



Emergency Response to Suspected Incursion of Foot and Mouth Disease Virus Serotype SAT-1 in India

Inaugural Edition

July 2026

Published by

ICAR-National Institute on Foot and Mouth Disease

Arugul, Bhubaneswar – 752050, Odisha, India

Email: director.nifmd@icar.org.in

Website: <http://nifmd.res.in>

Editorial committee:

Dr R P Singh, Director, Chairman
Dr J K Mohapatra, Pr. Scientist- Member
Dr S Saravanan, Pr. Scientist- Member
Dr M Rout, Sr. Scientist- Member
Dr J K Biswal, Sr. Scientist- Member
Dr L N Saranagi, Sr. Scientist- Member
Dr S Das, Sr. Scientist- Member
Dr R S Arya, Sr. Scientist- Member Secretary

Authors: R S Arya, S Saravanan, L N Sarangi, S Das, M Rout, S Nautiyal, N R Sahoo, M Choudhary, R Ranjan, B V S Kumar, J K Biswal, M Sahoo, S Mallick, T Das, S S Dahiya, J K Mohapatra and R P Singh.

Citation: *Emergency Response to Suspected Incursion of Foot and Mouth Disease Virus Serotype SAT-1 in India*. ICAR–National Institute on Foot and Mouth Disease, Arugul, Bhubaneswar, Odisha, India. Edition July 2026. ISBN: 978-81-689-5390-1

© 2026 ICAR–National Institute on Foot and Mouth Disease, Bhubaneswar. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, whether electronic, mechanical, photocopying, recording, scanning, or otherwise, without the prior written permission of the Director, ICAR–National Institute on Foot and Mouth Disease, Bhubaneswar, Odisha (director.nifmd@icar.org.in), except for brief quotations used for academic review, research, or educational purposes with appropriate acknowledgement.

ISBN: 978-81-689-5390-1



9 788168 953901



Disclaimer: This document has been prepared as a technical guidance manual for emergency preparedness and response to the suspected incursion of Foot and Mouth Disease Virus (FMDV) serotype SAT-1 in India. The recommendations contained herein are based on the scientific knowledge and information available at the time of publication and are intended to support decision-making by competent authorities. Figures and visual representations used in this document were generated with the assistance of artificial intelligence (AI) tools. Users are advised to refer to the latest guidelines, policies, and statutory provisions issued by the Government of India and other competent authorities. The publisher shall not be liable for any loss or consequences arising from the use of the information contained in this publication.

Scope Note: While this document is intended primarily for emergency response to the suspected incursion of FMDV serotype SAT-1 in India, its principles and operational framework are broadly applicable and may, wherever appropriate, be adapted for preparedness and response to other exotic FMDV serotypes, subject to disease-specific epidemiological considerations and the directions of the competent authority.

Suggestions for Improvement: This publication is intended to be a dynamic technical resource and will be updated periodically as new scientific evidence, epidemiological information, and operational experience become available. Constructive suggestions, observations, and recommendations from readers are sincerely welcomed and may be communicated to the director.nifmd@icar.org.in. Valuable feedback received will be duly considered while revising and updating future editions of this document.

Emergency Response to Suspected Incursion of Foot and Mouth Disease Virus Serotype SAT-1 in India

Table of Content

Section	Title	Page No.
Chapter 1	Background & Risk Context	1
Chapter 2	Case Definition & Trigger Points	4
Chapter 3	Clinico-Epidemiology	7
Chapter 4	Outbreak Investigation & Field Epidemiology	10
Chapter 5	Immediate Outbreak Containment Measures	13
Chapter 6	Wildlife & Zoo Interface Management	18
Chapter 7	Sample Collection, Storage & Transport	20
Chapter 8	Laboratory Diagnosis & Confirmation	24
Chapter 9	Vaccination Preparedness Strategy	26
Chapter 10	Resource Mobilization & Logistics	27
Chapter 11	Risk Communication & Public Awareness	33
Chapter 12	Data Management & Reporting	36
Chapter 13	Coordination & Command Structure	38
Chapter 14	International Collaboration	42
Chapter 15	Training & Capacity Building	47
Chapter 16	Post-Outbreak Actions	48
Chapter 17	Conclusion	50
Annexure 1	Triggers Indicating SAT-1 Entry in India	51
Annexure 2	FMDV Serotype O vs. SAT-1 and Clinical Features in Indian Wildlife	57
Annexure 3	Epidemiology and Response	59
Annexure 4	Types of Surveillance	63
Annexure 5	Zoning and Movement Control Framework	65
Annexure 6	Guidelines for Compartmentalization	70
Annexure 7	Wildlife Interface Logistics and Biosecurity Preparedness	79
Annexure 8	Use of Disinfectants	84
Annexure 9	Sampling and Transport	86
Annexure 10	Preventive Vaccination Plan	96
Annexure 11	Risk Communication	98
Annexure 12	Data Collection, Reporting, and Information Management	99
Annexure 13	National Incident Response and Coordination System (NIRCS)	105
Annexure 14	The International Framework	111
Annexure 15	SAT-1 FMD Preparedness Training and Capacity Building Framework	117



भारतीय कृषि अनुसंधान परिषद

कृषि भवन, डॉ० राजेन्द्र प्रसाद रोड, नई दिल्ली-110001

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Krishi Bhawan, Dr. Rajendra Prasad Road, New Delhi-110001

Phone : 011-23381119, E-mail : ddgas.icar@nic.in

डा. राघवेंद्र भट्टा

उप महानिदेशक (पशु विज्ञान)

Dr. Raghavendra Bhatta

Deputy Director General (Animal Science)

M. V. Sc. Ph.D., Postdoctorate (Japan, USA)

No. AS/PS/DDG(AS)/Message/2026/18

Dated 7th July, 2026

Foreword

The livestock sector is an indispensable pillar of Indian agriculture, making a significant contribution to food and nutritional security, rural livelihoods, employment generation, and the national economy. Sustaining the productivity, health, and resilience of this vast livestock resource requires continuous scientific innovation, robust disease surveillance systems, advanced diagnostic capabilities, and effective coordination among research institutions, veterinary services, and policymakers. In this context, preparedness against transboundary animal diseases assumes paramount importance in safeguarding national animal health and ensuring the long-term sustainability of the livestock sector.

Foot-and-Mouth Disease (FMD) remains one of the most economically devastating transboundary animal diseases worldwide, causing substantial production losses and trade restrictions. India has made remarkable progress in controlling the disease through systematic vaccination, strengthened surveillance, enhanced laboratory networks, and the coordinated implementation of the Foot-and-Mouth Disease Control Programme. Nevertheless, the ever-evolving global epidemiological landscape necessitates sustained vigilance and proactive preparedness. The recent transboundary spread of Foot-and-Mouth Disease virus (FMDV) serotype SAT-1 beyond its traditional endemic regions serves as a timely reminder that emerging disease threats must be anticipated and addressed through strategic preparedness, scientific foresight, and rapid response, rather than reactive measures alone.

The present preparedness document, Emergency Response to Suspected Incursion of Foot-and-Mouth Disease Virus Serotype SAT-1 in India, is a significant step towards strengthening the country's capacity to respond effectively to such emerging threats. Developed through the collective expertise and dedicated efforts of scientists and subject matter experts at ICAR–National Institute on Foot and Mouth Disease, Bhubaneswar, this publication comprehensively brings together the current scientific understanding of FMDV serotype SAT-1, including its epidemiology, potential pathways of introduction, surveillance strategies, laboratory diagnosis, emergency response mechanisms, biosecurity measures, outbreak investigation, wildlife interface, vaccination considerations, risk communication, and capacity-building requirements. By integrating scientific evidence with practical operational guidance, the document provides a valuable framework for enhancing institutional preparedness and coordinated response across the country.

I congratulate all the contributing scientists and experts for their commendable efforts in developing this comprehensive and timely preparedness document. Their dedication and scientific commitment have resulted in a publication that will serve as an authoritative reference for researchers, veterinarians, policymakers, and animal health professionals. I am confident that this document will make a significant contribution to strengthening India's preparedness against the emerging challenges posed by Foot-and-Mouth Disease, particularly the potential incursion of exotic serotypes such as SAT-1, thereby reinforcing the country's animal health security.

I extend my best wishes for the successful dissemination, implementation, and widespread adoption of this important publication. I am confident that it will play a pivotal role in enhancing national preparedness and safeguarding the health, productivity, and sustainability of India's livestock sector.

(Raghavendra Bhatta)

Foreword

Foot-and-Mouth Disease (FMD) continues to be one of the most economically devastating transboundary animal diseases affecting livestock worldwide. India possesses one of the world's largest populations of susceptible domestic animals, and despite sustained implementation of the Livestock Health and Disease Control Programme (LHDCP), along with decades of scientific advances in diagnosis, surveillance, vaccination, and epidemiological investigations, FMD remains an important challenge for the livestock sector. The disease not only causes substantial production losses through reduced milk yield, impaired growth, infertility, and mortality in young animals, but also restricts national and international trade in animals and animal products, thereby affecting the livelihoods of millions of livestock-dependent farmers.

Historically, FMD in India has been associated predominantly with serotypes O, A, C, Asia-1. Serotype C got eliminated in 1995 from India. However, the recent emergence and rapid geographical expansion of FMD virus serotype SAT-1 beyond its traditional endemic range has fundamentally altered the global epidemiological landscape. The detection of SAT-1 in countries outside its historical distribution, including regions in Asia and Europe, highlights the ability of this serotype to spread across international borders and establish itself in previously unaffected areas. Although SAT-1 has not been reported in India to date, increasing international animal movements, expanding trade networks, porous transboundary interfaces, wildlife reservoirs in neighbouring regions, and changing ecological dynamics underscore the importance of maintaining a high level of preparedness against its potential introduction.

Experience from previous incursions of transboundary animal diseases, such as, HPAI, PRRS, ASF or LSD demonstrated that the success of disease containment depends largely upon preparedness before an outbreak occurs. Early recognition of unusual clinical presentations, rapid laboratory confirmation, timely reporting, coordinated epidemiological investigations, effective movement control, risk communication, and inter-agency collaboration collectively determine the effectiveness of the emergency response. Preparedness followed by training and simulation practice, therefore, is not merely a technical exercise but a continuous process involving surveillance systems, laboratory networks, veterinary services, policymakers and fund managers, border authorities, wildlife managers, and livestock owners working together under a unified framework.

Recognizing this emerging global threat, this preparedness document entitled **“Emergency response to suspected incursion of Foot & Mouth Disease virus serotype SAT-1 in India”** has been developed by ICAR-National Institute on Foot and Mouth Disease, Bhubaneswar to provide a comprehensive scientific resource for strengthening national readiness against a possible incursion of FMDV serotype SAT-1. Rather than serving as a rigid operational manual, the document presents an integrated compilation of current scientific knowledge, internationally accepted principles, national preparedness strategies, and practical guidance that can support evidence-based decision-making during both preparedness and emergency situations.

I congratulate all the contributing scientists and experts in preparation of this comprehensive document. This document is a running and dynamic conversation, which like any such documents will require periodic review and updating depending on how the SAT-1 FMD situation unfolds in India or hopefully never does. I am confident that this document will be immensely useful in developing a standard operating procedure for the Government of India or other stakeholders involved in the livestock sector, should the SAT-1 FMD invade the country.

Dr Santanu Kumar Bandyopadhyay

Former Animal Husbandry Commissioner to Government of India
Former Member of Agricultural Scientists Recruitment Board, ICAR
Former Senior Technical Coordinator, FAO of the UN, Vietnam and SAARC, Nepal



Dr R.P. Singh
Director

Dated: 12th July, 2026

Foreword

Foot-and-Mouth Disease (FMD) continues to pose a significant threat to livestock production, rural economies, and international trade. The recent geographical expansion of FMD virus serotype SAT-1 beyond its traditional endemic regions highlights the need for heightened vigilance and proactive preparedness, even in countries where this serotype has not been reported. Comprehensive preparedness planning is therefore essential to ensure rapid detection, coordinated response and effective containment. The guidance document entitled **“Emergency Response to Suspected Incursion of Foot & Mouth Disease Virus Serotype SAT-1 in India”** developed by Scientists of ICAR-National Institute on Foot and Mouth Disease (ICAR-NIFMD), Bhubaneswar will be a very handy tool and will provide field veterinarians, diagnosticians, epidemiologists, policymakers, emergency responders, and other stakeholders with a comprehensive technical framework to support preparedness and rapid response to a potential incursion of FMDV serotype SAT-1 into India. The principles described can be applied to other countries for similar preventive measures of FMD and similar transboundary animal diseases.

Such a prior preparedness becomes more and more relevant now a days with the kind of progress India is making in FMD control and possible virus elimination, especially when serotype C got eliminated in 1995, no incidences reported for serotype Asia-1 in last about 36 months, and reduced number of outbreaks for FMDV serotype O and A. All these developments will encourage us to focus more on prevention of re-entry of such viruses rather than control of disease, once incursion happens. This will also require a lot of active surveillance around the country and at international borders and neighbouring countries. The heightened biosecurity measures within country, at the international borders and a lot of capacity building within the country and within region following regional approaches is the need of hour to prevent such incursions.

I congratulate the entire team at ICAR-NIFMD, Bhubaneswar, whose collective efforts have resulted in this timely document. I am confident that this will serve not only as an important resource for preparedness against FMDV serotype SAT-1 but also as a valuable reference for strengthening India's animal health preparedness and response capacity against other emerging, exotic, or re-emerging FMD virus serotypes in the future.

RABINDRA
PRASAD SINGH

Digitally signed by
RABINDRA PRASAD SINGH
Date: 2026.07.12 09:52:34
+05'30'

(R.P. Singh)
Director

Preface

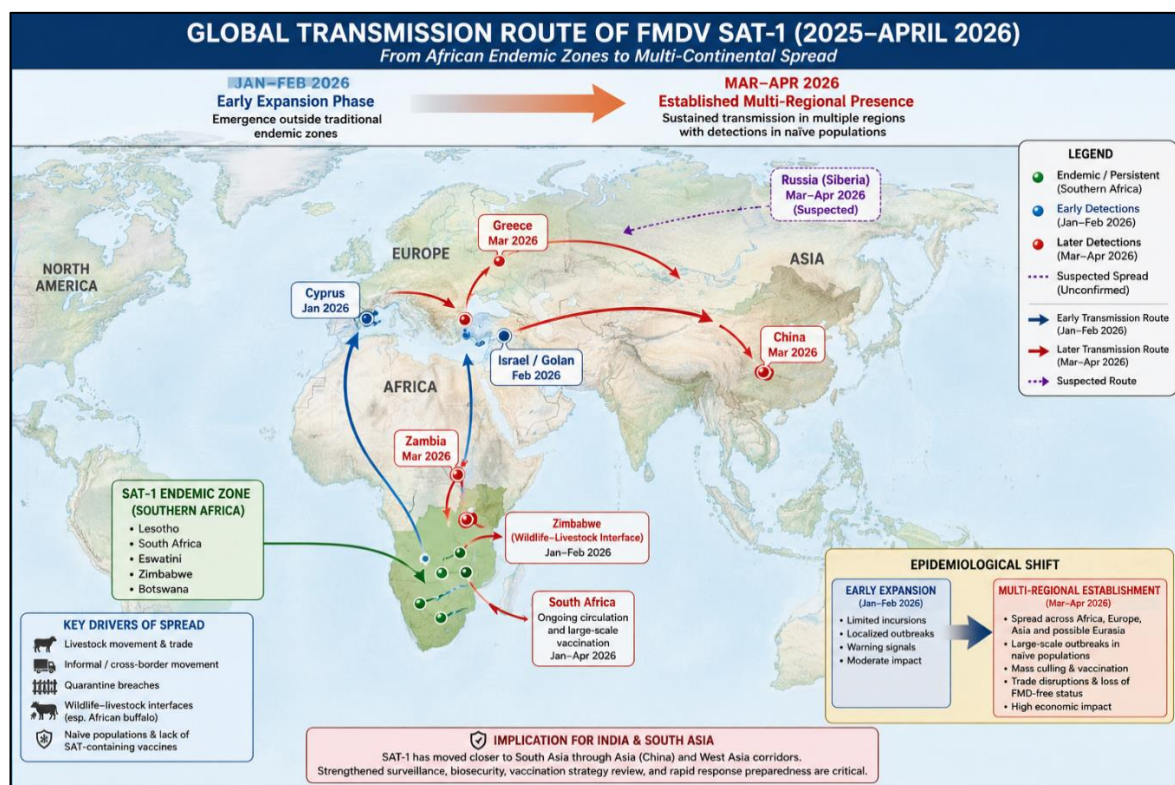
Foot and Mouth Disease (FMD) remains one of the most significant transboundary animal diseases, posing a persistent threat to livestock health, productivity, and trade. While India has made considerable progress in controlling FMD through systematic vaccination, surveillance, and strengthened veterinary services, the changing global epidemiological scenario demands continued vigilance. The recent emergence of FMD virus (FMDV) serotype SAT-1 beyond its traditional geographical distribution has highlighted the importance of preparedness against its possible introduction into previously unaffected regions, including India. An unfortunate incursion of FMDV serotype SAT-1 into India could have far-reaching consequences for the livestock sector. Besides causing substantial production losses through reduced milk yield, reproductive losses, and mortality in young animals, it could disrupt animal husbandry activities, adversely affect farmers' livelihoods, and lead to increased prices of livestock and livestock products due to supply chain disruptions and disease control measures. Such an event also has the potential to undermine the significant gains achieved through the Government of India's sustained FMD Control Programme under the Livestock Health and Disease Control Programme (LHDCP), which has substantially reduced FMD incidence across the country. As the current FMD vaccination programme in India is based on serotypes O, A, and Asia1, the incursion of SAT-1 could have serious epidemiological and economic consequences.

Recognizing the need to equip veterinary professionals, policymakers, laboratory personnel, and other stakeholders with current scientific knowledge and practical guidance, ICAR-NIFMD, Bhubaneswar, has developed this technical document for emergency preparedness and coordinated response in the event of a SAT-1 incursion. The document brings together contemporary scientific information, risk-based preparedness strategies, and key response considerations to facilitate timely detection, coordinated action, and informed decision-making in the event of a suspected SAT-1 incursion.

Preparedness is a continuous process that relies on awareness, capacity building, and effective coordination among all stakeholders. It is hoped that this document will serve as a valuable reference for strengthening national readiness and contribute to safeguarding India's livestock sector against emerging FMD threats. The authors and editors place on record their sincere appreciation to all the scientists, experts, and reviewers whose contributions have made this publication possible. Further, the editorial committee welcomes constructive feedback and suggestions for future editions. The document will be revised periodically to incorporate emerging scientific evidence, evolving epidemiological situations, and policy developments.

Authors & Editors

Chapter 1 Background & Risk Context



1.1 Introduction

Foot and Mouth Disease (FMD) remains one of the most economically devastating transboundary animal diseases, with severe implications for livestock productivity, trade, and rural livelihoods. Globally, outbreak control often relies on “stamping out” (mass culling); however, this approach is not socio-economically feasible in India, where livestock are integral to smallholder livelihoods, draught power, and cultural and religious systems. Consequently, an incursion of an exotic serotype such as South African Territories 1 (SAT-1) could result in prolonged endemicity, production losses, and trade disruptions rather than rapid elimination and eradication. The expanding geographic footprint of FMDV serotype SAT-1 in West Asia and North Africa since 2025 poses a significant, atypical risk to India, where livestock are highly vulnerable due to a lack of herd immunity and the absence of cross-protection from current vaccines. Due to informal trade and potential airborne transmission, expert bodies, including the World Organisation for Animal Health (WOAH) and the Food and Agriculture Organization (FAO), have advised implementing robust early warning systems and enhanced surveillance to prevent its introduction.

During the year 2025 and the first quarter of 2026, FMDV SAT-1 showed an unusual and rapid transboundary expansion beyond its traditional African distribution, creating a major preparedness concern for SAT-1-naïve regions, including India. FAO’s rapid risk assessment notes that the current SAT-1 spread was first reported in Iraq in March 2025, followed by reports from Azerbaijan, a quarantine station in Bahrain, Cyprus, Egypt, Iran, Israel, Kuwait, Lebanon and Türkiye. FAO assessed further spread to currently unaffected neighbouring countries as “very likely”, with a moderate to severe impact, mainly through informal animal movement, weak sanitary controls, and limited SAT-1 vaccine availability. The most important recent shift has been the entry of SAT-1 into Europe and the Eastern Mediterranean. Cyprus notified FMD outbreaks in Larnaca on 21 February 2026, with the circulating strain identified

as SAT-1; the European Commission deployed EUVET support and supplied SAT-1 vaccine doses. Greece confirmed SAT-1 FMD on Lesbos on 16 March 2026, followed by restricted zones and emergency movement controls. These incursions demonstrate that SAT-1 is no longer confined to historically endemic areas and can rapidly trigger major regional trade and movement restrictions. The eastward jump is equally significant. China confirmed its first detection of SAT-1 on 2nd April 2026 in Gansu and Xinjiang, involving 219 cases among 6,229 susceptible cattle, with the likely epidemiological concern linked to pastoral systems, livestock trade routes and cross-border animal movement. This detection is highly relevant to India because it places SAT-1 closer to South and Central Asian livestock corridors. Thus, SAT-1 cannot be considered a remote threat for India; rather, it should now be regarded as a near-regional emerging risk requiring heightened preparedness, surveillance, and border vigilance.

For India, the main concern is the absence of population immunity against SAT-1. Current FMD control under Indian programmes, namely “Livestock Health and Disease Control Programme (LHDCP)”, is based on repeated mass vaccination, and the trivalent vaccine used for eligible cattle and buffaloes targets serotypes O, A and Asia-1, not SAT-1. Therefore, an incursion could spread in an immunologically naïve livestock population, especially through border districts, informal animal trade, shared grazing systems, wildlife–livestock interfaces (WLI), animal markets and seasonal movements around festivals. FAO has highlighted periods of increased animal movement preceding certain religious festivals as potential risk amplifiers for transboundary spread. Evidence from recent outbreaks indicates that the introduction of SAT-1 into naïve populations can result in rapid and extensive transmission due to the absence of herd immunity. Given this evolving threat landscape, there is an urgent need for a proactive and structured Standard Operating Procedure (SOP) focusing on:

- Early detection and rapid diagnosis,
- Immediate containment and movement control, and
- Prevention of establishment and endemic circulation

In practical terms, SAT-1 may be described as not yet at India’s border but uncomfortably closer than before. The threat is no longer only “African”; it has shown an ability to jump into new epidemiological zones and continue spreading in susceptible livestock populations. WOAHA has specifically warned that SAT-1 has spread beyond its historical African range into countries in Southern Africa, Asia, Europe, and the Middle East. The risk pathways for introduction into India are multifactorial. Transboundary spread is strongly associated with informal livestock trade, cross-border animal movement, and porous borders (Nepal, Bhutan, Myanmar, and Bangladesh), particularly in endemic regions. India cannot solely depend on the capacity and ability of the neighbouring countries to detect such an incursion of a new disease and report it in real time for others to take appropriate actions for its transboundary spread. Additional risks include WLI, contaminated fomites, and long-distance aerosol transmission, especially under favourable climatic conditions such as cool temperatures and high humidity, which enhance viral survival and dispersal. FMDV is highly contagious and can spread via respiratory aerosols, animal products, and contaminated materials, making containment challenging. Seasonal factors further amplify risk, particularly large-scale animal movements during socio-religious festivals & cattle fairs, when livestock trade intensifies.

1.2 Learnings from ASF, PRRS and LSD for SAT-1

The recent Indian experience with African Swine Fever (ASF), Porcine Reproductive and Respiratory Syndrome (PRRS) and Lumpy Skin Disease (LSD) shows that exotic or emerging livestock viruses usually enter through one or more of four routes: porous borders, informal animal movement/trade, contaminated products/fomites, and ecological interfaces

such as wildlife or vectors. ASF first drew major attention in India in 2020, with confirmed outbreaks in Assam and Arunachal Pradesh, both located in the far North-East near international borders with China, Myanmar, Bhutan and Bangladesh. This geography strongly suggests a transboundary entry risk linked to porous borders, pig movement, pork/pig products, swill feeding, fomites and wild suid interfaces. Later ASF detections in wild boar also underline the risk of wildlife reservoirs and forest–farm interfaces. PRRS was first officially reported in India in 2013 in Mizoram, another North-Eastern border state. Subsequent studies described severe outbreaks and spread in pig populations, including later reports from Karnataka. The most likely pathways were the movement of infected pigs, informal trade networks, and the introduction through transboundary pig value chains. Unlike ASF, PRRS is not primarily a WLI disease, but it demonstrates how movement of live animals can rapidly introduce a new virus into distant production systems. LSD entered India in 2019 and expanded dramatically by 2022, affecting more than 15 states and causing very high cattle morbidity and mortality. Its spread differed from ASF and PRRS because LSD is mainly vector-borne, involving biting flies, mosquitoes and ticks, though animal movement, cattle fairs, transport and contaminated fomites also contributed. The 2022 spread from western/north-western India to multiple states shows how vector ecology plus livestock movement can convert a localized incursion into a national epidemic or continental epidemic.

These patterns are directly relevant to SAT-1 preparedness. Like ASF and PRRS, it may enter through porous land borders, informal animal trade, shared grazing corridors, transport of infected animals, contaminated vehicles, feed, equipment and animal products. Like LSD, its spread may be amplified by ecological and seasonal conditions, although SAT-1 is not vector-borne. FMDV can spread efficiently through direct contact, fomites and aerosols; under favourable conditions such as cool winds and high humidity, short- to medium-range airborne spread may become important. ASF incursion in India revealed the importance of border and wildlife vigilance; PRRS provided evidence of risks associated with live-animal trade networks; LSD demonstrated how quickly a disease can spread across the country due to uninhibited movement or minor changes in the ecology. SAT-1 may exploit all these vulnerabilities simultaneously, making prevention and early containment more difficult, requiring a realistic strategy for India. Therefore, the situation could resemble ASF/PRRS in terms of transboundary entry, but the scale could resemble or exceed LSD because cattle, buffalo, sheep, goats and pigs may all be susceptible to this exotic serotype of FMD.

The practical lesson is that waiting for confirmation of SAT-1 would be dangerous. Since stamping-out or test-and-slaughter policies are socio-economically not possible in India, SAT-1 preparedness must be much stricter than routine FMD prevention & control. Priority should be given to border surveillance, creation of an immune belt at the international border, rapid SAT-1-specific laboratory confirmation, movement control, animal-market regulation, festival-period vigilance, such as animal movement during festivals, WLI monitoring, ring surveillance, emergency vaccine access planning and strong risk communication between all stakeholders.

In view of all this, it was thought to design an FMDV SAT-1 preparedness document for India covering early suspicion, rapid laboratory confirmation, immediate movement control, ring surveillance, emergency vaccine access planning, and prevention of virus establishment. Unlike European strategies, where stamping out is a central control tool, India's smallholder livestock economy makes large-scale stamping out socially, economically and religiously impossible; hence, rapid detection, zoning, biosecurity, risk communication and vaccination preparedness become the foundation of SAT-1 emergency response. Also, the quantity of vaccine required under Indian socio-economic conditions needs to be assessed, which will be several times more than the regions which practice the stamping out policy.

Chapter 2

Case Definition and Trigger Points

The current chapter compiles the clinical, epidemiological, and communication-linked triggers for early diagnosis and prompt response towards future incursions of suspected FMD-like disease caused by FMDV serotype SAT-1 in India. The journey starts with the identification of a suspected case, trigger recognition, and activation of further associated protocols in line with transboundary risk pathways and real-world scenarios in the field. (Annexure 1)

2.1 Indicators of incursion of SAT-1

The identification of the Indicators suggestive of SAT-1 incursion in India is important for taking further necessary actions. These include the occurrence of FMD-like disease in the region, unusual outbreaks in vaccinated populations, rapid spread across multiple holdings or villages, evidence of silent infection in sheep and goats, and epidemiological linkage to affected countries, border regions, livestock markets, or animal movement networks. Detection of FMDV in a suspected outbreak where currently deployed vaccines targeting serotypes O, A, and Asia 1 are unlikely to provide protection should further strengthen suspicion and warrant immediate laboratory investigation for SAT-1.

2.2 How to define an FMD case

A case of FMD can be defined as the infection in any cloven-hoofed animal (cattle, buffalo, sheep, goats, pigs, or wild ruminants) or other susceptible animals (such as elephant) exhibiting clinical signs consistent with FMD, including fever and depression, excessive salivation, vesicular lesions (blisters/erosions) on the mouth and muzzle, teats, feet (coronary band/interdigital space), lameness and reluctance to move, where the virus/its antigen/ genome is detected in the test samples under suspicion using laboratory diagnostics thereby confirming the involvement of FMDV in the sample. It can further be supported by the demonstration of anti-FMDV or its non-structural protein (NSP) antibodies in the serum collected from the suspected animal. For operational clarity under SAT-1 preparedness, the combination of the development of vesicular lesions along with lameness intermingled with a drastic reduction in milk production should be treated as a highly suspicious field definition. When all or some of these clinical signs are observed simultaneously in multiple animals, the suspicion should be escalated immediately.

2.3 Confirmed case

A confirmed case is a suspected case found positive for FMDV serotype SAT -1 in the present context, which is detected through rapid laboratory test (ELISA, RT-PCR/real-time PCR/sequencing, etc.) and virus isolation in suspected clinical samples like vesicular fluid/epithelium with/without detection of NSP-antibody in serum, depending upon the stage of infection.

2.4 Clinical characteristics/triggers of SAT-1

SAT-1, being one of the serotypes of FMDV, produces clinical symptoms similar to those of other endemic serotypes of the virus circulating in the country. Observations like outbreaks occurring in vaccinated herds, unusual severity compared to endemic FMD patterns, high calf mortality disproportionate to typical outbreaks, rapid spread across multiple herds or villages, and evidence of subclinical infection in sheep and goats are the high-suspicion triggers for an SAT-1 outbreak. Species variation may be similar, as severe in cattle, mild/subdued in sheep and goats, which can act as silent spreaders, masking early incursion signals. Other

similar-looking diseases mimicking FMD that need to be ruled out include vesicular stomatitis and swine vesicular disease, both of which are still exotic to India. Accurate laboratory diagnosis is therefore essential before confirmation.

2.5 Trigger points for immediate field action

Trigger points are defined as the aspects of clinical or epidemiological events demanding or necessitating immediate/prompt reporting with simultaneous initiation of containment measures soon after the suspected case is encountered, followed by its confirmation.

2.5.1 Primary clinical triggers/ clinical red flags

The rapidly increasing morbidity in naïve or vaccinated populations and severe vesicular disease with high production losses are the clinical alerts. Unexplained mortality in young animals, as well as clinical signs consistent with FMD but with greater magnitude than the expected severity, are also to be taken into account (refer to Chapter 3 and [Annexure 1](#)).

2.5.2 Epidemiological triggers / Epidemiological red flags

Epidemiological triggers are linked to transboundary risk. Given the documented transboundary movement pathways, the epidemiological context plays a decisive role in suspicion escalation. Detection of SAT-1 in neighbouring countries or trade partners, evidence of spread along transboundary corridors, and introduction of animals from affected regions are the points of concern.

2.5.3 Proximity and movement-based / communication-linked triggers

Farms located near international borders, presence within a protection or surveillance zone of a known outbreak, introduction of animals from border districts, livestock markets, and communal grazing areas are the proximity triggers. Movement (intended or illegal) during high-risk periods, such as festivals or seasonal migration, increases the risk that the disease can spread quickly from one animal to another in very little time. Increased reporting of suspicious symptoms by farmers, community alerts regarding sudden disease spread, and field-level observations linked to animal movement or market activity trigger the response and the management of the activities.

2.5.4 Laboratory-based triggers

Confirmation of SAT-1 serotype by antigen ELISA, RT-PCR, or sequencing, with further isolation of virus from the clinical materials collected from suspected incidences, triggers the subsequent steps to be followed as a response strategy.

2.6 Corridor-specific risk linkages

The following high-risk entry pathways significantly influence trigger interpretation. The north-western corridor, which includes the Pakistan Route, falls under a high-risk corridor. Entry of infected animals driven by informal livestock movement and pastoral systems or illegal trafficking through Jammu & Kashmir, Punjab, and Rajasthan may prove risky. The Northern corridor includes the Nepal route, which is an open border risk as there is no movement restriction of human or livestock in these areas through any adjoining states like Uttar Pradesh, Bihar, West Bengal, and Sikkim. North-eastern (NE) corridor (ecological interface) allows entry via Arunachal Pradesh, Sikkim, and other NE states sharing international borders with China, Myanmar and Bangladesh.

2.7 Indirect pathways (pan-India amplification)

Indirect pathways include movement of contaminated livestock products, transport vehicles, equipment, fomites, feed and fodder contamination, livestock aggregation points and markets etc. Even the introduction of the pathogen through any single point can rapidly amplify due to India's dense livestock population and interconnected and unrestricted movement systems without any legal enforcement at any point.

2.8 Red flag criteria for SAT-1 protocol activation

Activation of the SAT-1 emergency response protocol is warranted when one or more of the above red flag criteria are observed. These triggers are like wake-up calls that should be responded to with immense sensitivity and promptness by taking the necessary steps.



Chapter 3

Clinico-Epidemiology

FMD caused by the SAT-1 serotype must be interpreted within the dual framework of its classical African ecology and the unique livestock-production systems of the Indian sub-continent. In India, all major domestic cloven-hoofed livestock species are susceptible to FMDV infection, including cattle, buffalo, sheep, goat, pig, mithun, yak, and several captive and free-ranging wild ungulates. The epidemiology of SAT-1 in India would therefore likely involve complex interactions among domestic livestock, migratory pastoral systems, WLI, and transboundary animal movement corridors.

