



Veterinary education in India: Shaping the future agenda with focus on veterinary public health education

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ABSTRACT

Veterinary education provides human resource required for augmenting public good. In a country, where up to 80% population is rural and animal husbandry is the livelihood, veterinary profession provides the desired professional coverage. The available 46 colleges are inadequate to turn out the required number of vets. Out of these, only six conform to the standards laid down by the Veterinary Council of India. One lacuna that remains, common to all, is 'shortage of teachers'. This paper attempts to address this problem. A veterinary college requires constant, continuous and caring support of government. Compliance of the VCI/ICAR accreditation inspection reports lies with the government. A synchronous functional operation of Government and veterinary colleges provides uninterrupted supply of human resource to carry out the state development programmes. Technical advisory support is provided by the VCI/ICAR. ICAR extends support through funding some research projects and also investment in building infrastructure in the form of development grants. VPHE discipline occupies a central position in veterinary teaching. On one side, it is connected with the wellness of animals – 'prevention and control of animal diseases' and on the other side it takes care of the health of humans – professionally exposed to zoonotic infections. Farmers, animal products' processors, lab workers, epidemiologists, health workers, sylvan, camping and recreational groups constitute a large chunk of population that is served by VPHE professionals. They also provide a protective role to consumers from Farm to Fork. Reputation of a college depends upon the reputation of faculty and available infrastructure. Professors of VPHE and Deans of veterinary faculty are expected to be highly knowledgeable. They need to connect horizontally with public – all stakeholders and in all such areas where veterinary services are required to address the problems. Such initiatives would benefit both. The expertise/services of veterinarians, especially VPHE personnel are not sufficiently utilized for want of a Government policy adopting "One Health", although advocated jointly by OIE, WHO, FAO and adopted by most countries. This has been advocated strongly in this paper.

Key words: India, Veterinary education, Veterinary public health

Indian Council of Agricultural Research (ICAR) and Agricultural Universities (AUs) including Veterinary and Animal Science/Fisheries Science Universities, spread over different agro-ecological zones of the country, have played a key role in transforming livestock production scenario of the country through sustained animal health research, teaching and extension services backed by competent human resource generated from these institutions. With the diversification of livestock sector, the role of veterinarians is becoming ever challenging. This sector needs to expand exponentially so that it is better equipped to share the burden in societal built-up through veterinary and animal husbandry enterprise and practices. In view of this, the development of quality human resource required at various levels has assumed greater significance to offer science and

knowledge-based interventions to the society.

Veterinary education under NARES

There are 73 Agricultural Universities (AUs) under National Agricultural Research and Education System (NARES) comprising 61 State Agricultural Universities (SAUs), 5 Deemed-to-be-Universities, 3 Central Agricultural Universities and 4 Central Universities having agriculture faculty. Of these 73 AUs, 46 Veterinary Colleges are functional in 29 Universities (Anonymous 2016) and annually producing around 2,400 graduates (NAVS 2014).

Role of veterinary education in achieving food self-sufficiency and disease eradication

Historically, veterinary teaching and services were conceived by King Louis XV of France. He authorized Claude Bourgelat, Commissioner General of the Royal Horse Breeding establishment on 1st August, 1761 to lay the foundation and concept for a Veterinary School. The

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first Veterinary School, the Royal (later National) Veterinary School, with Claude Bourgelat as its founder Director was established during Feb, 1762 in Lyons, France under Agri-reforms in order to produce cattle, beef, prevention of cattle diseases, farmers' training, grazing land, etc. The philosophical testament (Rules for the Royal Veterinary Schools - published in 1777, 2 years before his death)-"to ensure the conservation of humanity, to be of service to the human species" and 'to observe and reflect' is inclusive, comprehensive, holistic – as much as and might be more than the current concept of One Health.

Skill, knowledge and attitude are important attributes of a human resource – say for example, a teacher in Veterinary college and all vets *per se*. A vet is required to communicate with his subjects (animals of various species) with zero knowledge of their language. Immediate next in line, necessary to communicate with, is animal owner. Effective communication with the farmer becomes very difficult considering his rural background, educational status and colloquial language/dialect. Vet's attitude to both – the animal and its owner- enables him to use the professional skill and knowledge to act as 'animal welfare man' and eventually contribute to the 'food production and security'.

Historically, cattle plague panzootic led to the establishment of veterinary schools and modern veterinary education in India began in 1862 with initiation of a diploma course at Army Veterinary School, Pune. On the recommendations of "Indian Cattle Plague Commission", four Veterinary schools were established at Lahore (1882), Bombay (1886), Calcutta (1892) and Madras (1903). A civil veterinary department was also established in 1881. A gradual metamorphosis took place over a period of more than one and a half century resulting into the modern veterinary science education as of today. The Bachelor of Veterinary Science degree course was first started at Madras Veterinary College in 1935. With only nine veterinary colleges in 1947, today we boast of 46 Veterinary colleges. India has been able to eradicate rinderpest (RP), Contagious Bovine Pleuropneumonia (CBPP), African Horse Sickness and control poultry diseases due to significant contributions made by the competent human resource from these colleges and ICAR institutes.

