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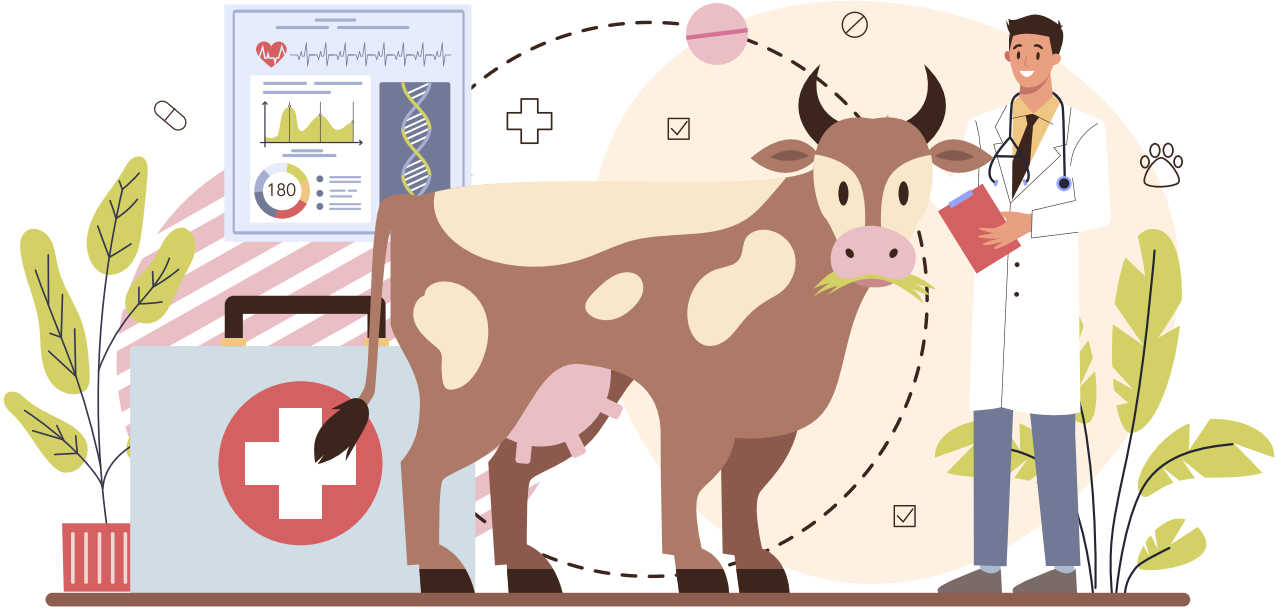
NITI Aayog

TELEMEDICINE FOR LIVESTOCK HEALTH & SAFETY

Framework and Guidelines



2023

Disclaimer

These guidelines are advisory and reflects the best available data at the time the guidelines were prepared. These guidelines should neither be interpreted as inclusive of all proper methods of care nor exclusive of other methods of care reasonably directed to obtaining the ultimate judgment regarding the propriety of any specific therapy that must be made by the Veterinarian.

The information in this Guideline is provided "as-is" with no warranty or representation, including any warranties of fitness for a particular purpose. NITI Aayog retains the right to carry out revisions to the recommendations in this guideline to reflect new data at any time without notice.

The use of telemedicine in livestock although envisages to facilitate greater access and availability, should not be interpreted to undermine the need to improve gaps in the physical veterinary infrastructure, if any.

Telemedicine for Livestock Health & Safety: Framework and Guidelines

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Table of Contents

List of Tables

List of Figures

Acknowledgement

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Neelam Patel

1 Livestock is at the Heart of Farmers' Welfare

Livestock, a sub-sector of agriculture, has been the biggest contributor to the share of total agriculture GVA. The share of livestock in the total agriculture output has increased from 13.88 per cent in 1980 to 30.13 per cent in 2021 (Figure 1).

Livestock has been instrumental in providing livelihood security to the poor and in meeting India's nutritional requirements. In contrast to the crop sector, which continues to be affected by weather and price fluctuations, dependence on livestock ensures stability of income. Farmers depend on livestock as a 'fallback' option to insure them against drought, floods, and price fluctuations. In equity terms, livestock is more egalitarian in generating employment and income for landless labourers, marginal farmers, and notably for a substantial proportion of women belonging to rural areas (Chand and Raja, 2008). Livestock has been found to have the biggest impact on alleviating poverty and hunger. For instance, it was found that adding one bovine to a household decreases the prevalence of hunger by 16-25 per cent (Kumar, 2017). Livestock has helped India become the largest producer of milk in the world. India's milk production has increased from 17 million tons in 1950- 51 to 210 million tons in 2020-21, with an annual growth rate of more than 6 per cent.

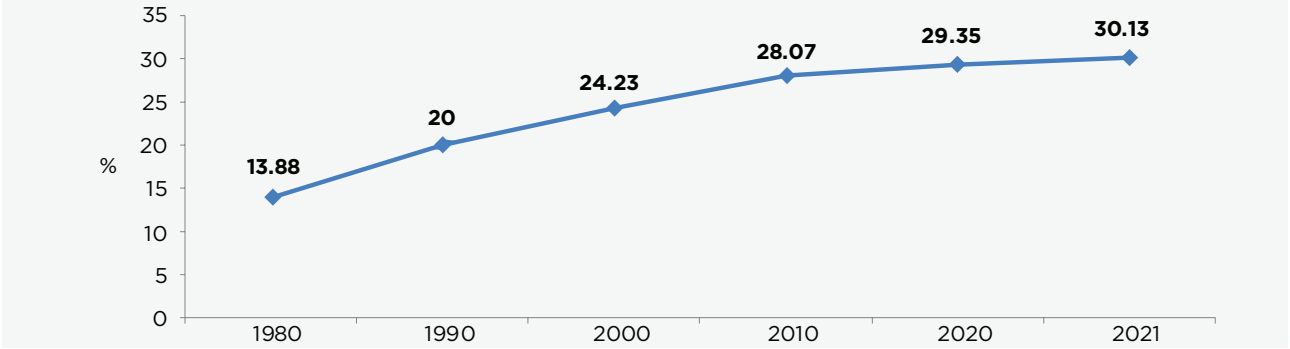


Figure 1: Share of livestock in total Agriculture GVA (at constant prices 2011-12 basic prices)

Source: *Basic Animal Husbandry Statistics 2020 and Economic Survey 2022-23*

2 Need of Telemedicine for Livestock

Despite the achievements in the sector, productivity levels are low. For instance, India is the second largest producer of cow milk yet, ranks 87/186 in yield (FAOSTAT, 2021). In addition, the high incidence of livestock related diseases imposes significant economic and social costs, both implicit and explicit. They include the transportation cost of ferrying the animal patient, opportunity cost of being away from employment, crowding in the emergency department of veterinary institution, milk production losses, and medicine costs, among others. The second-round effects contributing to costs are associated with poor quality of livestock produce. As an example, processed milk samples fail to meet the domestic quality norms of the Food Safety and Standards Authority of India (FSSAI) and International Sanitary and Phytosanitary (SPS) measures, set by importing countries, resulting in reduced foreign exchange earnings. An indicative summary of estimated financial losses attributable to the high incidence of diseases in livestock is shown in Table 1.

Table 1: Economic losses due to some livestock diseases

S. No.	Name of the disease	Economic and Financial Losses
1.	Foot & Mouth (FMD)	The economic losses in India due to FMD were projected to be USD 3159 million in severe incidence scenario (Govindaraj et. al., 2021).
2.	Brucellosis	In livestock, it is responsible for the loss of USD 3.4 billion (Singh et. al., 2015).
3.	Cystic Echinococcosis	Total losses estimated to be USD 212.35 million in India (Singh et. al., 2014).
4.	Avian Influenza	In Manipur alone, avian influenza caused a loss of USD 3.3 million (in 2020 dollars) (Kumar et. al., 2008).

2.1 Improving the Veterinary Services Imperative for Livestock Health

Provisioning of adequate veterinary services with timely provision of both preventive and curative services is vital for ensuring not only livestock productivity but also minimizing the social and economic losses attributable to livestock diseases. These health services include consultation, treatment, artificial insemination, and livestock insurance among others. Achieving adequacy of veterinary services can be seen as an important step towards achieving "One Nation One Health".

2.2 Gaps in Veterinary Infrastructure in India

According to norms set by the National Commission on Agriculture (1976), one veterinary doctor / institution is required for every 5,000 animals. The total livestock population in India is estimated to be about 53.58 crores (20th Livestock Census[1]) which amounts to a requirement of about 1.07 lakhs veterinary doctors / institutions. Currently, there are 65,894 veterinary institutions[2] in the country that translate into a shortage of approximately 41000 veterinary institutions/veterinarians. The state-wise capacity gap in veterinary institutions (comprising of Veterinary Hospitals, Polyclinics, Veterinary Dispensaries, Mobile Dispensaries, and Stockmen centers) against that of the requirement is shown in Figure 2.