3.1 Clinical observations

In domestic cattle, SAT-1 infection would be expected to produce the classical clinical syndrome of FMD characterized by high fever followed by vesicle formation on the tongue, dental pad, lips, gums, oral mucosa, interdigital cleft, coronary band, and teats. Following rupture, these vesicles form painful erosions associated with excessive salivation, lameness, and reluctance to move, anorexia, weight loss, and a sharp decline in milk production. Morbidity is generally high, whereas mortality among adults is usually low. However, young calves may develop severe viral myocarditis (“tiger heart disease”), resulting in sudden death even before typical vesicular lesions become apparent, and thereby complicating early field diagnosis ([Annexure 2](#)).

3.2 African Buffalo vs Asian Buffalo

A particularly important aspect in SAT-serotype epidemiology is the distinction between African buffalo (*Syncerus caffer*) and Asian buffalo populations. African buffalo are the recognised natural maintenance hosts of SAT serotypes in Africa and frequently harbour persistent infection with limited or inapparent clinical signs. In contrast, Indian domestic river buffalo (*Bubalus bubalis*), including Murrah, Jaffarabadi, Surti, and Mehsana breeds, are susceptible domestic hosts that generally develop clinically apparent disease similar to cattle. However, water buffalo are also recognized to maintain prolonged pharyngeal persistence of FMD virus more frequently and for longer durations than cattle, thereby complicating post-outbreak surveillance and “freedom from disease” certification. This aspect becomes especially relevant in SAT-1 contingency planning because prolonged carrier status in buffalo populations could complicate eradication and recovery programs even after apparent clinical control.

3.2.1 Swamp Buffalo

Special consideration is warranted for the swamp buffalo populations of north-eastern India, particularly Assam and adjoining border regions. These buffaloes are genetically and ecologically distinct from river buffalo breeds and are often reared under semi-extensive wetland and riverine production systems close to international borders with China and Myanmar. Their epidemiological importance lies not only in biological susceptibility but also in their proximity to transboundary livestock movement routes, wildlife habitats, informal trade networks, and floodplain grazing systems. Consequently, Assam and neighbouring north-eastern states may represent strategically important surveillance zones in the event of SAT-1 emergence in bordering regions.

3.3 Small Ruminants

Small ruminants such as sheep and goats represent one of the most significant silent epidemiological risks for SAT-1 introduction and dissemination in India. Infection in these species is frequently mild, transient, or clinically inapparent, with lesions often too small or

short-lived to be readily detected under field conditions. During acute infection, however, infected animals may shed substantial amounts of virus through respiratory secretions and other excretions despite the absence of obvious clinical signs. In the Indian context, this risk is amplified by seasonal migratory pastoralism. Large-scale migratory sheep and goat movements practised by pastoral communities such as the Raika/Rebari, Gaddi, Gujjar, and Deccani pastoral systems involve long-distance interstate animal movement, congregation at fairs and markets, communal grazing, and temporary encampments. Such movements could facilitate silent dissemination of SAT-1 across large geographic areas before overt disease is recognized. Although small ruminants may enter a carrier state, the epidemiological importance of long-term carriers remains less certain than the risk associated with acute subclinical movement-related spread.

3.4 Swine

Pigs are also susceptible to SAT-1 infection and may develop severe lameness, hoof lesions, snout vesicles, reluctance to move, and sudden death in piglets due to myocarditis. In classical FMD epidemiology, pigs are regarded as important amplifier hosts because of their ability to excrete large quantities of aerosolised virus. For SAT-1 specifically, however, pigs are probably less central to long-distance aerosol epidemiology than cattle–buffalo transmission systems. Nevertheless, the Indian north-eastern context introduces an additional and highly important risk factor: swill feeding and informal pork-product movement. In several north-eastern regions bordering Myanmar and China, pigs are commonly raised under backyard systems where untreated food waste and pork remnants may be fed directly to animals. Consequently, contaminated pork products, illegally transported meat, or infected fomites crossing porous borders may constitute a realistic pathway for SAT-1 introduction into local pig populations, followed by onward spread to susceptible livestock. Thus, while pigs may not be the principal ecological maintenance hosts of SAT-1, they remain highly relevant in border biosecurity and transboundary risk assessments.

3.5 Wildlife

Unlike the epidemiological situation in parts of southern Africa, where SAT-1 is widely recognized to be maintained in free-ranging African buffalo (*Syncerus caffer*) as the principal natural wildlife reservoir, current evidence does not identify a comparable long-term maintenance reservoir among India's indigenous wildlife species. Consequently, the epidemiological role of susceptible Indian wildlife is considered to be primarily limited to transient spillover infection and, under favourable ecological conditions, short-term bridge transmission at the wildlife–livestock interface, rather than persistent, independent maintenance of the virus.

India's wildlife diversity further complicates SAT-1 preparedness planning. Several Indian wild bovids, cervids, caprines, and suids are susceptible to FMDV infection, including gaur (*Bos gaurus*), wild water buffalo (*Bubalus arnee*), Mithun (*Bos frontalis*), wild yak (*Bos mutus*), nilgai (*Boselaphus tragocamelus*), blackbuck (*Antilope cervicapra*), chousingha (*Tetracerus quadricornis*), chital (*Axis axis*), sambar deer (*Rusa unicorn*), barking deer (*Muntiacus vaginalis*), hog deer (*Axis porcinus*), and swamp deer (*Rucervus duvaucelii*). Other wildlife species of potential concern include the Indian wild boar (*Sus scrofa cristatus*), pygmy hog (*Porcula salvania*), Himalayan serow (*Capricornis thar*), and goral (*Naemorhedus goral*), which may also be susceptible to infection and participate in spillover transmission at the WLI. The Indian rhinoceros (*Rhinoceros unicornis*), although unlikely to serve as an epidemiologically important maintenance host, may be vulnerable to infection and therefore represents an important conservation concern in protected landscapes.

WLI across India may contribute to the transmission dynamics of FMDV SAT-1, particularly in regions where susceptible wildlife species share grazing areas, water sources, migration corridors, or habitat boundaries with domestic livestock. Areas containing high densities of wild ungulates and other susceptible wildlife, including protected areas, forest fringes, grasslands, floodplain ecosystems, and transboundary landscapes, warrant particular attention during surveillance and outbreak investigations. Although these species are not recognized maintenance reservoirs comparable to African buffalo, they may function as spillover or bridge hosts under conditions of close wildlife–livestock interaction ([Annexure 2](#)).

3.6 Differential diagnosis

The differential diagnosis of FMD caused by SAT-1 in India should prioritize diseases commonly encountered under Indian field conditions. These include lumpy skin disease (LSD), peste des petits ruminants (PPR), bluetongue, bovine papular stomatitis, infectious bovine rhinotracheitis, contagious ecthyma, malignant catarrhal fever, traumatic stomatitis, and chemical or plant-induced oral lesions. In pigs, Senecavirus A and swine vesicular diseases remain important exotic differential diagnoses, although they are not presently established in India. Because mucosal erosions and oral lesions associated with LSD, PPR, or traumatic conditions may be confused with FMD during rapid field screening, definitive diagnosis requires urgent laboratory confirmation using RT-PCR, antigen ELISA, sequencing, and virus isolation through designated national laboratories such as ICAR-NIFMD network.

Overall, the potential epidemiology of SAT-1 in India would likely involve severe clinical disease in cattle and domestic buffaloes. The potential for viral persistence in buffalo populations and silent dissemination within susceptible livestock populations would require close investigation in the event of SAT-1 introduction into India. Additional attention would be needed for transmission through migratory small-ruminant production systems, transboundary risks associated with pig movement, pig production systems, and pork-product trade, as well as complex wildlife–livestock interactions involving susceptible wild ungulates and other wildlife species. The northern and north-eastern regions of India warrant special strategic attention because of their proximity to international livestock movement corridors, porous borders, migratory livestock systems, ecological connectivity with neighbouring regions, and the presence of diverse susceptible wildlife populations, including swamp buffaloes, wild water buffaloes, cervids, antelopes, wild suids, and other free-ranging ungulates.

ICAR

Chapter 4

Outbreak Investigation and Field Epidemiology

In the event of an incursion of a SAT serotype of FMD in India, it is essential to undertake a comprehensive and systematic outbreak investigation alongside clinical examination and laboratory confirmation. This becomes particularly critical because SAT serotypes are exotic to India, and any introduction can have severe epidemiological and economic consequences. A structured epidemiological investigation, including identification of the index case, enables authorities to determine how long the infection has been present in the affected area, identify the most probable source of introduction, assess the extent and direction of spread, and implement targeted control measures to limit further transmission.

The primary objective of outbreak investigation is to answer the following key operational questions like: how long has the infection been present? What is the source of infection? Where has the infection spread? What control measures will stop further spread?

Addressing these questions in a timely and scientifically robust manner is essential for effective containment. All outbreak investigations must be conducted using a standardized epidemiological investigation format to ensure uniform data collection across regions. This should include details of animal inventory, clinical history, movement history (both inward and outward), contact networks, and biosecurity practices, thereby enabling consistent analysis and decision-making.

4.1 Verification of Outbreak and Case Definition

Verification of the outbreak should be undertaken immediately, and in the case of SAT serotypes, even a single confirmed case must be treated as an outbreak. The investigation team must verify clinical signs consistent with FMD and ensure alignment with a standardized case definition incorporating species, clinical presentation, time frame, and geographical location (refer chapter 2). Establishing a consistent case definition is critical to ensure uniformity in surveillance and reporting.

4.2 Identification of Index Case and Timeline

A key step in outbreak investigation is the identification of the index case and the construction of an accurate outbreak timeline. It is important to recognize that the first reported case may not represent the true index case. The investigation team should examine multiple animals across different groups within the infected premises and identify the oldest lesion, as this provides the most reliable indication of the duration of infection. Oral lesions are generally more reliable for ageing than foot lesions, which may be affected by environmental factors or secondary infections. Lesion ageing should be carried out systematically, distinguishing between early vesicular stages, ruptured lesions, fibrin deposition, and healing phases. Based on this assessment, the approximate date of onset of clinical signs (Day 0) can be determined. Considering the incubation period of FMD, which typically ranges from 2 to 6 days but may extend up to 14 days, the estimated date of infection can be approximated by subtracting 2 to 5 days from the date of the oldest lesion observed. Where the oldest lesion exceeds 7 days in age, the reliability of the estimated timeline decreases and extended tracing windows should be applied.

The outbreak timeline must include the estimated infection date, date of first clinical signs, date of detection or reporting, and the period during which onward transmission may have occurred.

4.3 Backwards and Forward Tracing

Backward tracing is undertaken to identify the source of infection, while forward tracing is used to identify premises that may have been exposed through transmission from the infected site. The backward tracing window should extend at least 14 days prior to the estimated date of infection, with an additional buffer period of up to 7 days where uncertainty exists. Forward tracing should cover the period from the estimated date of infection up to the date of detection and implementation of control measures. In situations where the onset of infection cannot be determined reliably, particularly when lesions are older than 6–7 days, an extended tracing window of up to two weeks should be considered to ensure that all potential transmission events are captured. Tracing activities must be prioritised based on risk, with high-risk contacts investigated within 24 hours, moderate-risk contacts within 48 hours, and lower-risk contacts within 72 hours ([Annexure 3](#)).

Tracing must encompass all possible pathways of disease transmission. This includes movement of susceptible animals, animal products such as milk, meat, and by-products, fomites including vehicles and equipment, and human movements involving farmers, traders, veterinarians, and artificial insemination workers. In the Indian context, particular emphasis must be placed on informal livestock markets, interstate animal movement, and cross-border trade, which represent high-risk pathways for both introduction and spread. Milk collection networks, veterinary service providers, and artificial insemination activities constitute moderate-risk pathways, while visitors and equipment sharing represent lower but still relevant risks. Similarly, forward tracing must focus on direct animal contacts, shared grazing areas, milk transport routes, and local aerosol spread, particularly in areas with high livestock density.

4.4 Line Listing and Outbreak Mapping

All identified premises must be systematically recorded through line listing, with each epidemiological unit assigned a unique identifier and documented with location, species composition, herd size, date of onset, date of detection, epidemiological classification, and movement history. For operational clarity, premises should be classified as Infected Premises (IP), Suspect Premises (SP), Dangerous Contact Premises (DCP), or other at-risk premises, based on epidemiological evidence.

Spatial mapping of infected, suspect, and contact premises should be undertaken using GIS tools or manual plotting, enabling identification of clusters and patterns of spread.

Epidemic curves should be constructed to understand the temporal and spatial progression of the outbreak and to distinguish between point source and propagated transmission. Clustered patterns of infection typically indicate local spread, whereas scattered cases are suggestive of movement-driven transmission. Network mapping may further aid in visualizing transmission pathways and identifying key nodes such as markets or transport routes.

Outbreak surveillance should include active surveillance through systematic door-to-door inspections in defined zones, passive surveillance through reporting mechanisms involving farmers and field veterinarians, and targeted surveillance focusing on high-risk premises and networks identified through epidemiological investigation. The objectives of surveillance are to detect previously unrecognised infected premises, determine the extent of the outbreak, and provide evidence to guide movement control and eventual declaration of disease freedom. Surveillance activities must be coordinated through a structured reporting system, with data flowing from village and block levels to district and state authorities and consolidated at the national level through Department of Animal Husbandry and Dairying (DAHD). Daily situation reports should be generated to support real-time decision-making.

4.5 Rapid Response Team

In the event of a suspected or confirmed incursion of FMDV SAT-1 serotype in India, a Rapid Response Team (RRT) should be immediately activated as part of the national emergency disease containment framework (Annexure 3). Considering that SAT-1 is an exotic serotype for India, the rapid field-level intervention becomes critical to prevent the establishment of transmission chains in domestic livestock, peri-domestic populations, and WLI zones. The RRT should function as a multidisciplinary operational unit comprising field epidemiologists, laboratory experts, state animal husbandry officials, local veterinary officers, para-veterinary personnel, biosecurity teams, surveillance staff, and law-enforcement or administrative representatives. The team should ideally be mobilized within hours of notification of an unusual vesicular disease event or laboratory confirmation by ICAR-NIFMD or designated network laboratories. Core responsibilities of the RRT should include outbreak investigation, epidemiological tracing, establishment of infected and surveillance zones, implementation of movement restrictions, sample collection and transport under approved biosafety protocols, risk communication with local communities, and coordination of emergency vaccination or containment measures as per national policy. Given India's dense livestock population, porous borders, extensive animal movement networks, and socio-economic constraints against mass stamping-out, the RRT mechanism should emphasize rapid detection, coordinated containment, strict biosecurity, and evidence-based surveillance to minimize the risk of SAT-1 becoming established within the country.

4.6 Surveillance strategy

Effective surveillance is essential in India because the exotic SAT serotypes are not included in the current Indian vaccine formulation and may initially circulate unnoticed in livestock movement networks, border regions, peri-urban dairy systems, or WLI areas. India's dense livestock population, extensive informal animal trade, porous international borders, seasonal migratory pastoralism, and large-scale animal congregation events create favourable conditions for rapid dissemination of an introduced SAT-1 virus. Therefore, an integrated surveillance framework combining syndromic, epidemiological, risk-based, participatory, serological, and border surveillance is essential for early detection, rapid response, movement control, and evidence-based containment. A multi-layered surveillance system also supports timely activation of RRTs, strengthens outbreak tracing and zoning operations, facilitates laboratory confirmation through ICAR-NIFMD and network laboratories, and reduces the risk of SAT-1 becoming established within domestic livestock or WLI ecosystems in India. (Annexure 4).

Chapter 5

Immediate Outbreak Containment Measures

Rapid containment of a suspected or confirmed FMDV serotype SAT-1 outbreak depends on immediate implementation of coordinated veterinary, administrative, and biosecurity interventions. Given the extremely high transmissibility of FMDV, particularly in immunologically naïve livestock populations, response measures should prioritize rapid movement control, strict farm biosecurity, early detection of secondary spread, and risk-based vaccination strategies.

5.1 Case Definition and Immediate Trigger Criteria

A standardized suspect-case definition should be used to ensure rapid and uniform field-level response (chapter 2). Any report of vesicular lesions, excessive salivation, lameness, sudden reduction in milk yield, or unexplained mortality in young susceptible animals should trigger immediate notification to veterinary authorities and provisional implementation of containment measures subject to laboratory confirmation. Because SAT is exotic to India, field veterinarians should maintain a high index of suspicion for unusual vesicular disease events, particularly in areas associated with animal movement, border trade, or wildlife–livestock interaction.

The first response step should be immediate notification to district, state, and national veterinary authorities, followed by activation of the incident command structure and emergency response system. The affected premises must be placed under quarantine without delay. All movement of susceptible animals, animal products, vehicles, feed, equipment, and personnel into or out of the infected premises should be suspended, subject to epidemiological assessment. Controlled entry and exit points should be established with mandatory decontamination facilities, including footbaths and vehicle wheel disinfection units using approved FMDV-effective disinfectants (**Annexure 8**).

5.2 Rapid Response Team (RRT) Activation and Functions

In the event of a suspected or confirmed incursion of FMDV SAT-1 serotype in India, a Rapid Response Team (RRT) should be immediately activated as part of the national emergency disease containment framework (**Annexure 3**). Considering that SAT-1 is an exotic serotype in India and that the currently deployed national vaccination programme does not provide cross-protection against SAT serotypes, rapid field-level intervention is critical to prevent the establishment of transmission chains in domestic livestock and WLI zones. The RRT should function as a multidisciplinary operational unit comprising field epidemiologists, laboratory experts, state animal husbandry officials, local veterinary officers, para-veterinary personnel, and a local liaison person from the Panchayat/field worker. The team should ideally be mobilized within hours of notification of an unusual vesicular disease event or laboratory confirmation by ICAR-NIFMD or designated network laboratories. Core responsibilities of the RRT should include outbreak investigation, epidemiological tracing, establishment of infected and surveillance zones, implementation of movement restrictions, sample collection and transport under approved biosafety protocols, risk communication with local communities, and coordination of emergency vaccination or containment measures in accordance with national policy. Given India's dense livestock population, porous borders, extensive animal movement networks, and socio-economic constraints against mass stamping out, the RRT mechanism should emphasize rapid detection, coordinated containment, strict biosecurity, and evidence-based surveillance to minimize the risk of SAT-1 becoming established within the country.

5.3 Sampling and Safe Specimen Transport

Collection and transport of diagnostic specimens should be performed only by trained personnel in accordance with the approved biosafety and biosecurity procedures. Preferred samples include vesicular epithelium, vesicular fluid, oropharyngeal samples, and serum collected from clinically affected animals. Proper cold-chain maintenance, triple-layer packaging, chain-of-custody documentation, and rapid transport to designated laboratories are essential to support timely confirmation and molecular characterization of FMDV SAT-1 while minimizing risks of accidental dissemination during handling and transport.

5.4 Zoning and Movement Control

Zoning and movement control form the cornerstone of outbreak containment and must be implemented based on both geographical proximity and epidemiological evidence (Annexure 5). The zoning system should be dynamic, risk-based, and continuously updated based on new information derived from tracing and surveillance. In addition to geographical zoning, functional or network-based zoning must be applied in the Indian context. Livestock market catchment areas, milk collection routes, and animal trader movement networks should be treated as epidemiological extensions of the outbreak zone, even if they fall outside the defined geographical radius. In high-risk scenarios, such as areas with dense livestock populations or strong trade linkages, an extended surveillance zone of up to 20 kilometres may be warranted. Zoning boundaries must remain flexible and should be expanded or modified when new infected premises are detected outside existing zones or when epidemiological evidence indicates wider spread.

Control measures within zones must also be linked to premises classification. Infected premises must remain under strict quarantine with no movement permitted; dangerous contact premises must be subject to movement restrictions and intensive surveillance; and suspect premises must be investigated and tested before any movement is allowed. This integration of zoning with epidemiological classification ensures more targeted and effective control.

5.5 Zoning Hierarchy and Spatial Containment

International FMD emergency-response frameworks generally employ a tiered zoning system to contain viral spread following the rapid confirmation of an outbreak. These zones are established around infected premises and are adjusted according to epidemiological risk, livestock density, movement networks, WLI, and environmental conditions.

5.6 Protection/Infected Zone

A Protection Zone (commonly about a 3 km radius around the infected premises) is established immediately after confirmation of infection. Within this zone, all susceptible livestock movements are prohibited unless specifically authorized by veterinary authorities. Intensive active surveillance, including daily clinical inspection and targeted sampling, is conducted to identify secondary transmission. Further, strict quarantine, disinfection, and farm-level biosecurity measures are enforced.

For FMDV SAT-1, additional precautions may be necessary in areas with significant wildlife-livestock interaction. In southern African ecosystems, protection zones often extend to WLI, common watering points, grazing corridors, and veterinary cordon fences because African buffalo populations can maintain SAT serotypes for prolonged periods. Although India lacks African buffalo reservoirs, analogous attention may be required at forest-livestock interfaces, border grazing systems, feral animal habitats, and transboundary livestock movement corridors.

5.7 Surveillance/Buffer Zone

A wider surveillance or Buffer Zone (commonly extending up to approximately 10 KM or more, depending on risk assessment) is established around the infected zone. In this area, animal movement becomes strictly regulated through permit-based systems, intensified surveillance, epidemiological tracing, and movement documentation. The primary objective is early detection of viral “spillover” beyond the initial outbreak focus.

Surveillance intensity should be determined through risk assessment rather than fixed geographic distance alone. High-density livestock regions, dairy collection networks, transport corridors, communal grazing systems, and border districts may require expanded surveillance coverage and repeated clinical inspections.

5.8 Free Zone or Wider Monitoring Area

Areas outside the surveillance zone remain under broader monitoring and preparedness activities. Passive surveillance through farmer reporting, veterinary reporting systems, slaughterhouse inspections, and milk-route monitoring remains essential. However, modern contingency frameworks also recommend targeted risk-based active surveillance in high-risk districts, transit points, border areas, and livestock aggregation centres to ensure that long-distance dissemination has not occurred through animal movement or contaminated fomites.

5.9 Movement Restrictions and Emergency Standstills

A fundamental principle of FMD epidemiology is that rapid viral dissemination occurs primarily through movement of infected animals, contaminated products, vehicles, personnel, and fomites. Consequently, immediate movement restrictions represent one of the most effective outbreak-control interventions.

5.10 Closure of Livestock Aggregation Points

Livestock markets, fairs, collection centres, transport hubs, and animal assembly points should be suspended immediately following outbreak confirmation because these locations can function as major amplification points for viral transmission.

5.11 Emergency Standstill Measures

Many international FMD contingency plans recommend the implementation of a temporary standstill on the movement of susceptible animals and associated products. A 72-hour standstill period is commonly used in several emergency frameworks to allow epidemiological investigations, tracing, and risk assessment to proceed before further dissemination occurs. In large countries such as India, standstill implementation may be regional, state-level, or corridor-based, depending on outbreak location, livestock density, and epidemiological risk, rather than uniformly nationwide. Movement controls should include cloven-hoofed animals, raw animal products, milk transport, livestock vehicles, contaminated equipment, feed and fodder transport, and semen and embryo movement where relevant.

5.12 Compartmentalization

Compartmentalization differs fundamentally from geographic zoning because it is based on management systems and validated biosecurity rather than physical location (**Annexure 6**). Under WOAHP guidelines, a compartment refers to a livestock subpopulation maintained under a documented and auditable biosecurity system capable of remaining epidemiologically separated from surrounding infection risks. Such compartments may continue limited trade operations even during regional outbreaks, provided strict surveillance, traceability, movement control, and biosecurity standards are continuously maintained. Compartmentalization is most feasible in commercial dairy systems, export-oriented livestock

enterprises, integrated pig production systems, elite breeding farms, and highly controlled production environments. Successful implementation requires rigorous movement documentation, continuous surveillance, laboratory support, validated biosecurity, and regulatory oversight.

5.13 Management of Infected Premises

Within infected premises, clinically affected animals should be isolated from apparently healthy stock wherever feasible. Decisions regarding selective depopulation or humane culling are authorised by the competent authority, particularly under the Prevention and Control of Infectious and Contagious Diseases in Animals (Amendment) Act, 2025, based on epidemiological assessment, outbreak magnitude, and resource availability. In countries employing vaccination-based control programmes, emergency vaccination may be prioritised over extensive stamping-out strategies. Regardless of the control policy adopted, thorough cleaning and disinfection of sheds, equipment, vehicles, loading areas, and personnel contact surfaces remain essential to reduce environmental contamination and indirect transmission (Annexure 8).

5.14 Milk and Animal Product Movement Control

Milk collection and transport from infected or suspect areas should be strictly regulated. Raw milk from affected premises should not be moved without veterinary authorization, and any permitted processing must comply with scientifically validated virus inactivation procedures. Similar precautions should apply to frozen or wet semen, hides, meat products, feed materials, and fomites originating from affected zones.

5.15 Cleaning, Disinfection and Waste Disposal

Animal waste, manure, bedding, feed residues, and potentially contaminated materials should be treated as infectious material and disposed of safely through scientifically approved methods such as controlled composting, deep burial, or other biosecure disposal procedures approved by competent authorities. Wastewater drainage and slurry movement should also be controlled to minimize environmental dissemination of the FMDV SAT-1.

5.16 Emergency Vaccination

Where antigenically matched vaccines are available, emergency ring vaccination or risk-based suppressive vaccination should be rapidly deployed around infected foci to reduce viral amplification and create an immunological buffer (for response strategy without vaccination, refer to chapter 9 and Annexures 4, 5 & 6). Vaccination strategies should be designed according to epidemiological risk, livestock density, species susceptibility, and vaccine availability rather than fixed geographical distance alone. Maintenance of cold chain integrity, accurate animal identification, vaccination recording, and post-vaccination monitoring are critical for effective implementation. Because protective immunity is not immediate, vaccinated herds must remain under continued surveillance and movement control.

5.17 Personnel and Vehicle Biosecurity

Personnel biosecurity is critical during outbreak response operations. Veterinary teams and farm workers should use dedicated protective clothing, gloves, and footwear for each premises, with strict donning and doffing procedures. Movement of personnel between farms should be minimized, and appropriate downtime between farm visits should be maintained wherever operationally feasible. Vehicles used for surveillance, vaccination, or animal transport should undergo complete cleaning and disinfection before exiting infected premises or entering new holdings.

Given the transboundary epidemiology of SAT-1, coordination among veterinary services, local administration, law enforcement agencies, border authorities, and wildlife/forest departments is essential, particularly in border districts and WLI regions. Wildlife surveillance and monitoring of captive or free-ranging susceptible species may also be necessary depending on local epidemiological conditions.

5.18 Emergency Logistics and Operational Support

Effective outbreak containment depends on rapid mobilization of personnel, transport, disinfectants, personal protective equipment, sampling materials, vaccination supplies, cold-chain infrastructure, and field communication systems. Emergency stockpiles and contingency procurement mechanisms should be activated early to prevent operational delays, particularly in high-density livestock regions or multi-district outbreak scenarios.

5.19 Data Integration and Real-Time Reporting

Timely collection and sharing of outbreak information are essential to support containment decision-making. Data relating to infected premises, surveillance findings, laboratory results, vaccination coverage, animal movement restrictions, and epidemiological tracing should be continuously updated and communicated among district, state, and national authorities using standardized reporting systems. Geographic mapping and real-time situation assessment should be maintained throughout the response period.

5.20 Risk Communication and Public Awareness

Risk communication and public awareness are fundamental components of outbreak containment. Farmers, transporters, milk cooperatives, traders, and local communities should be informed regarding clinical recognition, reporting obligations, movement restrictions, and farm-level biosecurity measures. Transparent communication and fair compensation mechanisms, where applicable, improve compliance and encourage early reporting of suspected cases (refer to Chapter 11).

Simultaneously, laboratory confirmation should proceed through real-time RT-PCR, antigen detection assays, sequencing, and phylogenetic characterization to confirm serotype identity and support vaccine matching. Continuous data integration, daily situation reporting, epidemiological analysis, and adaptive response planning should continue until transmission is interrupted and freedom from infection can be demonstrated through structured surveillance in accordance with national and international guidelines.

Chapter 6

Wildlife and Zoo Interface Management

Effective management of FMDV SAT-1 outbreaks requires a One Health-oriented approach that integrates surveillance in wildlife and zoos, strict movement control, and strong coordination with forest authorities. In wildlife populations, especially free-ranging ungulates inhabiting forest fringes, surveillance is inherently challenging due to limited accessibility and visibility of clinical signs. Therefore, risk-based surveillance should focus on WLI zones, migratory corridors, and protected areas with known interaction between domestic and wild cloven-hoofed species. Clinical observation of lameness, salivation, or sudden mortality can provide initial clues, but reliance on non-invasive sampling is critical ([Annexure 2](#)). Collection of faeces, saliva from browsing sites, waterhole swabs, and environmental samples allows detection of viral RNA without disturbing animals, minimizing stress and risk of disease spread. Such approaches are particularly valuable for SAT-1, where wildlife reservoirs may play a role in persistence ([Annexures 2, 7 & 9](#)).

6.1 Surveillance and Monitoring

In zoo settings, surveillance can be more structured and systematic. Regular veterinary inspections, daily keeper observations, and periodic serological monitoring help in early detection. Isolation enclosures must be pre-designated, and rapid sampling (vesicular fluid, epithelial tissue, or serum) should be conducted under strict biosafety conditions ([Annexures 2, 4 & 9](#)).

Close coordination with the forest department is essential for successful surveillance and control. Forest personnel are often the first to observe unusual morbidity or mortality in wildlife and can provide valuable field intelligence. Joint surveillance teams involving veterinarians and forest staff should be established for sample collection, outbreak investigation, and monitoring. Training forest guards to recognize signs of FMD and to safely report cases enhances early warning capacity. Wildlife tracking, wherever feasible, can help understand transmission dynamics and guide buffer zone creation. Additionally, sharing geospatial data on animal movements, habitat use, and outbreak locations enables targeted interventions.

6.2 Containment Measures

Movement restriction is a cornerstone of containment in both wildlife-adjacent and captive environments. In outbreak scenarios, movement of domestic livestock near forest boundaries must be halted to prevent spillover, while access of zoo animals to external exposure (including shared water or feed sources) must be eliminated. Transport of animals between zoos or from wild capture sites should be suspended or subjected to stringent quarantine (typically 2–3 weeks with monitoring). Vehicles, equipment, and personnel moving between forest areas, farms, and zoos should undergo mandatory disinfection to prevent mechanical transmission of the virus ([Annexures 5 & 6](#)).

The introduction of a zoo biosecurity officer is an important enhancement, ensuring strict adherence to infection prevention protocols, overseeing quarantine procedures for new or transferred animals, and coordinating emergency responses. This role becomes crucial during suspected FMD events, as zoos house diverse susceptible species in proximity.

An often overlooked but critical pathway is contaminated feed. Implementing fodder treatment can help in reducing viral load in feed materials brought into zoos or livestock facilities near wildlife zones. This simple yet effective intervention adds an additional layer of protection against indirect transmission through fomites ([Annexure 8](#)).

6.3 Command Structure

During outbreaks, a unified command structure involving animal husbandry, forest, and local administrative authorities ensures harmonized action, particularly in enforcing movement restrictions and managing interface zones (**Annexure 13**).

Overall, integrating non-invasive surveillance, strengthening zoo biosecurity, controlling movement, and coordinating interdepartmentally is essential to mitigating the risk of the spread of SAT-1 across domestic and wild animal populations.



Chapter 7

Sample Collection, Storage, and Transport

Sample collection, preservation, documentation, and transport must be carried out in a standardized and biosecure manner to ensure reliable laboratory testing and to prevent degradation or contamination of samples. Improper sampling can lead to failure of virus detection and isolation, thereby affecting epidemiological investigation, vaccine matching, and the development of indigenous diagnostic tools. Sampling must always be carried out by trained personnel under strict biosecurity precautions.

7.1 Biosecurity during sample collection

The following biosecurity measures must be followed during sample collection:

7.1.1 Before entering the premises:

- Wear full PPE: disposable coverall, gloves, gumboots, mask, and eye protection
- Carry only essential equipment to minimize contamination risk
- Prepare appropriate and fresh disinfectant (e.g., 2% sodium carbonate or 1% Virkon) (Annexure 8)

7.1.2 During sampling:

- Firstly, attend to the healthy animals, followed by the sick animals
- Handle only one animal at a time
- Avoid touching non-target surfaces
- Use sterile instruments for each sample or disinfect thoroughly between animals

7.1.3 After sampling:

- Disinfect all equipment and reusable materials
- Safely dispose of consumables (burn/bury) as per biosecurity protocol
- Decontaminate personnel before leaving the premises

Critical precaution: Sampling teams must not visit multiple suspect farms without proper disinfection. Failure to comply can result in iatrogenic spread of FMD.

7.2 Types of samples and their purpose

Various types of specimens are essential for the rapid confirmation of FMD (Annexure 9) and are categorised as follows:

7.2.1 For agent detection and characterisation (fresh samples):

From live animals

- vesicular fluid in a sterile container
- Epithelial coverings, flaps or scrapings of vesicular lesions in phosphate-buffered saline (PBS) with 50% glycerol and antibiotics or, in an emergency, sterile PBS.
- whole blood
- oesophageal–pharyngeal fluid using probangs

From dead animals (in addition to samples from live animals, if available)

- Tissue samples, including lymph nodes (especially those around the head), thyroid, adrenals, kidney, spleen and heart, and any other observed lesions.

7.2.2 For serology

Serum (preferred), plasma

7.2.3 For histopathology (for differential diagnosis)

Samples in 10% Neutral Buffered formalin of lesion tissue (as above), including lesions of the upper gastrointestinal tract.

7.3 Sample collection procedure:

7.3.1 Collection of Vesicular Epithelium (Primary sample)

Vesicular epithelium is the most important sample for virus detection and isolation and should be collected from fresh or recently ruptured vesicles (preferably within 1–3 days of appearance). Animals with early lesions should be prioritised (Annexure 9).