Since 1950–51, the production of fish, milk and eggs has recorded an increase by 12, 8 and 27 times, respectively, compared to 5 and 6 times increase in food grains and horticultural products (ICAR Vision 2050). India now ranks first in milk production, accounting for 18.5% of the world production. The average annual growth rate of milk production, at 6.26% vis-à-vis the world average of 3.1% shows sustained growth in the availability of milk and milk products for the growing population (Economic Survey of India 2015–16).

Through White and Blue revolutions, animal and fish produce has been able to contribute 29% to the total agricultural production which, however, falls short compared to the global value of 40%. Therefore, much needs to be done to attain this level. This is all the more important

considering the requirement of providing food security to the projected 9.0 billion population by 2050. Two schemes launched in the 12th- Five year plan by GoI are significant in this direction: (a) Livestock Health and Disease Control aimed at transboundary diseases threatening national and international trade and (b) National Livestock Mission for sustainable livestock development through quantitative and qualitative improvement in production systems and capacity building of all stakeholders (Economic Survey of India 2014–15). Additionally, Rashtriya Gokul Mission is expected to improve indigenous breeds of cattle, upgrade non-descript cattle with elite indigenous breeds and increase milk production.

Let us review the Veterinary Science Education; its present status, shortfalls and areas requiring supplementation.

Manpower in animal husbandry sector

Veterinary graduates constitute only >1% of the total technical and science graduates, yet livestock sector contributes 3.9% of GDP (Economic Survey of India 2014–15) suggesting disparity and shortage. An estimated shortage of veterinarians, educationists for teaching and research and paravets is 32,500, 4,450 and 2,07,000, respectively (Table 1).

Table 1. Status of manpower in animal husbandry sector [Report of the Working Group on Animal Husbandry and Dairying 12th Five Year Plan (2012–17) submitted to Planning Commission, GoI]

Position	Required	Available	Gap
Veterinarians	67,000	34,500	32,500
Veterinary scientists/teachers	7,500	3,050	4,450
Paravets and other staff	2,59,000	52,000	2,07,000

Projected future for veterinarians

The total stock of graduates and above in veterinary and animal sciences, estimated from annual supplies, was about 42,166 in 2010 (Table 2).

Table 2. Overall projections of requirement of stocks of veterinarians

Year	Diploma	UG	PG	PhD	UG and above
2009–10	23,963	28,772	8,873	4,521	42,166
2019–20	38,846	45,395	15,042	7,319	67,756

Source: Rama Rao *et al.* (2011).

Assuming the outturn levels will grow at the same rate as observed during the last five years (i.e. 4.3% during 2006–10), the estimated supply and demand in 2020 would be 48,433 and 67,756 respectively with the gap being 28.5% of the demand. The current (in 2010) availability of 2,683 graduates and above students is one-third of the estimated flow of 7,672 needed by 2020. The annual out-turn required

Table 3. Students admitted and passed in veterinary science courses

Diploma		UG		PG		PhD		UG and above	
Admitted	Passed	Adm.	Passed	Adm.	Passed	Adm.	Passed	Adm.	Passed
4,925	3,136	2,358	1,761	933	797	230	125	3,521	2,683

Source: Rama Rao *et al.* (2011).

from the veterinary science education system by 2020 should be about 5,300 under-graduates, 1,800 post-graduates and 490 doctorates. The requirement of diploma holders, excluding those from dairy, would grow from 2,000 in 2010 to 2,850 in 2020 (Rama Rao *et al.* 2011).

During 2009–10, in UG and above 3,521 candidates were admitted to veterinary science courses, off which only 2,683 passed out (Table 3).

How to increase the number of veterinarians?

Acceleration of the rate of turning out graduates, postgraduates and doctorates is imperative to take advantage of the demographic dividend. This may be tapped through:

- Increasing the number of veterinary colleges
- Increasing the intake capacity in 46 veterinary colleges
- Increasing the age of superannuation as has been done for medical doctors
- Introduction of scholarships or some liberal incentives at 10+2 level for attracting students to the profession.
- Assurance of job after graduation

The Veterinary Council of India regulates veterinary practice, Minimum standards of Veterinary Education (MSVE) Regulations in all veterinary institutions across the country except Jammu and Kashmir. The Council also conducts All India Pre-Veterinary Test, for admission to 15% seats for B.V.Sc. and A.H. degree programme in veterinary colleges, while 85% seats are filled through State/college level entrance tests.

The VCI norms for a veterinary college of 17 Professors, 34 Associate Professors and 51 Assistant Professors

(provision of additional with justification) in place for an annual intake of 60 students are met with by only 6 of colleges and most of the colleges are operating around 50% of their approved faculty strength. The revised norms as per MSVE, 2016 regulations are 17 Professors, 16 Associate Professors and 41 Assistant Professors (provision of additional with justification).