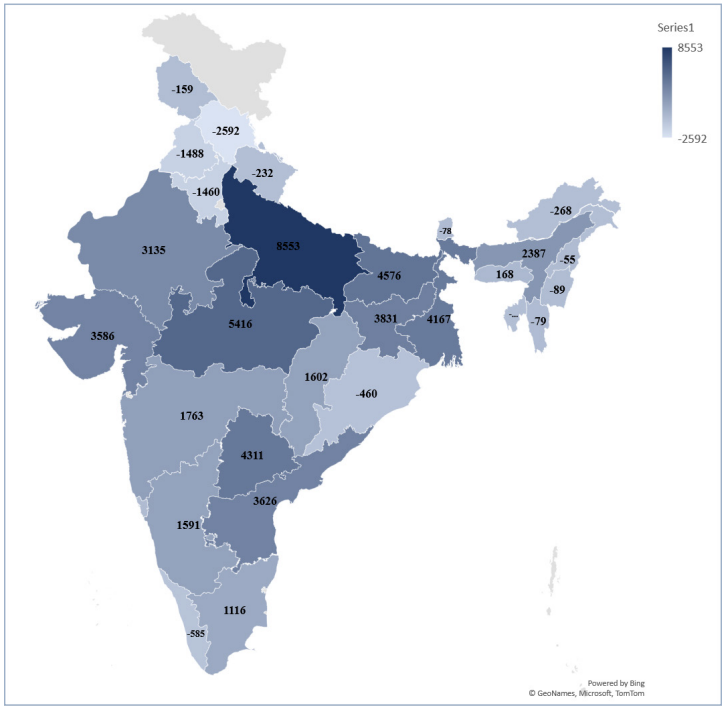


Figure 2: State-wise Gap of Veterinary Institutions (2020)*

Source: *Basic Animal Husbandry Statistics (2020)*

* *Data of J&K is from 2019, and negative numbers indicate a surplus of veterinary institutions compared to the requirement*

1 https://pib.gov.in/PressReleasePage.aspx?PRID=1588304

2 Forty fifth report of Standing Committee on Agriculture, Animal Husbandry and Food Processing (2022-2023), Status of veterinary services and availability of animal vaccine in the country, Lok Sabha Secretariat

2.3 Leveraging the Tele-Density in India for Providing Veterinary Services

Figure 3 reveals that the incidence of FMD is relatively higher in southern and eastern states. While Figure 4 shows that corresponding southern states have higher tele-density compared to other states of India. Kerala, for example, has one of the highest rural teledensity[3] (190.84), with almost two telephone connections subscribed by a single person. Kerala also has a higher incidence of FMD on an average over the years. This pattern fits for almost all animal diseases (see Appendix 1 to 6).

Therefore, states with high incidence as well as high tele-density are better equipped to provide telemedicine services to complement the physical veterinary infrastructure available in states. Other states, with the scope of improvement in internet penetration and rural tele-density, could simultaneously utilize the existing tele-density to its capacity for deployment of veterinary telemedicine.

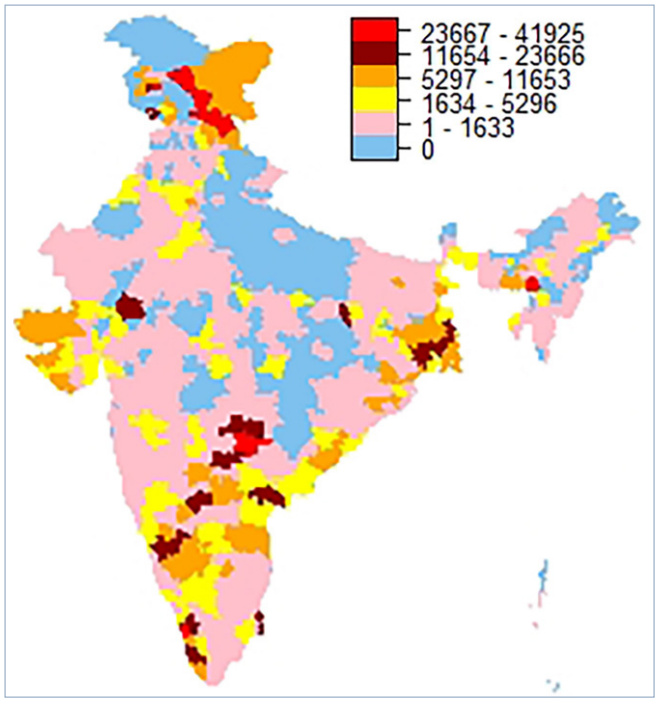


Figure 3: Incidence of FMD (1990-2020)

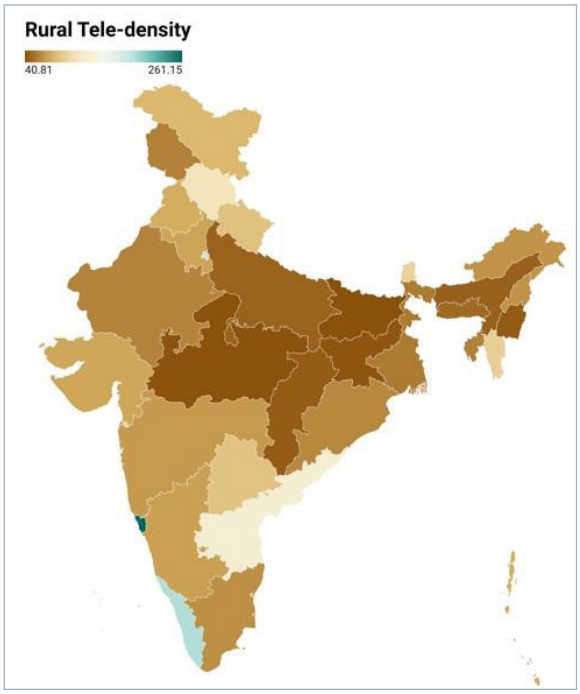
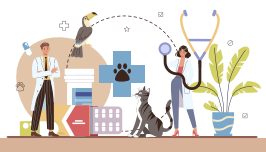


Figure 4: Rural Tele density (2020)

Source: *TRAI 2020*

3 is the number of telephone connections for every hundred individuals living within an area.



3 Telemedicine for Livestock Health & Safety

Prime Minister Shri Narendra Modi launched the National Digital Health Mission on 15 August 2021, to create an integrated healthcare system, linking practitioners with patients digitally, by giving them access to real-time health records.

Recognizing the potential of telemedicine in livestock health and safety towards achieving One Nation One Health (ONOH), NITI Aayog initiated drafting of framework and guidelines for livestock telemedicine in India, including the development of telemedicine system for livestock health and safety. Eventually, the Union Minister of State, Fisheries, Animal Husbandry & Dairying, Dr. Sanjeev Balyan, unveiled the National Digital Livestock Mission Blueprint[4] on 7 October 2021, with a vision to create a farmer-centric, technology-enabled ecosystem, where farmers are able to realize better income through livestock activities, with the right information and enabling infrastructure to obtain timely, high quality services and access to markets as a result of connected systems that optimize sustainable economic opportunities for the health of humans and animals.

The following expert committee was formed to finalize the draft framework and guidelines for telemedicine system for livestock:

Prof. A. K. Srivastava, Vice-Chancellor, DUVASU, Mathura (Chairman),

Dr. Praveen Malik, former Animal Husbandry Commissioner, DAHD,

Dr. R. S. Sodhi, MD, GCMMF Ltd. (AMUL),

Dr. Bhupendra Nath Tripathi, DDG (Animal Science), ICAR,

Dr. R. T. Sharma, President, Pet Animal Welfare Society,

Dr. Devender Sharma, Joint Director (Disease Control), Department of Animal Husbandry, Uttarakhand

Dr. Triveni Dutt, Director, ICAR-IVRI, Bareli, UP

4 **https://dahd.nic.in/sites/default/filess/National%20Digital%20Livestock%20Mission-Blueprint-Draft%20%28002%29.pdf**

3.1 Genesis and Definition of Telemedicine

The term telemedicine was first coined in the 1970s which means healing at a distance (Strehle, 2006). It is believed to reduce the load on the healthcare system, especially in developing countries where there is a shortage of medical practitioners and paramedics, inadequate health infrastructure, limited reach of animal keepers living in rural and remote areas and most importantly, high cost of travelling to the health care centers (Devi et. al., 2015).

The terms 'telemedicine' and 'teleheath' have the risk of being used interchangeably. To remove such ambiguities, there is a need to clearly distinguish telemedicine from other terms. In this regard, telemedicine can be defined as follows:

- According to the American Veterinary Medical Association (AVMA), telemedicine is the use of medical information exchanged from one site to another via electronic communications to improve a patient's clinical health status (AVMA, 2017).
- The Royal College of Veterinary Surgeons defines telemedicine as the use of electronic communication and information technologies to provide clinical healthcare remotely. It further explains that telemedicine extends to the provision of veterinary services by video, text, instant messaging or telephone, or by any other remote means (RCVS, 2018).
- Medical Council of India states telemedicine as 'the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities' (MoHFW, 2020).
- Telehealth', in contrast to telemedicine, is an 'overarching term that encompasses all uses of technology geared to remotely deliver health information or education' (AVMA, 2017). The Medical Council of India defines telehealth as 'the delivery and facilitation of health and health-related services including medical care, provider and patient education, health information services, and self-care via telecommunications and digital communication technologies' (MoHFW, 2020).