The lesion surface may be gently cleaned without applying disinfectant. Using sterile forceps and scissors, approximately 1–2 cm² of epithelial tissue should be collected from the advancing edge of the vesicle and immediately placed into transport medium (PBS with 50% glycerol and antibiotics). In the absence of a transport medium, sterile PBS may be used. The final pH of the medium should be maintained between 7.2 and 7.6. It is recommended to collect the samples from the advancing edge of lesion and to avoid necrotic and dead tissues. Samples should preferably be collected from multiple affected animals to improve diagnostic accuracy.

7.3.2 Collection of Vesicular Fluid

Vesicular fluid should be collected using a sterile syringe by aspirating fluid from intact vesicles and transferring it into a sterile, leak-proof vial. This is particularly useful when epithelial tissue is not available. Care must be taken to avoid contamination with dirt or debris.

7.3.3 Collection of Oropharyngeal (OP) Fluid (Probang Sampling)

A probang cup is inserted over the tongue into the oropharyngeal region and moved vigorously (5–10 times) between the proximal oesophagus and the back of the pharynx. This helps collect fluid and superficial epithelial cells from the pharynx, tonsillar crypts, and soft palate. If adequate cellular material is not obtained, the procedure may be repeated. The sample should be immediately transferred into a transport medium containing antibiotics. Proper care must be taken to avoid injury to the animal, and the probang must be thoroughly disinfected between animals (Annexure 8). This procedure should only be performed by trained personnel.

7.3.4 Collection of Serum Samples:

Blood samples should be collected aseptically from both affected and in-contact animals using serum vacutainers. Serum should be separated following standard procedures (Annexure 9). Sampling should follow the prescribed sampling frame for outbreak confirmation and surveillance. Multiple samples are recommended to support the detection of infection in contact or suspect premises. Where conventional sampling is not feasible due to field constraints, alternative methods such as swabs in viral transport media or filter paper/card-based sampling may be considered.

7.3.5 Collection of Trade Samples

Trade samples submitted for quarantine, import-export verification, regulatory investigation, or FMD risk assessment should be collected in accordance with applicable national regulations and competent authority requirements. Such samples may include hides and skins, leather products, wool, hair, pelts, meat and meat products, milk and milk products,

animal feed ingredients, biological materials, trophies, and other commodities derived from susceptible animal species.

Sampling procedures should be appropriate to the nature of the commodity. Biological materials, fresh tissues, unprocessed animal products, milk, and meat products intended for laboratory examination should be collected using aseptic techniques and sterile equipment wherever applicable. Samples should be placed in suitable leak-proof containers and handled in a manner that preserves sample integrity and prevents contamination (**Annexure 9**).

For stable or processed commercial commodities such as hides, skins, leather products, wool, hair, pelts, trophies, and animal feed ingredients, sampling should focus on obtaining representative material while preventing cross-contamination between consignments through the use of clean, dedicated sampling equipment and appropriate handling procedures.

Each sample should be appropriately labelled and accompanied by relevant documentation, including commodity description, consignment identification number, country of origin, importer/exporter details, date of collection, and details of the submitting authority. A documented chain of custody should be maintained throughout collection, transport, storage, and laboratory examination.

Biological materials, fresh tissues, unprocessed animal products, or other samples requiring diagnostic examination for FMDV should be packaged and transported using the IATA-recommended triple packaging system comprising a leak-proof primary container, a durable leak-proof secondary container containing absorbent material, and a rigid outer container. Other trade commodities should be packaged securely in durable containers to prevent leakage, contamination, pest infestation, or physical damage during transport.

Appropriate temperature conditions should be maintained according to the nature of the commodity and the intended laboratory examination. Diagnostic biological samples should normally be transported under refrigerated or frozen conditions as specified by the receiving laboratory. In contrast, processed or shelf-stable commodities generally do not require cold-chain transport but should be protected from excessive heat, moisture, and environmental contamination.

Prior intimation should be provided to the receiving laboratory before dispatch of trade samples, particularly where testing for infectious agents is requested or special handling requirements apply.

7.4 Sample handling and storage

Immediately after collection, samples should be placed in a cool box maintained at 2–8°C and transported to the nearest laboratory without delay. Short-term storage should be at 4°C ($\pm 2^\circ\text{C}$), and repeated freeze-thaw cycles must be avoided as they can degrade viral particles.

Vesicular epithelium should not be frozen unless specifically required. However, OP fluid samples that cannot reach the laboratory on the same day should be frozen rapidly, preferably in liquid nitrogen.

7.5 Labelling and documentation

Each sample must be labelled immediately at collection site using waterproof labels. Label must include the following:

- Unique Sample ID
- Location/ farm/ premises ID

- Animal ID/species
- Sample type
- Date of collection
- Collector name

Sample submission form must include:

- Clinical signs recorded
- Date of onset of clinical sign
- Vaccination status
- Movement history
- Epidemiological linkage

Care should be taken to avoid a mismatch between the sample and the form, as it can compromise diagnosis and epidemiological interpretation.

7.6 Chain of custody

It is recommended that the chain of custody be maintained to ensure traceability and accountability of samples. Each transfer of samples-from field collection to transport and laboratory receipt-should be documented. Samples must be sealed properly, and a logbook should be maintained indicating handlers and transfer points.

Any breach in seal, delay, or discrepancy must be recorded, as this information is critical for regulatory and epidemiological purposes (**Annexure 9**).

7.7 International Air Transport Association (IATA)-recommended triple packaging

All samples must be transported using the IATA-recommended triple packaging system for infectious substances.

Unpreserved tissue and blood samples should be transported using ice packs or frozen gel packs. If transport is expected to exceed 48 hours, dry ice or liquid nitrogen should be used. Direct contact between ice and samples must be avoided.

OP fluid samples should be frozen and transported on dry ice if same-day delivery is not possible.

7.7.1 Components of Triple Packaging: (Annexure 9**)**

- Primary Container: Leak-proof vial containing the sample, properly sealed and wrapped with absorbent material.
- Secondary Leak-proof, durable container containing one or more primary containers, with additional absorbent material.
- Outer Container: Rigid, shock-resistant box.

The outer container must include:

- Sender and receiver details
- “Keep Refrigerated” marking
- Orientation arrows (for liquid samples)
- UN3373 label (“Biological Substance, Category B”) for air transport

Samples must be transported to ICAR-NIFMD, Bhubaneswar or designated network laboratories, and prior intimation to the receiving laboratory is mandatory. The fastest possible mode of transport should be used, and in emergencies, samples may be hand-delivered by designated personnel to avoid delays.

Chapter 8

Laboratory Diagnosis & Confirmation

Accurate and rapid diagnosis is essential for outbreak containment, surveillance and international trade compliance. Timely and scientifically appropriate sample collection is critical for the early detection and confirmation of FMDV SAT-1 in India. Since SAT-1 is considered an exotic serotype with significant transboundary and epidemiological implications, samples should be collected as early as possible from clinically suspected animals using strict biosafety and biosecurity precautions. Fresh vesicular epithelium, vesicular fluid, oral or lesion swabs, serum, and oropharyngeal (probang) samples constitute the principal diagnostic materials for laboratory confirmation, molecular characterization, and surveillance investigations. Proper maintenance of the cold chain, use of validated transport media, accurate labelling, and rapid transport to ICAR-NIFMD, Bhubaneswar or designated network laboratories are essential to preserve sample integrity and ensure reliable diagnosis. Detailed procedures for sample collection, preservation, packaging, transport, and biosafety are provided in the relevant annexures of this SOP ([Annexure 9](#)).

A structured diagnostic cascade for the detection of SAT-1 serotype of FMDV involves initial screening of suspected clinical samples by pan-serotype RT-PCR, screening with serotype-specific antigen ELISA and/or serotype-specific RT-PCR, followed by molecular epidemiological study by genome sequencing, and virus isolation in cell culture. Robust reporting of the disease, rapid dispatch of field samples to the referral laboratories and efficient diagnosis form the backbone of robust surveillance and FMD control strategies.

8.1 Diagnosis

8.1.1 Strengthening First-line Screening

Increased effort should be made for attending every outbreak in the country, looking for unusual rise, quick spread and severity in the affected areas and initial screening of FMD-suspected samples by pan-serotypic RT-PCR systems (both agarose gel-based and real-time RT-PCR). The pan-serotypic RT-PCR assays have been developed at ICAR-NIFMD; these assays can be used at the ICAR-NIFMD network diagnostic laboratories. All the RT-PCR positive samples and a representative set of negative samples should be submitted to the ICAR-NIFMD, Bhubaneswar as soon as possible for subsequent confirmation of serotype and further characterization including virus isolation within the BSL-3Ag containment laboratory.

8.1.2 Serotype-specific antigen ELISA

Serotype-specific antigen ELISA in the double antibody-sandwich format has been a widely used frontline diagnostic tool for detection and serotyping of FMDV. Since serotyping ELISA for the detection of FMDV SAT-1 serotype is yet to be developed in the country, an imported serotyping ELISA kit {from World Reference Laboratory for Foot-and-Mouth Disease (WRLFMD), The Pirbright Institute, United Kingdom, or the Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia-Romagna (IZSLER), Italy} would be used for the detection and serotyping of FMDV SAT-1.

8.1.3. Serotype-specific RT-PCR

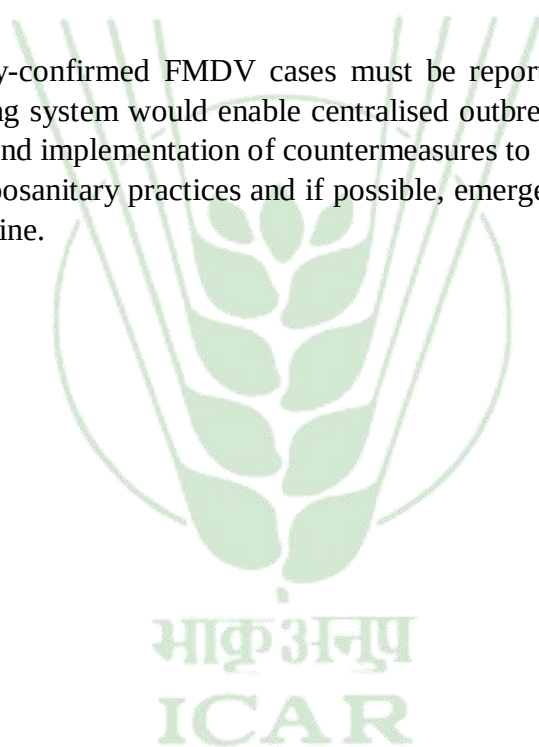
Serotype-specific RT-PCR, both in the agarose-gel electrophoresis format and real-time RT-PCR format are available at ICAR-NIFMD. These assays are based on both in-house designed and published primers and probes available in scientific literature and reflected on the WRL FMD website. These assays will be used for the detection and serotyping of SAT-1 virus, along with the multiplex RT-PCR assays that are in use for the detection of FMDV serotypes O, A and Asia 1.

8.1.4 Nucleotide sequencing of SAT-1 positive samples

Antigen ELISA and/or RT-PCR positive SAT-1 samples will subsequently be processed for deciphering VP1/P1 nucleotide sequences for the molecular epidemiological studies. Both capillary-based Sanger sequencing and NGS platforms can be used for nucleotide sequencing and subsequent molecular phylogenetic analyses.

8.2 Reporting

All the laboratory-confirmed FMDV cases must be reported to DAHD as early as possible. A swift reporting system would enable centralised outbreak monitoring, and would facilitate rapid response and implementation of countermeasures to contain the spread, such as enhanced bio-security, zoosanitary practices and if possible, emergency ring-vaccination with the imported SAT-1 vaccine.



Chapter 9

Vaccination Preparedness Strategy

The vaccination preparedness strategy shall follow a two-tiered approach:

1. Without vaccination (initial response phase till effective vaccine is unavailable)
2. With vaccination (post-availability of matched vaccines)

9.1 Response Strategy without Vaccination

In the absence of immediately available SAT-1 vaccines, containment shall rely on rapid implementation of non-vaccination measures, such as:

- Intense surveillance and epidemiological investigation (Annexure 4)
- Movement control and zoning (Annexure 5)
- Biosecurity and risk mitigation (Annexure 6)

9.2 Response Strategy with Vaccination

Upon the availability of effective SAT-1 vaccines, vaccination shall be deployed as a targeted control measure. Vaccine sourcing and stockpile access will require timely procurement through available resources like WOAHA/FAO vaccine banks, bilateral or multilateral emergency agreements, or SAT vaccine manufacturers like Botswana Vaccine Institute (BVI), Biogénesis Bagó, Onderstepoort Biological Products, Boehringer Ingelheim, etc (refer to chapter 10). Considering global constraints, including limited availability of SAT-1 vaccines, procurement will require advance preparedness agreements. The veterinary service authority needs to facilitate timely decision-making on the strategic importation of SAT-1 vaccine antigens and ready-to-use vaccines, including the establishment of expedited regulatory clearance mechanisms to ensure rapid availability and deployment in the event of an incursion. India should also consider emergency stockpiling of SAT-1 vaccine as part of long-term preparedness.

Considering the possibility of co-circulation of multiple SAT-1 topotypes, the available SAT-1 vaccine strain may not perfectly match the circulating field strain, potentially reducing vaccine efficacy. This necessitates strain characterization of the outbreak virus and vaccine matching prior to vaccine deployment. In case of a confirmed outbreak, the vaccination strategy should involve implementing ring vaccination within a 3-10 km radius around the infected premises. High-density livestock areas and epidemiologically linked premises should be prioritized for vaccination. A periphery-to-centre (outside-in) vaccination approach should be adopted, involving initial vaccination in outer buffer zones followed by progressive coverage towards infected areas. Efforts should be made to complete vaccination within 5-7 days of outbreak confirmation to limit transmission, giving priority to highly susceptible species (cattle and buffalo) and amplifier species (pigs). At the first sign of the FMDV SAT-1 getting entrenched in India, an all-out effort should be made to indigenously develop a SAT-1-specific vaccine appropriate for the region. This would require involvement of Research Institutes, e.g., ICAR-NIFMD, ICAR-IVRI and allocation of adequate financial resources.

For post-vaccination surveillance, non-structural protein (NSP) ELISA should be employed for differentiation of infected from vaccinated animals (DIVA). In addition, sero-monitoring should be undertaken to assess seroconversion, population immunity, and vaccine response following emergency vaccination. Continued integrated surveillance in vaccinated populations will be required to detect residual infection and to support proof of disease freedom.

Chapter 10

Resource Mobilization & Logistics

Effective preparedness and response to FMD outbreaks due to exotic serotypes in India requires a coordinated multi-pronged strategy involving logistical, financial, and administrative support across national, state, and district levels. The key components are as follows:

10.1 Emergency funds

Timely utilization of contingency resources under the LHDCP, State Disaster Response Funds, and other approved emergency provisions for rapid procurement of vaccines, disinfectants, PPE, medicines, and diagnostic materials. These funds also support immediate deployment of veterinary teams, transport and logistics, temporary containment operations, awareness activities, and compensation or relief assistance to affected farmers in accordance with prevailing government norms.

10.2 Deployment of veterinary teams

Rapid mobilization of trained veterinary personnel from State Animal Husbandry Departments, ICAR institutes, State Agricultural Universities (SAUs), and the Indian FMD Laboratory Network across the country for immediate outbreak investigation, active field surveillance, clinical examination of affected animals, collection and dispatch of diagnostic samples, epidemiological assessment, implementation of containment measures, and emergency vaccination campaigns in affected and surrounding areas.

10.3 Coordination with State AH Departments and District Administration

Close coordination with Directors of State Animal Husbandry departments, forest and wildlife authorities, District Collectors, Block Development Officers, Panchayati Raj institutions, and local veterinary officers to ensure prompt reporting of outbreaks, rapid field response, enforcement of movement control measures, ring vaccination in affected and surrounding areas, and effective implementation of quarantine and biosecurity protocols. Awareness and advisory messages are disseminated through extension platforms such as Mera Gaon Mera Gaurav (MGMG), Krishi Vigyan Kendras (KVKs), farmer groups, and local media for wider outreach.

10.4 Human resource surge capacity

A contingency human resource mobilization framework should be established for rapid deployment of additional trained manpower during large-scale outbreaks, particularly in high-risk and border regions. This surge capacity may include reserve veterinary personnel from State Animal Husbandry Departments, ICAR institutes, SAUs, forest and wildlife departments, KVKs, trained para-veterinary staff, laboratory technicians, livestock inspectors, and field extension workers. Where necessary, support may also be obtained from retired veterinarians, trained volunteers, veterinary students, disaster-response personnel, and local community-based animal health workers to strengthen field surveillance, vaccination, sample collection, awareness activities, movement control, and logistics support during emergency response operations. Periodic training, simulation exercises, biosafety orientation, and emergency preparedness drills should be conducted to ensure operational readiness and coordinated response during suspected SAT-1 incursions.

10.5 Mobile diagnostic units

Deployment of mobile diagnostic laboratories equipped with real-time PCR, ELISA, cold storage, and basic sample processing facilities, supported by strict biosecurity measures, for rapid on-site or near-site diagnosis during outbreaks. These units can be strategically stationed in remote, border, and high-risk districts such as Gujarat, Rajasthan, Punjab, West Bengal, and the North-Eastern states to minimize delays in sample transport, enable immediate screening of suspected cases, support epidemiological investigations, and facilitate the timely implementation of containment and vaccination measures.

10.6 Inventory management and provision of PPE, disinfectants, and sampling kits

- Ensuring timely procurement and adequate availability of personal protective equipment (PPE) such as gloves, masks, coveralls, boots, and face shields for field veterinarians and support staff engaged in outbreak response.
- Centralised and decentralised real-time inventory monitoring of diagnostic kits, PPE, disinfectants, sampling consumables, and cold-chain materials at ICAR-NIFMD, Regional Centres, RRDLs, and laboratories under the BSL-3 network, along with vaccine stocks maintained at central and state depots.
- Approved disinfectants, including 4% sodium carbonate and Virkon-S, are supplied for effective sanitization of infected premises, vehicles, equipment, and animal handling areas ([Annexure 8](#)).
- Standardized FMD sampling kits containing PBS-glycerol transport medium, sterile swabs, collection vials, syringes, labels, biohazard bags, and ice packs are maintained for safe, hygienic, and temperature-controlled collection, storage, and transport of diagnostic specimens to designated laboratories ([Annexure 9](#)).
- This system enables timely replenishment, prevents stock shortages, ensures optimal distribution of resources, and facilitates efficient last-mile delivery of vaccines and essential materials up to the district, block, and village levels during outbreak situations.

10.7 Digital surveillance and GIS integration

- Digital surveillance platforms integrated with the National Animal Disease Reporting System (NADRS), GIS-based outbreak mapping, and real-time field reporting systems should be utilized for rapid epidemiological tracking, risk assessment, and resource deployment during outbreak situations.
- Mobile-based reporting applications, geo-tagging of outbreak locations, digital movement tracking, and centralized outbreak dashboards should be employed for the timely collection, visualization, and dissemination of epidemiological data from field units, laboratories, quarantine stations, and vaccination teams.
- GIS-supported spatial analysis may be used for identification of high-risk zones, surveillance prioritization, mapping of domestic and wild animal movement corridors, monitoring of containment and vaccination zones, and prediction of potential disease spread pathways, particularly in border and high-density livestock regions.
- Real-time digital integration among ICAR-NIFMD, State Animal Husbandry Departments, forest and wildlife authorities, district administrations, laboratories, and national disease monitoring systems should be maintained to facilitate rapid decision-making, coordinated outbreak response, and evidence-based implementation of containment measures.

10.8 SAT-1 vaccine reserves and antigen bank preparedness

- Maintenance or rapid access to SAT-1-specific vaccine antigen reserves, emergency vaccine procurement mechanisms, and validated vaccine-matching support should form part of national preparedness planning for potential exotic SAT-1 incursions into India.
- Strategic emergency antigen banks and vaccine reserve systems should be developed at the national level to ensure immediate availability of SAT-1-specific vaccine components for rapid formulation and deployment during outbreak situations.
- Preparedness plans should include identification of suitable SAT-1 vaccine strains based on global epidemiological trends, reference laboratory recommendations, antigenic matching studies, and risk assessments related to transboundary spread.
- Validated vaccine-matching support should be regularly coordinated with recognized national and international reference laboratories to assess antigenic compatibility between circulating SAT-1 strains and available vaccine candidates for effective emergency vaccination response.
- Emergency regulatory pathways and fast-track import permissions should be pre-defined for rapid procurement, importation, storage, and deployment of SAT-1 vaccines, vaccine antigens, diagnostic reagents, and related biological materials during emergencies.
- Coordination mechanisms should be established among the DAHD, ICAR institutes, vaccine manufacturers, customs authorities, quarantine agencies, and regulatory bodies for expedited approval and movement of emergency vaccine consignments.
- Cold-chain deployment systems, including refrigerated storage, insulated transport units, temperature monitoring devices, regional vaccine depots, and field-level vaccine carriers, should be maintained to preserve vaccine potency during transport and emergency vaccination campaigns.
- Periodic review of vaccine reserve capacity, antigen stock availability, deployment timelines, cold-chain readiness, and emergency procurement procedures should be conducted through simulation exercises and preparedness audits to ensure operational efficiency during suspected SAT-1 outbreaks.
- Where necessary, international collaboration mechanisms may be explored for emergency access to global antigen banks, reference vaccine repositories, and technical support platforms maintained by international animal health organizations and collaborating countries.

10.9 Cold-chain logistics and vaccine integrity

- Dedicated cold-chain systems with continuous temperature monitoring using digital temperature loggers, insulated transport containers, cold boxes, refrigerated vehicles, and vaccine carriers should be maintained to preserve vaccine potency and diagnostic sample integrity during storage and transportation.
- Backup power support through generators, solar-powered systems, or uninterrupted power supply (UPS) units must be ensured at vaccine depots, regional laboratories, mobile diagnostic units, and temporary field vaccination centres to prevent cold-chain failure during emergencies.
- Regular monitoring of vaccine viability, cold-chain performance audits, maintenance of temperature records, and validation of storage conditions should be

undertaken to ensure the effectiveness of emergency SAT-1 vaccination campaigns and reliability of transported diagnostic samples.

10.10 Border preparedness logistics

- Special logistical preparedness measures and enhanced surveillance systems should be established in high-risk border and transboundary regions, including Jammu & Kashmir, Ladakh, Himachal Pradesh, Uttarakhand, Punjab, Rajasthan, Gujarat, West Bengal, and the Northeastern States, to facilitate early detection and rapid response to any suspected introduction of FMDV through transboundary movement of livestock and livestock products, informal animal trade, and disease transmission at the wildlife–livestock interface.
- Identify and monitor all the formal and informal regular or unconventional cross-border entry points for livestock or its products, including movement thereafter.
- Strengthening of border check-posts, interstate and international quarantine stations, animal transport inspection units, and designated livestock movement control points should be undertaken for early detection and restriction of potentially infected animals and contaminated materials.
- Regular inspection and disinfection of livestock transport vehicles, verification of movement permits, health certification checks, and strict enforcement of quarantine and biosecurity protocols should be implemented in identified high-risk corridors.
- Enhanced surveillance measures should also include monitoring at seaports, airports, integrated check-posts, livestock markets, and cargo handling facilities dealing with imported animal products, biological materials, hides, skins, feed ingredients, and livestock-associated consignments.
- Cross-border epidemiological intelligence sharing, coordination with customs authorities, border security agencies, port authorities, and neighbouring countries should be strengthened for the timely exchange of information regarding SAT-1 outbreaks, animal movement risks, and emerging transboundary disease threats.

10.11 Carcass disposal logistics

- Safe and scientifically managed carcass disposal systems should be established for animals that die during outbreaks or are euthanized (if applicable under government policy) as part of disease containment operations, in accordance with national biosafety and environmental safety guidelines.
- Approved disposal methods such as deep burial, incineration, or other environmentally acceptable biosecure disposal procedures should be adopted based on local feasibility, environmental conditions, groundwater safety, and administrative approval.
- Disposal sites and burial pits should be properly disinfected using recommended disinfectants, secured against scavengers and wildlife access, and located away from water bodies, grazing areas, and human settlements to prevent environmental contamination and secondary disease spread.
- Transport of carcasses should be undertaken using leak-proof and disinfected vehicles under strict biosecurity precautions to minimize risk of virus dissemination during handling and disposal operations.

- Rendering, open dumping, or unauthorized disposal of infected carcasses, animal waste, bedding material, and contaminated organic matter should be strictly prohibited during SAT-1 outbreak situations.

10.12 Transport and movement logistics

- A comprehensive transport and movement logistics framework should be established to support the rapid deployment of veterinary response teams, the safe transportation of diagnostic samples, the uninterrupted supply of vaccines and disinfectants, movement control enforcement, and biosecure disposal operations during SAT-1 outbreak situations.
- Dedicated transport routes and controlled animal movement corridors should be identified in advance for safe movement of emergency response vehicles, vaccine distribution units, mobile diagnostic laboratories, and essential supplies, particularly in high-risk districts and containment zones.
- Vehicle disinfection corridors and mobile sanitization points should be established at infected premises, quarantine checkpoints, livestock markets, border entry points, containment zones, and strategic transportation hubs to ensure systematic decontamination of animal transport vehicles, equipment carriers, and personnel movement vehicles entering or exiting affected areas (**Annexure 8**).
- Disinfection facilities should include approved disinfectants, high-pressure spraying systems, footbaths, wheel baths, waste-water containment arrangements, and trained personnel for supervised implementation of biosecurity protocols.
- Movement permits, route authorization systems, vehicle tracking mechanisms, and inspection procedures should be implemented for the transport of livestock, animal products, feed materials, veterinary supplies, and carcasses within or across containment and surveillance zones.
- Special transport arrangements should be made for safe and biosecure movement of diagnostic samples under IATA-compliant triple packaging systems, cold-chain conditions, and chain-of-custody documentation to designated laboratories (**Annexure 9**).
- Carcass transport logistics should include dedicated leak-proof vehicles, biosecure loading and unloading procedures, disinfection after transport, and designated disposal routes to minimize environmental contamination and accidental spread of FMDV during disposal operations.
- Fuel reserves, emergency vehicle support systems, transport contingency planning, maintenance support, and logistical coordination centres should be established to ensure uninterrupted field operations during prolonged outbreak response activities, especially in remote, border, and geographically difficult areas.
- Logistical planning should also include availability of portable storage units, temporary field camps, communication systems, backup transport arrangements, and emergency procurement mechanisms for uninterrupted outbreak response and containment operations.

10.13 Compensation and farmer support mechanisms

- Rapid and transparent compensation mechanisms should be established and operationalized to encourage early disease reporting, farmer cooperation, compliance

with containment measures, and timely implementation of outbreak control strategies during SAT-1 emergencies.

- Compensation policies should clearly define eligibility criteria, valuation procedures, approval mechanisms, documentation requirements, and timelines for financial assistance to affected livestock owners in accordance with prevailing government regulations and emergency response guidelines.
- Compensation and relief support may include assistance for mortality losses, production losses, reduced milk yield, reproductive losses, emergency slaughter or culling operations (if applicable under government policy), carcass disposal expenses, and economic losses resulting from animal movement restrictions and quarantine measures.
- Special financial assistance provisions may also be considered for smallholder farmers, marginal livestock keepers, dairy cooperatives, pastoral communities, and economically vulnerable populations disproportionately affected by prolonged outbreak control measures.
- Fast-track disbursement systems using digital payment platforms, direct benefit transfer (DBT) mechanisms, and district-level emergency approval committees should be established to ensure timely release of compensation and minimize administrative delays.
- Transparent communication regarding compensation procedures, reporting mechanisms, and farmer entitlements should be disseminated through local veterinary institutions, Panchayati Raj bodies, extension networks, KVKs, farmer cooperatives, and community awareness programmes to improve trust and compliance during outbreak response operations.
- Adequate financial provisions should be maintained under emergency disease response funds, disaster contingency resources, and LHDCP mechanisms to support uninterrupted compensation and relief operations during large-scale outbreaks.
- Monitoring and audit systems should be established to ensure accountability, prevent fraudulent claims, maintain transparency in compensation disbursement, and evaluate the socio-economic impact of outbreak response measures on affected farming communities.

Chapter 11

Risk Communication and Public Awareness

Managing risk and public awareness are important tools in relation to the FMDV SAT-1 incursion. Communicating risks and educating the public about SAT-1 involves informing stakeholders about the nature of the virus, its transmission and preventive measures, which can reduce disease spread and protect the livestock. An effective response should rely on veterinary interventions, robust communication strategies, community engagement, rumour control, and institutional coordination. Communication of risk should be timely, transparent, consistent and stakeholder-specific, ensuring appropriate actions. Time is the most critical factor in controlling FMD outbreaks, as delays in detection and subsequent response can lead to exponential spread across the regions.

Effective outbreak communication requires prior planning, training and well-established systems. Capacity building and progressive evaluation strengthen communication effectiveness. Activating communication coordination mechanisms ensures the rapid dissemination of information during emergencies. In the veterinary sector, communication, instead of being unidirectional from government officials to stakeholders, should rely on two-way communication that treats stakeholders as equal partners. According to the WOA, risk communication is defined as the interactive exchange of information, advice and opinions between risk assessors, risk managers, and other interested parties.

Risk communication must include the technical threat as well as public perception and response to the threat. Effective communication should address intellectual as well as emotional responses of stakeholders. The approaches must be continuously evaluated and updated with new information. Public concerns should be dealt with empathy, honesty and openness so that stakeholders are receptive. Messages must be clear and transparent, simple and actionable, especially during outbreak situations. Failure to provide complete and timely information can erode public trust and hinder outbreak control. Coordination with national and international agencies, including WOA, FAO, ICAR, DAHD and state veterinary departments, is essential to ensure consistent messaging and resource sharing.

11.1 Communication strategy framework

A communication strategy for a suspected incursion of SAT-1 serotype in India should focus on rapid, transparent, and coordinated messaging to farmers, veterinarians, and the public to ensure early detection, strict biosecurity and compliance with movement restrictions while preventing panic and misinformation. The primary objective of risk communication is to inform stakeholders about the heightened threat, promote early reporting, encourage behavioural changes to reduce transmission, and prevent rumour-driven responses. Transparency in outbreak communication has two aspects: firstly, communication should be factually accurate, timely and easily understood; secondly, it should share information with the public and partners for their understanding of decision-making processes in outbreak management. The framework must also define clear roles and responsibilities among agencies involved in outbreak response. Establishing designated communication channels and spokespersons ensures clarity and consistency. Messages should explain the nature of the threat, outline public health actions being taken and reinforce commitment to controlling the situation.

11.2 Multi-channel communication strategy

In a country like India, a multi-channel communication strategy is essential to reach all segments of the population. Social media platforms such as WhatsApp, YouTube, Facebook,

Twitter, and Instagram are important and effective tools for communication, helping with the real-time dissemination of information. Official digital platforms and websites can serve as repositories of updated information, advisories, and data, including maps, case counts, and guidelines that can be accessible to anyone at any time. Mass media such as television, radio, and newspapers play a vital role in reaching a wide audience quickly and effectively. Local communication tools like loudspeaker announcements, especially in rural areas, are highly effective when delivered in local languages. Community-level communication through panchayats, village meetings, cooperatives, and farmer associations enhances outreach and ensures better engagement. Authorities must maintain strong relationships with media organisations, as they play a crucial role in conveying public concerns and disseminating verified information in understandable language. Field communication by veterinarians and extension workers provides direct interaction with farmers, enabling tailored guidance. Additional tools such as call centres, digital press kits, webinars, and clinician outreach platforms further strengthen communication systems and ensure accessibility to information.

11.3 Key public advisories

Crucial public advisories are essential to restrict the spread of disease, protect livestock and guide public behaviour. Early reporting of symptoms enables rapid containment and reduces transmission risks. Restricting animal movement and isolating sick animals are critical control measures. Avoidance of animal gatherings and closure of local markets during suspected outbreaks help prevent widespread transmission. Farmers should adopt biosecurity practices such as disinfection of footwear, equipment, farm premises and limiting external visitors. It is equally important to discourage panic and the spread of rumours, emphasizing reliance on official and verified information sources.

11.4 Targeted awareness and messaging

Targeted awareness and messaging should be audience-specific, culturally appropriate and action-oriented. Communication for farmers should focus on symptom recognition, reporting mechanisms and biosecurity practices, while veterinarians should receive technical advisories on surveillance and response protocols. Traders and transporters must be informed about movement restrictions and compliance requirements. For the general public, communication should emphasize minimal risk to human health and responsible information sharing. Media engagement should encourage accurate reporting and discourage sensationalism.

11.5 Inter-departmental coordination

Effective community engagement and institutional coordination require collaboration among veterinary systems, local communities, and national authorities. Clear delineation of roles among departments and agencies is essential to prevent confusion and ensure coordinated messaging. Engagement with gram panchayats, cooperatives, and community leaders strengthens grassroots communication and promotes early reporting and compliance. Collaboration with international agencies such as FAO and WOAHA supports surveillance, information exchange, and resource mobilization.

11.6 Rapid reporting and service integration

Rapid reporting and service integration ensure a seamless flow of information from the field to decision-makers, enabling swift containment actions. Communication must be directly linked to accessible reporting systems such as helplines, mobile applications, and veterinary networks. Reported cases should be rapidly communicated to district and state surveillance systems and linked to diagnostic laboratories, quarantine services, vaccination teams, and

movement control authorities. Integration with national databases and alignment with WOAHA reporting standards enhance transparency and timely decision-making.