Establishment of Veterinary and Animal Science Universities, recruitment of teachers in the existing colleges with enhancement of infrastructure, opening new colleges including private ones is urgently required. Qualitative improvement requires creating Centres of Excellence, capacity building for postgraduate teaching and research in the existing institutions. All these steps require liberal funding in the form of catch-up grants and escalation of budget.

The following approaches may be used:

- Use of Information and Communication Technology for online teaching for strengthening the 40 Veterinary colleges (not conforming to VCI standards) with respect to faculty requirements in short time without compromising with the quality. A repository of resource persons (National and International Professors) may be created who can deliver lectures organized through WEBINAR/recorded videos/teleconferencing and such other interactive communication technologies.
- Such technologies enable holding virtual classrooms [even permitting twice the intake capacity (60×2 students) of a college]. The existing college teachers will have added responsibility to organize practical

Virtual Global Health training

The computerized program invoked three adult education principles; active learning, learner-centered education and experiential learning and thereby served as an efficient learning tool...

Patricia A. Conrad and David Hird developed a computerized case-based CD-ROM. It offered veterinary students opportunity to “virtually” work along-side vets as they tried to solve challenging health problems relating to tuberculosis in South African wildlife, bovine abortion in Mexico and neurologic disease caused by plant toxins in Rapa Nui, Chile.

Each of the three case modules presented, in a highly interactive format, a problem or mystery that must be solved by the learner..... wildlife and livestock management practices, diagnostic methods, related disease control issues, economic factors, human health risks and the opinions of local experts. formulate an action plan to confirm the diagnosis or make appropriate health recommendations.

Individual cases or their component parts, such as videos and animations, developed for this program are freely available and have been used in courses offered online and in the classroom as well as for auto-tutorial instruction. The program is accessible on the Web at http://calf.vetmed.ucdavis.edu/html/International_web/international_menu.html. A broadband internet connection is recommended.

Source: Conrad *et al.* (2009)

classes. Illustrative guiding example is ‘Virtual global health training’ (see box). Once the current requirement of the number of teachers and veterinarians is met, we may revert back to “interpersonal/one-to-one contact between teacher and student-system” and use this facility for demanding tailor made courses.

- Collaboration with foreign Universities and/or developing Memorandum of Understanding. Qualifying countries should have good faculty and infrastructure to share and need to supplement their professional human resource with Indian vets.

Hypothetically, say, demographically poor USA/Japan is experiencing shortage of human resource. A US-University ties up with one or more veterinary colleges in India, supplements the faculty (personal or online teaching) and adds to infrastructure. In return, trains, say 10, Indian students to serve in US. This means 60+10 students would be admitted every year to this programme. This also falls in line with the GoI’s plan to provide skilled manpower to the world. Presently, while IT professionals are in demand for this kind of programme, attempt should be made to include veterinary professionals for this programme.

Quality of veterinary education

The word university is derived from the latin ‘*Universitas magistrorum et scholarium*’ which roughly means community of teachers and scholars. It is an institution of higher or tertiary education and research, granting academic degrees – under and postgraduate. It makes students ‘whole/universus’. Therefore ‘universities are for the-, of the - and by the students and teachers’. A total absence of either would mean closure of the universities. There is an essential need for a third component – ‘facilitator’, commonly known as university administration.

Roles are defined for the learner, teacher and administrator. This trio performing, without losing sight of the objective, will enable university to turn out quality graduates and postgraduates capable of responsibly discharging their duties towards society, institution and nation.

Often University administration forgets the ‘facilitator’s role’; arbitrary authoritative bureaucratic decisions/overdoing and underdoing (shirking from or shelving responsibility/compromising with principle or rule) create serious problems.

State’s/centre’s responsibility and role

Veterinary colleges under State/Central/Private organizations are in fact (a) research and development institutions in the area of animal production and (b) related human resource production. Product quality is directly related with the number of quality personnel in position; in the instant case, teachers. Government should provide good infrastructure facilities, fund and adequate freedom for research and academic growth.

Autonomy

The academic regulations as per VCI spare about 45–48 days only in a year consisting of two semesters to conduct all examinations (internal, external, practical), evaluation of papers and declaration of results. Regulations in most of the Agricultural Universities are not so stringent. Therefore, academic autonomy is required in veterinary colleges. Swaminathan Committee report (Anonymous 1997) recommends “where no separate veterinary university has so far been set up, the administration of agricultural universities should ensure that the veterinary and fisheries colleges under the SAUs should be granted the status of Autonomous colleges so that they can function with the needed autonomy and accountability.”