3.2 Definition of Livestock

Food And Agriculture Organisation describes livestock as domesticated terrestrial animals that are raised to provide a diverse array of goods and services such as traction, meat, milk, eggs, hides, fibres and feathers. As per the Livestock Importation Act, 1898, livestock includes horses, kine, camels, sheep and any other animal which may be specifies by the Central Government by notification in the Official Gazette.

3.3 Definition of Registered Veterinary Practitioner (RVP)

Registered Veterinary Practitioner' means veterinary practitioner registered as defined in the Indian Veterinary Council Act, 1984.

3.4 Evolution of Veterinary Telemedicine

In 1980, the Animal Medical Center and Dr. Tilley (DVM) were recognized for pioneering telemedicine by broadcasting electrocardiograms over telephone lines for interpretation by a cardiologist or internist, allowing primary care doctors to benefit from guidance from experts thousands of miles away. Tele radiology, a part of tele consulting that began in the mid-1980s, allowed an attending veterinarian to take images, such as radiographs, CTs, or MRIs, and send them to a radiologist for interpretation. After examination the radiologist provides a report with their findings, interpretation and potential diagnoses. In 2007, the Italian Society of Veterinary Science recognized the potential impact telemedicine could have on the veterinary profession and created the first veterinary telemedicine study group. In 2017, the American Telemedicine Association (ATA), founded in 1993, created a set of guidelines and operating procedures for the use of telehealth in pediatric medicine because neither infants nor animals can reliably communicate their feelings or complaints.

3.4.1 Types of telemedicine

i. **Store-and-forward telemedicine**: clinical data is gathered and electronically sent through a secure encrypted internet connection to a different location for analysis. Demographic information, medical history, documents like lab reports, MRI scans, test results, X-ray photos, and image, video, and/or sound files are typical types of information. The data can subsequently be studied and analyzed by RVPs as if they were there during data collection in the clinic.

ii. **Remote monitoring–based telemedicine**: is a type of healthcare delivery that collects patient data outside of conventional healthcare settings by utilizing the most recent developments in information technology. For example, using body-worn smart devices for remote monitoring of pets.

iii. **Interactive telemedicine:** it is simple to conduct a doctor-patient visit whenever and wherever you like with interactive telemedicine, often known as live telemedicine. Any two-way connection that enables RVPs and patients to speak in real-time, such as video conferencing and phone consultations, is referred to as live telemedicine. Real-time telemedicine technology is more immediate. It offers real-time access to the test site for remote healthcare professionals, not merely through video conferencing but also through live broadcasting of medical pictures and video. This makes it possible for the patient and doctor to truly interact, making the clinical assessments more comparable to those done during face-to-face consultations.

3.5 Literature on Veterinary Telemedicine

The evidence on telemedicine used primarily for veterinary services is limited. However, major findings from studies conducted in different parts of the world are presented below:

i. Flemming (2003) states that although veterinarians are interested in using telemedicine, there are legal and ethical concerns associated with virtual care between veterinarians and animal keepers. These ethical concerns include animal keeper's privacy, security of medical records, and payment data (Marshall, 2019; Freiman, 2019).

ii. Studies and newspaper articles also point out the risks involved in practicing telemedicine for livestock in comparison to physical visit (Limb, 2018; Milani, 2009). These risks include missed diagnoses, lack of physical examination, differences in communicating via technology compared to in-person, monetization of virtual care visits, and limitations of technology.

iii. Telemedicine for livestock has helped to reduce the workload of veterinary staff, and is found to be a better alternative to consulting the internet (Freiman, 2019; Lacroix, 2017).

iv. Kogan et. al. (2016) observed that younger veterinarians were more comfortable with newer technologies compared to old veterinarians. It was also found that communicating with the animal keeper through emails or text could be less time consuming than physical in-person visits.

v. Nelson-Pratt (2018) highlights that telemedicine should be a part of veterinary services and advocate for regulatory agencies to keep pace with technology.

vi. Bishop et. al. (2018) reveals that the most frequently recommended telemedicine practice for veterinarians is 'post-surgical recheck' exams. The same study, also found that virtual care could reduce stress and anxiety in animal patients.

vii. Gyles (2019) notes that telemedicine can guide animal keepers to an 'appropriate level of intervention' with animal keepers willing to pay for the service.

3.6 Benefits of Veterinary Telemedicine

i. Faster access reducing financial cost: Rural animal keepers do not have to transport their animals for long distances for conditions in which animal patients are not required to be physically present in front of the RVP or veterinary institution. These scenarios include surgery follow ups, routine consultation, monitoring, and advice on health calendar, diet chart, and artificial insemination.

ii. Increase in efficiency by reducing the burden of veterinary infrastructure.

iii. A digital repository of records and history of the animal patient: This would help in uniquely identifying the animal patient, thereby reducing time for follow up consultations.

iv. Ensure the safety of animals, animal keepers, and veterinary health workers from contagious zoonotic diseases, thereby reducing the risk of animal to human transmission.

v. Addresses information asymmetry among livestock farmers.

3.7 Potential uses of Livestock Telemedicine

i. **Remote consultation with a veterinarian**: Farmers/owners can use telemedicine technologies to connect with veterinarians for advice and guidance on the health and care of their animals. This can be particularly useful for remote or rural areas with limited access to veterinary care.

ii. **Early detection and management of animal health issues**: Telemedicine technologies can be used to monitor the health of livestock, including their vital signs and production data. This can help farmers and owners identify potential health issues early on and take appropriate action to prevent the spread of disease.

iii. **Improved efficiency and productivity**: By using telemedicine technologies, farmers can streamline their healthcare management processes and make better use of their time and resources. This can help improve the overall efficiency and productivity of their operations.

iv. **Enhanced food safety**: By using telemedicine technologies to monitor the health of livestock, farmers can help ensure that the food produced by their animals is safe for consumption. This can help prevent food-borne illness and protect public health.

v. **Improved animal welfare**: Telemedicine technologies can be used to improve the overall welfare of farm animals by providing timely and effective veterinary care. This can help reduce the suffering of sick or injured animals and improve their quality of life.

vi. **Streamlining service delivery:** Remote patient monitoring can further streamline the service delivery. For example, suppose a patient from some district in Uttar Pradesh needs advice from a radiology specialist. In the absence of a radiologist in Uttar Pradesh, telemedicine should have the provision of patient being able to reach out to any radiologist in any part of India.

3.8 Use cases of Livestock Telemedicine

i. Electronic transmission of pictures of skin lesions and skin parasites for the accurate diagnosis of skin infections and disorders. This has immediate significance as the Lumpy Skin Disease was widespread, causing a significant number of cattle deaths in the country.

ii. An animal owner may use telemedicine to connect with a veterinarian for a remote consultation. This can be especially useful if the animal is experiencing a non-emergency health issue, such as a minor skin irritation or digestive problem.

iii. In some cases, the veterinarian may be able to diagnose and treat the animal's condition entirely through telemedicine, using remote monitoring and diagnostic tools. For example, the veterinarian may use a remote stethoscope to listen to the animal's heart and lungs, or a remote ophthalmoscope to examine the animal's eyes. The veterinarian can then prescribe medication or other treatments as needed, and the animal owner can administer them at home.

3.9 Approaches for Practicing Telemedicine for Livestock

The technology limitations and constraints associated with telemedicine make it imperative that telemedicine services should include only those health services that are deemed appropriate. On a macro level, an indicative list of livestock health services that can be potentially provided through telemedicine is presented in Table 2.

Seasonal diseases result in substantial losses along with the uncertainty of outbreak around the

year. Therefore, a targeted disease-oriented treatment is one of the approaches that could be practiced under telemedicine for livestock.

Table 2: Indicative list of services to be provided by telemedicine for livestock

Telemedicine applications	Brief description
Animal health information	◆ Health calendar, diet chart for appropriate nutrition and good management practices for clean milk production, health *etc.*
Tele-consultation	◆ Evaluation and examination of the animal patient ◆ Make referral for specialists or in-person physical consultation
Tele-diagnostics	◆ Artificial Intelligence (AI) based diagnostics based on images and history of the patient ◆ Patients triaged by image penetration
Tele-prescription	◆ Prescribing medicines
Assessing patient progress	◆ Post-surgical evaluations ◆ Follow-up consultation
Specialty consultations	◆ Species-specialized veterinary practice (with respect to Avian, Cattle, Dairy, Swine among others). ◆ Internal Medicine, Cardiology, Neurology, Microbiology, Nutrition, Ophthalmology, Radiology, Pathology, etc.
Remote patient monitoring	◆ Collection of patient records from one location and transmitting them to specialists in different locations for evaluation and recommendation.
Insurance	◆ Provide list of companies with premiums and past performance ◆ Application for Insurance
Education	◆ Webinars and e- Extension services

Source: *Secondary Research in consultation with a veterinarian*

3.10 Status of Regulation for Telemedicine in India

The Ayushman Bharat Digital Mission (National Digital Health Mission) launched in August 2020 aims to build a backbone to support the integrated digital health infrastructure of the country through the use of technology. It also lays significant focus on using telemedicine for healthcare service delivery in India.