11.7 Misinformation control mechanism

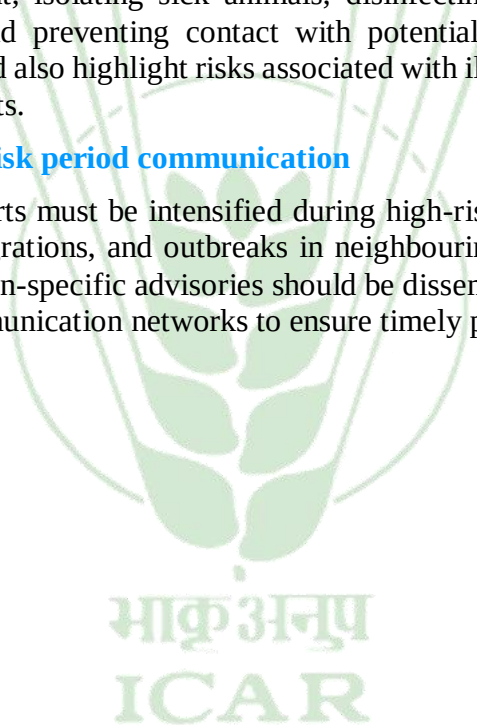
During outbreaks, misinformation can spread rapidly and undermine control efforts. Robust rumour and misinformation control mechanisms are essential, including monitoring of social media and local narratives, rapid verification of information and dissemination of accurate updates through official channels. Designated spokespersons should provide consistent communication and outreach in local languages to counter misinformation that quickly reaches the public. Transparency, timely updates and acknowledgement of uncertainties are critical for public trust.

11.8 Biosecurity and risk awareness messaging

Biosecurity and risk awareness messaging should emphasize practical and easy-to-follow measures to reduce disease spread at farm and community levels. These include restricting animal movement, isolating sick animals, disinfecting equipment and vehicles, avoiding shared grazing and preventing contact with potentially contaminated materials. Awareness campaigns should also highlight risks associated with illegal animal movement and contaminated animal products.

11.9 Timeliness and high-risk period communication

Communication efforts must be intensified during high-risk periods such as festivals, livestock fairs, seasonal migrations, and outbreaks in neighbouring regions. Early warnings, frequent updates, and location-specific advisories should be disseminated through SMS alerts, social media and local communication networks to ensure timely preventive action.



Chapter 12

Data Management and Disease Reporting

Data management and disease reporting are critical pillars of an effective animal disease control programme. They enable veterinary authorities to detect outbreaks early, respond quickly, allocate resources efficiently, and protect livestock, livelihoods, and public health. This helps in accurate and timely data collection for the identification of unusual illnesses, deaths, or production losses before diseases spread widely. Besides, reliable disease reporting and data management help in rapid response and disease containment, monitoring disease trends, better decision-making, efficient resource allocation, strengthening surveillance systems, trade and economic benefits, *etc.* The importance of Standardised Animal Disease Outbreak Reporting, daily Situation Report (SITREP), GIS mapping, LHDCP integration, and real-time data sharing lies in building an efficient, transparent, and rapid animal health surveillance system. These components are essential for preventing disease spread, protecting livestock productivity, ensuring public health, and supporting evidence-based decisions.

To strengthen preparedness, early warning systems, coordinated response, disease surveillance, and containment measures in the country, the following Standard Operating Procedure (SOP) may be considered for immediate compliance by all stakeholders, including field veterinarians, ICAR institutes, and all concerned field functionaries. This SOP establishes a uniform framework for timely detection, reporting, visualization, database integration, and real-time dissemination of animal disease outbreak information for effective surveillance, control, and response. Further, this SOP can be applicable across all states and union territories, including districts, blocks, municipal areas, Gram Panchayats, livestock clusters, border check-posts, and organized farms (**Annexure 12**).

12.1 Standardised Animal Disease Outbreak Reporting

A uniform reporting format ensures that disease data collected from villages, blocks, districts, and states is accurate, comparable, and timely. This procedure eliminates confusion caused by different reporting styles and enables quick epidemiological analysis at district, state, and national levels.

12.2 Daily Situation Report (SITREP)

A Daily SITREP refers to a concise operational update shared during active outbreaks. Such a report provides a daily outbreak report, tracks new cases, deaths or recoveries, and containment measures, supports rapid decision-making and keeps all stakeholders informed. For example, during an SAT-1 outbreak, a daily SITREP will help officials know where vaccines or manpower are urgently needed. The following format for SITREP may be followed for uniformity in data collection.

12.3 GIS Mapping

The GIS mapping visually maps outbreaks on digital platforms using coordinates and locations. The importance of GIS mapping of outbreaks is: detection of disease clusters and spread patterns; identification of high-risk zones and buffer zones; implementation of containment and movement control; and planning vaccination campaigns strategically. For example, if multiple villages show FMD cases in a cluster, GIS mapping can guide ring vaccination around infected areas.

12.4 Integration with LHDCP Database

The LHDCP focuses on the control of diseases such as FMD and Brucellosis in India. Integrating outbreak reporting with LHDCP systems improves national surveillance. This integration will help in monitoring vaccine coverage vs disease occurrence, support national policy planning, and enable targeted interventions in low-coverage areas. Further, this will help achieve India's disease-free status goals. For example, if outbreaks continue in vaccinated zones, authorities can investigate the vaccine cold chain, coverage gaps, or strain variation.

12.5 Real-Time Data Sharing Framework

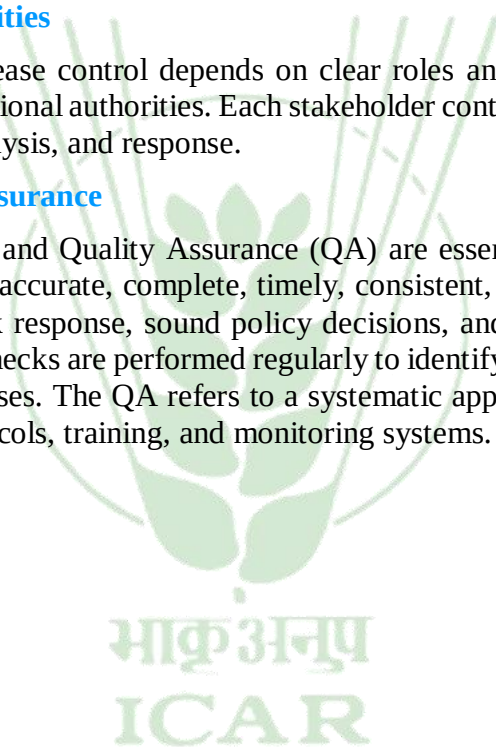
The real-time sharing of disease information between field staff, district offices, labs, and policymakers is critical. This step reduces delay in response, speeds up sample collection and lab diagnosis, allows quick alerts to neighbouring districts/states and prevents rumours and misinformation. For example, a suspected FMD report shared instantly can trigger containment before spread to markets or neighbouring farms.

12.6 Roles and Responsibilities

Effective animal disease control depends on clear roles and responsibilities at every level—from grassroots to national authorities. Each stakeholder contributes to timely reporting, accurate data collection, analysis, and response.

12.7 Quality Check and Assurance

Quality Check (QC) and Quality Assurance (QA) are essential to ensure that animal disease data and reports are accurate, complete, timely, consistent, and reliable. High-quality data supports rapid outbreak response, sound policy decisions, and effective disease control programs. The operational checks are performed regularly to identify and correct errors in data, reports, samples, and processes. The QA refers to a systematic approach to prevent errors by establishing standards, protocols, training, and monitoring systems.



Chapter 13

Coordination & Command Structure

Effective management of a suspected or confirmed incursion of FMDV SAT-1 in India requires a coordinated multi-level emergency response system involving veterinary services, technical institutions, district administration, law-enforcement agencies, laboratories, local governance systems, and state and national authorities. Since SAT-1 is an exotic serotype for India with the potential for rapid spread through livestock movement networks, markets, milk collection systems, and transboundary trade routes, outbreak response must be rapid, field-oriented, and operationally coordinated.

Although India does not currently have a dedicated national veterinary incident command system for transboundary animal diseases, existing animal health response mechanisms under the DAHD, Government of India, together with state animal husbandry departments and district administration systems, may be integrated to support coordinated outbreak management. Existing emergency preparedness mechanisms, One Health coordination platforms, and disaster-management support systems may also be utilized wherever required, depending on the scale and epidemiological impact of the outbreak.

The coordination framework should facilitate: (i) rapid detection and reporting of suspected outbreaks; (ii) timely laboratory confirmation and epidemiological assessment; (iii) coordinated implementation of surveillance, quarantine, movement control, vaccination, and biosecurity measures; (iv) efficient resource mobilization and inter-sectoral coordination; (v) rapid information sharing and unified communication; and (vi) continuous situational assessment during outbreak containment operations ([Annexure 13](#)).

The potential incursion of exotic FMDV serotypes such as SAT-1 further highlights the need for strengthening India's veterinary emergency coordination capacity through the development of a structured national animal health emergency response framework integrating technical coordination, field operations, laboratory networks, surveillance systems, emergency logistics, and inter-sectoral response mechanisms under the leadership of DAHD.

13.1 National and State-Level Coordination

13.1.1 DAHD, Government of India

The DAHD serves as the national policy, coordination and administrative authority for animal health emergencies in India. It provides strategic leadership, policy direction, legal authority, intergovernmental coordination, and national oversight during animal health emergencies. The DAHD is the apex institution responsible for ensuring that technical recommendations are translated into enforceable policy actions and coordinated implementation across states.

The major responsibilities of the DAHD includes: (i) Declaration of national animal health emergencies when required; (ii) Approval of containment policies, movement restrictions, compensation, and interstate coordination; (iii) allocation of emergency funds and national resources (refer chapter 10); (iv) coordination with other ministries, disaster authorities, and international agencies; (v) issuance of national advisories and official public communication; (vi) Review incident progress and authorize escalation/de-escalation.

13.1.2 ICAR-NIFMD

ICAR-NIFMD serves as the national technical lead authority for FMD preparedness and emergency response. It is the principal institution responsible for scientific leadership, technical coordination, disease intelligence, diagnostics, epidemiology, risk analysis, and operational guidance. While the DAHD provides policy command, ICAR-NIFMD converts evidence into actionable technical direction for the national response system.

The major responsibilities of the ICAR-NIFMD includes: (i) confirming laboratory diagnosis and risk assessment; (ii) preparation of standard operating procedures (SOPs) for surveillance, containment, vaccination, biosafety and sample handling; (iii) epidemiological investigations and risk assessments; (iv) technical advisory support to DAHD and state AH departments on evidence-based decisions; (v) operation of technical situation room and data dashboards; and (vi) deployment of technical experts and training support during outbreak response operations.

13.1.3 State Animal Husbandry (AH) Departments – Implementation Authority

The State AH Departments serve as the primary operational implementation authority in the National Incidence Command System (NICS). They are the principal agencies responsible for translating national policy directions and technical guidance into field action across the state. The state AH Departments form the critical bridge between national command structures (DAHD and ICAR-NIFMD) and district, block, village, and farm-level execution systems. They are responsible for preparedness, rapid response, containment, service continuity, recovery, and resilience building within their jurisdiction.

The major responsibilities of the state AH Departments include: (i) activating state incident command centres; (ii) conducting surveillance, sample collection, tracing, vaccination, quarantine, and field response; (iii) coordinating district veterinary teams; (iv) enforcing movement controls and biosecurity orders; (v) Managing logistics, manpower, PPE, and field reporting; and (vi) Submit daily situation reports to national command.

13.1.4 District Outbreak Response Structure

The district should function as the primary operational unit for SAT-1 outbreak containment. Since the initial response activities, including quarantine enforcement, village containment, movement control, active surveillance, and emergency vaccination, occur at the field level, district administration and district veterinary authorities play a critical role in outbreak management.

A District Outbreak Response Unit or District Disease Control Cell should be activated immediately following notification of a suspected or confirmed outbreak. The district response structure should function through close coordination between district administration, veterinary services, police authorities, local governance institutions, and technical teams.

The District Magistrate/Collector may provide administrative coordination and enforcement support, while the District Animal Husbandry Officer or Chief Veterinary Officer may function as the technical and operational lead for veterinary outbreak response activities.

Major district-level responsibilities may include: (i) implementation of quarantine and movement restrictions; (ii) establishment of infected, surveillance, and buffer zones; (iii) deployment of surveillance and vaccination teams; (iv) enforcement of livestock market closures and animal transport restrictions; (v) coordination of sample collection and transport; (vi) management of field logistics and biosecurity measures; and (vii) daily review of outbreak status and field operations.

13.2 Functional Response Units

Effective SAT-1 outbreak containment requires the deployment of specialized operational units working under coordinated district-level supervision. Depending on outbreak magnitude and resource availability, the following functional units may be activated.

13.2.1 Surveillance and Active Case Search Unit

This unit should conduct active clinical surveillance in infected and surrounding villages through house-to-house or village-level inspections, syndromic surveillance, mortality monitoring, and rapid identification of suspect animals. The unit should support early detection of secondary spread and provide daily surveillance updates to district response authorities.

13.2.2 Epidemiological Investigation and Tracing Unit

This unit should undertake forward and backward tracing to identify potentially exposed animals, holdings, markets, milk routes, traders, transport vehicles, and contact networks associated with the outbreak. Epidemiological findings should be continuously integrated into zoning, surveillance, and movement-control activities.

13.2.3 Movement Control and Enforcement Unit

This unit should function through coordination between veterinary authorities, district administration, police departments, transport authorities, and local enforcement agencies. Responsibilities may include establishment of quarantine checkpoints, road barricading, movement permit verification, livestock market closure, border surveillance, and enforcement of animal movement restrictions within infected and surveillance zones.

13.2.4 Vaccination and Field Operations Unit

This unit should coordinate emergency vaccination activities, including vaccine distribution, cold-chain management, deployment of vaccination teams, animal identification, vaccination recording, and post-vaccination monitoring. Vaccination coverage and field performance should be regularly reviewed to ensure adequate immunological protection within target populations.

13.2.5 Biosecurity, Disposal, and Decontamination Unit

This unit should supervise cleaning and disinfection operations, safe disposal of contaminated materials, carcass disposal where required, management of animal waste, and implementation of farm-level biosecurity measures. The unit should also monitor use of disinfectants, PPE compliance, and environmental contamination risks.

13.2.6 Laboratory and Sample Transport Coordination Unit

This unit should coordinate sample collection, packaging, documentation, cold-chain maintenance, and transport of diagnostic materials to designated laboratories under approved biosafety procedures. Rapid communication with laboratories should be maintained to support timely diagnosis and outbreak assessment.

13.2.7 Community Coordination and Risk Communication Unit

This unit should support communication with livestock owners, village leaders, milk cooperatives, traders, and local governance institutions regarding movement restrictions, reporting requirements, vaccination schedules, and biosecurity measures. The unit should also help address rumours, misinformation, panic sale of livestock, and non-compliance with outbreak-control measures.

13.2.8 Information Flow and Situation Reporting

Rapid and accurate information flow is essential for effective outbreak management. Surveillance findings, laboratory results, vaccination coverage, epidemiological investigations, movement-control activities, and field-response data should be rapidly communicated from village and district levels to state and national authorities to support risk assessment and strategic decision-making.

Similarly, technical guidance, containment policies, operational instructions, and resource-support decisions should flow efficiently from national and state authorities to district and field-level implementation teams. Daily situation reporting, geographic mapping, and real-time outbreak assessment should be maintained throughout the response period to support coordinated containment operations.

13.2.9 Intersectoral Coordination

Depending on the scale and epidemiological impact of the outbreak, coordination with additional sectors and agencies may become necessary to support outbreak containment operations. These may include district administration, police and transport authorities, border-control agencies, wildlife authorities, disaster-management agencies, local governance institutions, and public-health agencies under One Health coordination mechanisms.

Such inter-sectoral coordination may support implementation of animal movement restrictions, quarantine enforcement, logistics management, public communication, border surveillance, emergency resource mobilization, and continuity of essential veterinary services during outbreak response activities.

13.3 Command structure

The command structure (chains of command) defines who leads, who supports, who decides, who reports, and who executes during an animal health emergency. It creates a clear chain of authority from the national level to the village level so that technical decisions, policy directions, and field actions move quickly and consistently. Further, the command structure can be of two types: upward and downward command structures (**Annexure 13**).

13.4 Upward Reporting Chain

The upward reporting chain is the structured flow of information from the field level to higher command authorities during an animal health incident. It ensures that decision-makers receive timely, accurate, and verified information from the ground. This chain supports early detection of outbreaks, rapid escalation of serious incidents, resource mobilization, risk assessment, national situational awareness, and policy and technical decision-making. The principle is that information rises quickly, and decisions flow downward quickly (**Annexure 13**).

13.5 Downward Reporting Chain

The Downward Command Chain is the structured flow of authority, decisions, technical directions, and operational orders from higher command levels to lower execution levels during an animal health emergency. It ensures that national decisions are translated into field action; commands are clear, lawful, and consistent; resources move quickly to the point of need; technical measures are uniformly implemented; accountability exists at every level; and conflicting instructions are avoided. The principle is that decisions move downward fast, and implementation moves outward fast (**Annexure 13**).

Chapter 14

International Collaboration

Preventing the incursion of FMDV serotype SAT-1 into India requires a coordinated international approach, given the transboundary nature of the disease and the porous livestock movement corridors across South Asia. Strengthened collaboration with neighbouring countries, particularly:

- Pakistan, Afghanistan-linked western and north-western routes
- China/Tibet, Nepal and Bhutan linked northern and northeast routes and ecological interfaces
- Bangladesh, Myanmar/northeast ecological interfaces,
- Maritime trade routes.

The linkage is essential for harmonized surveillance, real-time information sharing, and synchronized control measures along shared borders. Joint risk assessments, coordinated outbreak reporting, and alignment of vaccination strategies can significantly reduce the risk of silent virus circulation and cross-border spread, especially in regions with informal livestock trade and migratory animal movement.

At the global level, active engagement with international organizations such as the WOA and FAO is critical to accessing early warning systems, technical expertise, and standardized response frameworks. Participation in regional laboratory networks and formal mechanisms for sample sharing will enable rapid confirmation and genetic characterization of suspected SAT-1 cases. Furthermore, strategic coordination with international and regional vaccine banks will be vital to ensure timely access to SAT-1-specific vaccine antigens in the event of an incursion, thereby strengthening India's preparedness and response capacity against this emerging threat (Annexure 14).

14.1 Collaboration with neighbouring Countries

Regional collaboration within South Asia provides a critical first line of defence against the transboundary spread of FMD, particularly emerging serotypes such as SAT-1. Cooperation is formally anchored through the SAARC Agriculture Centre (SAC), including the Chief Veterinary Officers (CVO) Forum, which facilitates policy dialogue and harmonization of animal health strategies across member states. However, for operational effectiveness, especially in emergency scenarios, this collaboration must extend beyond formal structures to include bilateral and sub-regional coordination mechanisms. Countries sharing immediate borders with India, namely Nepal, Bhutan, and Bangladesh, require intensified engagement due to high volumes of informal livestock movement and porous border controls.

These neighbouring countries represent critical epidemiological interfaces where synchronized surveillance and control measures are essential. Joint initiatives should include real-time outbreak information sharing, harmonized surveillance protocols, coordinated risk-based vaccination campaigns, and cross-border livestock movement monitoring. The SAARC Regional Support Unit (RSU) located in Nepal can serve as a facilitating hub for technical coordination, particularly for transboundary animal diseases (TADs), but must be complemented by direct institutional linkages between national veterinary services and reference laboratories. Regular cross-border simulation exercises, joint field investigations, and shared databases for outbreak intelligence would significantly strengthen early detection and rapid response capabilities.

Collaborative disease control efforts in the region have traditionally focused on priority diseases such as *Peste des Petits Ruminants* (PPR), FMD, and Lumpy Skin Disease (LSD),

with SAARC targeting regional eradication of PPR by 2028. While these platforms provide a strong foundation for cooperation, the current epidemiological situation necessitates re-prioritization with a sharper focus on FMD, particularly exotic serotypes like SAT-1. Importantly, unlike endemic FMD serotypes, SAT-1 poses a unique challenge due to the absence of cross-protection from existing vaccination programs. Therefore, regional collaboration must also encompass joint planning for access to SAT-1 vaccine strains, antigen banks, and emergency vaccination strategies, ensuring that preparedness is not limited to surveillance alone but extends to rapid containment and control.

14.2 Engagement with WOA, FAO, and Regional Networks

Engagement with global organizations such as the World Organisation for Animal Health and the Food and Agriculture Organization is central to India's preparedness against the potential incursion of FMDV serotype SAT-1. These organizations jointly coordinate the Global Framework for the Progressive Control of Transboundary Animal Diseases, which provides a structured platform for regional cooperation, risk assessment, and progressive disease control pathways, including the PCP-FMD framework. Through GF-TADs, India and neighbouring countries can align surveillance strategies, share epidemiological intelligence, and participate in coordinated regional action plans. Additionally, tools such as WOA's World Animal Health Information System (WAHIS) and FAO's Emergency Prevention System for Animal Health Information (EMPRES-i) enable real-time global outbreak monitoring, which is critical for anticipating SAT-1 spread and initiating timely preventive measures.

The Quadripartite alliance comprising FAO, WOA, WHO, and UNEP promotes the One Health approach globally. In the context of Foot-and-Mouth Disease (FMD), the One Health framework provides a basis for strengthening integrated surveillance, laboratory capacity, and intersectoral coordination among relevant sectors. Although FMD is not zoonotic, the One Health framework enhances preparedness by improving early detection systems, coordinated response structures, and risk communication capacities, which are equally critical for managing transboundary animal diseases like SAT-1.

Specialized regional and thematic networks further reinforce technical capacity and collaboration. Initiatives such as the South Asia Rabies Laboratory Network (SA-RabNet), though focused on zoonotic diseases, demonstrate the value of regional laboratory collaboration, standardized diagnostics, and capacity building, which can be replicated for FMD-specific networks. More directly, FAO's Emergency Centre for Transboundary Animal Diseases plays a significant operational role in countries like Bangladesh and Nepal by strengthening field epidemiology, surveillance systems, laboratory diagnostics, and emergency response preparedness. Leveraging such platforms, India can enhance cross-border coordination, promote joint training and simulation exercises, and establish mechanisms for rapid sample sharing and confirmatory testing through international reference laboratories.

Importantly, engagement with WOA and FAO also facilitates access to global FMD reference laboratories, antigen characterization services, and international vaccine banks, which are crucial for responding to exotic serotypes like SAT-1. Coordinated efforts in virus strain matching, vaccine selection, and emergency vaccine deployment will be essential components of preparedness. Thus, effective engagement with these global and regional networks must move beyond policy alignment to operational integration, ensuring that India remains connected to global early warning systems, technical expertise, and rapid response resources in the face of evolving FMD threats.

14.3 Regional and Global Coordination Framework for Surveillance, Sample Sharing, and Vaccine Access

Effective preparedness against the incursion of FMDV serotype SAT-1 necessitates robust systems for rapid sample sharing and assured access to vaccines, as these form the backbone of early detection and outbreak containment. Systematic resource sharing must go beyond intent and be operationalized through standardized protocols for sample collection, packaging, and transport, ensuring compliance with international biosecurity guidelines. Establishing pre-approved mechanisms for cross-border sample movement, along with designated nodal laboratories, will significantly reduce delays in confirmatory diagnosis and enable timely response actions.

At the regional level, the proposal for a SAARC Regional Vaccine Bank, endorsed during the Eighteenth SAARC Summit, reflects a strategic intent to ensure equitable and cost-effective access to quality vaccines. However, given potential operational limitations, India's preparedness strategy should adopt a multi-layered approach, combining regional initiatives with access to global mechanisms such as those coordinated by the WOA. WOA-managed vaccine banks provide emergency reserves for priority diseases, including FMD, and can be mobilized upon request. For SAT-1 specifically, preparedness must include advance arrangements for antigen availability, strain matching, and regulatory clearances, ensuring that vaccine deployment is not delayed during an outbreak scenario.

Sample sharing and laboratory networking are equally critical for accurate and timely diagnosis. Countries in the region should strengthen linkages with recognized reference laboratories, including FAO/WOA Reference Laboratories such as ICAR-NIFMD in India, for molecular confirmation, sequencing, and phylogenetic analysis of suspected cases. Rapid genetic characterization not only confirms the presence of SAT-1 but also informs vaccine strain selection and epidemiological tracing of virus origin and spread. To support this, a coordinated regional framework for data sharing, joint analysis, and real-time reporting should be institutionalized, leveraging platforms supported by organizations like the FAO.

14.4 Operational Preparedness and Response Framework

To complement international collaboration, a national operational framework shall be instituted to ensure a rapid and coordinated response:

14.4.1 Trigger-Based Response System

Under the trigger-based response system, a three-tiered approach shall be followed. At Level 1, the detection of SAT-1 in neighbouring countries shall lead to immediate intensification of surveillance activities in border districts, with a focus on early identification of suspect cases and monitoring of livestock movement. At Level 2, the occurrence of a suspected case within India shall prompt immediate implementation of movement restrictions, systematic sample collection, and strict quarantine measures to prevent further spread. At Level 3, confirmation of an outbreak shall result in the establishment of containment zones and the implementation of ring vaccination in defined perimeters.

14.4.2 Diagnostic Strengthening

There are no field-level rapid diagnostic kits available for preliminary detection at the point of care. Therefore, diagnostic capacity must be strengthened for preliminary screening at field-level laboratories. All suspected cases must be subjected to laboratory confirmation within 24–48 hours through ICAR-NIFMD or other designated laboratories upon sample receipt to ensure timely and accurate diagnosis. Additionally, surge capacity shall be developed

to handle increased diagnostic loads during outbreak situations, including augmentation of manpower, equipment, and laboratory infrastructure.

14.4.3 Vaccine Preparedness Strategy

A comprehensive vaccine preparedness strategy must be adopted to ensure rapid response capability. This shall include advance procurement arrangements with the private companies. Simultaneously, efforts shall be made to fast-track indigenous SAT-1 vaccine development through national research institutions. In the event of an outbreak, ring vaccination strategies shall be implemented in defined zones to contain the spread of infection effectively.

14.4.4 Border Biosecurity Measures

Border biosecurity measures shall be strengthened by enhancing quarantine infrastructure and enforcing strict monitoring at livestock checkpoints. Regulatory mechanisms shall be put in place to control livestock markets and transport systems, ensuring compliance with biosecurity protocols. Particular attention shall be given to monitoring informal livestock movement pathways, which often serve as critical routes for transboundary disease transmission.

14.4.5 Governance and Coordination

Effective governance and coordination shall be ensured through a clearly defined institutional framework. The DAHD shall function as the nodal authority responsible for overall policy direction and coordination. Technical leadership shall be provided by ICAR-NIFMD, which will guide diagnostic, surveillance, and response strategies. At the operational level, state-level rapid response teams and district veterinary officers shall be responsible for field implementation and emergency response activities.

14.4.6 Simulation and Preparedness Testing

Preparedness shall be regularly evaluated through structured simulation and testing exercises. Annual national mock drills shall be conducted to assess readiness and identify operational gaps. Cross-border simulation exercises shall be organized in collaboration with neighbouring countries to enhance regional coordination. In addition, periodic preparedness audits shall be undertaken to ensure compliance with established protocols and continuous improvement of response systems.

14.4.7 Digital Surveillance Systems

Digital surveillance systems should support real-time monitoring and decision-making. This shall include the development of real-time outbreak dashboards and GIS-based mapping tools for spatial analysis of disease spread. Integration with global platforms such as FAO EMPRES-i and WOAHA WAHIS shall be ensured to facilitate timely access to international outbreak data and strengthen early warning capabilities.

14.4.8 Risk Communication Strategy

An effective risk communication strategy shall be implemented to ensure the timely dissemination of information to all international stakeholders. Farmer awareness campaigns shall be conducted to promote early reporting and adoption of biosecurity measures across the borders. Multilingual advisories shall be issued to ensure accessibility across diverse regions. Community-based reporting mechanisms shall also be established to strengthen grassroots-level surveillance and response.

14.4.9 Financial Preparedness

Economic preparedness measures shall be instituted to mitigate the financial impact of potential outbreaks. This shall include establishing emergency compensation mechanisms to support affected farmers. Livelihood protection measures shall be implemented to minimize disruptions to rural economies. Additionally, trade risk mitigation strategies shall be developed to safeguard national and international market access in the event of an outbreak.



Chapter 15

Training & Capacity Building

Training and capacity-building programmes must be designed and implemented to strengthen national preparedness for the potential introduction of FMDV serotype SAT-1. The primary objectives are to enhance early recognition of suspected SAT-1 infection, improve differentiation from endemic FMD outbreaks, strengthen outbreak investigation and biosecurity practices, and support rapid implementation of containment measures (**Annexure 15**).

15.1 Target Participants

Training programmes should include personnel from multiple sectors to support a coordinated emergency response. It must include at least:

- A. State Animal Husbandry Department veterinarians, para-veterinarians, livestock inspectors, and disease surveillance personnel.
- B. Diagnostic laboratory personnel, epidemiologists, and emergency response teams.
- C. Forest Department personnel, wildlife veterinarians, protected area managers, and sanctuary range officers.
- D. Border enforcement agencies, customs officials, quarantine authorities, and personnel involved in livestock and livestock-product inspection.
- E. District administration, police, transport authorities, and other agencies involved in emergency response and movement control.

15.2 Simulation Exercises and Diagnostic Preparedness

Regular tabletop exercises, simulation exercises, and field mock drills should be conducted to evaluate preparedness for a suspected SAT-1 incursion. Exercises should assess early recognition and reporting of suspect cases, rapid activation of incident response mechanisms, implementation of movement restrictions, zoning, and biosecurity measures in accordance with national contingency plans, safe collection, packaging, transport, and submission of samples to designated national reference laboratories, and coordination among veterinary, wildlife, administrative, & enforcement agencies.

15.3 Traceability Documentation and Risk Assessment

Training programmes should build competency in epidemiological investigation and traceability procedures relevant to a suspected SAT-1 incursion. Personnel should be trained in completion of standardized outbreak investigation and reporting formats, collection and interpretation of animal movement histories, identification of high-risk epidemiological links, including livestock markets, transport routes, migratory grazing systems, and border-associated animal movements, mapping of wildlife–livestock interaction points, shared grazing areas, and common water sources, use of digital surveillance and reporting platforms to support real-time data collection and decision-making.

15.4 Community Awareness and Risk Communication Capacity

Training programmes should strengthen the capacity of veterinary personnel and field staff to conduct effective risk communication and community engagement during a suspected SAT-1 event. Training should cover communication of key clinical signs and reporting triggers to livestock owners, approaches for encouraging early reporting of FMD-like disease, delivery of biosecurity messages appropriate to local production systems, management of misinformation and rumours during disease emergencies, engagement with farmer groups, livestock traders, transporters, community leaders, and wildlife stakeholders to support preparedness and response activities.

Chapter 16

Post-outbreak actions

Post-outbreak actions following an FMDV SAT-1 incursion in India should aim to ensure that the exotic serotype does not establish silent circulation in livestock, domestic animals, wildlife interfaces, or captive susceptible populations. This phase is especially important for India because stamping-out or test-and-slaughter-based eradication is neither socio-economically feasible nor permissible. Therefore, the post-outbreak phase must provide evidence that transmission has stopped, high-risk populations have been monitored, and future re-emergence risk has been minimized.

16.1 Carrier surveillance

It should be undertaken in recovered and high-risk susceptible animals, particularly cattle and buffaloes, as FMDV may persist in the oropharyngeal region beyond the acute phase. However, carrier surveillance should not be treated as a stand-alone activity. Probang sampling with RT-PCR/virus isolation may be used selectively in recovered animals, outbreak-contact herds, vaccinated herds, breeding farms, border villages, gaushalas, zoos and WLI zones. This should be supported by clinical follow-up and movement-history analysis to identify possible residual infection chains.

16.2 Sero-monitoring

It should be used to assess whether SAT-1 virus circulation has occurred beyond the clinically detected outbreak area. NSP-based assays like 3AB3/3ABC ELISA are particularly useful for identifying infection-derived antibody responses and for DIVA-based surveillance where emergency vaccination has been applied. However, NSP positivity should be interpreted at the population level and followed by epidemiological investigation, because it indicates exposure or viral circulation rather than proof that each animal is actively shedding virus. Comparative evaluation studies have shown the usefulness of NSP ELISAs for detecting antibodies to non-structural proteins of FMDV.

16.3 Sentinel species

In the post-outbreak phase of a suspected or confirmed SAT-1 incursion, the strategic use of sentinel species can provide an early indication of residual viral circulation in high-risk zones. Sentinel animals—typically unvaccinated or seronegative susceptible livestock maintained under controlled conditions—may be deployed in previously affected or buffer areas to detect low-level transmission that escapes routine surveillance. In the Indian context, this approach must be applied cautiously and ethically, ensuring strict monitoring, biosecurity, and veterinary oversight. Regular clinical observation, periodic serological testing (SP/NSP ELISA), and targeted virological sampling of sentinel animals can help identify silent virus persistence and guide decisions on lifting movement restrictions or continuing control measures. Given the absence of stamping-out policies in India, sentinel surveillance and selective culling can serve as an additional tool to verify that SAT-1 has not established subclinical circulation.

16.4 Wildlife species

Wildlife species, particularly cloven-hoofed animals such as deer and antelope, represent an important consideration in the post-outbreak evaluation of SAT-1, as they may act as spillover hosts or indicators of ongoing transmission at the WLI. Although the long-term epidemiological role of wildlife in SAT-1 persistence in India remains uncertain, their involvement could complicate eradication efforts by creating undetected reservoirs. Therefore,

targeted surveillance in wildlife habitats adjoining outbreak areas, protected forests, and zoological parks is essential. This should include non-invasive monitoring approaches, observation of clinical signs, and coordinated reporting of unusual morbidity or mortality events through the Forest Department. Integration of wildlife surveillance data with livestock epidemiology will be critical to ensure that SAT-1 does not persist undetected in interface zones, particularly under Indian conditions where elimination strategies rely heavily on early detection and containment rather than depopulation.