Faculty

Many colleges run with half to one-third of the sanctioned strength of teachers ignoring the recommendations of the Inspector of VCI. The State Govt. Departments controlling the Universities must respect the reports of VCI/ICAR Accreditation Committees and promptly initiate action to remove deficiencies with respect to the faculty/infrastructure. Active recruitment process, synchronizing with anticipated vacancies and thawing of ‘frozen posts’ held by the promotee teachers is important. Teaching may not be preferred by many and thus candidates for recruitment may not be available. ‘Teachers in making’ may be identified from academically excellent candidates from bachelors and postgraduate levels. They may be encouraged to clear NET/ARS exams by assuring appointment with advanced increments/attractive pay packages. Universities should make provision for ‘star salary’ as per the practice in vogue in USA, China, South Korea, Singapore, etc. to retain good faculty.

Linkages with beneficiaries

Relevance of veterinary colleges, education and professional can become more visible through establishing connection with beneficiaries, communicating with them and linking activities to their benefit/advantage.

Veterinary colleges can contribute to the National Prosperity Index by augmenting the quality of life in the 6,00,000 plus villages of India through ‘connectivity’. Wherever possible, linkage between “College-Govt.-Industry and People” should be encouraged. It is needless to mention that Peoples’ participatory Epidemiology/surveillance has helped control bird flu (Highly Pathogenic Avian Influenza–2009) in Indonesia.

Advantages of connecting Veterinary colleges with beneficiaries:

- Connects teachers and students with beneficiaries
- Interface provides opportunity for innovations
- Application of classroom acquired knowledge is facilitated
- Facilitates health and production delivery
- Opportunity to understand rural settings, farmers’ problems and to develop village teams for resolving

their problems

- Participatory Disease Surveillance and Response and Village based Biosecurity education and Communication programme
- Beneficiaries’ settings provide a real laboratory with vets posted in situ as experienced guides
- Students get used to the conditions of future place of postings
- Helps create a database on animals’ health and production that may be digitized, enlarged to cover entire state and eventually a national database.

There may be more than one beneficiary; may or may not be an organized sector. The college Dean may organize such beneficiary groups’ meetings, invite, explain what the college is doing for their benefit and discuss opportunities where college can make more contribution. For example, he may connect the VPH department with FSSAI (Food Safety and Standards Authority of India, established under Food Safety and Standards Act 2006) Commissioner, milk producers and vendors, consumer groups/representatives and offer lab. facilities for testing, training and conducting need-based studies.

Funding

The Government of India in the past allocated a ‘one time grant’ of Rs. 100 crore to Kerala Veterinary and Animal Science University. Such grants from Govt. must flow from time to time for capacity building in the Veterinary Universities. The Department of Animal Husbandry of the

state governments should adequately fund the colleges to sustain supply of professionals, continued education and research. Following facts need to be realized:

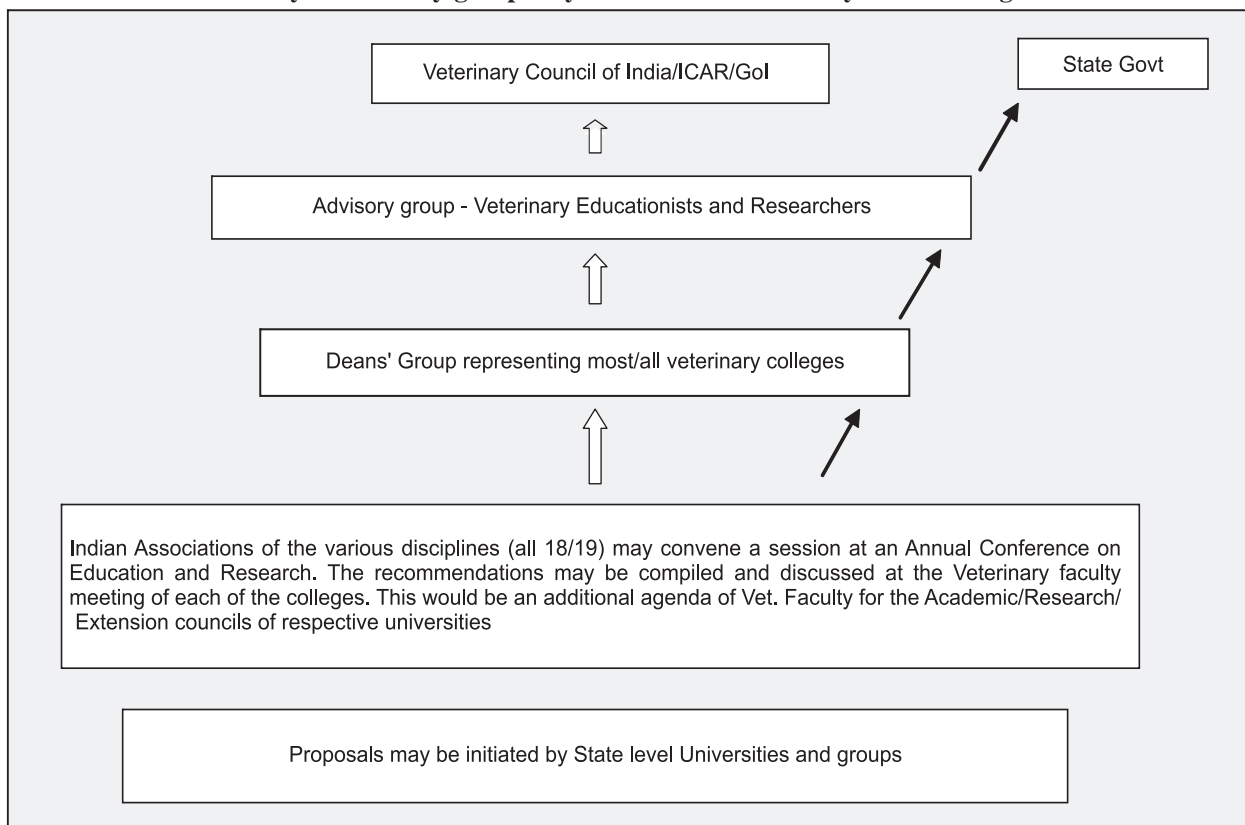
- Veterinary colleges are the R and D centers in the state in the area of animal production, animal diseases including zoonoses and food safety.
- The clinics at veterinary colleges should be strengthened with suitable financial support and designated as the State Veterinary Referral Centres. Similarly, other units such as animal farms as nodal training centers or diagnostic labs as state’s most dependable centers for tests not conducted elsewhere in the state must be suitably financed.
- Broad areas of research and the required infrastructure for each or most of the departments need to be identified and supported for a sustained contribution.
- Some of these activities excellently executed may attract Financial Institutions; attain Centres of Excellence, National centres,etc.