The Board of Governors in supersession of the Medical Council of India, in partnership with NITI Aayog published the 'Telemedicine Practice Guidelines' in March 2020, spelling out the framework, guidelines and principles for practicing telemedicine from the perspective of health care for humans (MoHFW, 2020). The same has been included as an amendment to the Indian Medical Council (Professional Conduct, Etiquette and Ethics) Regulations, 2002, by adding Regulation 3.8 titled "Consultation by Telemedicine". Thus Indian Medical Council (Professional Conduct, Etiquette and Ethics) (Amendment) Regulations, 2020, give statutory support and basis for the practice of telemedicine in India.

However, for animal health, framework and guidelines for practicing telemedicine do not exist. The only major provision in India is that a Registered Veterinary Practitioner (RVP) can provide veterinary services. Any person other than a Registered Veterinary Practitioner practicing Veterinary medicine shall be considered as 'Illegal Veterinary Practice' which is punishable (Minimum Standards of Veterinary Practice, Regulations (Draft Copy, 2016).

4 Guidelines for Telemedicine for Livestock in India

Guidelines lay the basis for the broad components in the practice of telemedicine for livestock. These guidelines provide norms, protocols, and practical advice with respect to a) issues on liability and negligence, b) privacy and security concerns of the patient, c) animal keeper and the RVP, d) identification of the animal keeper and the patient, e) mode of technology to be used for different telemedicine services, f) consent of the animal keeper in accepting treatment through telemedicine, g) evaluation of the patient, h) dealing emergency, i) maintaining medical records, j) health education and k) consultation among others. The guidelines can be conceptualized into five broad components, as shown in Figure 5, and their brief description is presented in the subsequent section.

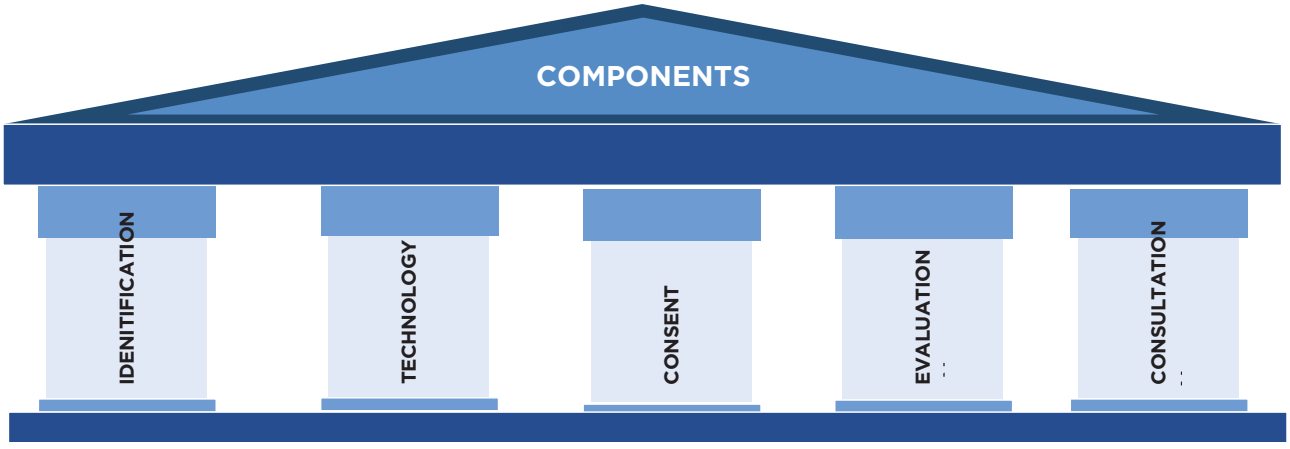


Figure 5: Components in the guidelines

4.1 Component 1: Identification of the Animal Keeper, Patient, and the RVP

i. RVP and the animal keeper need to know each other's identity. This can be achieved by assigning unique user IDs to both the RVP and the animal keeper. The RVP should inform the animal keeper about her qualification and specialization.

ii. The qualification and registration number of the RVP need to be verified by the Veterinary Council of India/ the state nodal officers before using the telemedicine platform. The registration number should be displayed on the telemedicine platform. Such verification should be deemed sufficient to identify the credentials of the RVP.

iii. In addition, the RVP should verify the animal patient's identity in terms of age and breed when applicable. For follow up consultations, the unique ID assigned to the patient in the first consultation may be used.

4.2 Component 2: Mode of the Technology

i. RVP's judgment is sufficient to decide whether telemedicine or a physical examination is required. The assessment of choosing a mode in telemedicine (text, audio or video) needs to be done by the RVP taking into account the adequacy of diagnosis and examination in that particular mode.

ii. In using her discretion in assessing the mode of examination, the RVP should not compromise in the quality of the examination and care. In other words, regardless of the nature and criticality of the medical condition of a particular animal, the RVP shall exercise the same standard under telemedicine, considering the strengths, weaknesses and limitations of the different modes, as she would under the physical mode of examination.

4.3 Component 3: Consent

The consent of the animal keeper needs to be taken before the consultation through telemedicine. The consent can be recorded by the animal keeper through a message or by clicking a textbox associated with the acknowledgement by the animal keeper. A sample acknowledgement text can be "I agree to avail consultation through telemedicine". This implied consent acknowledges that the owner understands and accepts the limitation and risks associated with the nature of service being provided.

4.4 Component 4: Patient Information and Evaluation

The RVP would gather the information of the animal patient from the animal keeper to exercise judgment on examination and treatment. Information sought by RVPs may vary depending on their professional expertise, and experience, but that information should be within the ambit of veterinary standards set by the Veterinary Council of India.

4.5 Component 5: Telemedicine Consultation

i. Based on the evaluation of the information provided by the animal keeper with respect

to the animal patient, the RVP might take the following actions: provide counseling, prescribe medicines, and recommend referrals.

ii. Counseling involves advice given by the RVP to the animal keeper on the patient's diet and general information on maintaining the proper health of the animal patient.

iii. RVP may prescribe medicines via telemedicine when she is satisfied that the prescription would be in the best interest of the animal patient. RVP, while prescribing medicines should take utmost care as there are certain limitations to prescribe medicines (which may include traditional medicines) based on the diagnosis done through modes of telemedicine. Therefore, the diagnosis done through telemedicine must be within standard operating procedures vetted by the Veterinary Council of India.

5 Framework for Telemedicine for Livestock in India

This section lays out the framework for practicing telemedicine for veterinary care involving a client (in our case, an animal keeper), patient (the animal concerned) and the veterinarian (RVP). The basic principles are given below

5.1 Basic Principles

i. The professional judgment of the Registered Veterinary Practitioner (RVP) should be treated as sufficient to decide whether telemedicine based consultation is sufficient for the animal or an in-person physical review is required.

ii. RVP should exercise her professional discretion regarding the mode of communication depending on the type of medical condition. If a case requires a video consultation or sharing of images for examination, RVP should explicitly ask for it.

iii. The animal keeper opting for telemedicine for veterinary services should imply that he or she has given consent for examination of his or her patient. This implied consent acknowledges that the owner understands and accepts the limitation and risks associated with the nature of service being provided.

iv. The RVP can choose not to proceed with the telemedicine consultation/examination at any time and may refer or request an in-person consultation/examination.

v. At any stage, the animal keeper has the right to choose to discontinue the telemedicine consultation.

vi. Rules, ethics, and regulations for general veterinary practice apply for telemedicine in veterinary services as applicable.

vii. An RVP who in good faith engages in the practice of veterinary medicine by rendering

or attempting to render emergency or urgent care to a patient when a client cannot be identified, and a veterinarian - client - patient relationship is not established, should not be subject to penalty based solely on the veterinarian's inability to establish a veterinarian - client- patient relationship.

viii. For extension related to digital literacy and accountability of implementation, a district nodal officer is to be appointed.

ix. The existing infrastructure/ human resources/ frameworks at local level put in place by the Government should be integrated with the guidelines as far as possible.

x. Any platform providing telemedicine services should have an inbuilt grievance redressal mechanism.

xi. These guidelines exclude RVPs from licensing of pets, from providing certificates for trauma, quarantine clearance, fitness, birth/death and euthanasia through telemedicine.

5.2 Telemedicine Consultation

Three scenarios emerge with respect to telemedicine for livestock: first consultation, follow up consultation, and repeat consultation.

i. First consultation: Under the first consultation, three scenarios emerge:

   a. The animal keeper is consulting with the RVP for the first time for a particular animal.

   b. The animal keeper consulted with the RVP earlier, but for a different animal.

   c. The animal keeper consulted with the RVP earlier but for a different health condition of a particular animal.

ii. Follow up

   Under follow up, consultation will be provided to the same animal with the same disease condition until the initial 15 days of case registration.

iii. Repeat consultation

   Consultation will be provided to the same animal with same disease condition after 15 days of case registration.

5.3 Schematic Process Flow of the Framework

The flow of the process is briefly outlined in Figure 6 and can be broken down in 4 steps:

Step 1: Animal keeper registration and identification

Telemedicine is initiated by the animal keeper. She either registers and logs in for the first time through her system generated unique user id or logs in through her unique user id generated prior. Animal keeper, after logging in, gives her consent that she is willing to tele-consult with the RVP. Note that the animal keeper registers only once; for availing services in the future, she only needs to login.