16.5 Evaluation of control measures

These should include a formal epidemiological audit of the outbreak response. This should assess the time taken from first suspicion to reporting, sample collection, laboratory confirmation, serotyping, containment-zone declaration, movement restriction, ring surveillance and risk communication. If emergency vaccination was used, vaccine matching through virus neutralization or related antigenic matching should be reviewed to determine whether the deployed SAT-1 vaccine strain was appropriate. The economic and operational impact of control measures should also be documented, as FMD causes major losses through production decline, vaccination costs and trade disruption.

16.6 Documentation and reporting

These should be comprehensive and traceable. All clinical, laboratory, epidemiological, vaccination, movement-control, mortality, morbidity, WLI and genomic data should be compiled in a standardized format. SAT-1 isolates should be sequenced to identify lineage/topotype and probable origin. Reporting should move through the State Animal Husbandry Department, DAHD and ICAR-NIFMD, with international notification to WOA-H-WAHIS through the competent national authority. The objective is not “regaining FMD-free status” for India, but demonstrating transparent reporting, containment, and prevention of establishment.

Summary table

Component	Recommended focus	Purpose
Carrier surveillance	Selective probang/OP fluid testing, RT-PCR, virus isolation in recovered/high-risk animals	Detect persistent infection and residual risk
Sero-monitoring	SAT-1 SP antibody and NSP ELISA	Detect spread, exposure and post-vaccination infection
Control-measure evaluation	Timeline audit, tracing, zoning, movement control, vaccine matching	Identify gaps and refine future response
Documentation/reporting	Standard outbreak dossier, sequencing, DAHD/ICAR-NIFMD/WOAH reporting	Ensure transparency and prevent establishment

Chapter 17

Conclusion

The collective synthesis of all the information highlights that the potential incursion of FMDV serotype SAT-1 into India represents a high-impact, transboundary threat that demands a shift from routine control to intensified, preparedness-driven emergency response. Given the complete susceptibility of the Indian livestock population and the absence of cross-protection from existing vaccines, any delay in detection, response or acceptance of the SAT-1 virus could lead to rapid and widespread dissemination with severe socio-economic consequences. A key overarching principle is that prior preparedness, early warning, and rapid action are critical and unavoidable. The identification of clinical and epidemiological trigger points—such as vesicular disease in vaccinated herds, increased calf mortality, and links to transboundary movement—must immediately activate national emergency response mechanisms. The complex epidemiology of SAT-1, involving severe disease in cattle, persistence in buffalo, silent spread through small ruminants (goat and sheep), high population of pigs in the north eastern region and potential wildlife reservoirs, necessitates a multi-species, risk-based surveillance approach.

Effective outbreak management depends on rapid epidemiological investigation, strict movement control, and strong biosecurity, supported by parallel laboratory confirmation and strain characterization. High-quality sample handling and a robust diagnostic cascade are essential to ensure timely and accurate confirmation, which in turn guides containment and vaccination strategies. In the absence of immediate vaccine availability or low vaccine availability, preparedness must rely on non-vaccination measures, followed by targeted emergency vaccination once suitable SAT-1 vaccines are accessible. The success of response efforts further relies on integrated resource mobilization, efficient logistics, and coordinated governance structures, including the implementation of a National Incident Command System that ensures clear roles, accountability, and unified communication across all administrative levels. Equally important is the role of risk communication, which must be proactive, transparent, and community-centred to ensure compliance, minimize misinformation, and strengthen grassroots surveillance.

The current document emphasizes a One Health approach, integrating livestock, wildlife, and environmental surveillance, particularly at interface zones, along with strengthened zoo biosecurity and interdepartmental coordination. Reliable data management and real-time reporting systems are indispensable for converting field observations into actionable intelligence, enabling timely interventions and informed decision-making. Recognizing the transboundary nature of SAT-1, international collaboration emerges as a cornerstone of preparedness, facilitating early warning, harmonized surveillance, rapid diagnostics, and assured access to vaccines through global and regional partnerships. Finally, post-outbreak actions must be rigorous and evidence-based, focusing on proving the absence of virus circulation through sustained surveillance and documentation, rather than treating outbreak closure as a routine endpoint.

In short, preparedness for the SAT-1 incursion in India requires a comprehensive, multi-layered, and coordinated framework that integrates prior preparedness for vaccination, surveillance, diagnostics, post-outbreak vaccination strategy, logistics, governance, communication, and international cooperation. Proactive implementation of all these measures will be essential to prevent the establishment of the disease/virus, protect livestock productivity, and safeguard national economic and biosecurity interests. Sustained training and capacity building underpin all these efforts, ensuring that veterinary personnel and all stakeholders remain equipped to respond effectively to emerging threats.

Annexure-1

Triggers indicating SAT-1 entry in India

S. No.	Trigger Category	Trigger / Red Flag Indicator	Epidemiological Significance	Recommended Immediate Action
1	Clinical Trigger	Severe vesicular lesions with excessive salivation, oral lesions, and lameness in cattle or buffaloes	Classical suspicion of FMD-like disease may indicate SAT-1 incursion in susceptible populations	Immediate reporting, isolation, sample collection, dispatch for diagnosis, and movement restriction
		Sudden and marked reduction in milk production associated with fever, salivation, oral lesions, or lameness	Early indicator of a rapidly spreading vesicular disease outbreak	Clinical investigation and active surveillance in surrounding herds
		Unexplained high mortality in calves or young stock during or shortly after a vesicular disease outbreak	Suggestive of acute FMDV infection with possible myocardial involvement in susceptible populations	Emergency field investigation and laboratory confirmation
		Severe disease or unusually high morbidity in herds with high vaccination coverage (>80%) under LHDCP	Possible vaccine mismatch, vaccine failure, or introduction of an exotic serotype such as SAT-1	SAT-1-targeted investigation, vaccine-matching assessment, and enhanced surveillance
		Mild oral lesions, interdigital lesions, or subtle lameness in sheep and goats	Small ruminants may facilitate unnoticed viral circulation and dissemination	Intensified surveillance and targeted sampling of small ruminants
2	Epidemiological Trigger	Detection of SAT-1 outbreaks in neighbouring countries, border regions, trading partners, or epidemiologically linked territories	Increased probability of transboundary introduction through animal movement, trade, fomites, or wildlife interfaces	Heightened surveillance, border preparedness measures, and risk-based sampling
		Sudden outbreak of FMD-like disease near international borders or in previously unaffected regions	High suspicion of a recent introduction event requiring urgent investigation	Rapid epidemiological investigation, tracing, and containment measures
3	Movement-Related Trigger	Introduction, transport, or movement of animals from affected/high-risk regions, including undocumented or illegal animal movement	Potential pathway for SAT-1 introduction and spread	Quarantine, trace-back and trace-forward investigations, and laboratory testing
		Disease occurrence associated with livestock markets, fairs, aggregation points, transport hubs, seasonal transhumance, or large-scale festival-related animal movement	Increased risk of rapid amplification and dissemination through animal movement networks	Immediate movement control, market surveillance, and targeted inspections

4	Border/Pathway Trigger	Sudden outbreaks in coastal districts near major seaports, airports, or international cargo entry points	Possible indirect introduction through contaminated animal products, fomites, or transport pathways	Port-associated epidemiological investigation and enhanced monitoring
5	Wildlife Interface Trigger	FMD-like illness in livestock sharing grazing areas or water sources with wildlife, or unusual disease events in wild ungulates or zoo animals	Potential wildlife–livestock transmission interface or bridge-host involvement	Joint veterinary and wildlife surveillance, sampling, and risk assessment
6	Environmental / Ecological Trigger	Drought, floods, displacement, or environmental disruption causing unusual livestock migration, congregation, or mixing	Increased opportunity for inter-herd transmission and transboundary spread	Intensified surveillance in migration corridors and congregation points
7	Pig-Associated Trigger	Swill feeding practices in peri-urban, backyard, or border pig-production systems	Potential indirect introduction of exotic FMDV strains through contaminated animal products	Biosecurity inspection, awareness campaigns, and targeted surveillance
8	Diagnostic Trigger	Detection of FMDV RNA or antigen through bulk milk surveillance, environmental surveillance, or other early-warning systems before widespread clinical disease	Possible early circulation during the incubation or pre-clinical phase	Cluster investigation, tracing, and intensified surveillance
		Detection of SAT-1 by RT-PCR, ELISA, sequencing, virus isolation, or other confirmatory laboratory methods	Laboratory confirmation of SAT-1 incursion	Immediate activation of national emergency response protocols
9	Community Participatory /Community Digital Surveillance Trigger	Sudden increase in farmer reports of salivation, lameness, vesicular lesions, reduced milk yield, or unexplained calf mortality	Early community-level indication of outbreak emergence	Field verification and activation of syndromic surveillance
		Multiple informal alerts through social media, social media groups, helplines, or local information networks regarding vesicular disease	Event-based surveillance signal potentially preceding official reporting	Rapid field verification and district-level alert generation

TRIGGERS FOR SAT-1 ENTRY – INDIA

Trigger points are defined as the aspects of clinical or epidemiological events demanding or necessitating immediate/prompt reporting with simultaneous initiation of containment measures soon after the suspected case is encountered followed by its confirmation.

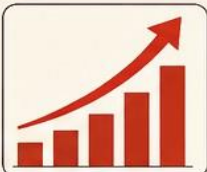
1 PRIMARY CLINICAL TRIGGERS / CLINICAL RED FLAGS



Severe vesicular disease with high production losses



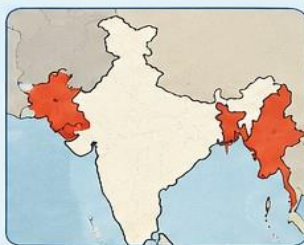
Unexplained mortality in young animals



Rapidly increasing morbidity in naïve or vaccinated populations

! Clinical signs consistent with FMD but with greater magnitude than the expected severity are also to be taken into account.

2 EPIDEMIOLOGICAL TRIGGERS / EPIDEMIOLOGICAL RED FLAGS



Detection of SAT-1 in neighbouring countries or trade partners



Evidence of spread along transboundary corridors



Introduction of animals from affected regions

IMMEDIATE FIELD ACTION

- ✓ REPORT IMMEDIATELY
- ✓ INITIATE CONTAINMENT
- ✓ SAMPLE & DIAGNOSE
- ✓ CONFIRM & ACT

3 PROXIMITY & MOVEMENT-BASED / COMMUNICATION-LINKED TRIGGERS



Farms near international borders



Within protection or surveillance zone of a known outbreak



Introduction of animals from border districts



Livestock markets & communal grazing areas



Movement (intended or illegal) during high-risk periods (festivals, seasonal migration)



Increased reporting of suspicious symptoms by farmers



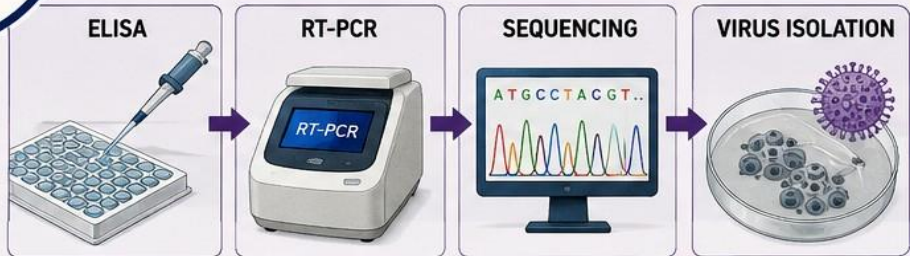
Community alerts regarding sudden disease spread



Field observations linked to animal movement or market activity

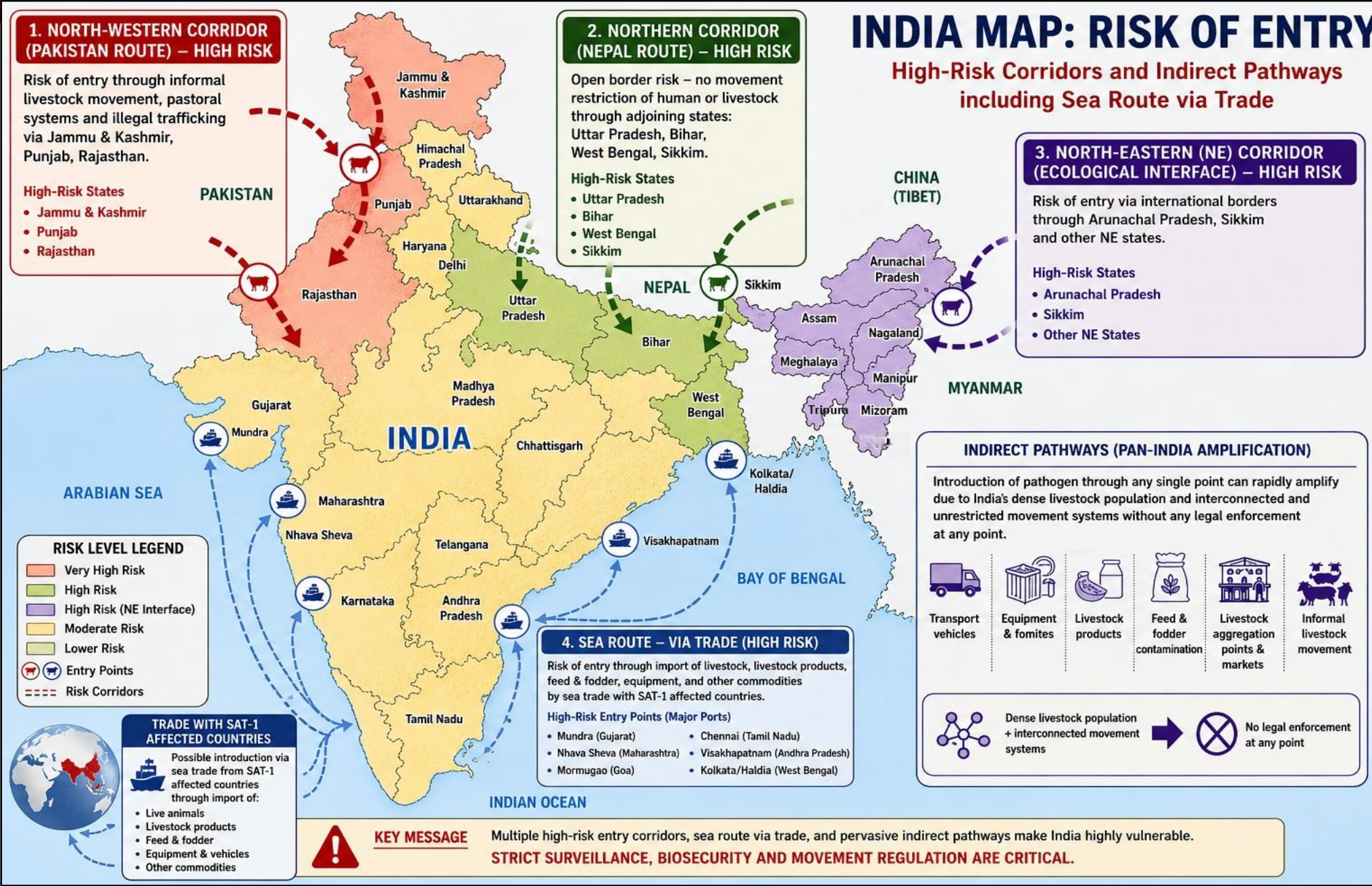
4 LABORATORY-BASED TRIGGERS

Confirmation of SAT-1 serotype triggers the subsequent response actions.



Further isolation of virus from clinical materials collected from suspected incidences

Triggers ensure **EARLY DETECTION, RAPID REPORTING** and **TIMELY CONTAINMENT** to prevent SAT-1 entry and spread.



IMMEDIATE RESPONSE MEASURES UPON TRIGGER ACTIVATION

! Once trigger thresholds are reached, the following actions must be implemented immediately

1 **QUARANTINE OF THE AFFECTED HERD/FARM**



Immediately isolate and quarantine the suspected or affected herd/farm to prevent further spread.

2 **MOVEMENT RESTRICTION OF ANIMALS, PRODUCTS, AND EQUIPMENT**



Restrict movement of animals, livestock products, vehicles, equipment and other related items in and out of the area.

3 **PROMPT REPORTING TO LOCAL AND NATIONAL VETERINARY AUTHORITIES (DAHD)**



Report immediately to local veterinary offices and the Department of Animal Husbandry and Dairying (DAHD).

4 **ESTABLISHMENT OF CONTAINMENT ZONES (3–10 KM RADIUS)**



Establish containment and buffer zones (3–10 km radius) around the affected premises.

5 **ACTIVE SURVEILLANCE AND TRACING OF CONTACTS**



Conduct active surveillance in the surrounding area and trace all potential contacts and movements.

6 **ACCURATE SAMPLE COLLECTION AND CAREFUL DISPATCH FOR LABORATORY CONFIRMATION**

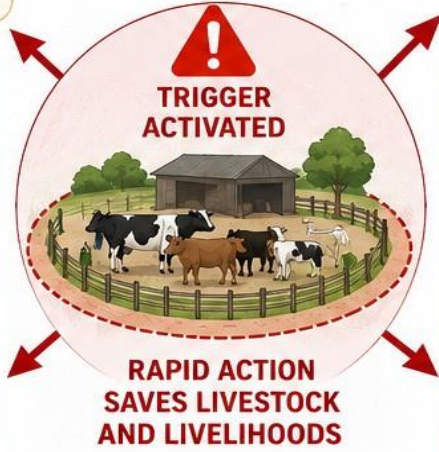


Collect appropriate samples following standard protocols and dispatch safely to designated laboratories for confirmation.

7 **IMPLEMENTATION OF STRICT BIOSECURITY MEASURES**



Enforce strict biosecurity: disinfection, control of personnel, vehicle disinfection, use of PPE, and hygiene practices.



8 **PREPARATION FOR EMERGENCY RING VACCINATION USING SAT-1 SPECIFIC STRAINS**



Prepare for and implement emergency ring vaccination with SAT-1 specific vaccine strains in and around the containment zone as per guidelines.

9 **INTERNATIONAL REPORTING TO RELEVANT BODIES (E.G., WOA)**



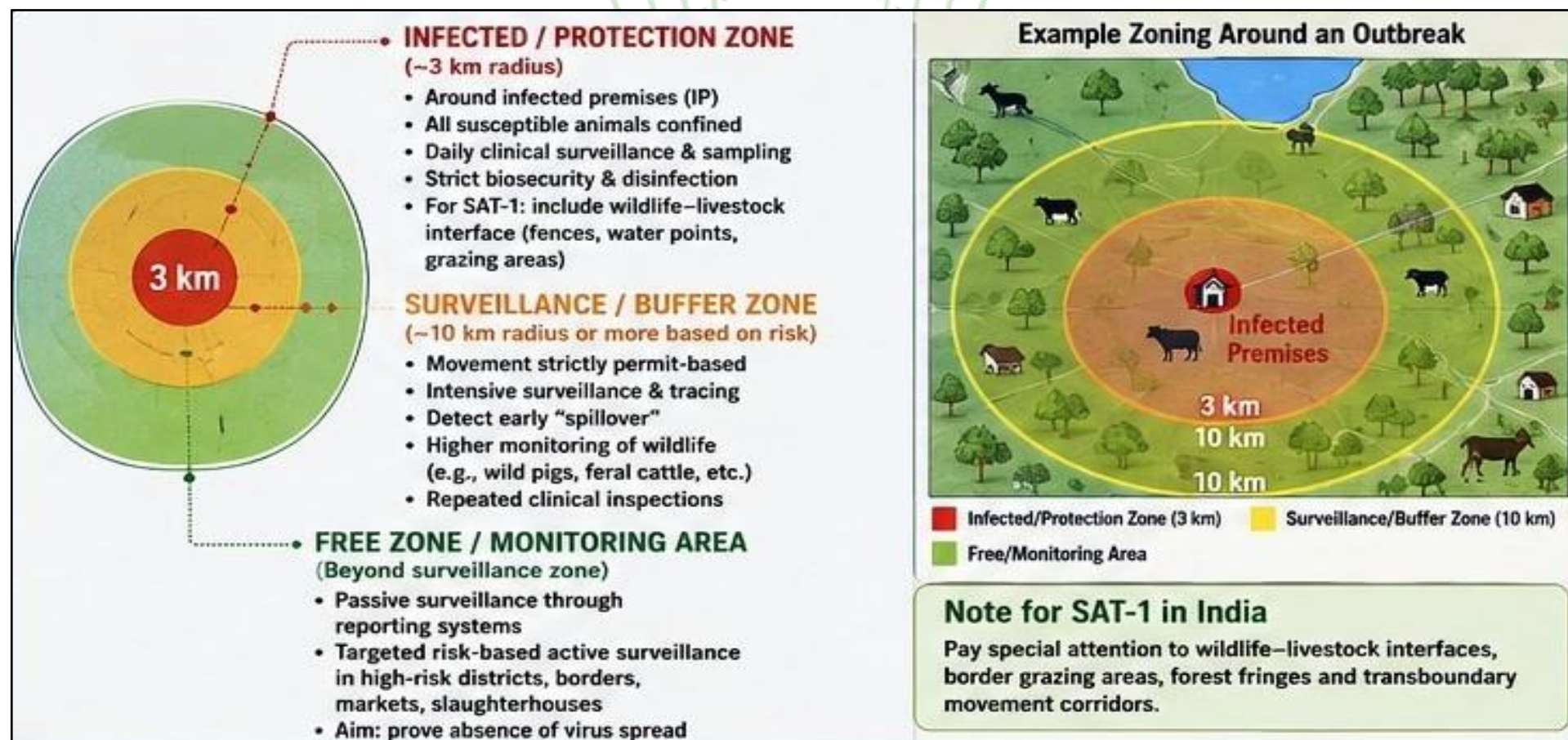
Report the event to international bodies, including WOA, in accordance with the International Animal Health Regulations (IHR).

COORDINATION IS CRUCIAL: Close coordination between field teams, laboratories, veterinary authorities, and all stakeholders is essential for effective containment, control and prevention of further spread of SAT-1.



Once trigger thresholds are reached, the following actions must be implemented:

- Quarantine of the affected herd/farm
- Movement restriction of animals, products, and equipment
- Prompt reporting to the local and national veterinary authorities (DAHD)
- Establishment of containment zones (3-10 km radius)
- Active surveillance and tracing of contacts
- Accurate sample collection and careful dispatch for laboratory confirmation
- Implementation of strict biosecurity measures
- Preparation for emergency ring vaccination using SAT-1 specific strains
- International reporting to relevant bodies (e.g., WOA)



Annexure-2

FMDV Serotype O vs. SAT-1 and Clinical Features in Indian Wildlife

Feature	Serotype O (Eurasian Endemic)	SAT-1 (Emergent Transboundary)	Remarks
Host Adaptation	Highly adapted to domestic cattle and pigs; commonly responsible for extensive outbreaks in intensive livestock systems across Eurasia.	Traditionally maintained in African buffalo (<i>Syncerus caffer</i>) populations, recent incursions into immunologically naïve Eurasian livestock populations have raised concerns regarding rapid spread and severe production impacts.	SAT serotypes are historically linked to wildlife–livestock interfaces in sub-Saharan Africa.
Clinical Severity	High morbidity (often 80–100%) with classical vesicular lesions involving the tongue, dental pad, interdigital space, and coronary bands.	Recent outbreaks have been characterised by severe vesicular and erosive lesions, accompanied by marked lameness and rapid herd-level spread in susceptible cattle populations.	Clinical manifestations overlap substantially among serotypes.
Myocarditis (“Tiger Heart”)	Myocarditis and sudden mortality are well recognized in suckling calves and young stock; pale streaking of the myocardium is characteristic.	Acute myocarditis and sudden death in young animals may also occur during SAT-1 infection, occasionally preceding the development of classical vesicular lesions.	Myocarditis is not unique to SAT-1 and may occur with multiple FMDV serotypes.
Swine	Pigs serve as major amplifying hosts and may shed very large quantities of aerosolized virus; severe hoof lesions and detachment may occur.	Pigs are susceptible to SAT-1 infection and may contribute to virus amplification, although epidemiological dynamics vary among strains and outbreaks.	Serotype O remains the most important pig-amplified epidemic lineage globally.
Small Ruminants	Infection is frequently subclinical or mild in sheep and goats, permitting silent transmission within mixed-production systems.	Usually mild or clinically inapparent; however, small ruminants may contribute to transmission between wildlife and domestic livestock populations.	Clinical surveillance in small ruminants remains challenging for all serotypes.
Persistence (Carrier State)	Cattle and buffalo may remain carriers for approximately 6–24 months; persistence in sheep and goats is generally shorter.	African buffalo may harbour SAT viruses for prolonged periods, contributing to long-term ecological maintenance.	Persistence in Indian water buffalo under SAT-1 exposure remains insufficiently documented.
Immunological Profile	Well characterised antigenically, India’s trivalent vaccine (O, A, Asia 1) provides established protection against circulating homologous strains.	Antigenically distinct from O, A, and Asia 1 serotypes, existing trivalent vaccines are not expected to provide meaningful cross-protection against SAT-1.	Immunological naivety of Asian livestock populations remains a major preparedness concern.

The comparative pathology table is synthesized from recent technical reports (FAO, WOA, 2025–2026) and established virological studies regarding the emergence of FMDV SAT-1 in Eurasia versus the endemic Serotype O.

FMD Clinical observations in wildlife in India

Species Group	Primary Oral & Facial Signs	Primary Foot & Limb Signs	Systemic & Behavioural Signs
Wild Bovids (Gaur, Wild Water Buffalo, Mithun, Wild Yak)	Profuse salivation; vesicles and erosions on tongue, dental pad, gums, and buccal mucosa; lip smacking and difficulty feeding	Vesicles and erosions of the interdigital space and coronary band; painful gait; reluctance to walk or graze	Fever, depression, rapid loss of body condition; marked reduction in milk production in lactating females; myocarditis and sudden death may occur in young animals
Wild Suids (Indian Wild Boar, Pygmy Hog)	Vesicles and erosions on snout, muzzle, tongue, and oral mucosa; refusal to feed due to oral pain	Severe coronary band lesions; hoof horn separation ("thimbling") in severe cases; knuckling and difficulty standing or walking	High fever, marked depression, recumbency, rapid spread within groups, and potentially high mortality in young animals
Wild Caprines and Mountain Ungulates (Serow, Goral, Bharal, Nilgiri Tahr)	Mild to moderate oral vesicles or erosions; salivation may be less conspicuous than in cattle	Coronary band and interdigital lesions; lameness is often more evident than oral lesions	Reduced mobility, separation from herd groups, weight loss, depression, and reduced foraging activity
Cervids and Antelopes (Chital, Sambar, Swamp Deer, Hog Deer, Barking Deer, Nilgai, Blackbuck, Chousingha)	Oral erosions may be subtle and easily overlooked; lesions on the dental pad, gums, and tongue; salivation of variable severity	Interdigital and coronary band lesions; secondary bacterial infection may result in chronic lameness; hoof deformities may occur during recovery	Depression, isolation from herd, reduced grazing, rapid loss of body condition, and occasional mortality in young or severely affected animals
Captive Wild Ungulates (Zoo and Conservation Collections)	Similar lesions to their free-ranging counterparts, often detected earlier because of close observation	Lameness, foot lesions, and reluctance to move within enclosures	Reduced feed intake, behavioural changes, and increased risk of transmission where susceptible species are housed in proximity
Rhinoceroses (Indian and other susceptible rhinoceros species)	Hypersalivation; vesicles, erosions, or ulcerations on lips, tongue, oral mucosa, and nostrils; difficulty prehending feed	Coronary band inflammation; painful foot lesions; footpad erosions or ulceration; severe lameness and reluctance to move	Fever, lethargy, hyporexia or anorexia, weakness, isolation, and reduced activity

The information presented in this table is based on documented reports of Foot-and-Mouth Disease in wildlife species from India over time. It does not specifically represent infections caused by FMDV serotype SAT-1. It is intended solely as a field reference to assist in the recognition of FMD in susceptible wildlife species. Clinical manifestations may differ according to the infecting serotype, viral lineage, host species, age, immune status, and environmental conditions.

Annexure-3

Epidemiology and Response

Figure 1: Determination of Backward tracing to identify infection source

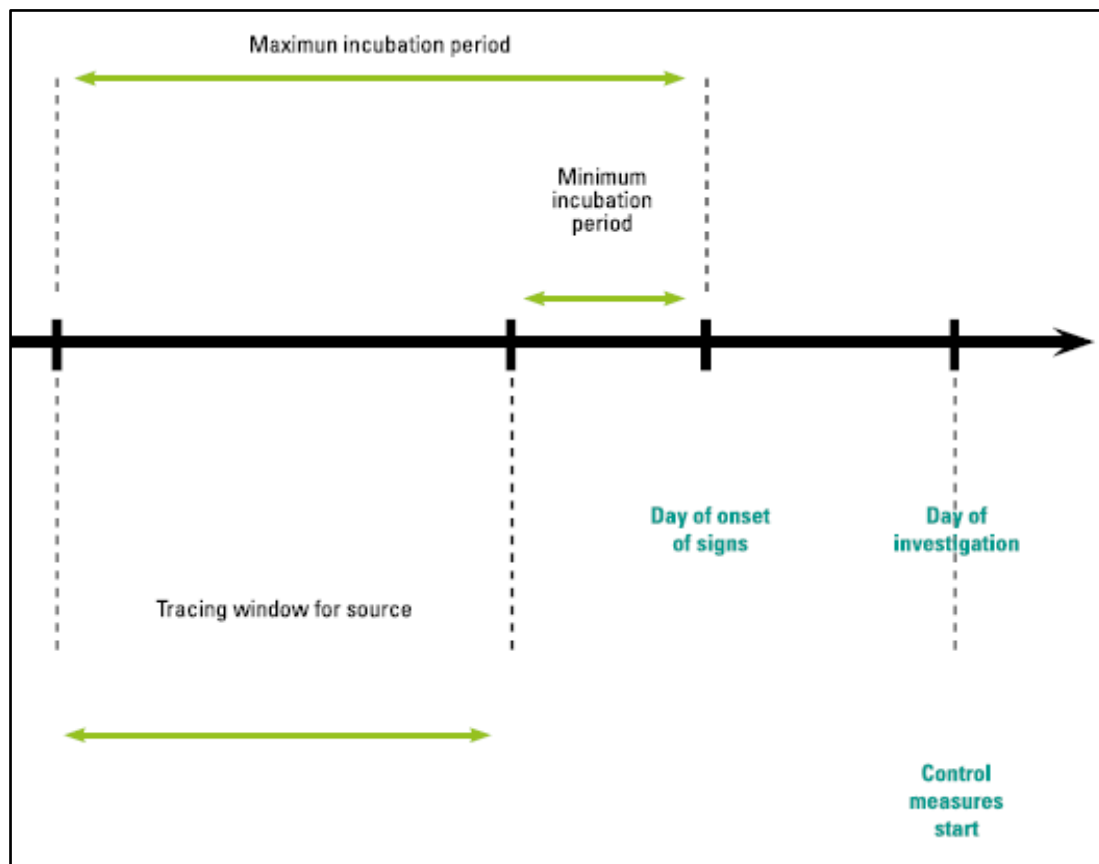


Figure 2: Determination of forward tracing to identify spread of infection from the infected premise

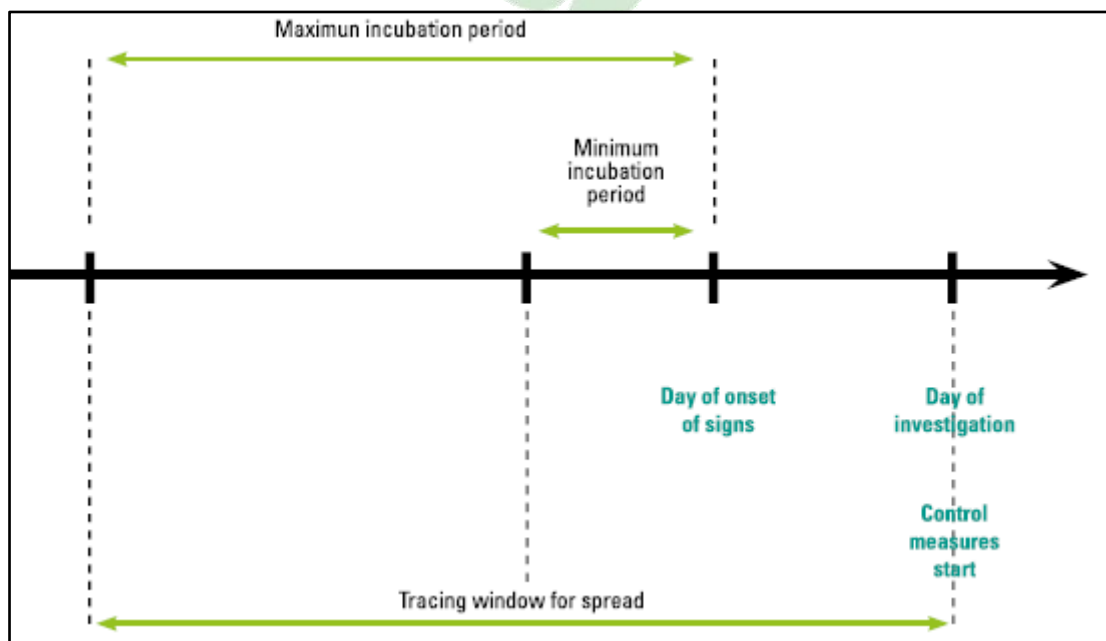
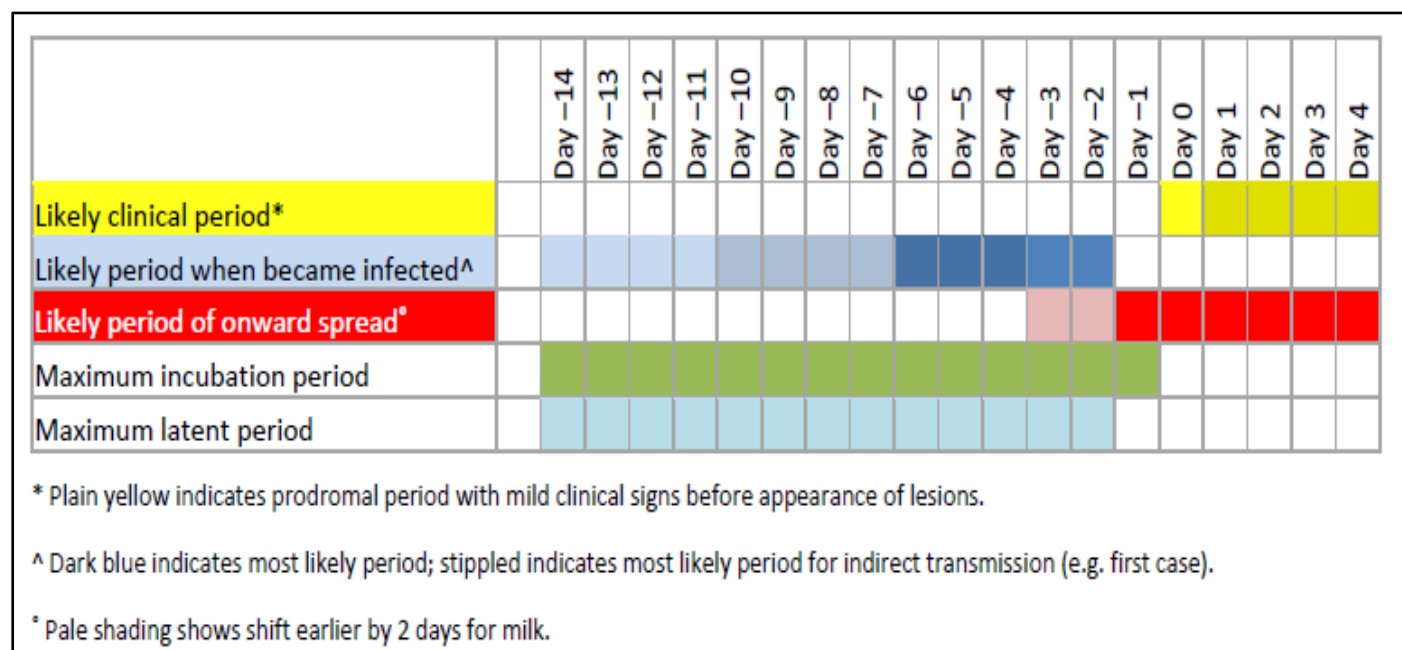
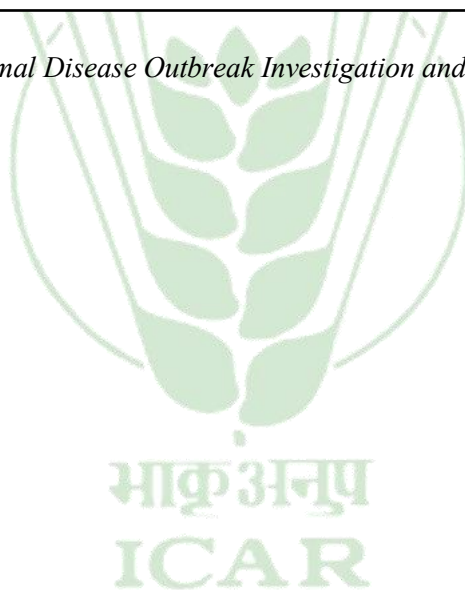


Figure 3: Tracing timeline (for forward and backward tracing) for infected cattle:



Adapted from 'A Field Manual for Animal Disease Outbreak Investigation and Management' published by WOAH



A field guide to estimating the age of Foot-and-Mouth disease lesions

Lesions and their ages from experimentally infected cattle



Lesions and their estimated ages from cattle observed in the field



Guidelines for estimating the approximate age of FMD lesions

Day 1 – The first day intact fluid filled vesicles are seen to be formed. The overlying skin becomes blanched.