This approach should be able to amend the courses, give direction to meet societal and market demands and identify research areas funded by state/central government. This system offers a check on development of a situation of stagnancy feared out of continuous apathy and in-breeding.

Course curricula and new courses

The curricula should be in sync with the changing role of veterinarians, from ‘traditional animal doctors’ to ‘quality assurance managers’ and ‘VPH policy negotiators’ (Ortega

Academic advisory/consultancy group may be constituted that may function as given in Box 2.



et al. 2007). The process of revision of the syllabus by VCI is time consuming and fails to keep pace with the changes in the advancement of veterinary science. Some mechanism, therefore, needs to be evolved to address this issue of timely and regular revision of the syllabus.

A teacher should be the initiator and has to proactively take responsibility for modification/addition to the contents of lecture dynamically in sync with the requirements of time. It is suggested that the society of a discipline, say IAVPHS, that is represented mostly by the teachers from colleges across the country may discuss and unanimously agree on a revision, when more than 60% of the contents of the syllabus in vogue have become obsolete. VCI may subsequently agree/authorize the universities to process the 'revised syllabus' through the respective Academic Council and Board of Management.

a. Competency driven curriculum

The Veterinary Council of India has been consistent in its objective of providing a curriculum that turns out a good professional. Emphasis has been laid on 'hands-on' laboratory, farm practicals and lots of clinical practice. The syllabus is so designed to offer a good blend of "Flexenerian structure" (basic/preclinical, followed by paraclinical and finally clinical disciplines) and "outcome-based" curriculum. There is a suggestion (Viner and Jenner 2005) to introduce 'Clinical audit'. Clinical audit may be defined as "a quality improvement process (Fig. 1.) that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and the implementation of change".

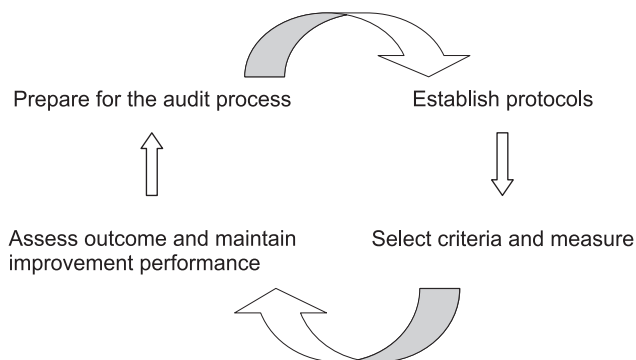


Fig. 1. Clinical audit (Viner and Jenner 2005).

This is a continued cyclic process designed to bring about improvement by means of organizational change. The driving forces are (a) desire to improve, (b) assuring quality of safety standards and (c) satisfying the government that it is obtaining good value for its health spending. This forms a part of the overall strategy of clinical governance, which oversees the whole range of delivery of services to patients.

The outcome-based and clinical-audit are gaining more popularity and thus either at the level of curricula revision or at the level of course delivery this shifting emphasis needs to be kept in mind.

b. In tune with syllabus in other countries

The world has shrunk with open trade and globalization. So far as service sector is concerned, Indians are rated the best manpower. Indian veterinary graduates thus need to have equal opportunity. Inter-country collaborative programmes that coordinate improvements in school accreditation, professional certification and curricular harmonization across the whole continent are operational in American countries. There is thus a need to examine the existing veterinary curriculum in the light of global curricula, making it consistent with at least European Association of Establishments of Veterinary Education and also the requirement/criteria of American Veterinary Medical Association. The possibilities of international accreditation agreement for professional veterinary degrees on the pattern of 'Washington Accord' need to be explored. VCI may seek the assistance of selected Professors and Deans in this regard.