Step 2: Animal registration and identification

For a new patient, the unique 12-digit Pashu Aadhaar number[5] tagged under the NDLM/INAPH has to be entered, which would be linked with the user id of the animal keeper. If the animal is not tagged, a unique 12-digit ID could be generated, which should then be linked with the NDLM/INAPH.

For an existing patient, the Pashu Aadhaar number can be entered by the animal keeper after step 1, which would display all relevant medical records of the patient in concern. Here, the RVP should be convinced that she knows the medical history of the concerned patient before she accepts the patient for consultation.

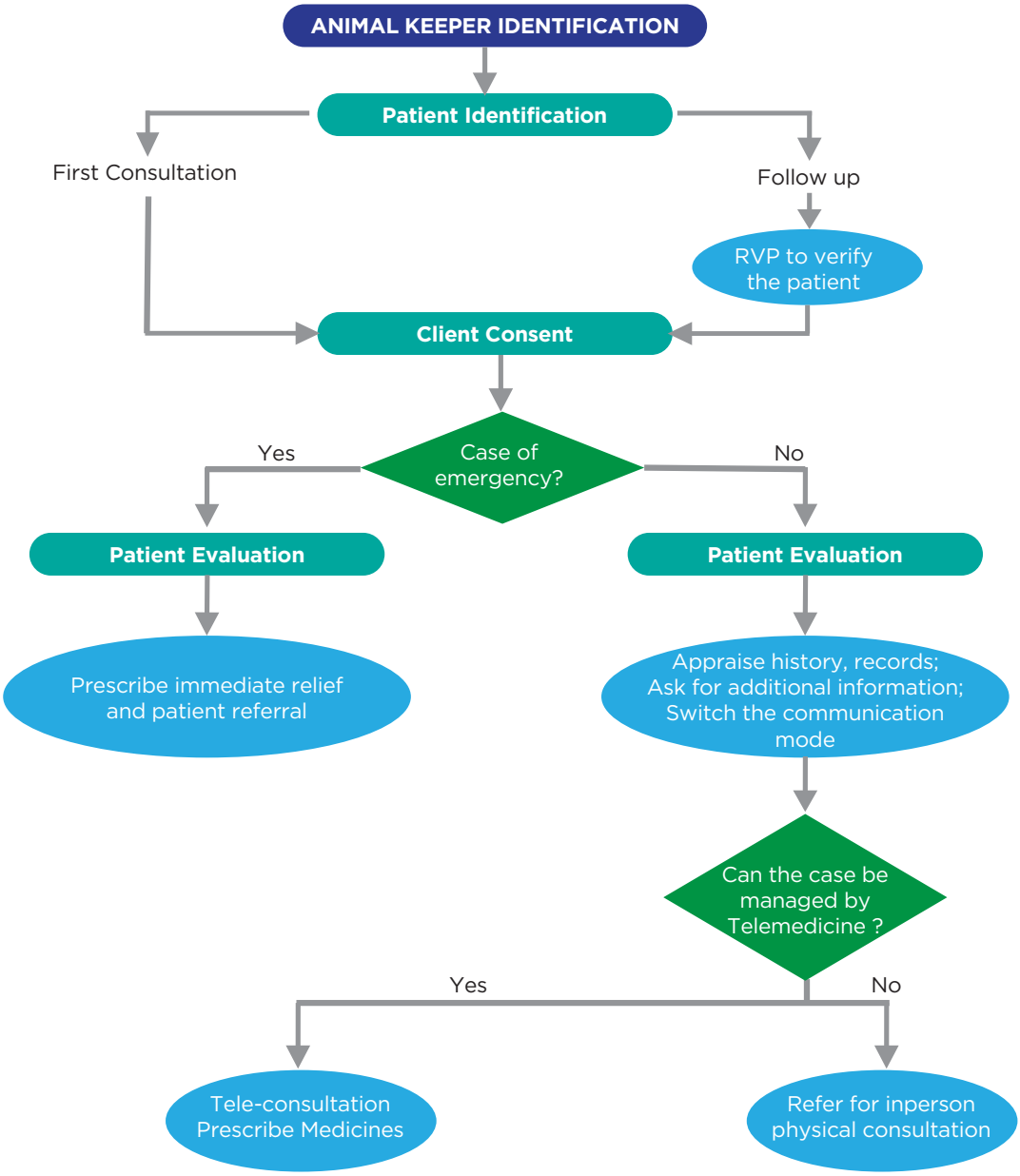


Figure 6: Process flow explaining the framework

5 According to the NDLM blueprint, over 15 crore cattle and buffaloes (representing more than half of the bovine population of the country) have been tagged with a unique 12-digit Pashu Aadhaar number.

Step 3: Evaluation of patient

a. The patient needs to be evaluated by the RVP based on inputs provided by the animal keeper and assess available history or records, if any.

b. RVP uses her discretion to determine to assess if emergency care is required. Subsequently, immediate relief is to be provided, which includes prescription of medicines and recommending referral for further treatment and care.

c. If the case does not merit emergency care, the animal keeper is requested to provide the relevant details of the patient's condition. The animal keeper will be responsible for the accuracy of the information.

d. Based on the information about the patient, RVP uses her professional judgment to assess whether the case can be managed through telemedicine. If the case is not deemed appropriate for telemedicine, the animal keeper is guided with a referral to other RVP / specialist or in-person examination / consultation.

Step 4: Consultation through telemedicine

a. If the RVP in her professional judgment is convinced that the case can be handled by telemedicine, she can offer tele-consultation and prescribe medicines.

5.4 Technology Related Aspects

The animals should be registered using the animal ID / Pashu Aadhar number tagged under NDLM (digital platform developed by DAHD and NDDB on the foundation of Information Network for Animal Productivity and Health (INAPH)) in the telemedicine platform. If the animals are not yet tagged under the NDLM, the concerned veterinarian could be notified to tag the animal immediately, or a new 12-digit ID could be created, which can then be linked to NDLM. This not only helps curb the duplication of animal IDs under various platforms, but also helps in the convergence of government schemes through proper identification of the animals. For example, the health records could be accessed to verify the livestock insurance payouts without in-person visits.

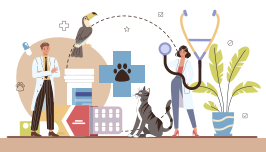
Like the Unified Payments Interface (UPI) used by many private and government players (BHIM, Paytm, Phone etc.) to provide financial services (which has reached millions of customers), the telemedicine system should enable an ecosystem where the data / electronic health records (EHRs) of the animals treated through the system is transferable across the systems (when new / private telemedicine systems enter the market) via APIs worked on top of NDLM architecture. For example, if an animal keeper wants to shift from one telemedicine system to other one, the treatment and disease history or the EHRs of the animals owned by him should be available on the new system.

The telemedicine system should have a digital payment option to facilitate transactions between the animal keeper and RVP if and when the private RVPs offer their services through telemedicine.

5.5 Artificial Intelligence (AI) and Telemedicine

Tools from Information and Communication Technology (ICT) can be utilized to address the problems with the imbalance between the supply and demand for livestock healthcare services. AI could help with this problem by creating algorithms to match the availability of RVPs with the necessary clinical skills to the need for such skill sets nearby. However, telehealth poses a number of operational problems, such as when the communication link breaks or the RVP providing remote care is not accessible. AI may be able to help in these circumstances by facilitating human or virtual interactions, which will solve issues with timing and RVP availability (such as the length of time needed to comprehend the animal's problem or take a history). AI can also be used in identifying animals using pictures/videos, monitoring, preliminary diagnosis, preventive care, etc.

To determine if the predictions provided by machine learning models could be utilized to automate the workflow without the involvement of RVPs (autonomous AI) or support the RVPs in making the final judgments, AI application solution design will be crucial. Let's imagine that a deep learning model is employed to determine whether or not an animal has a condition. Whether or if RVPs are still required to make the ultimate decision based on the forecast must be considered in the solution design.



6 Development of "NITIVeT" Web Based System

A user-friendly web based system titled 'NITIVeT' to facilitate telemedicine for veterinary services has been developed broadly adhering to the principles mentioned in the framework and guidelines in English, Hindi and Gujarati languages.

The portal connects the animal keeper to an RVP on a real-time basis with respect to the animal patient within the district. Through text, audio, or video calling, the RVP evaluates and examines the patient and provides suitable recommendations based on the condition which includes referrals for laboratory tests, advice for in-person physical examination and/ or prescription of medicine (including traditional medicine).

It may be noted that the portal can be envisaged to include other important livestock related services such as information of relevant schemes, application for livestock insurance, age wise diet chart and for timely reminders of the health calendar. For farmers who cannot write but speak and understand a particular language, virtual voice assistants in every step can be deployed in the portal. For extension related to digital literacy and accountability of implementation, concerned nodal officers may provide the overall supervision. Major services envisaged to be offered by the NITIVet are shown in Figure 7 below.