Day 2 – The vesicle is ruptured but much of the blanched epithelium is still intact, having sharp edges (arrowed), and where detached, raw red underlying dermis can be seen.

Days 3-4 – Vesicular epithelium is lost, with subsequent fibrin deposition evident on the exposed dermis. Epithelium starts to re-grow at lesion borders.

Day 5-7 – Epithelial regrowth is marked, with loss of fibrin infilling, and subsequent scarification present.

Day 7 onwards – Fibrin infilling has disappeared, with new epithelium covering the dermis. Scar formation progresses.

Figure 4: FMD lesions

Figures are Adapted from EuFMD -Real TimeTraining -Foot -and -Mouth Disease – 2016 booklet

Activation of the rapid response team (RRT)

Trigger for Activation

A rapid response team should be activated within 6 hours of:

- Clinical suspicion of SAT serotype FMD
- Laboratory confirmation by ICAR-NIFMD or network laboratories

Field epidemiology and surveillance activities must begin within 24–48 hours

Structure of the Rapid Response System

A. Field Epidemiology Unit (Core Investigation Team):

- Scientist, ICAR-NIFMD (Team Lead)
- DAHD representative
- State animal husbandry department representative
- Local Veterinary Officer
- Para-veterinary staff
- Data recorder (digital/GIS-enabled)
- Local liaison (Panchayat/field worker)

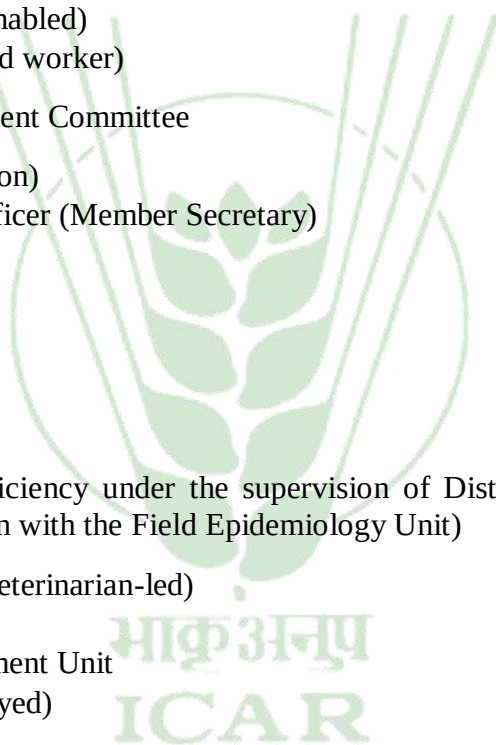
B. District-Level Incident Management Committee

- District Collector (Chairperson)
- Chief District Veterinary Officer (Member Secretary)
- Superintendent of Police
- Tahsildar
- Block Veterinary Officers
- Block Development Officer

C. Operational Sub-Units:

(To function independently for efficiency under the supervision of District level incidence management committee and in active coordination with the Field Epidemiology Unit)

- Tracing Teams (dedicated, veterinarian-led)
- Surveillance Unit
- Movement Control Enforcement Unit
- Vaccination Teams (if deployed)



Annexure-4

Types of Surveillance

Types of surveillance systems to be employed for confirmation and control of SAT-1 in India

S. No.	Type of Surveillance	Definition	Primary Purpose	Key Components / Activities	Major Operational Areas / Targets
1	Syndromic surveillance	Systematic monitoring of clinical signs and disease syndromes suggestive of FMD before laboratory confirmation	Early detection of unusual vesicular disease events and rapid recognition of outbreaks	Monitoring salivation, vesicular lesions, lameness, fever, milk drop, calf mortality, sudden morbidity clustering	Border districts, livestock markets, dairy-intensive regions, migratory pastoral systems, and animal congregation points
2	Trigger-Linked Surveillance and Response	Surveillance linked to predefined epidemiological or clinical triggers that activate immediate response measures	Rapid operational response and early containment following suspicion	Trigger activation, quarantine, movement restriction, sample collection, epidemiological investigation, and rapid response team activation	High-risk outbreak situations, border districts, animal movement corridors, and unusual vesicular disease events
3	Epidemiological surveillance	Continuous and systematic collection, analysis, interpretation, and dissemination of disease-related information	Understand disease dynamics and support preparedness and policy planning	Active surveillance, passive surveillance, outbreak investigations, targeted sampling, data analysis	National surveillance systems, NADRS/NADRES, veterinary institutions, and livestock production systems
4	Risk-based surveillance	Surveillance prioritizing areas, populations, or systems with increased probability of disease introduction or spread	Optimize surveillance efficiency and improve the probability of early detection	Monitoring high-risk zones, trade routes, aggregation points, wildlife interfaces, and high-mobility livestock systems	Borders, transport corridors, animal markets, dairy networks, quarantine stations
5	Intensified outbreak surveillance	Geographically focused surveillance implemented during outbreak containment operations	Detect secondary spread and support zoning and movement control measures	Clinical inspections, repeated farm visits, contact tracing, permit-based surveillance testing, and epidemiological mapping	Infected zones, protection zones, surveillance/buffer zones, and extended risk areas as defined by outbreak response policy
6	Border and Transboundary Surveillance	Surveillance aimed at preventing the transboundary introduction and spread of SAT-1	Early detection of cross-border introduction and monitoring of high-risk animal movement	Border inspections, quarantine monitoring, transport verification, animal movement documentation, and check-post surveillance	Pakistan border, Nepal border, Bhutan border, Bangladesh border, Myanmar corridor, China/Tibet interface, seaports, airports, quarantine facilities

7	Wildlife and WLI surveillance	Surveillance targeting susceptible wildlife populations and interface ecosystems	Detect spillover events and monitor potential bridge-host transmission	Opportunistic sampling, wildlife mortality monitoring, zoo surveillance, and interface risk assessment	Forest-fringe livestock systems, protected areas, zoos, rescue centres, North-Eastern states, WLI regions
8	Participatory surveillance	Community-based disease reporting and local epidemiological intelligence gathering	Strengthen early warning systems and improve reporting from remote or resource-limited areas	Farmer reporting, helplines, WhatsApp/mobile reporting, community veterinary communication	Rural villages, pastoral communities, dairy cooperative networks, remote livestock areas
9	Sentinel surveillance	Repeated monitoring of selected representative herds or livestock populations	Provide early evidence of infection or virus circulation in high-risk populations	Periodic monitoring of sentinel herds, repeated clinical and serological testing	Border dairy farms, gaushalas, organized farms, transit hubs, high-risk livestock clusters
10	Serological surveillance	Surveillance based on antibody detection to assess exposure, infection history, or immunity status	Detect previous exposure and evaluate population immunity profiles	NSP ELISA, SP ELISA, virus neutralization tests, structured serosurveys	Vaccinated populations, post-outbreak zones, surveillance programmes, high-risk populations
11	Post-vaccination monitoring (sero-monitoring)	Monitoring conducted after vaccination to assess vaccine-induced immunity and identify possible residual infection	Evaluate vaccination effectiveness and identify immunity gaps or vaccine failure	DIVA, seromonitoring surveys, immunity profiling, vaccine coverage assessment	LHDCP/NADCP vaccination programmes, vaccinated livestock populations, post-vaccination assessment zones

Annexure-5

Zoning and Movement Control Framework

Principles of zoning and movement control

The primary objective of zoning is to:

- rapidly contain viral spread,
- minimize movement-associated dissemination,
- facilitate structured surveillance,
- prioritize emergency vaccination,
- support epidemiological tracing,
- reduce the risk of long-distance spread.

Given the high transmissibility of FMDV, especially in immunologically naïve livestock populations, movement control must be implemented immediately after suspicion or confirmation of FMDV SAT-1.

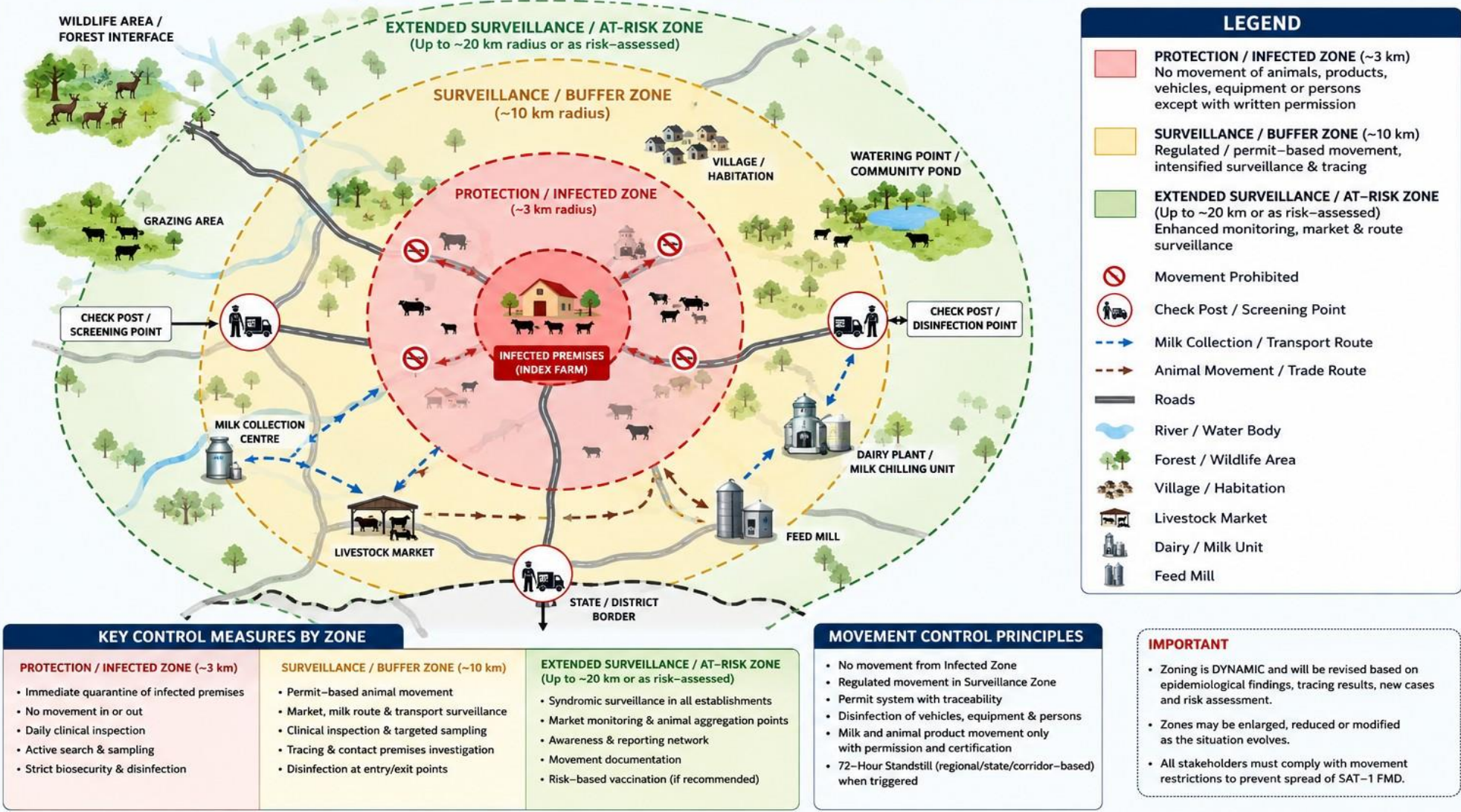
Zoning boundaries should remain dynamic and subject to revision based on:

- epidemiological tracing,
- livestock density,
- milk collection routes,
- livestock market linkages,
- border proximity,
- wildlife-livestock interface,
- emergence of secondary infected premises.



OPERATIONAL SPATIAL CONTAINMENT MODEL FOR SAT-1 FMD

Dynamic Zoning, Movement Control and Surveillance Framework (India Context)



Note: Distances are initial operational guidelines and may be extended based on livestock density, movement networks, market linkages, milk routes, border proximity, wildlife interface, terrain and epidemiological evidence.

Early Detection
Saves Livestock

Report Immediately
Suspected Cases

Biosecurity Today
Protection Tomorrow

Summary for operational zoning

Zone Category	Indicative Radius*	Major Restrictions	Surveillance Strategy	Operational Priority
Infected / Protection Zone	Around 3 km	Complete movement restriction of susceptible animals, products, vehicles, feed, and equipment	Daily active surveillance, clinical inspection, and targeted sampling	Immediate containment
Surveillance / Buffer Zone	Around 10 km or more	Permit-based movement, tracing, market closure, regulated transport	Active and risk-based surveillance	Early spillover detection
Extended Risk / Monitoring Area	Risk-based	Enhanced monitoring and preparedness	Syndromic and passive surveillance	Prevention of long-distance dissemination

*Note: Distances are operational guidelines and may be expanded or modified according to epidemiological assessment, livestock density, movement networks, dairy collection systems, border proximity, and outbreak evolution.

Functional or network-based zoning

In the Indian context, geographic zoning alone may be insufficient because FMD spread is strongly influenced by livestock trade, dairy transport systems, informal animal movement, and market linkages.

Therefore, the following should also be treated as epidemiological extensions of outbreak zones:

- livestock market catchment areas,
- milk collection routes,
- animal transport corridors,
- border livestock transit points,
- trader movement networks,
- communal grazing areas,
- shared watering points.

Where epidemiological evidence indicates wider dissemination risk, the surveillance zone may be extended beyond conventional radii.

Movement control measures

Immediate Restrictions

Immediately after suspicion or confirmation of FMDV SAT-1, the following should be restricted or suspended:

- movement of cloven-hoofed animals,
- livestock transport vehicles,
- milk movement from infected premises,
- raw animal products,
- hides and skins,
- feed and fodder transport from infected areas,
- contaminated equipment,
- semen and embryo movement where applicable,
- livestock market operations.

Closure of Livestock Aggregation Points

The following facilities should be suspended immediately within affected areas:

- livestock markets,

- animal fairs,
- transport hubs,
- milk aggregation centres,
- animal assembly points,
- temporary holding facilities.

These locations can function as major amplification points for FMD transmission.

Emergency standstill measures

Operational Concept

A temporary emergency standstill on the movement of susceptible animals and associated materials may be implemented immediately after outbreak confirmation.

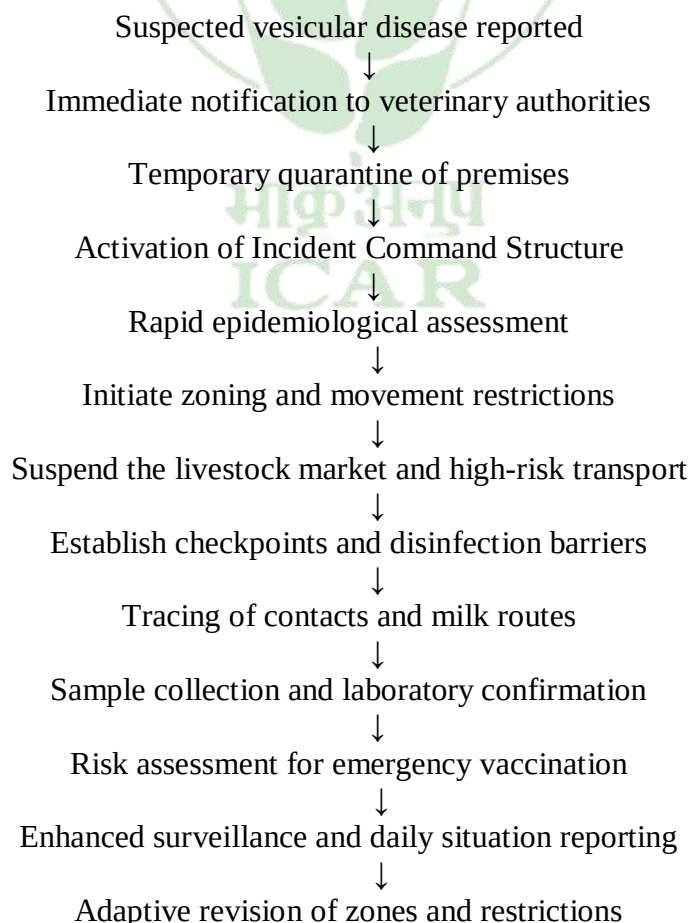
International FMD contingency frameworks commonly utilize an initial 24–72-hour standstill period to facilitate:

- epidemiological tracing,
- outbreak investigation,
- risk assessment,
- surveillance activation,
- establishment of movement checkpoints.

In India, depending on outbreak location, livestock density, trade connectivity, and transboundary risk, standstill implementation may be:

- district-based
- corridor-based
- state-level
- or regional

Movement control flow diagram



Checkpoints and disinfection barriers

Vehicle and personnel checkpoints should be established at strategic entry and exit points within infected and surveillance zones. The following should be ensured:

- controlled access,
- footbaths,
- wheel disinfection systems,
- dedicated PPE,
- cleaning before disinfection,
- movement documentation.

Removal of organic matter before disinfection is essential because FMDV can persist in manure, slurry, and organic debris.

Important operational note

Zoning distances and movement restrictions should never be treated as rigid fixed values. They must remain dynamic and subject to continuous revision according to:

- outbreak evolution
- epidemiological tracing
- livestock movement patterns
- milk collection networks
- environmental conditions
- detection of secondary infected premises



Annexure 6

Guidelines for compartmentalization

1. Concept of compartmentalization

Compartmentalization is a disease-control and trade-continuity strategy based on biosecurity management rather than geographical separation.

Under WOAHP principles, a compartment refers to:

“A subpopulation of animals contained in one or more establishments under a common biosecurity management system with a distinct health status with respect to a specific disease for which required surveillance, control, and biosecurity measures have been applied.”

Unlike zoning, which depends primarily on geographical boundaries, compartmentalization depends upon:

- validated biosecurity,
- traceability,
- movement control,
- surveillance systems,
- epidemiological separation,
- regulatory oversight.

2. Objectives of compartmentalization

The objectives of compartmentalization during SAT-1 emergency response include:

- maintenance of epidemiologically secure livestock populations,
- continuity of critical dairy and breeding operations,
- protection of elite genetic resources,
- minimization of production disruption,
- facilitation of regulated movement under controlled conditions,
- support for disease-free certification and recovery.

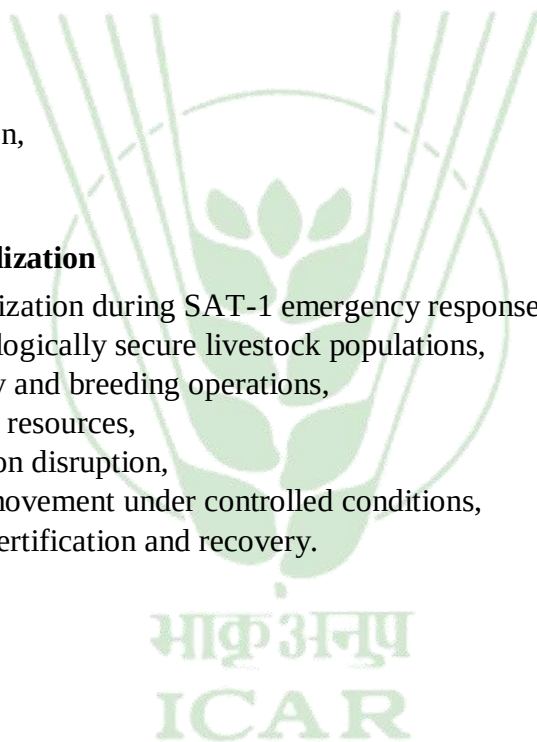
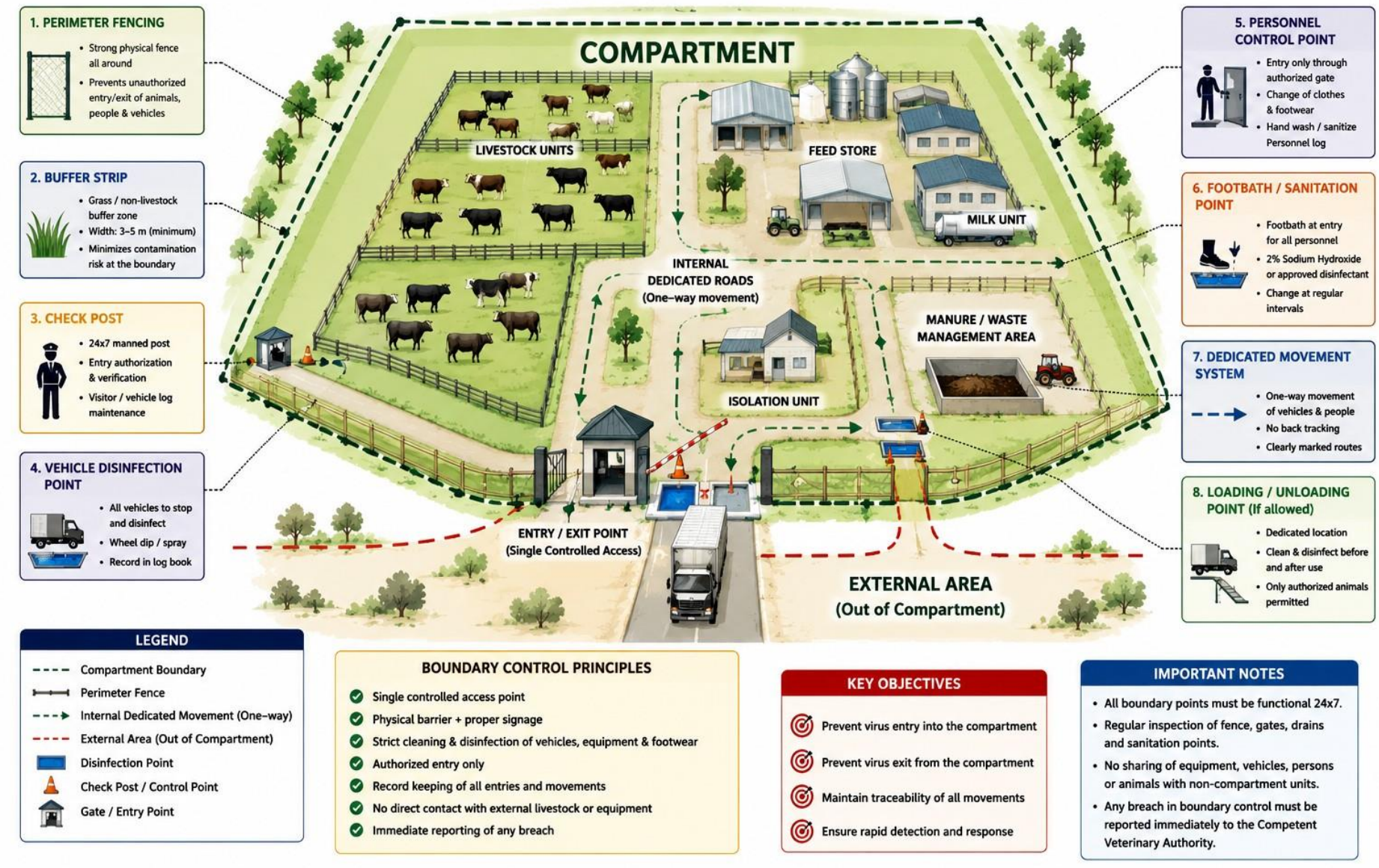


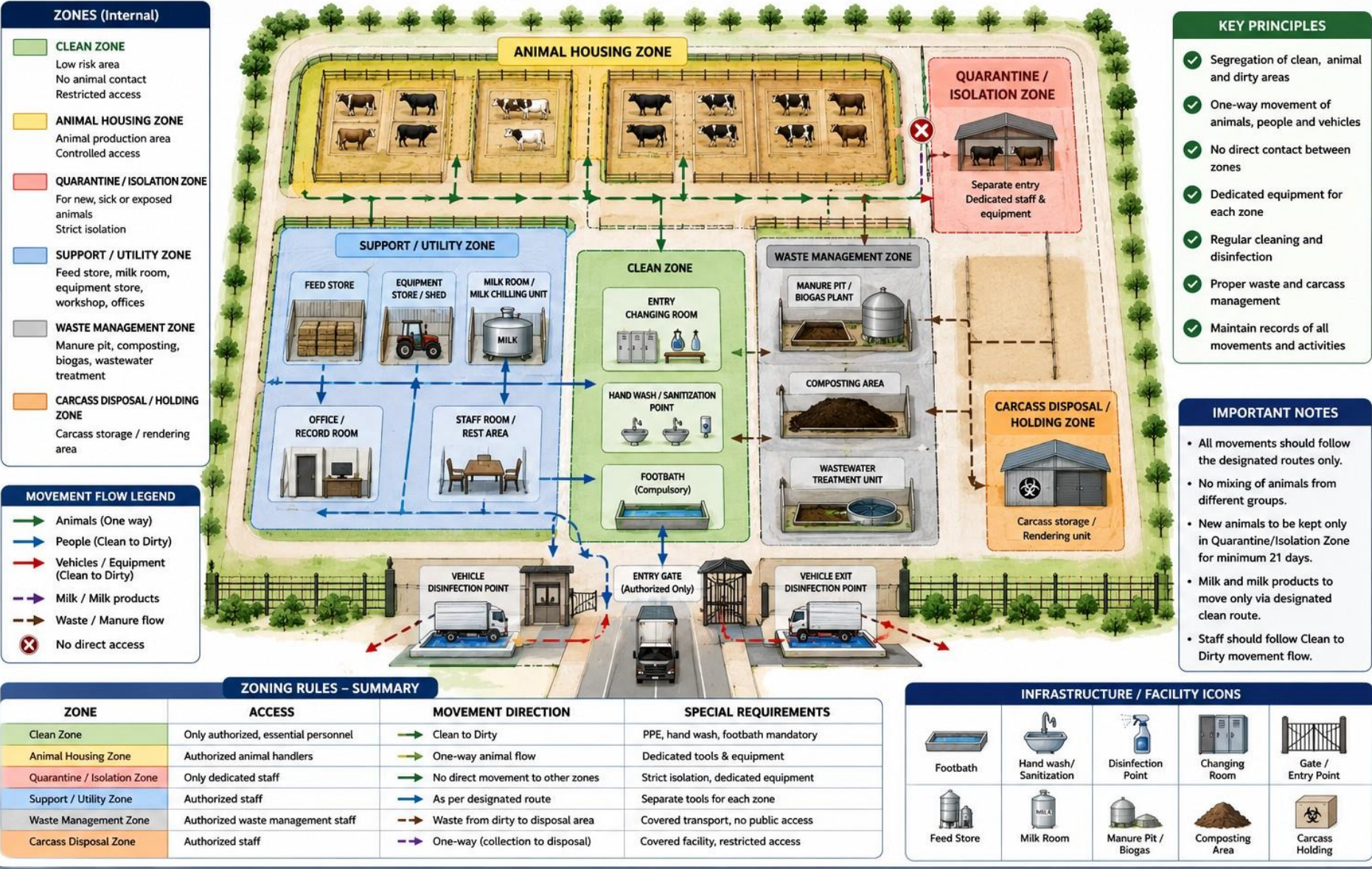
DIAGRAM OF COMPARTMENT BOUNDARY CONTROL SYSTEM

For SAT-1 FMD Emergency Response – Compartmentalized Livestock Operation



FARM ZONING LAYOUT WITHIN COMPARTMENT PREMISES

Internal Biosecurity Zoning to Prevent Introduction and Spread of SAT-1 FMDV



PPE AND VEHICLE DISINFECTION WORKFLOW

A. PPE DONNING WORKFLOW

1

HAND HYGIENE
Wash hands with soap or use sanitizer

2

WEAR INNER CLOTHING
Dedicated clothing/coverall

3

WEAR BOOTS
Dedicated boots

4

WEAR APRON (IF REQUIRED)
Waterproof apron

5

WEAR GLOVES
Long cuff, disposable

6

WEAR MASK & EYE PROTECTION
Mask (N95/surgical) and goggles/face shield

7

FINAL CHECK
Ensure all PPE is on properly

B. PPE DOFFING WORKFLOW

1

REMOVE GLOVES
Turn inside out and dispose

2

HAND HYGIENE
Wash hands or use sanitizer

3

REMOVE APRON (IF USED)
Remove and dispose

4

REMOVE BOOTS
Use boot dip, then remove boots

5

HAND HYGIENE
Wash hands or use sanitizer

6

REMOVE MASK & EYE PROTECTION
Remove without touching front; dispose

7

HAND HYGIENE
Final hand wash

C. VEHICLE DISINFECTION WORKFLOW

1

APPROACH CONTROL POINT
Stop vehicle at designated point

2

PRE-CLEANING (REMOVAL OF ORGANIC MATTER)
Remove visible dirt, manure, straw, feed residues using water and detergent

3

WASH
High pressure wash of entire vehicle (including undercarriage, wheel arches, tyres, foot wells, exterior)

4

DISINFECTION
Spray or foam all surfaces with approved disinfectant (refer to disinfectant chart)

5

CONTACT TIME
Allow minimum 30 minutes contact time (or as per disinfectant label)

6

FINAL RINSE (IF REQUIRED)
As per disinfectant guidelines

7

RELEASE
Vehicle allowed to proceed only after confirmation by authorized staff

KEY PRINCIPLES

- Use dedicated PPE for animal areas only
- Change PPE if contaminated or torn
- Avoid touching face, hair and surfaces
- Perform hand hygiene after removing PPE

IMPORTANT: Pre-cleaning is essential – Organic matter reduces effectiveness of disinfectants.

VISITOR ENTRY PROTOCOL CHART

1. PRE-ENTRY REQUEST
Visitor submits request in advance with purpose, date, duration and contact details.

2. RISK ASSESSMENT
Authority assesses risk based on purpose, origin, recent animal contact, and epidemiological situation.

