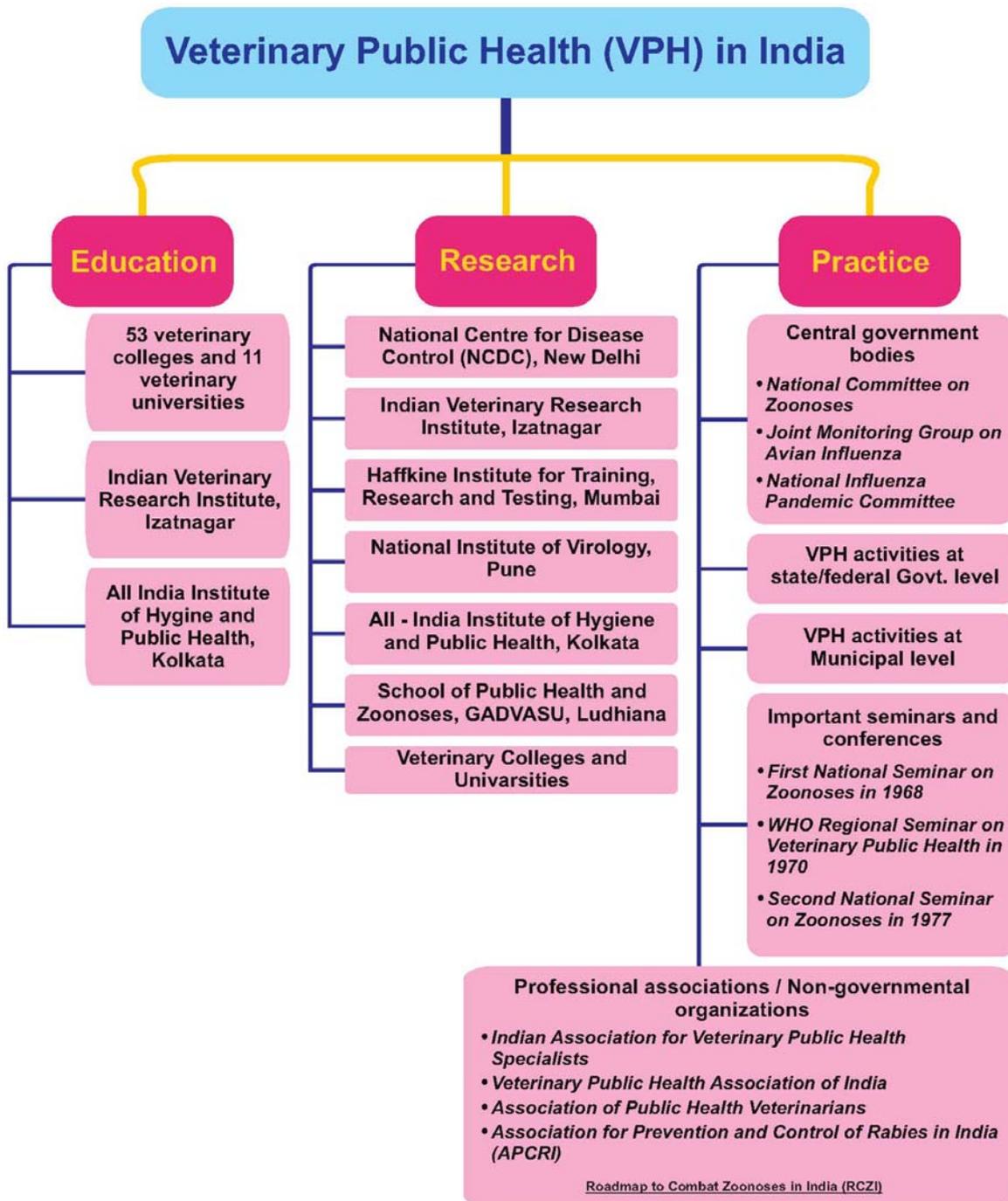
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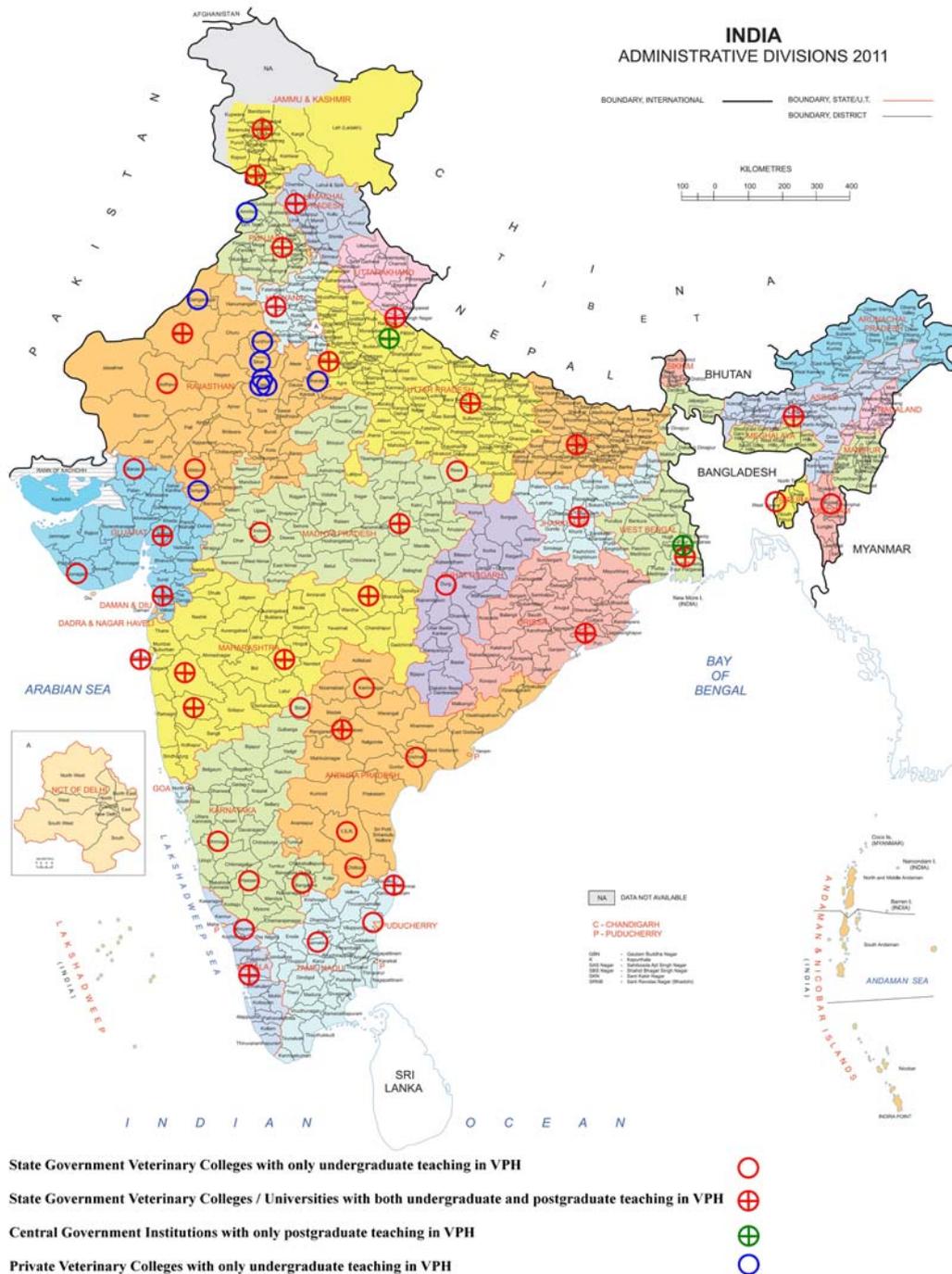
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**Fig. 1**  
**Components of the veterinary public health system in India**



**Fig. 2**  
**Location of undergraduate and postgraduate veterinary teaching institutes in India**

Source: Veterinary Council of India (12), and individual college websites