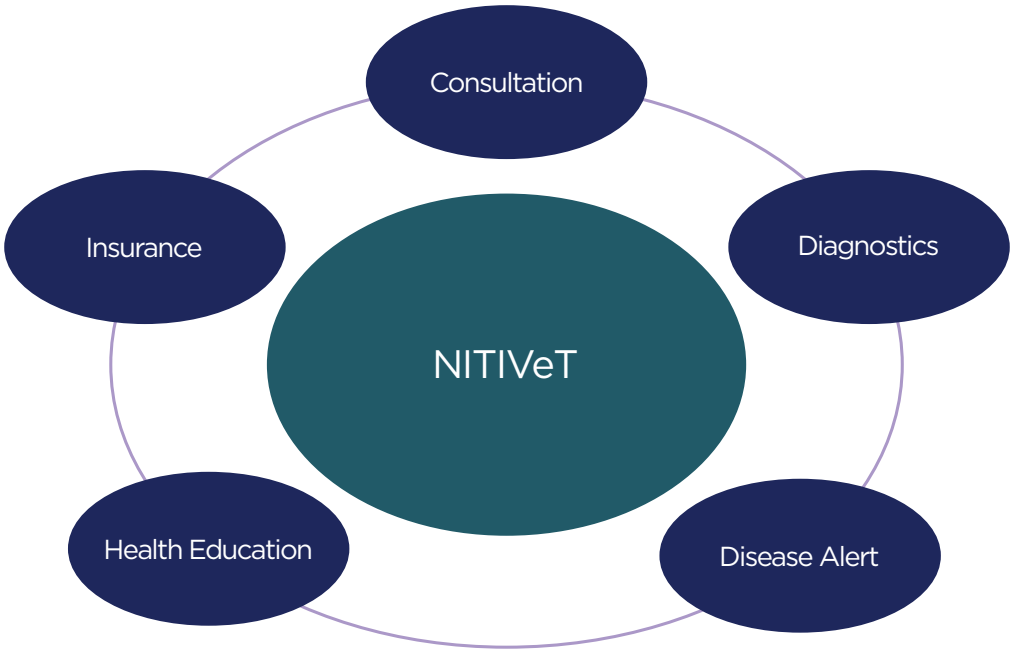


Figure 7: Diagram depicting the different services offered by the workable system

The simplified stylized web system has three separate logins. A brief description of the process flow is given below.

6.1 Login for Animal Keeper

The animal keeper registers for the first time through an OTP; a unique user id is assigned to the animal keeper. For existing users, the animal keeper logs in with her user id. After logging in, the animal keeper registers her animal using the Pashu Aadhar ID. If the animal is not tagged (does not have a Pashu Aadhar ID), a unique ID will be generated which may be linked to NDLM/INAPH. She then books an appointment with the RVP. After the successful completion of the consultation, the dashboard gets updated. There will also be a provision for grievance redressal and feedback from the animal keepers.

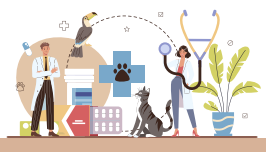
6.2 Login for RVP

The RVP can register to the portal by providing details and uploading certificates and other credentials confirming their eligibility to practice through the system. A notification is sent to VCI / nodal officer of the state who approves, after which the concerned RVP can start practicing on the web system. Retired / part time veterinarians not associated with any hospital can also login following the same procedure.

6.3 Admin Login

This login is to track and monitor the system, particularly pending appointments as a check on the accountability of the veterinarians. The access will be granted to the officials of the Department of Animal Husbandry and Dairying.

A stylized process flow for the animal keeper is shown in the diagram below:



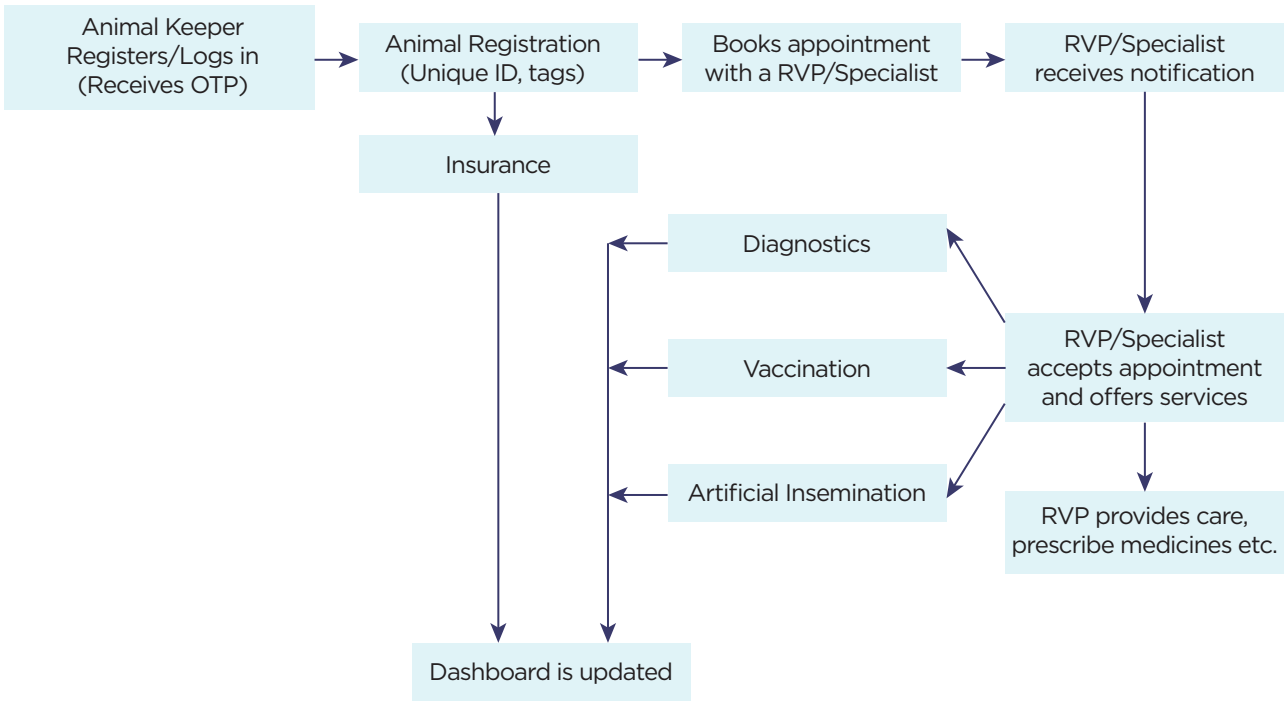


Figure 8: Process flow for the animal keeper

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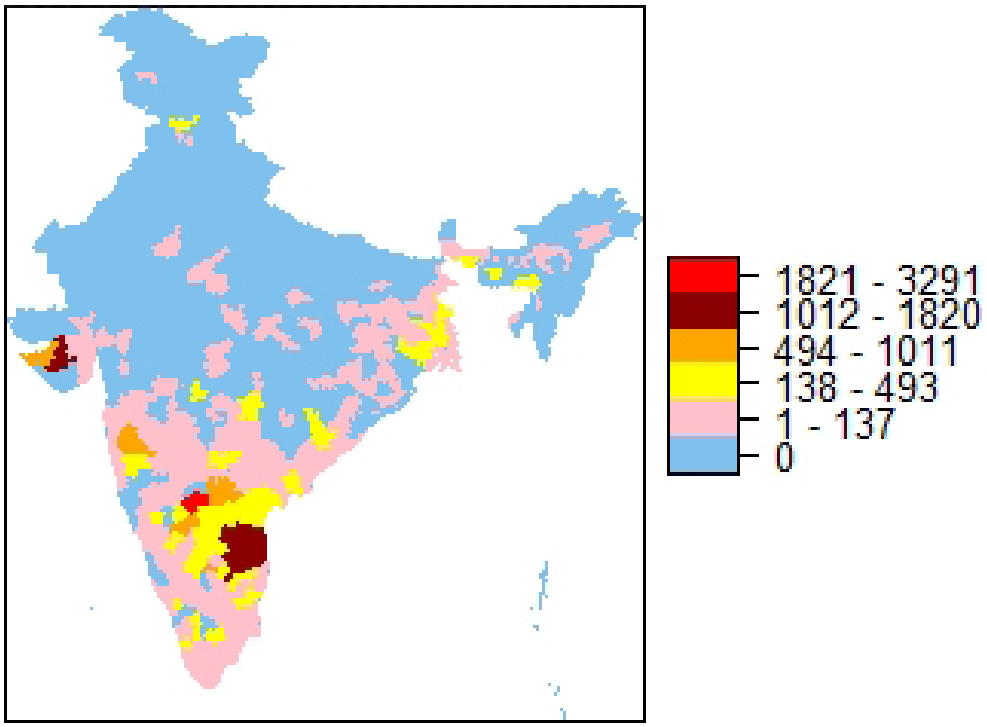
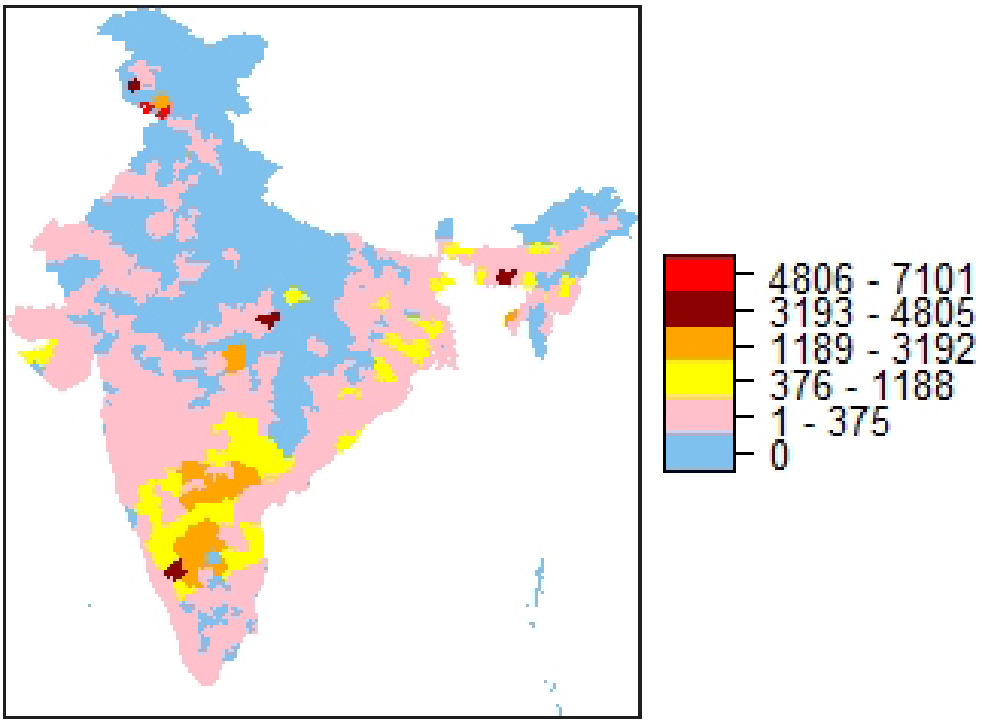
Appendices