3. APPROVAL
Approved by Competent Veterinary Authority. High-risk visitors may be denied.

4. ENTRY AT CONTROL POINT
Visitor reports to entry point. Verification of approval and identity.

5. BIOSECURITY ORIENTATION
Visitor briefed on biosecurity rules, movement restrictions and emergency procedures.

6. ENTRY REQUIREMENTS (MANDATORY)

Wear dedicated PPE provided by premises

Hand wash / Sanitize

Footbath / Boot dip

Vehicle disinfection (if applicable)

No access to animal areas unless authorized

7. EXIT PROTOCOL

Return PPE, hand hygiene, log out at exit point.

IMPORTANT NOTES

- Visitors with history of contact with livestock, markets, slaughterhouses or other farms in the last 72 hours may be restricted or denied entry.
- Movement within premises only in authorized areas and accompanied if required.
- All visits must be recorded in Visitor Register.
- Non-compliance will lead to immediate exit and future restriction.

LIVESTOCK MOVEMENT AUTHORIZATION PATHWAY

1. APPLICATION SUBMISSION
Applicant submits movement request with details of:

- Origin & destination
- Species & numbers
- Purpose
- Route & transport details

2. RISK ASSESSMENT
Veterinary authority assesses:

- Disease status of origin & destination
- Zoning status
- Purpose of movement
- Epidemiological risk

3. VERIFICATION AND INSPECTION

- Farm inspection (if required)
- Documentary verification
- Clinical assessment of animals (if needed)

4. LAB TESTING (IF INDICATED)
Sampling and testing as per risk level and purpose:

- RT-PCR / Antigen Serology (if required)
- Other tests

5. DECISION

- APPROVE
- APPROVE WITH CONDITIONS
- REJECT

6. MOVEMENT AUTHORIZATION
Permit issued with:

- Validity period
- Route
- Biosecurity conditions
- Reporting requirements

7. MOVEMENT & COMPLIANCE
Movement as per approved route. Compliance with all conditions. Maintain records.

ESSENTIAL CONDITIONS FOR AUTHORIZATION

Animals clinically healthy

From notified zone

Meet testing requirements

Approved transport & disinfection

Direct route, no unauthorized stops

Movement within validity period

NOTE: In Infected/Protection Zone – No movement allowed except under official control for culling, vaccination or emergency purposes.

BIOSECURITY AUDIT CHECKLIST INFOGRAPHIC

A. PERIMETER BIOSECURITY

Perimeter fencing intact and secure

Entry/exit points controlled

Signage and biosecurity notices displayed

Buffer zone maintained

B. ENTRY CONTROL

Visitor entry protocol followed

Visitor register maintained

PPE available and used

Footbath/hand hygiene at entry

C. VEHICLE CONTROL

Vehicle entry restricted

Vehicle disinfection facility functional

Vehicle disinfection log maintained

Dedicated parking area available

D. ANIMAL MANAGEMENT

Animal identification & records maintained

Quarantine/isolation facility available

Sick animals reported and isolated

Mixing of animals from different sources prevented

E. FEED, WATER & EQUIPMENT

Feed sourced from approved suppliers

Feed storage protected

Water sources protected and clean

Equipment dedicated / cleaned & disinfected

F. WASTE MANAGEMENT

Manure disposal system in place

Carcass disposal system in place

Wastewater treatment functional

Waste records maintained

G. CLEANING & DISINFECTION

Cleaning schedule displayed and followed

Approved disinfectants available

Disinfection records maintained

Contact time ensured

H. TRAINING & AWARENESS

Staff trained in biosecurity

SOPs available and accessible

Emergency plan available

Regular drills conducted

BIOSECURITY AUDIT CHECKLIST

COMPLIANCE STATUS

☐ COMPLIANT

☐ PARTIALLY COMPLIANT

☐ NON-COMPLIANT

☐ NOT APPLICABLE

AUDITOR'S REMARKS

ICAR – National Institute on Foot and Mouth Disease

73

3. Types of establishments suitable for compartment status

Compartmentalization is most feasible in highly controlled livestock systems such as:

- commercial dairy farms,
- organized breeding farms,
- elite germplasm centres,
- artificial insemination centres,
- integrated pig production systems,
- nucleus breeding units,
- export-oriented livestock enterprises,
- high-biosecurity research facilities,
- government livestock farms operating under documented biosecurity systems.

Smallholder village systems generally do not qualify unless operating under formally integrated and auditable management structures.

4. Eligibility criteria for compartment approval

Essential Eligibility Requirements

To qualify for compartment status, establishments should demonstrate:

A. Biosecurity Infrastructure

- perimeter fencing or controlled boundary,
- restricted entry system,
- dedicated vehicle disinfection area,
- footbath systems,
- controlled visitor access,
- PPE availability,
- animal isolation facilities.

B. Traceability and Record Systems

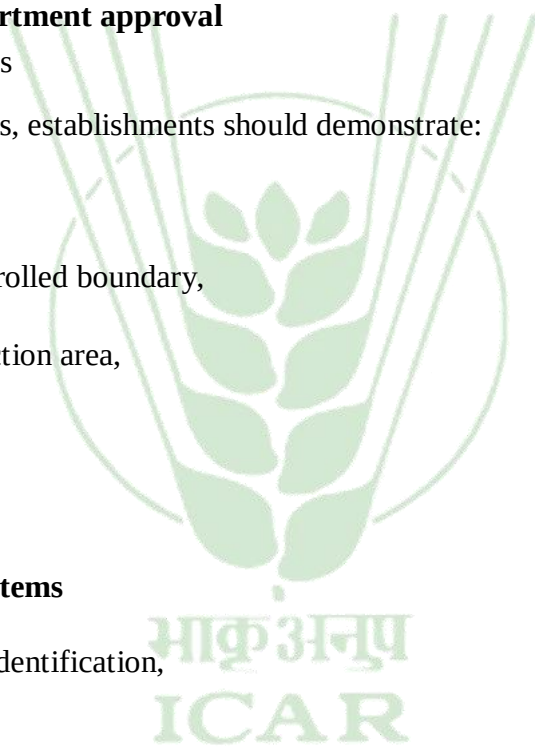
- individual/group animal identification,
- movement records,
- visitor logs,
- mortality records,
- vaccination records,
- feed procurement records,
- milk dispatch records,
- treatment history.

C. Surveillance Capacity

- regular veterinary inspection,
- documented disease reporting system,
- sampling and testing capability,
- linkage with designated diagnostic laboratories.

D. Operational Separation

- epidemiological separation from external livestock populations,



- controlled sourcing of animals,
- restricted contact with outside herds,
- management systems minimizing indirect exposure.

Compartment Approval Criteria Table

Component	Minimum Requirement	Verification Method
Boundary Security	Controlled perimeter access	Physical inspection
Animal Identification	Traceable identification system	Record audit
Biosecurity SOPs	Written and implemented	SOP review
Visitor Control	Entry restriction and logs	Documentation review
Vehicle Disinfection	Functional disinfection facility	Physical verification
Veterinary Supervision	Regular veterinary oversight	Service records
Disease Surveillance	Routine monitoring and reporting	Surveillance records
Laboratory Access	Linkage to approved laboratory	Verification of agreements
Animal Procurement	Controlled sourcing policy	Procurement audit
Vaccination Records	Updated vaccination documentation	Record verification
Isolation Facility	Separate holding area available	Physical inspection
Staff Training	Biosecurity training evidence	Training records

5. Core biosecurity requirements

The following biosecurity measures are essential for maintenance of compartment integrity:

Personnel Biosecurity

- dedicated clothing and footwear,
- controlled entry protocols,
- hand hygiene,
- visitor restriction,
- movement logging.

Vehicle Biosecurity

- vehicle disinfection at entry and exit,
- cleaning before disinfection,
- dedicated transport routes,
- restriction of external livestock vehicles.

Animal Movement Biosecurity

- quarantine of newly introduced animals,
- health certification,
- movement authorization,
- separation from external livestock populations.

Feed and Equipment Control

- safe sourcing of feed,
- controlled equipment entry,
- equipment disinfection,
- restriction of shared tools.

Wildlife and Feral Animal Exclusion

- prevention of contact with wild or feral susceptible animals,
- fencing and enclosure maintenance,
- monitoring of wildlife interaction points.

6. Surveillance requirements

Compartmentalized establishments must maintain continuous surveillance systems.

Surveillance Components

Clinical Surveillance

- daily observation for vesicular disease,
- lameness,
- salivation,
- production decline,
- mortality.

Syndromic Surveillance

- monitoring of abnormal morbidity patterns,
- milk yield reduction,
- reproductive disturbances,
- unusual mortality events.

Laboratory Surveillance

- periodic diagnostic sampling,
- serological monitoring where applicable,
- rapid laboratory confirmation of suspect cases.

Epidemiological Surveillance

- movement tracing,
- contact assessment,
- milk-route monitoring,
- review of nearby outbreak reports.

7. Suggestive flowchart for compartment approval process (Operational Certification Workflow)

Farm/Enterprise applies for compartment recognition



Submission of biosecurity documentation



Veterinary authority review



On-site audit and physical inspection



Verification of surveillance and traceability systems



Assessment of epidemiological separation



Corrective actions (if deficiencies are identified)



Final compliance verification



Approval of compartment status



Continuous surveillance and regulatory monitoring



Periodic re-audit and renewal

8. Maintenance of compartment status

Compartment approval should remain conditional upon continuous compliance.

The following are essential:

- uninterrupted surveillance,

- maintenance of records,
- periodic veterinary inspection,
- functioning biosecurity systems,
- staff compliance,
- timely reporting of suspect disease events.

Compartment status should be reviewed periodically through:

- scheduled audits,
- surprise inspections,
- surveillance evaluation,
- epidemiological risk assessment.

9. Conditions requiring suspension of compartment status

Compartment status may be suspended immediately if:

- FMD-compatible clinical signs are detected,
- epidemiological linkage with infected premises is identified,
- unauthorized animal movement occurs,
- traceability systems fail,
- laboratory confirmation of infection occurs,
- major biosecurity breaches are identified,
- surveillance systems become non-functional.

Suspension should trigger:

- intensified surveillance,
- quarantine,
- epidemiological investigation,
- diagnostic sampling,
- reassessment by competent authorities.

10. Restoration of compartment status

Reinstatement of compartment status should occur only after:

- successful epidemiological investigation,
- elimination of infection risk,
- corrective biosecurity measures,
- negative surveillance outcomes,
- formal re-certification by competent authorities.

11. Special SAT-1 preparedness considerations

Given the transboundary nature of FMDV SAT-1, compartmentalized establishments should implement enhanced preparedness measures including:

- heightened border-risk awareness,
- monitoring of regional outbreak intelligence,
- restricted procurement from high-risk areas,
- emergency isolation protocols,
- contingency staffing plans,
- rapid communication systems.

Additional vigilance is required in establishments located near:

- international borders,
- livestock aggregation routes,
- dairy transport corridors,
- wildlife interfaces,
- transit-linked epidemiological networks.

12. Responsibilities of compartment operators

Operators of approved compartments should ensure:

- full compliance with veterinary regulations,
- maintenance of all records,
- immediate reporting of suspect disease,
- implementation of emergency biosecurity measures,
- cooperation with veterinary inspections,
- support for surveillance and tracing activities.

13. Responsibilities of competent authorities

Competent veterinary authorities should:

- establish regulatory oversight,
- conduct audits and inspections,
- verify surveillance compliance,
- maintain certification records,
- coordinate laboratory testing,
- review epidemiological risk continuously.

14. Rapid response actions for compartments during nearby outbreaks

If outbreaks occur in surrounding areas, compartment operators should immediately:

- restrict non-essential movement,
- intensify biosecurity,
- review all recent animal and vehicle movement,
- suspend visitor access,
- increase surveillance frequency,
- verify disinfectant availability,
- notify veterinary authorities of any suspicious findings.

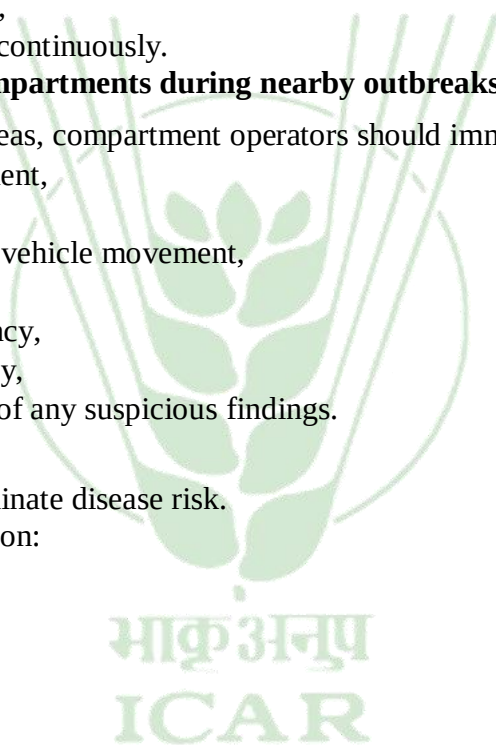
15. Important operational note

Compartmentalization does not eliminate disease risk.

Its effectiveness depends entirely upon:

- continuous compliance
- strong traceability systems
- rigorous surveillance
- validated biosecurity
- rapid reporting.

Compartment status should never override epidemiological evidence or emergency disease-control requirements.



Annexure 7

Wildlife Interface Logistics and Biosecurity Preparedness

Key Operational Principle

Wildlife surveillance for SAT-1 in India should primarily be treated as risk-based spillover surveillance at the livestock–wildlife interface. While SAT serotypes are strongly associated with African buffalo maintenance cycles in endemic African ecosystems, the role of native Indian wildlife in long-term maintenance of SAT-1 remains uncertain and should not be overstated without epidemiological evidence.

Objective

This annexure provides operational guidance for surveillance, movement control, zoo biosecurity, wildlife–livestock interface management, and interdepartmental coordination during preparedness and response to suspected or confirmed incursions of FMDV SAT-1 in India. The document is intended for use by veterinary authorities, forest departments, zoo administrations, wildlife surveillance teams, district administrations, and emergency response personnel.

1. Wildlife–Livestock Interface Risk Management

1.1 High-Risk Interface Areas

The following locations should be considered priority surveillance and biosecurity zones during SAT-1 preparedness and outbreak situations:

- Forest fringe villages with free-ranging livestock
- Protected areas with livestock grazing interfaces
- Migratory animal corridors and wildlife movement routes
- Shared water points between livestock and wildlife
- Zoological parks and safari facilities
- Wildlife rescue centres and rehabilitation facilities
- Areas with feral or stray cloven-hoofed animal populations
- Border districts with transboundary animal movement risks

2. Wildlife Surveillance Logistics

2.1 Joint Wildlife Surveillance Teams

Joint surveillance teams should be constituted for coordinated outbreak preparedness and field response.

Recommended composition:

1. State Animal Husbandry Department veterinarians
2. Forest Department officials and wildlife wardens
3. Zoo veterinarians and zoo biosecurity personnel
4. ICAR-NIFMD/Regional FMD laboratory representatives
5. Para-veterinary personnel and livestock inspectors
6. District administration representatives
7. Trained wildlife rescue personnel (where required)

Major responsibilities:

- Field surveillance in interface zones
- Reporting unusual morbidity or mortality
- Clinical observation and outbreak investigation
- Non-invasive environmental sample collection
- Coordination of laboratory sample dispatch
- Movement control and quarantine support
- GIS-based mapping of risk areas and contact zones
- Awareness generation among local communities

3. Wildlife Surveillance Approaches

3.1 Risk-Based Surveillance

Surveillance should focus on areas with:

- Known livestock–wildlife interaction
- Shared grazing systems
- Common water sources
- High livestock density near forests
- Animal congregation points
- Cross-border animal movement routes

3.2 Clinical Indicators for Field Reporting

In domestic or captive susceptible species:

- Lameness
- Excess salivation
- Oral erosions or vesicles
- Foot lesions
- Reluctance to move
- Sudden milk drop
- Reduced feed intake
- Mortality in young animals

In wildlife:

- Abnormal gait or reluctance to move
- Oral lesions or drooling (where visible)
- Clustered illness events in susceptible species
- Unusual congregation near water sources
- Unexpected mortality in young susceptible wildlife

4. Non-Invasive Wildlife Surveillance

4.1 Environmental and Non-Invasive Sampling

Where direct restraint or capture is impractical, the following supplementary surveillance samples may be collected:

- Faecal samples
- Saliva-contaminated browse material
- Waterhole or trough swabs
- Environmental swabs from feeding points
- Soil or surface contamination samples from congregation areas

Important note:

Environmental sampling should be considered supplementary surveillance only. Detection of viral RNA does not necessarily confirm active infection or infectious virus. Confirmatory sampling from clinically affected susceptible animals should be prioritized wherever feasible.

5. Zoo Biosecurity Preparedness

5.1 Zoo Coordination and Administration

Close coordination should be maintained among:

- Zoo authorities
- State zoo veterinary officers
- Central Zoo Authority (CZA)
- Forest Department

- Local veterinary units
- District administration

5.2 Zoo Biosecurity Officer

Each zoological park should designate a Zoo Biosecurity Officer responsible for:

- Monitoring disease-prevention protocols
- Supervising quarantine procedures
- Ensuring disinfection compliance
- Monitoring feed and water safety
- Coordinating outbreak response activities
- Maintaining visitor and staff biosecurity records
- Coordinating with veterinary authorities during emergencies

5.3 Isolation and Quarantine Facilities

Zoos should maintain:

- Pre-designated isolation enclosures
- Quarantine units for new or transferred animals
- Separate feeding and watering arrangements
- Dedicated PPE and disinfection stations
- Restricted personnel access systems

Recommended quarantine period:

- Minimum 2–3 weeks with active monitoring before animal introduction or transfer

6. Fencing and Perimeter Biosecurity

6.1 Perimeter Control Measures

The following infrastructure should be regularly inspected and strengthened:

- Boundary fencing and perimeter walls
- Livestock-exclusion barriers
- Gate-entry control systems
- Vehicle entry checkpoints
- Footbaths and wheel-disinfection systems
- Wildlife containment fencing
- Protected feed-storage facilities

6.2 Prevention of Interface Contact

The following activities should be restricted during outbreak situations:

- Unauthorized livestock grazing near protected areas
- Livestock trespassing on zoo or wildlife premises
- Movement of feral animals into captive facilities
- Livestock markets adjacent to zoo premises
- Shared transport of livestock and captive animals

7. Water-Point Management

7.1 Shared Water Source Risk Reduction

Shared water points represent important indirect transmission pathways and should be identified and mapped.

High-risk water sources:

- Natural ponds and lakes
- Streams and drainage channels
- Community troughs
- Waterholes used by wildlife and livestock

- Artificial watering systems near forest boundaries

7.2 Water Biosecurity Measures

During outbreak situations:

- Shared water access should be minimized
- Alternative protected drinking-water arrangements should be established
- Species-wise water separation should be maintained where feasible
- Water troughs and tanks should be cleaned and disinfected regularly
- Drainage contamination from infected premises should be prevented
- Zoo animals should be prevented from accessing external water sources

8. Movement Restriction and Disinfection

8.1 Movement Control Measures

During suspected or confirmed SAT-1 outbreaks:

- Movement of livestock near forest boundaries should be restricted
- Transfer of zoo animals should be suspended unless essential
- Wild animal capture and relocation operations should be minimized
- Movement permits and veterinary authorization should be mandatory
- Visitor access to sensitive enclosures should be regulated

8.2 Vehicle and Personnel Disinfection

Mandatory disinfection should be implemented for:

- Vehicles entering or leaving zoos and protected areas
- Animal transport vehicles
- Field surveillance vehicles
- Equipment and sampling kits
- Footwear and PPE of personnel

Recommended disinfectants: (Annexure-8)

- 4% sodium carbonate
- 2% sodium hydroxide
- 0.2% citric acid
- 1% potassium peroxymonosulphate-based disinfectants
- Approved sodium hypochlorite formulations

9. Feed and Fomite Biosecurity

9.1 Feed Safety Measures

- Fodder and feed should be sourced from low-risk areas
- Feed-storage areas should be protected from contamination
- Contaminated bedding and waste should be safely disposed of
- Feed transport vehicles should be disinfected
- Water and feed contamination risks should be assessed regularly

10. Interdepartmental Coordination

10.1 Unified Command Structure

A coordinated emergency command structure should include:

- State Animal Husbandry Department
- Forest Department
- District administration
- Zoo authorities
- Police and transport authorities

- ICAR-NIFMD and associated laboratories
- Local veterinary institutions

10.2 Information Sharing

Real-time sharing should include:

- Outbreak locations
- Wildlife movement information
- GIS mapping data
- Movement restriction status
- Sample testing results
- Surveillance findings
- Risk assessment reports

11. Training and Preparedness

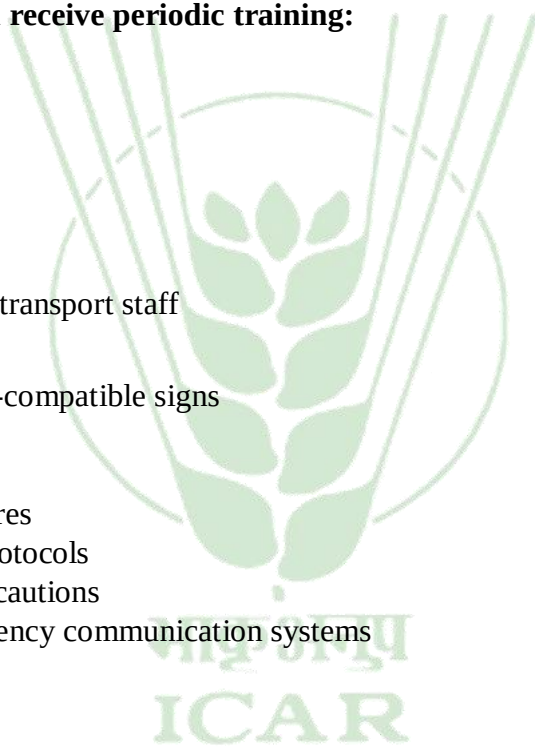
11.1 Personnel Training

The following personnel should receive periodic training:

- Forest guards
- Zoo keepers
- Wildlife rescue staff
- Field veterinarians
- Para-veterinary staff
- Laboratory personnel
- Animal handlers and transport staff

Training components:

- Recognition of FMD-compatible signs
- Safe sample handling
- PPE usage
- Disinfection procedures
- Movement control protocols
- Carcass handling precautions
- Reporting and emergency communication systems



Annexure-8

Use of disinfectants

Disinfectant	Working concentration	Suggested contact time	Preparation/method of use	Target use	Major limitations/precautions
Sodium carbonate (washing soda/soda ash)	4%	≥30 min	Prepare a fresh solution; apply after cleaning	Animal sheds, floors, equipment, vehicle wheels, loading areas	Activity reduced by heavy organic matter; alkaline irritant; should not be confused with sodium bicarbonate
Sodium hydroxide (caustic soda)	2%	≥30 min	Apply after removal of manure and organic matter; use on hard surfaces only	Floors, drains, concrete yards, and heavily contaminated premises	Highly corrosive; hazardous to skin/eyes; unsuitable for metals and delicate equipment
Potassium peroxymonosulfate-based oxidizing disinfectant (e.g., Virkon® formulations)	1% or a validated label claim	10–30 min	Prepare according to the manufacturer's guidance; apply as a spray, foam, or dip	Vehicles, equipment, footbaths, farm surfaces	Activity declines over time after preparation; efficacy is reduced by a heavy organic load
Citric acid	0.2–0.3% or validated protocol	≥30 min	Use as a spray, footbath, dip, or wipe solution after cleaning	PPE, boots, footbaths, small tools, personnel-associated surfaces	Less effective on heavily contaminated surfaces; repeated use may corrode some metals
Acetic acid	2%	≥30 min	Apply to pre-cleaned surfaces	Small equipment and selected surfaces	Strong odour; acidic; may damage concrete and metals
Sodium hypochlorite	0.5–2% available chlorine	≥30 min	Use a freshly prepared solution after cleaning	Hard surfaces, equipment, selected vehicle surfaces	Rapidly inactivated by organic matter; corrosive; avoid mixing with acids
Chlorine dioxide	As per the approved label	As per the label	Use validated formulation only	Water systems, surfaces, equipment	Requires careful preparation and ventilation
Accelerated hydrogen peroxide	As per the validated label	As per the label	Use a validated FMDV-effective formulation	Equipment, indoor surfaces, selected facilities	Product-specific efficacy: not all peroxide products are equivalent
Heat treatment	Core temperature 70°C for 30 min	30 min at core temperature	Validated thermal processing	Meat/products requiring validated processing	Not suitable as a field surface disinfectant

Steps of animal shed disinfection

Step	Action
1	Remove animals from the area wherever feasible.
2	Dry clean: remove dung, bedding, mud, feed residues and organic debris.
3	Wet clean with water/detergent.
4	Apply the selected FMDV-effective disinfectant at the correct concentration.
5	Maintain minimum contact time.
6	Reapply if the surface dries before the required contact time.
7	Record date, disinfectant, concentration, area treated and responsible person.

- Avoid relying on iodophores, quaternary ammonium compounds and phenolic disinfectants alone for FMDV, especially where organic matter is present.
- Sodium bicarbonate has occasionally been explored experimentally as a mild alkalizing agent for reducing microbial contamination; however, it is not considered a validated primary disinfectant for FMDV-contaminated feed and should not replace established biosecurity, quarantine, or approved virucidal decontamination measures.

The Three-Bucket Disinfection Sequence of the Probang Cup

When collecting oesophageal-pharyngeal fluid samples from livestock, the WOAHA outlines the following standard field sequence:

- **First Bucket (Tap Water/detergent):** The probang cup is thoroughly washed and scrubbed in plain water or with detergent to remove biological matter, mucus, and debris.
- **Second Bucket (Disinfectant Solution):** The cup is submerged in a target disinfectant solution (such as 2% to 4% Sodium Carbonate or 0.2% to 0.5% Citric Acid) to completely inactivate viral pathogens.
- **Third Bucket (Tap Water):** The instrument is submerged in fresh water to rinse off residual chemical disinfectants before sampling the next animal.

Critical Biosecurity Protocols

- **Debris Removal:** Organic material shields viruses from chemical agents. Ensure the first bucket is used effectively to clear all physical buildup before moving to the chemical stage.
- **Contact Time:** The cup should be soaked in the second chemical bucket for a recommended duration (typically 3 to 5 minutes) to guarantee total pathogen inactivation. If the concentration is low, then the contact time has to be increased.
- **Chemical Alternatives:** If citric acid or sodium carbonate is unavailable, authorized alternatives like 0.1% sodium hydroxide (lye) or acetic acid (vinegar) can be prepared according to regional FMD Field Manual guidelines.
- **Water Refreshing:** The clean water in the third bucket must be monitored and changed frequently to avoid tracking chemical residue back into the animal's throat.

Annexure 9

Sampling and Transport

Brief Standard Operating Procedure (SOP) for Field Staff

Step 1: Pre-collection Preparation

1. Verify that all transport media are within their expiry date and stored under recommended conditions.
2. Ensure that the transport medium is clear, uncontaminated, and maintained within the recommended near-neutral pH range.
3. Prepare sterile collection instruments, PPE, sample containers, labels, and transport materials before entering the premises.
4. Label all sample containers clearly with:
 - unique animal identification,
 - farm/location details,
 - sample type,
 - date and time of collection,
 - collector identification.

Step 2: Sample Collection

A. Vesicular Epithelium

1. Restrain the animal safely using appropriate biosecurity precautions.
2. Using sterile forceps and scissors, collect sufficient fresh non-necrotic vesicular epithelium (approximately 1–2 cm²) from recently ruptured or intact lesions.
3. Avoid dried, contaminated, or chronically necrotic tissue.

B. Oropharyngeal (Probang) Samples

1. Preferably withhold feed for approximately 2–4 hours before sampling where operationally feasible.
2. Collect samples only by trained personnel using the approved probang technique.
3. Pass the probang cup carefully into the oropharyngeal/proximal esophageal region and recover oropharyngeal fluid and cellular material.
4. Immediately transfer recovered material into pre-chilled validated buffered transport medium.

Step 3: Cold Chain and Packaging

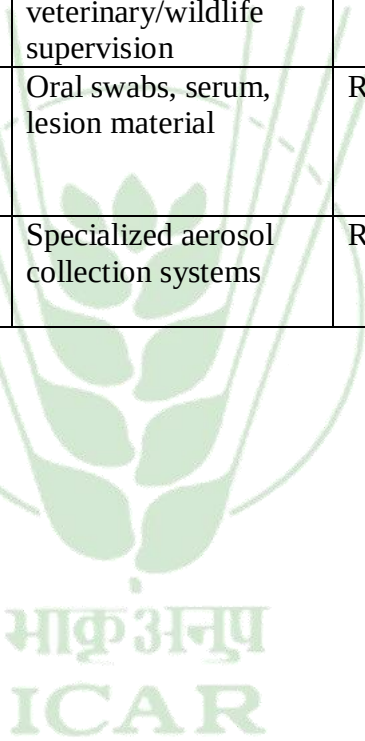
1. Fully immerse tissue samples in validated phosphate-buffered glycerol transport medium.
2. Seal primary sample containers securely to prevent leakage.
3. Place primary containers into leak-proof secondary packaging containing absorbent material.
4. Pack samples within insulated outer packaging using frozen gel packs, ice packs, dry ice, or liquid nitrogen as appropriate.
5. Maintain the uninterrupted cold chain during transport.
6. Transport samples rapidly to ICAR-National Institute on Foot and Mouth Disease or designated network laboratories using approved biological sample transport procedures.
7. Notify the receiving laboratory before dispatch and include complete epidemiological and sample documentation.

Recommended Clinical and Field Samples for Foot-and-Mouth Disease Diagnosis: Collection, Transport, Storage, and Diagnostic Applications

S. No.	Sample Type	Preferred Stage of Disease	Primary Diagnostic Purpose	Recommended Collection Method	Recommended Transport / Storage	Major Remarks / Limitations
1	Vesicular epithelium (tongue, dental pad, gums, feet, teats)	Acute vesicular stage (fresh lesions)	Gold-standard sample for virus detection, serotyping, sequencing, and virus isolation	Collect 1–2 cm pieces of fresh epithelium aseptically using sterile forceps/scissors	Transport in an equal volume of 50% glycerol prepared in 0.04 M phosphate buffer (pH 7.2–7.6) or equivalent validated transport medium; maintain cold chain whenever possible	Highest virus concentration; avoid necrotic or dried lesions; transport medium should not be used if pH falls below 7.0, as acidic conditions rapidly reduce FMDV viability
2	Vesicular fluid	Early acute stage before vesicle rupture	Virus detection and molecular diagnosis	Aspirate vesicular fluid aseptically using a sterile syringe	Refrigerated transport; avoid leakage and repeated freeze-thaw cycles	Useful but often limited in quantity
3	Oropharyngeal fluid (OP fluid/probang sample)	Convalescent phase or carrier surveillance	Detection of persistent/carrier infection	Collect using a probang cup by trained personnel	Collect into validated buffered transport medium such as Fowler's phosphate-buffered medium or equivalent; maintain chilled or frozen transport	Buffer should maintain near-neutral to mildly alkaline pH conditions (preferably ~7.4–7.6) to preserve FMDV viability; specialized procedure mainly for cattle and buffalo surveillance
4	Oral swab/lesion swab	Early clinical stage	RT-PCR detection where epithelium is unavailable	Sterile synthetic swab rubbed over lesion margins/oral cavity	Viral transport medium; chilled transport	Lower sensitivity than fresh epithelium
5	Nasal swab	Acute febrile or early infection stage	Ancillary molecular detection	A sterile swab inserted into the nasal cavity	Viral transport medium; chilled transport	Variable viral load and lower sensitivity
6	Saliva / oral secretions	Acute stage	Molecular detection and field screening	Collect directly into a sterile tube or an absorbent swab	Refrigerated transport	Useful in difficult field conditions but less reliable than epithelial tissue
7	Whole blood (EDTA blood)	Very early febrile stage	Detection of viraemia by RT-PCR	Collect aseptically into an EDTA vacutainer	Refrigerated transport; avoid repeated freeze-thaw cycles	Viraemia is transient and usually persists for only approximately 3–5 days post-infection, limiting the diagnostic window

8	Serum (clotted blood)	Acute and convalescent stages	Serology (NSP/SP antibodies), serosurveillance, paired antibody titres	Collect blood without anticoagulant and separate serum	Refrigerated or frozen transport	Essential for serosurveillance and post-vaccination monitoring
9	Paired sera (acute and convalescent)	Samples collected 2–4 weeks apart	Demonstration of seroconversion	Sequential serum collection	Refrigerated/frozen transport	Valuable for retrospective confirmation and epidemiological investigations
10	Milk	Early infection and dairy outbreaks	Herd-level surveillance and RT-PCR screening	Collect aseptically into a sterile container	Refrigerated transport	Useful for dairy herd surveillance; sensitivity may vary
11	Heart tissue (“tiger heart” myocardium)	Sudden calf mortality cases	Confirmation of FMD-associated myocarditis	Collect myocardial tissue aseptically during necropsy	Refrigerated or frozen transport	Important in calf deaths occurring without obvious vesicular lesions
12	Lymph nodes	Necropsy investigations	Ancillary virus detection	Sterile collection during post-mortem examination	Chilled/frozen transport	Supportive sample only
13	Tonsil / pharyngeal tissue	Necropsy or advanced investigations	Viral persistence and research investigations	Sterile tissue collection	Frozen transport preferred	Primarily for reference laboratory or research use
14	Foot lesion scrapings	Animals with ruptured/healing lesions	RT-PCR when fresh vesicles are unavailable	Sterile scraping from active lesion margins	Chilled transport	Lower sensitivity compared to fresh epithelium
15	Environmental swabs	Outbreak investigations	Assessment of environmental contamination	Swab contaminated surfaces, equipment, and vehicles	Viral transport medium; chilled transport	Ancillary epidemiological tool; interpretation may be difficult
16	Feed/fodder samples	Epidemiological tracing investigations	Investigation of the possible contamination source	Collect a representative sterile sample	Refrigerated/chilled transport	Limited direct diagnostic value; mainly epidemiological

17	Water samples	Environmental investigations	Assessment of possible environmental contamination	Sterile collection from drinking/wash sources	Chilled transport	Supplementary epidemiological sample only
18	Wildlife samples (oral swabs, serum, tissues)	Wildlife surveillance and interface investigations	Detection of spillover or wildlife-associated circulation	Species-appropriate collection under veterinary/wildlife supervision	Strict cold chain essential	Requires wildlife authority coordination and biosafety precautions
19	Zoo animal samples	Zoo surveillance and captive animal investigations	Early detection in susceptible captive species	Oral swabs, serum, lesion material	Refrigerated/frozen transport	Important for SAT-1 preparedness in captive ungulates
20	Air/aerosol samples (specialized)	Experimental or high-risk investigations	Aerosol surveillance and research	Specialized aerosol collection systems	Rapid chilled transport	Primarily research/reference laboratory application



Preparation of FMD Virus Transport Media

A. Transport Medium for Vesicular Epithelium / Tissue

Component	Recommended formulation
Base	Equal volumes of glycerol and 0.04 M phosphate buffer
Final glycerol concentration	50% v/v
Final pH	7.2–7.6
Optional antibiotics	Penicillin 1000 IU/mL, neomycin sulphate 100 IU/mL, polymyxin B sulphate 50 IU/mL, mycostatin/nystatin 100 IU/mL
Alternative if 0.04 M phosphate buffer is unavailable	Tissue culture medium or PBS may be used, but final glycerol/buffer pH must remain 7.2–7.6

Preparation procedure:

Prepare sterile 0.04 M phosphate buffer and adjust pH to 7.2–7.6. Mix equal volumes of sterile neutral glycerol and the phosphate buffer. Add antibiotic–antimycotic mixture if used under local laboratory SOP. Confirm final pH after mixing. Dispense aseptically into sterile leak-proof containers and store refrigerated until use. Do not use medium that is contaminated, expired, leaking, or outside the pH range.