For continuous progression of capability and competence, continuing veterinary education (CVE) must be made mandatory personal obligation of all responsible Veterinary Surgeons. The recommended minimum continuing professional development (CPD) in UK is 105 hours over a rolling three year period with an average of 35 hours per year (Quentin-Baxter *et al.* 2005).

Interfaces

It is necessary to be aware of the interfaces touching the veterinary education and practice. While revising syllabus of the first year courses of BVSc and AH degree programme, it is essential to have knowledge about the method of teaching and contents of the syllabus at the level of +2. Similarly, knowledge of development in the areas of national and international live animal trade would be required to tailor the contents of animal production and study of epidemiology. Knowledge of current OIE requirements about the quality of frozen semen, embryo and live animal, safety requirements for veterinarians, animal attendants, standards of products of animal origin, etc. is essential for revising syllabus of the related courses.

Dean of Veterinary faculty is the academic advisor to the Vice-chancellor. He needs to be well-acquainted with such interfaces in education system, national policies in areas with emphasis on veterinary profession, collaborations and Memorandum of Understanding with other countries in the areas of veterinary education, etc.

Integration

In the delivery of veterinary professional knowledge and skills integration of paraveterinarians (including laboratory workers), primary animal producers (individual owners/farm managers), the manufacturers of value added products, consumers of animal produce marketing and commercial organizations and other stakeholders is very essential.

Earlier, veterinary colleges used to run training programmes for compounders and livestock assistants. Similar short-term need-based diploma/training

programmes in specialized areas such as wildlife, marketing of animal produce, phytosanitary regulations, etc. need to be run by integrating the curricula.

Quality and monitoring

Website for almost each and every veterinary college is available at present. Reputation of a college primarily depends upon the quality of the faculty reflected through these websites followed by employment percentage/ placement and finally by the graduates' performance. Professors and Associate Professors are expected to have earned reputation in their respective fields of specialization. Assistant Professors are expected to make strong base through 'horizontal expansion' of knowledge over which they grow vertically. Colleges have the potential to attract students from around the world. All 46 veterinary colleges thus provide a national repository of reputed scientists and teachers.

Improvement is a continuous process. Every college should have a system of ongoing internal assessment. It should define parameters for its evaluation and strive hard to excel over time. Our colleges/universities, are externally monitored by the VCI/ICAR/Accreditation agencies. One may adopt 'Six sigma', a management technique, recently introduced in education. Selection for centre of excellence followed by lucrative grants for teaching, research, book writing etc. is likely to promote healthy competition, thereby promoting capacity building.

Veterinary public health and epidemiology education in India

Epidemiology (study of determinants of disease in population/herd) is a subject common to and essential to understanding diseases of animals and humans. Epidemiology is subtly but very significantly ingrained in Veterinary Science. Veterinary Science largely deals with herd/flock/population. Prevention of diseases is the most economical method of maintaining animal health and production. The essential tools are Monitoring and Surveillance, Disease Intelligence ('Early warning systems must provide enough time to mobilize all resources and timely organize preventing measures', viz. tele-epidemiology, remote sensing, geographic positioning system to link remotely sensed data, proactive monitoring), Risk Assessment, Effective Channel of Communication, Action and Advocacy, etc. These have succeeded in controlling most of the zoonotic/pandemics as these are common to both human and animal disease control and central to the concept of One Health.

Veterinary Public Health (VPH) is "the sum of all contributions to the complete physical, mental and social well-being of humans through an understanding and application of veterinary medical science. It is multidimensional and is already connected to veterinary medicine and animal production and has the potential to connect outside with wildlife and global public health (Narayan 2011).

'One Health' is defined as a collaborative, international, cross-sectoral, multidisciplinary mechanism to address threats and reduce risks of detrimental infectious diseases at the animal-human-ecosystem interface (http://www.fao.org/ag/againfo/home/en/news_archive/2010_one-health.html).

The overall objective of the strategic framework of One Health represents an international public good. While it does not prioritize diseases to target, it does have a clear aim to benefit the poor by helping to reduce the risks of infectious diseases that are important locally – e.g. Rift Valley fever, tuberculosis, brucellosis, rabies, foot and mouth disease, African swine fever and *Peste des Petits Ruminants*. The One World One Health paradigm is aimed at improving global, national and local public health, food safety and security and the livelihoods of poor farming communities everywhere while protecting fragile ecosystems. (FAO 2009).

Cost of human-animal disease greatest for world's poor

India, Nigeria and Ethiopia are the most impacted. It is estimated that one in eight livestock animals in poor countries including India is affected by brucellosis, reducing milk and meat production in cattle by 8%. In addition, 27% of livestock in developing countries showed signs of current or past infection with bacterial food-borne disease. Report identified 13 such zoonotic diseases (including TB, Anthrax, Hepatitis E) which together caused 2.4 billion human cases, 2.2 million deaths annually, mostly in low and medium income nations – Gilbert, N. (2012).