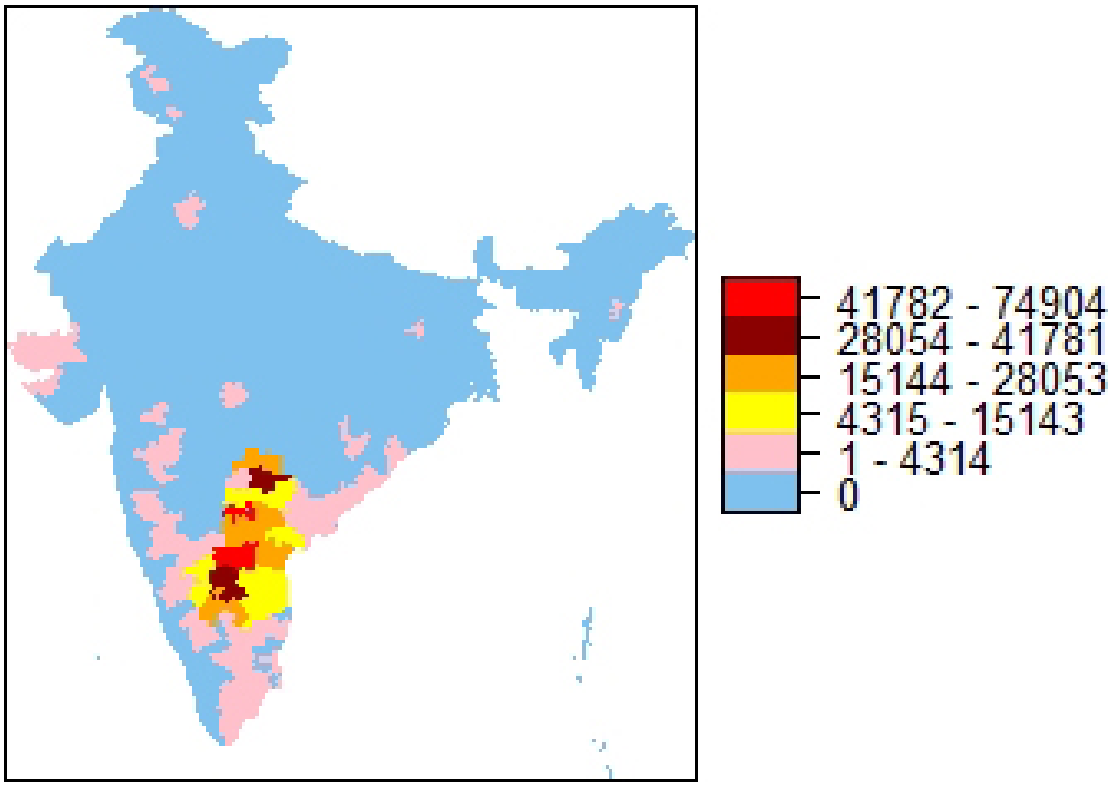
Source: *NADRES, ICAR-NIVEDI (*https://nivedi.res.in/Nadres_v2/fmd.php#*)*

Appendix 1: Outbreaks/Incidence of Anthrax (1990-2020)



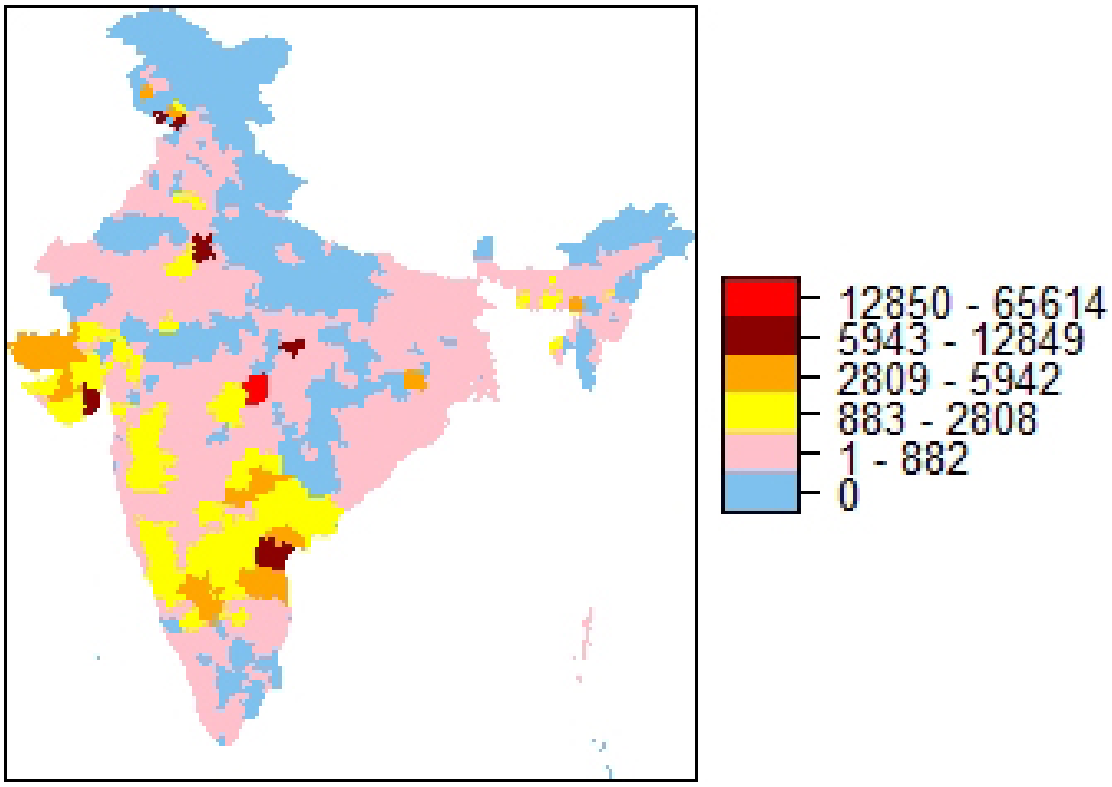
Source: *NADRES, ICAR-NIVEDI (*https://nivedi.res.in/Nadres_v2/fmd.php#*)*

Appendix 2: Outbreaks/Incidence of Blackquarter (1990-2020)



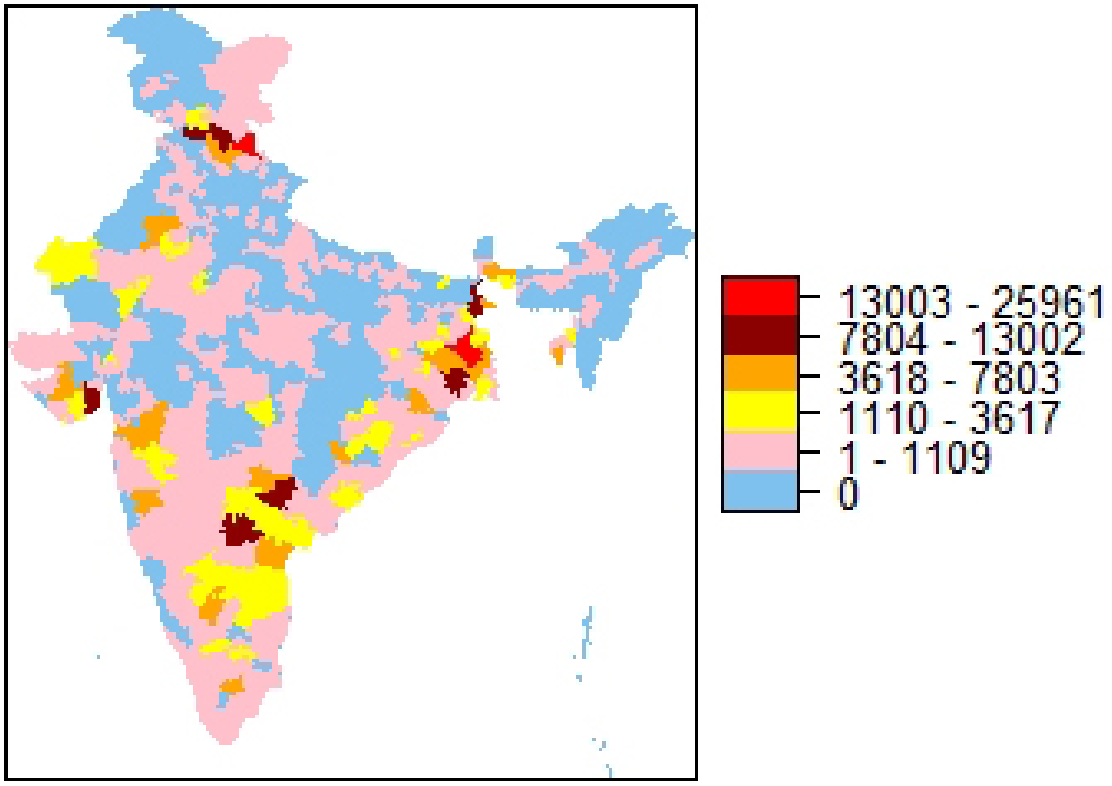
Source: *NADRES, ICAR-NIVEDI (*https://nivedi.res.in/Nadres_v2/fmd.php#*)*

Appendix 3: Outbreaks/Incidence of Bluetongue (1990-2020)



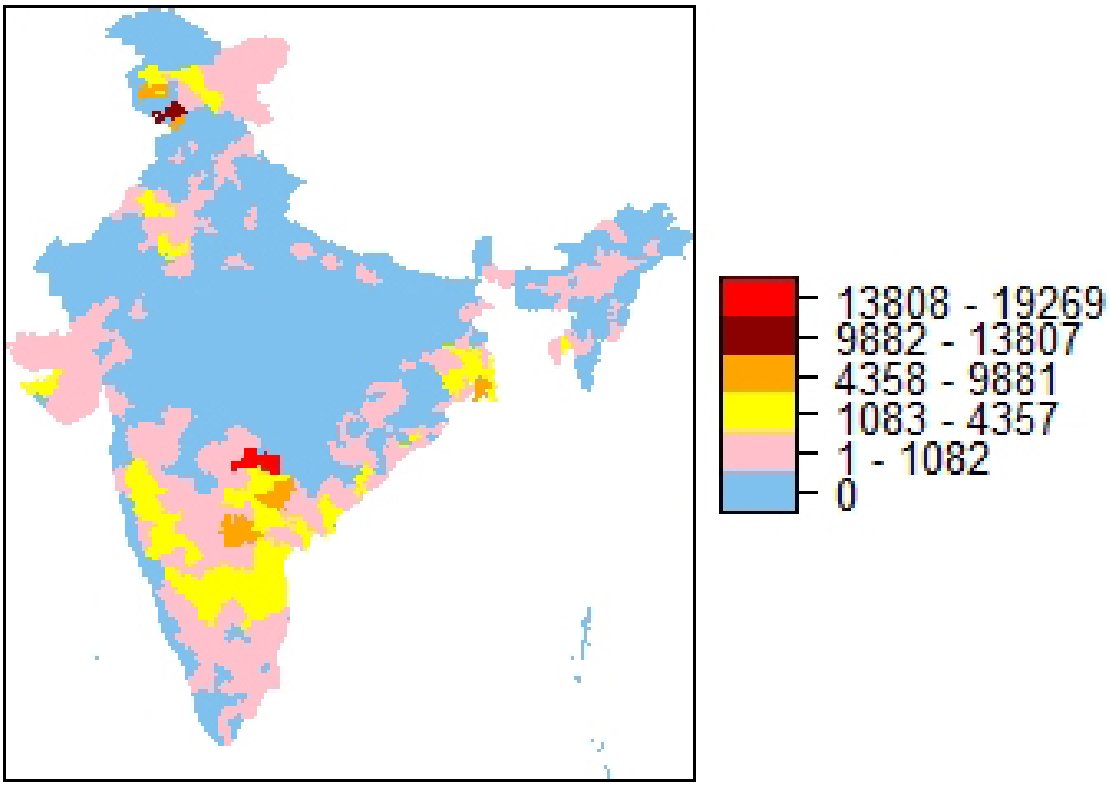
Source: *NADRES, ICAR-NIVEDI (*https://nivedi.res.in/Nadres_v2/fmd.php#*)*

Appendix 4: Outbreaks/Incidence of Haemorrhagic Septicaemia (1990-2020)



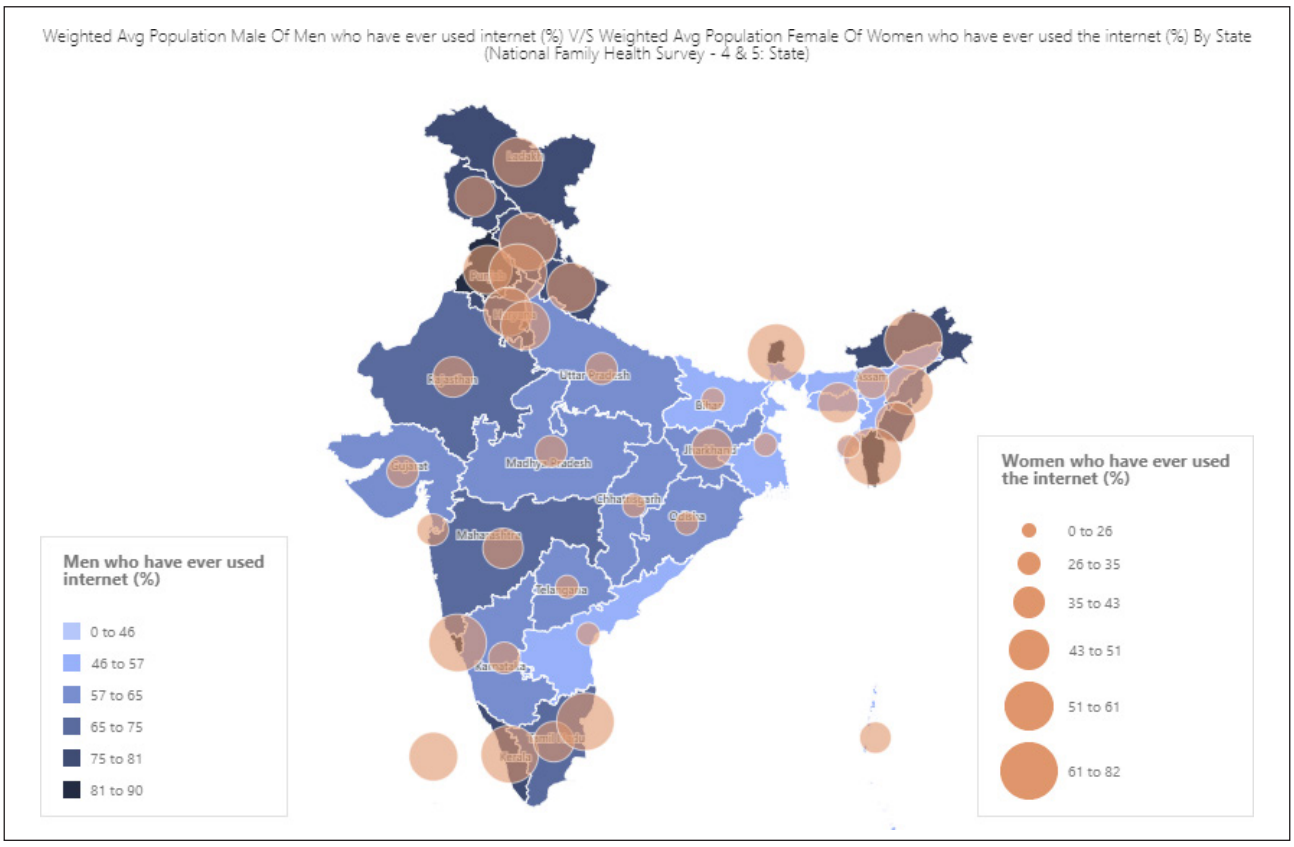
Source: *NADRES, ICAR-NIVEDI (*https://nivedi.res.in/Nadres_v2/fmd.php#*)*

Appendix 5: Outbreaks/Incidence of Peste des petits ruminants (1990-2020)



Source: *NADRES, ICAR-NIVEDI (*https://nivedi.res.in/Nadres_v2/fmd.php#*)*

Appendix 6: Incidence of Sheep and Goat Pox (1990-2020)



Source: *NFHS-5*

Appendix 7: Share of men and women who have ever used internet (%)