According to Grace (2014), one dollar invested in One Health can generate five dollars' worth of benefits and a global investment of US\$25 billion over 10 years could generate benefits worth at least US\$125 billion.

The conjoint efforts to systematize VPH capacity building date back to 1964 with establishment of a Division of Zoonoses at the National Institute of Communicable Diseases (now National Centre for Disease Control, New Delhi).

VPH has been a component of the veterinary curriculum but with different names. College of Veterinary and Animal Sciences, G. B. Pant University of Agriculture and Technology had a post of Assistant Professor (Zoonoses) and Master's degree course in VPH in 1965 much ahead of the course that started at the All-India Institute of Hygiene and Public Health, Kolkata in 1970. Later, VPH Division was established at the Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh in 1971.

MSVE-1993, revised in 2008 are in vogue at all the veterinary colleges in India imparting BVSc and AH degree. Students take 3 courses with a total of 9 credit hours in semester system. This has been revised with MSVE-2016 to annual system with 4 credits.

Postgraduate in VPH includes a 2-years Master's and 3-years PhD degree programme of 60 and 75 credits

respectively comprising major, minor and supporting subjects, seminar and research (Agricultural Education Division 2009).

Admissions to UG and PG courses are through competitive tests indicating 'quality education'. ICAR conducts All India Entrance Examination for Admission (AIEEA-UG) for 15% seats of agriculture and allied science subjects (other than veterinary science) and award of National Talent Scholarship (NTS) for Bachelor degree programmes (including 15% seats in Dairy Technology at NDRI, Karnal). Similarly, it conducts All India Entrance Examination for Admission (AIEEA-PG) for 25% seats of agriculture and allied science subjects (including veterinary and animal sciences) for Master's degree programmes of SAUs and 100% seats of ICAR-Deemed-to-be-Universities (DUs) and award of ICAR-JRF/NTS (PGS) in different universities across the ICAR-AU system. The ICAR also conducts All India Competitive Examination for admission to 25% seats of agriculture and allied science subjects (including veterinary and animal sciences) for pursuing Ph.D degree and the award of ICAR-SRF (PGS) in different universities across the ICAR-AU system (Agnihotri and Rana 2012). From the academic session 2016–17, the seats for doctoral degree programmes at the four ICAR-DUs, viz. IVRI, NDRI, IARI and CIFE are to be filled-up through their own separate national level entrance examinations.

Demand of VPHE personnel

The contemporary roles envisaged for veterinarians (Ortega *et al.* 2007) in different functional areas related to VPHE are: disaster management; transboundary movement of animals, diseases transmission and spread; averting emergence of diseases; animal welfare, consumers and animal food production system –related, antibiotic use and emergence of resistance; sustainable production, protection of both man and animals - environmental management related national and international policies.

VPHE personnel have huge potential of employment in many areas on account of following facts:

1. Eighty per cent of livestock sector is mixed farming, managed by small and marginal farmers. This close proximity exposes farmers to a variety of zoonoses (Kakkar *et al.* 2013).
2. VPHE specialists are most suited to fill positions in the animal produce and product processing chain up to consumers; as Lab workers, Epidemiologists, Health workers caring Sylvan, Camping and Recreational groups.
3. Approximately 75% of recently emerging infectious diseases affecting humans are of animal origin and approximately 60% of all human pathogens are zoonotic (Bueno-Mari *et al.* 2015).
4. To meet the requirements of World Trade Organization (WTO), Agreement on Agriculture (AoA) and Sanitary and Phyto-sanitary (SPS) measures.
5. Utilizing the services of Veterinary Public Health

Specialists in the programmes like IDSP (Integrated Disease Surveillance Programme) with respect to zoonotic and foodborne infections.

6. VPHE professionals on account of their holistic and collaborative approach by training have better understanding of integrating national and international problems and are good resources for finding easy economic solutions at local and global level. They can liaison best with national and international organizations like WHO, FAO and OIE.

Some developments in the area of VPHE

Following developments are worth appreciating and helpful in building institutional capacity in India for strengthening education, training, research and policy development in the area of public health:

1. Twenty-six institutes in the country provide VPH Master's degree and 15 offer a doctoral degree, with around 60–70 public health veterinarians successfully completing the course and 25 scholars awarded doctoral degrees every year. However, from the perspective of long-term capacity building, for a country as large as India, this human-resource output is extremely limited, thus making the core capacity to support growing VPH needs grossly under-planned (Kakkar *et al.* 2013).
2. Public Health Foundation of India (PHFI), a public private initiative, was established in 2006 to build Indian Institutes of Public Health (IIPHs). At present, four IIPHs (Hyderabad, Delhi, Gandhinagar, Bhubaneswar) are operational and are offering postgraduate diploma programs in some specialized areas of public health. The 'Centre for Environmental Health', a joint initiative of the Public Health Foundation of India (PHFI) and Tata Institute of Social Science (TISS) has recently been launched by the Union Health and Family Welfare Ministry to assess the impact of environment related problems due to climate change, air pollution, pesticide use and sanitation on health.
3. Kerala Veterinary and Animal Sciences University (KVASU), Pookode, Wayanad, Kerala, established an autonomous Center for One Health Education, Advocacy, Research and Training (COHEART) in February 2014 and has launched two new postgraduate courses on "One Health" - One Health PG Certificate and PG Diploma in One Health, the programs to have been offered for the first time by an Indian University (<http://www.coheart.ac.in>).
4. National Standing Committee on Zoonoses (NSCZ) has proposed recruitment of VPH professionals in Central/state surveillance units of the Integrated Disease Surveillance Programme (IDSP).
5. The department of VPHE in GADVASU, Ludhiana is functioning as School Of Public Health and Zoonoses.
6. The concept of One Health - The realization that

Veterinary service is very inclusive and conforms to most of the components of the concept and that VPHE is the route to translate the concept of One Health into action.

Examples of collaboration of institutions crossing the barriers (Transboundary/Trans-disciplinary/Trans-sectoral) are increasing.

1. Med-Vet-Net: European Network of Excellence for Zoonoses research that aims to develop a network of excellence for the integration of veterinary, medical and food scientists, in the field of food safety, at the European Level, in order to improve research on the prevention and control of zoonoses, including food-borne diseases.
2. The Caribbean Animal Health Network (CaribVET): A robust network involving 32 countries/territories with an objective to improve animal and veterinary public health in all the countries and/or territories of the Caribbean conforming to the objectives of "One health".
3. SAPUVETNET: It is the acronym of "Red de Salud Publica Veterinaria/Network of Veterinary Public Health", a series of projects co-financed under the EU ALFA program, initially aimed to support an International Network on Veterinary Public Health (VPH) constituted by Faculties of Veterinary Medicine from Latin-America (LA) and Europe (EU) [<http://www.sapuvetnet.org>].
4. One-Health Activities for Building Institutional Capability across seven countries in South Asia: 'The European Commission through the Avian and Human Influenza Trust Fund administered by the World Bank funded (2010–13)- major contributions ["India One Health Symposium, 26th Nov. 2013, Delhi"]'.
5. HubNet or One Health networks within and between participating countries -HubNet is a web-based communication and collaboration tool to connect people cross sectors and countries.
6. Collaborative disease Investigation Projects (CIPs) –Rabies, brucellosis, anthrax, Q Fever, leptospirosis, CCHF have been taken up by seven countries –India, Bhutan, Nepal, Sri Lanka, Bangladesh, Pakistan and Afghanistan.

Some of the other networks include: Connecting Health Organizations for Regional Disease Surveillance (CHORDS), ASEF Europe Network of Public Health, Agriculture for Nutrition and Health, IFPRI, Strategic Network Neglected Diseases and Zoonoses (SNNDZ) and One Health Alliance of South Asia (OHASA) [<http://zoonoses.phfi.org/Network.php>].

Discussion fora

Fora for discussion of VPH education/global health issues of veterinary importance may be an important tool for the advancement of the discipline. American Veterinary Medical Association has a dedicated discussion group related to Public Health/One Health/Environmental issues.

The Network of Veterinary Public Health and Zoonotic Diseases in Asia (www.vphasia.org) was created in 2003. Its functional status at present, however, is unknown.

Promotion of student clubs

The Veterinary Public Health Club (VPHC) at the Iowa State University College of Veterinary Medicine (ISU CVM) provides a network for veterinary students interested in public health and those enrolled in the DVM/MPH concurrent program through ISU and the University of Iowa.

According to Cameron *et al.* (2005), the political and cultural rules rather than scientific logic has created gulf between human and animal physicians. Although public and political interest in veterinary public health declined in Britain towards the end of the 20th century, it remained an important part of veterinary education and is now a recognized specialty in the United Kingdom and the rest of Europe.

Unfortunately, this is not happening in India. Public and political interest in VPH education and practice needs to be created in order to allow the safety coverage of foods from farm to fork. Food safety requires integrating/coordinating the surveillance systems across (a) the animal health (b) food consumers' safety and (c) human health sectors. Rapid access to complete information on disease situation (identification, reporting and notification) is key to the successful control of diseases or possible epidemics in man and animals. The main objective of the 90 year old World Organization for Animal Health (OIE) is establishing rapid exchange of information on animal diseases including zoonoses. Global agencies engaged in this direction are: WHO, FAO, Food Safety International Authorities Network (INFOSAN), FAO/WHO/OIE Global Early Warning System for Major Animal Diseases including Zoonoses (GLEWS+) and Emergency Prevention System for Food safety (EMPRES Food Safety) [Narayan 2014].

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