Use:

Place fresh vesicular epithelium in an approximately equal volume of this medium and keep samples refrigerated or on ice until received by the laboratory. FMDV is extremely labile at low pH and buffering is critical.

B. Transport Medium for Oropharyngeal Fluid / Probang Samples

Component	Recommended formulation
Buffer	0.08 M phosphate buffer
Bovine serum albumin	0.01%
Phenol red	0.002%
Antibiotics	Penicillin 1000 units/mL, mycostatin/nystatin 100 units/mL, neomycin 100 units/mL, polymyxin 50 units/mL
pH before use	Adjust to pH 7.2
Final pH after mixing with OP fluid	Around pH 7.6

Preparation procedure:

Prepare sterile 0.08 M phosphate buffer. Add BSA, phenol red, and the antibiotic–antimycotic mixture. Adjust the medium to pH 7.2. Dispense about 2 mL into sterile freeze-resistant screw-cap containers of about 5 mL capacity before OP sample collection.

Use:

After collection, mix the OP fluid with an approximately equal volume of transport fluid, ensuring that cellular material is transferred. The final mixture should be around pH 7.6. OP samples should be refrigerated or frozen immediately. If transport takes more than a few hours, freezing over dry ice or liquid nitrogen is preferred. Containers must be sealed airtight because CO₂ from dry ice can lower pH and inactivate FMDV.

Critical Quality-Control (QC) Points

QC point	Requirement
pH control	Maintain epithelium medium at pH 7.2–7.6; do not use acidic medium
Sterility	Prepare aseptically using sterile reagents and containers
Cold chain	Keep samples refrigerated/on ice; freeze OP samples if delayed
Packaging	Use leak-proof primary containers and approved biological-sample transport packaging
Safety	Prepare media in designated laboratory conditions; field teams should use pre-prepared validated media

IATA triple Packaging

Objective

The purpose of the IATA triple packaging system is to ensure safe, secure, and contamination-free transport of suspected Foot-and-Mouth Disease samples from the field to designated diagnostic laboratories while maintaining sample integrity, biosafety, and cold-chain requirements. All infectious or potentially infectious materials should be transported according to the guidelines prescribed for “Biological Substance, Category B (UN3373).”

1. Preparation of Samples before Packaging

Immediately after collection, each sample should be properly labelled and secured before packaging. Labels should include:

- Sample identification number
- Species
- Type of sample
- Date of collection
- Location/farm details
- Name or initials of collector

The outer surface of the sample vial should be wiped using an appropriate disinfectant before further handling. Caps should be checked to ensure tight sealing to prevent leakage during transport.

2. Primary Container (First Layer)

The primary container is the first containment layer directly holding the sample material.

Requirements

- The primary container should:
- Be leak-proof and waterproof
- Possess a secure screw cap or tight seal
- Be chemically resistant and durable

Examples include:

- Cryovials
- Sterile screw-cap tubes
- Serum tubes
- Sample collection vials

Procedure

1. Place the collected sample inside the vial.
2. Ensure the lid is tightly closed.
3. Seal the cap using Parafilm or adhesive tape whenever possible.

4. Wrap the primary container individually using sufficient absorbent material such as:
 - Tissue paper
 - Cotton
 - Gauze
 - Absorbent pads

The absorbent material must be sufficient to absorb the entire content in case leakage occurs.

3. Secondary Container (Second Layer)

The secondary container serves as the second leak-proof protective barrier.

Requirements

The secondary container should:

- Be durable and leak-proof
- Resist pressure and minor physical impact
- Accommodate one or more primary containers

Examples include:

- Biohazard specimen containers
- Screw-cap plastic jars
- Secondary sealed canisters
- Heavy-duty zip-lock biohazard pouches

Procedure

1. Place the absorbent-wrapped primary container inside the secondary container.
2. Add additional absorbent material.
3. When multiple samples are transported together:
 - Each primary container must be individually wrapped or separated using foam, cardboard, or bubble wrap to avoid breakage.
4. Seal the secondary container securely.

The secondary container must be capable of containing all material if leakage or breakage occurs within the primary container.

4. Cold Chain Arrangement

Maintenance of the cold chain is critical for preservation of viral integrity and diagnostic quality.

For Short Transport Duration (≤48 hours)

Use:

- Frozen gel packs
- Ice packs

Important Precautions

- Direct contact between sample vials and ice packs should be avoided.
- A foam sheet, cardboard separator, or insulating material should be placed between refrigerants and sample containers.

Recommended temperature: 2–8°C for routine refrigerated transport

For Long-Distance or Delayed Transport (>48 hours)

- Use Dry ice or Liquid nitrogen dry shippers

Important Dry Ice Precautions

- Dry ice should never be placed inside airtight sealed containers.
- Adequate ventilation must be ensured because sublimation of dry ice releases carbon dioxide gas, which may cause pressure buildup.

5. Outer Container (Third Layer)

The outer container provides the final external protection during transport.

Requirements

The outer package should be:

- Rigid
- Shock-resistant
- Crush-resistant
- Properly insulated if cold-chain transport is required

Examples include:

- Vaccine carriers
- Thermocol boxes
- UN-certified transport boxes
- Hard plastic insulated transport cases

The outer surface should be disinfected before dispatch.

6. Labelling and Marking of Outer Container

The outer package must display all mandatory transport markings clearly and legibly.

Mandatory Information

The following should be present:

- Sender's name, address, and contact number
- Receiver laboratory details
- Orientation arrows for liquid samples
- "KEEP REFRIGERATED" or "KEEP FROZEN" markings
- UN3373 diamond-shaped label marked:
 - BIOLOGICAL SUBSTANCE, CATEGORY B

Care should be taken to ensure labels remain visible and waterproof throughout transport.

7. Documentation

Each package should contain appropriate documentation enclosed within a waterproof pouch.

Documents to Include

- Sample submission form
- Epidemiological investigation form
- Clinical history
- Number and type of samples
- Contact details of sender
- Suspected disease information

Documentation should preferably be placed:

- Inside the outer container,
- But outside the secondary container.

8. Disinfection before Dispatch

Before dispatch, the outer surface of the package should be disinfected using approved disinfectants effective against FMDV.

Examples include: (Annexure-8)

- 4% sodium carbonate
- Virkon® or equivalent disinfectants
- 2% sodium hydroxide
- Citric acid solution

Personnel handling packaging and disinfection should use:

- Gloves
- Protective clothing
- Appropriate personal protective equipment (PPE)

9. Transport and Dispatch

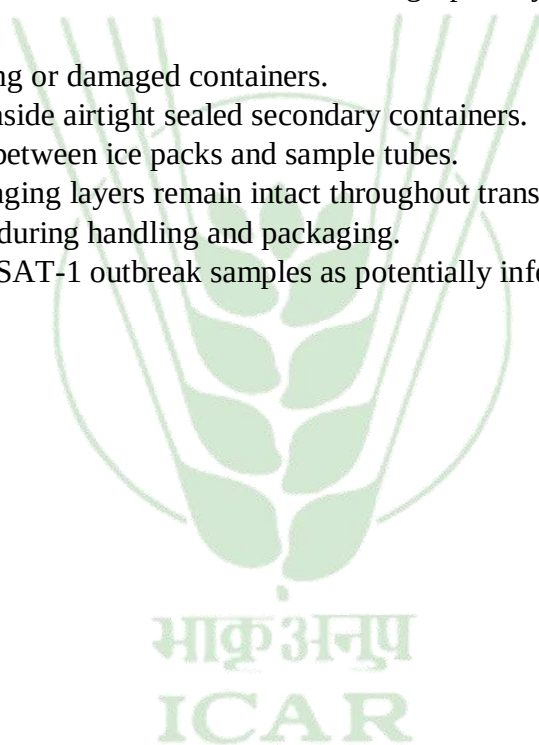
Samples should be dispatched to ICAR-National Institute on Foot and Mouth Disease, Bhubaneswar or designated FMD network laboratories using the fastest feasible mode of transport.

Important Operational Instructions

- Prior intimation to the receiving laboratory is mandatory before dispatch.
- Cold chain integrity must be maintained throughout transportation.
- In emergencies, hand delivery by authorized personnel may be used to avoid delays.
- Chain-of-custody records should be maintained for high-priority outbreak samples.

Key Biosafety Precautions

- Never transport leaking or damaged containers.
- Never place dry ice inside airtight sealed secondary containers.
- Avoid direct contact between ice packs and sample tubes.
- Ensure all three packaging layers remain intact throughout transport.
- Use appropriate PPE during handling and packaging.
- Handle all suspected SAT-1 outbreak samples as potentially infectious material



FLOW CHART: PACKAGING OF SAMPLES AS PER IATA TRIPLE PACKAGING SYSTEM

Goal: Safe packaging and transport of infectious (Category B) samples to Laboratory

1 PREPARE SAMPLE



- Collect the required sample
- Label the primary container (Sample ID, Date, Species, Location, Collector)
- Tighten cap properly
- Wipe exterior with disinfectant

2 PRIMARY CONTAINER



- Leak-proof, screw-capped vial/tube
- Wrap with absorbent material (tissue / gauze / cotton)
- Ensure it can absorb entire contents if leaked

EXAMPLES

- Cryovials
- Screw cap tubes
- Serum tubes
- Sterile containers

3 SECONDARY CONTAINER



- Leak-proof, durable, sealable container
- Place the wrapped primary container(s) inside
- Add additional absorbent material
- Separate multiple vials to prevent breakage
- Seal the container tightly

EXAMPLES

- Screw cap plastic canister
- Biohazard specimen container
- Sealed plastic jar
- Secondary zip-lock biohazard pouch

4 COLD CHAIN ARRANGEMENT



FOR 2-8°C TRANSPORT (≤ 48 HOURS)



- Use ice packs or frozen gel packs
- Do NOT allow direct contact between ice packs and samples
- Use cardboard / foam separator

FOR LONG TRANSPORT (> 48 HOURS)



Use Dry Ice
or
Liquid Nitrogen
Dry Shipper

IMPORTANT

- Dry ice must NEVER be placed inside sealed secondary container
- Ensure ventilation in outer packaging to prevent pressure build-up (CO₂)

5 OUTER CONTAINER



- Rigid, strong, shock-resistant outer container
- Insulated container recommended for cold chain
- Close and seal properly
- Disinfect the exterior surface

EXAMPLES

- Thermocol / vaccine carrier
- Hard plastic transport box
- UN-certified shipping box

6 LABELING OF OUTER CONTAINER



Sender & Receiver
Details



Orientation Arrows
(for liquid samples)



KEEP
REFRIGERATED
Temperature
Marking



UN3373 Label
"Biological Substance,
Category B"



BIOLOGICAL
SUBSTANCE
CATEGORY B



Handle
with Care

7 DOCUMENTATION



- Sample submission form
- Epidemiological / clinical information
- Number and type of samples
- Contact details of sender
- Place documents in waterproof pouch and put inside outer container (not outside)

8 DISINFECTION BEFORE DISPATCH



- Disinfect outer surface using suitable disinfectant:
- 4% Sodium carbonate
 - 2% Sodium hydroxide
 - Virkon® / other suitable disinfectant

9 TRANSPORT



- Prior intimation to receiving laboratory (ICAR-NIFMD / Designated Lab) is MANDATORY
- Use the fastest possible mode of transport
- In emergency, samples may be hand-delivered by authorized personnel
- Maintain cold chain and handle with care



KEY POINTS



Use PPE
(gloves, protective
clothing)



Use sufficient
absorbent
material



Prevent breakage
and leakage at
all three layers



Maintain cold chain
(2-8°C or as
required)



Maintain chain
of custody



Ensure compliance
with IATA
regulations

Annexure- 10

Preventive Vaccination Plan

1. Strategic Vaccination Preparedness

- An immediate ring vaccination strategy should be implemented in high-risk zones, particularly within 10 km of international borders in vulnerable states such as Arunachal Pradesh, Sikkim, Uttar Pradesh, Uttarakhand, Bihar, West Bengal, Assam, and Meghalaya.
- Border States should conduct rapid livestock population estimation (cattle and buffalo) within these zones to enable accurate vaccine demand planning.
- Vaccination should also extend to identify risk-prone areas beyond borders, based on epidemiological assessment.

2. Emergency Vaccine Procurement and Supply Chain

- Import of at least one million doses of SAT-1 vaccine should be undertaken urgently through the National Dairy Development Board.
- Procurement may be sourced from globally recognized manufacturers such as Boehringer Ingelheim Animal Health, MSD Animal Health, and Botswana Vaccine Institute.
- NDDDB should coordinate logistics and equitable distribution of vaccines to states based on assessed needs.

3. Scientific and Strain Selection Guidance

- Vaccine selection and matching should be guided by latest genomic and antigenic data from the World Reference Laboratory for Foot-and-Mouth Disease.
- Continuous monitoring of circulating SAT-1 topotypes should inform vaccine strain suitability and updates.

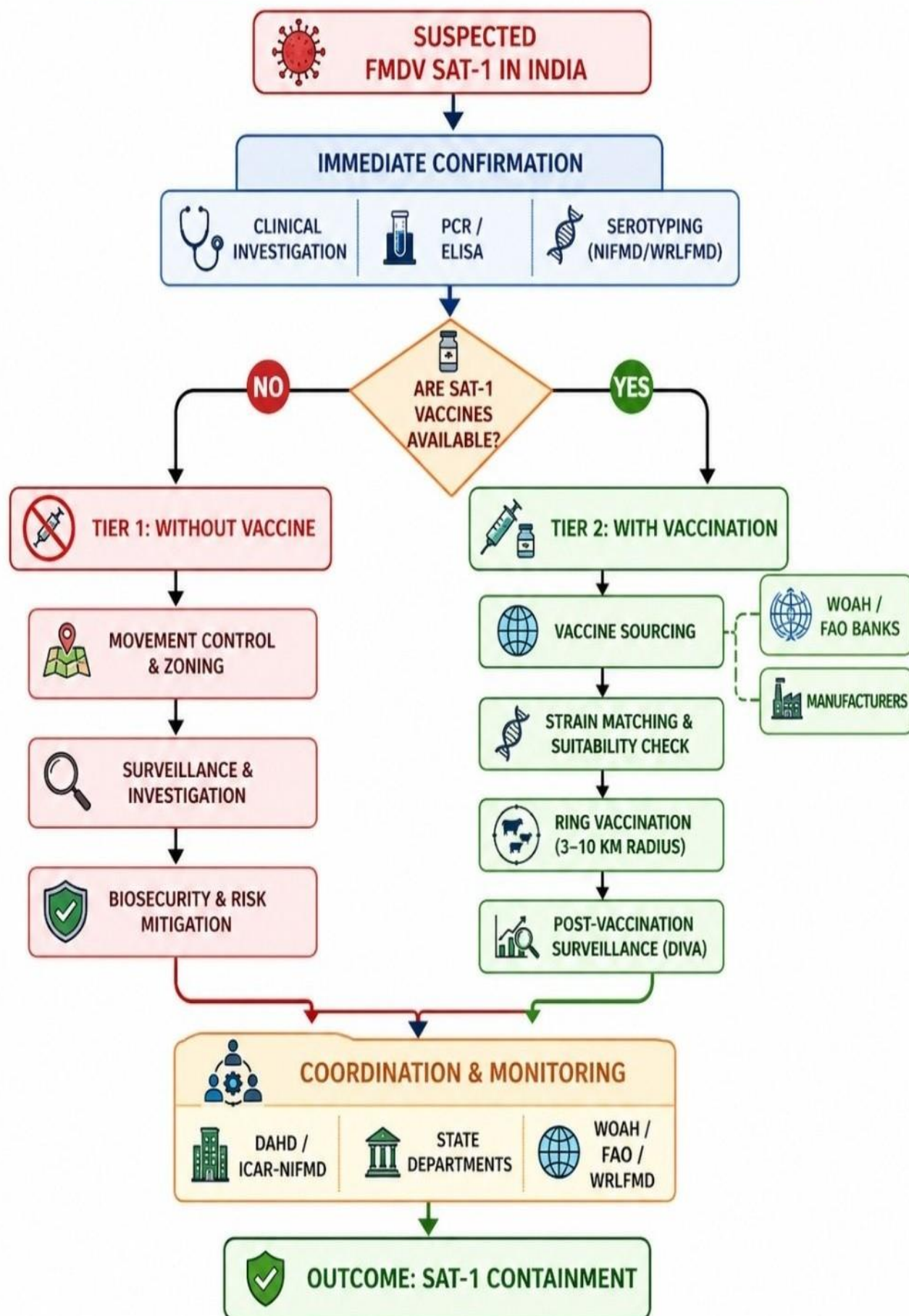
4. Cold Chain and Biosecure Storage

- Imported SAT-1 vaccines should be stored under high biosafety conditions at the ICAR-NIFMD (BSL-3 facility).
- Coordination with ICAR (DDG, Animal Science) is required to ensure secure storage, inventory control, and regulatory compliance.

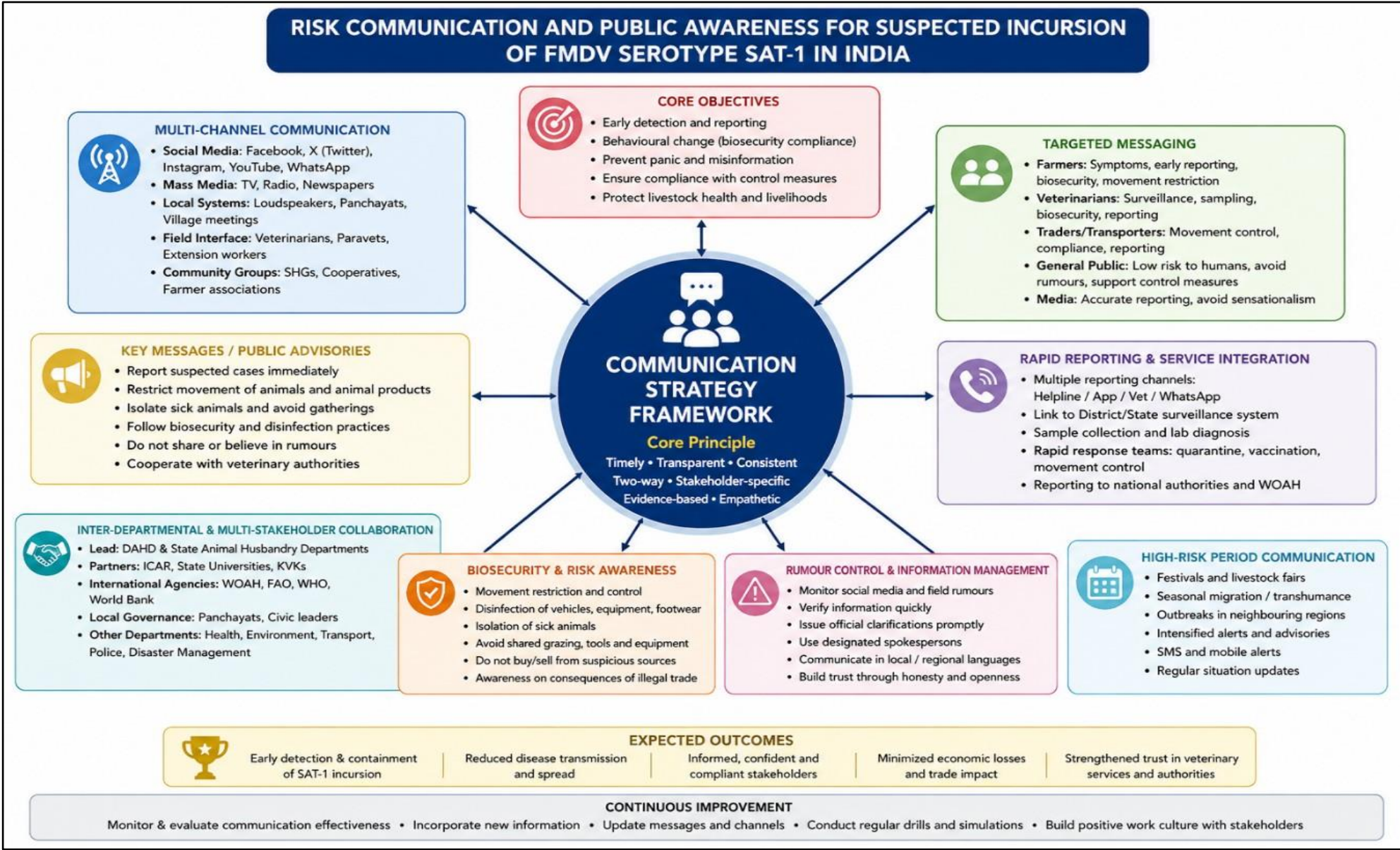
5. Indigenous Vaccine Development

- The Department of Animal Husbandry and Dairying should fast-track the import of bulk antigen in collaboration with the Central Drugs Standard Control Organization to enable rapid domestic SAT-1 vaccine development.
- Public-private partnerships should be leveraged to reduce long-term dependency on imports.

FMDV SAT-1 RESPONSE STRATEGY



Annexure -11



Annexure-12

Data Collection, Reporting, and Information Management

1. Purpose

This annexure provides a standardized field-ready format for:

- outbreak detection,
- epidemiological investigation,
- laboratory coordination,
- GIS-based surveillance,
- movement tracing,
- wildlife interface assessment,
- SITREP preparation,
- NADCP-compatible digital integration,
- and real-time disease reporting.

This format is intended for use by:

- field veterinarians,
- rapid response teams,
- district animal husbandry authorities,
- laboratories,
- surveillance officers,
- ICAR institutes,
- and state/national disease monitoring units.

2. Case Classification

Classification	Definition
Suspected Case	Animal showing clinical signs compatible with FMD or epidemiological linkage to infected premises
Probable Case	Clinically compatible case with epidemiological association but awaiting laboratory confirmation
Confirmed Case	Laboratory-confirmed FMD case through approved diagnostic methods
Epidemiologically Linked Case	Case linked to confirmed outbreak through animal movement/contact tracing

3. Standardized Outbreak Reporting Form

PART-A: Administrative Information

Field	Details
Report ID	
Date of Reporting	
Time of Reporting	
Reporting Officer Name	
Designation	
Mobile Number	
Email Address	
State	
District	

Block/Tehsil	
Village/Farm Name	
GPS Coordinates (Lat/Long)	
Proximity to International Border	Yes / No
If Yes, specify border/corridor	
Proximity to Livestock Market	Yes / No
Proximity to Wildlife Area/Forest	Yes / No

PART-B: Epidemiological Information

Field	Details
Species Affected	Cattle/Buffalo/Sheep/Goat/Pig/Wildlife
Breed	
Age Group	
Sex	
Production System	Dairy/Backyard/Commercial/Extensive/Pastoral
Population at Risk	
Number Susceptible	
Number of Cases	
Number of Deaths	
Number Recovered	
Morbidity Rate (%)	
Mortality Rate (%)	
Vaccination Status	Vaccinated/Unvaccinated/Unknown
Date of Last Vaccination	
Vaccine Batch Number	
Movement History (Last 30 Days)	
Contact Farms/Premises	
Market Exposure History	
Shared Grazing/Water Source	
Wildlife Contact History	
Migratory Animal Exposure	
Transport Vehicle Exposure	

4. Clinical Investigation Format

Field	Details
Date of Onset	
Number Initially Affected	
Primary Clinical Signs	
Vesicular Lesions Present	Yes / No
Oral Lesions	Yes / No
Foot Lesions	Yes / No
Teat Lesions	Yes / No
Salivation	Yes / No
Lameness	Yes / No
Sudden Milk Drop	Yes / No
Calf Mortality	Yes / No
Myocarditis Suspected	Yes / No
Abortion Storm	Yes / No
Differential Diagnoses Considered	
Provisional Diagnosis	

5. Wildlife Interface Assessment

Field	Details
Nearby Wildlife Species Observed	
Wild Ungulates Present	Yes / No
Feral Pig Activity	Yes / No
Shared Watering Points	Yes / No
Forest Fringe Grazing	Yes / No
Wildlife Mortality Observed	Yes / No
Forest Department Informed	Yes / No
Wildlife Surveillance Initiated	Yes / No

6. Sample Collection and Laboratory Reporting

Field	Details
Sample ID	
Barcode/QR Code	
Sample Type	Vesicular fluid/Epithelium/OP fluid/Blood/Serum
Date Collected	
Time Collected	
Sample collector name	
Cold Chain Maintained	Yes / No
Triple Packaging Used	Yes / No
Dispatch Date	
Dispatch Mode	Road/Air/Courier
Testing Laboratory	
Laboratory Accession Number	
Tests Requested	RT-PCR/ELISA/Virus Isolation/Sequencing
Result Status	Pending/Positive/Negative
Serotype Identified	
Lineage/Genotype	
Date of Result	
Confirmed Diagnosis	

7. Traceability and Movement Investigation

7.1 Backward Tracing

Parameter	Details
Source Farm Identified	Yes / No
Recent Animal Purchases	
Livestock Market Exposure	
Interstate Movement History	
Border Crossing History	
Shared Transport Vehicle	

7.2 Forward Tracing

Parameter	Details
Animals Moved from Premises	Yes / No
Destination Farms	
Milk Collection Route	
Slaughterhouse Linkage	
Trader/Agent Contact	
Contact Premises Notified	Yes / No

8. GIS and Spatial Risk Mapping

Mandatory GIS Layers

Layer	Status
Administrative Boundary	Completed/Pending
Infected Zone Mapping	Completed/Pending
Surveillance Zone Mapping	Completed/Pending
Vaccination Zone Mapping	Completed/Pending
Livestock Density Overlay	Completed/Pending
Wildlife Corridor Mapping	Completed/Pending
Transport Corridor Mapping	Completed/Pending
Livestock Market Mapping	Completed/Pending

9. Control Measures Implemented

Measure	Yes/No	Date Initiated
Quarantine		
Movement Restriction		
Ring Vaccination		
Check-post Establishment		
Farm Disinfection		
Awareness Campaign		
Active Surveillance		
Contact Tracing		
Wildlife Surveillance		
Market Closure		
Border Alert Issued		

10. Daily SITREP Format

Basic Information

Field	Details
Disease/Event	
SITREP Number	
Date and Time	
Reporting Authority	
Incident Commander	

Epidemiological Summary

Parameter	Today	Cumulative
New Cases		
Total Cases		
Deaths		
Recoveries		
Villages Affected		
Farms Affected		
Samples Tested		
Positive Samples		

Operational Activities

Activity	Status
Vaccination Conducted	
Surveillance Teams Deployed	
Disinfection Operations	
Check-post Functionality	
Public Awareness Activities	
Wildlife Monitoring	

Critical Risks

Risk Factor	Status	Planned Actions (Next 24 Hours)
New Cluster Detected		
Border Spread Risk		
Wildlife Interface Risk		
Vaccine Shortage		
PPE Shortage		
Resistance to Control Measures		

11. Alert Triggers for Immediate Escalation

Immediate escalation to District/State/National authorities shall occur under the following conditions:

- First suspected SAT-1 compatible case
- Sudden vesicular disease outbreak
- Rapid increase in morbidity (>20% within 24 hours)
- Unusual mortality in calves
- Multiple village involvement
- Border district occurrence
- Wildlife-associated event
- Detection in vaccinated populations
- New district/state spread
- Unexplained abortion storms
- Severe lameness clusters
- Sudden production collapse

12. Data Quality and Validation Checklist

Parameter	Acceptable Standard
Mandatory Field Completion	>95%
GPS Accuracy	Verified
Duplicate Records	Nil
Laboratory Linkage	Complete
Sample Traceability	Complete
Daily SITREP Submission	Timely
GIS Mapping Accuracy	Verified
Data Backup Status	Active

13. Data Security and Governance

The following minimum standards shall be maintained:

- Role-based access control
- Two-factor authentication
- Encrypted data transmission
- Secure backup systems
- Audit trail maintenance
- Controlled inter-agency sharing
- Confidential handling of farm-level data

14. Outbreak Closure Criteria

An outbreak may be considered closed only after:

- No new cases during the defined surveillance period
- Completion of active surveillance
- Negative follow-up investigations
- Completion of disinfection procedures
- Verification of containment effectiveness
- Final epidemiological assessment
- Approval by competent veterinary authority

15. Recommended Digital Integration Components

The reporting platform should preferably support:

- NADCP-compatible architecture
- Mobile app reporting
- QR/barcode-based sample tracking
- GIS dashboard integration
- Real-time alerts
- Laboratory Information Management System (LIMS)
- Sequencing/genomic surveillance linkage
- Automated SITREP generation

16. Recommended Reporting Hierarchy

Level	Responsibility
Field Veterinarian	Initial detection and reporting
District Authority	Verification and containment
State Authority	Coordination and SITREP consolidation
National Authority	Strategic response and international notification
Reference Laboratory	Confirmation and strain characterization

17. International Reporting Obligations

Confirmed transboundary disease events shall be reported as per applicable national and international protocols, including:

- World Organisation for Animal Health notification procedures
- national veterinary authority guidelines
- regional disease intelligence systems
- emergency epidemiological reporting frameworks

Annexure- 13

National Incident Response and Coordination System (NIRCS)

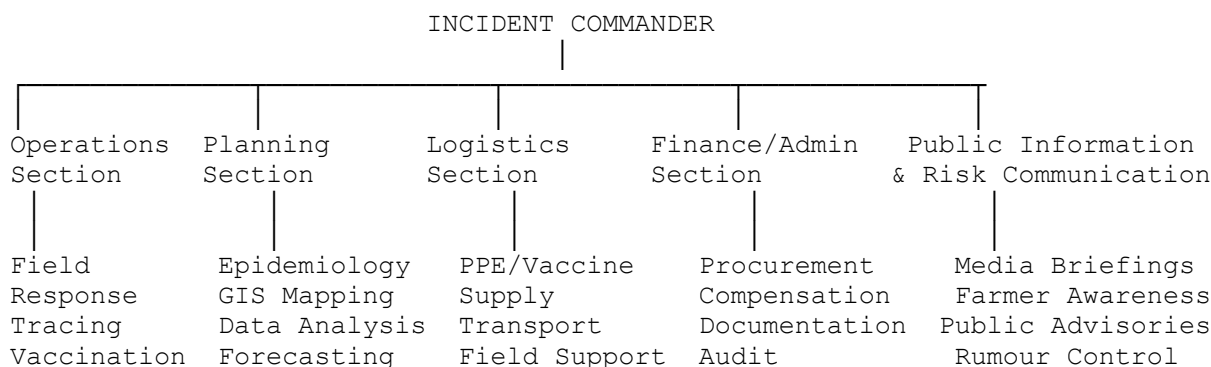
The National Incident Response and Coordination System (NIRCS) will function on the following principles:

- Unified command and coordinated decision-making
- Rapid information flow
- Scientific evidence-based response
- Clearly defined authority and accountability
- Multi-agency coordination
- Standardized reporting structure
- Scalability according to outbreak severity
- Integration of epidemiology, laboratory intelligence, and field response
- Real-time surveillance and situational awareness

Key Operational Principles

Principle	Description
Unity of Command	One coordinated response chain
Technical Consistency	Standardized SOP implementation
Rapid Escalation	Fast reporting of serious events
Accountability	Clearly defined responsibilities
Scientific Decision-Making	Evidence-based interventions
Multi-Agency Coordination	Integrated response system
Scalability	Flexible response expansion
Real-Time Intelligence	Continuous situational awareness

INCIDENT RESPONSE STRUCTURE



Roles and Responsibilities

Department of Animal Husbandry and Dairying (DAHD)

Role: National Competent and Policy Authority

Responsibilities:

- Declare national animal health emergency (if required)
- Issue policy directives and advisories
- Interstate coordination
- International communication and notification
- Resource mobilization
- Emergency fund allocation
- Coordination with NDMA and other ministries
- National-level media communication
- Approval of containment policies

ICAR-NIFMD

Role: National Technical Lead and Reference Laboratory

Responsibilities:

- Laboratory confirmation
- Serotyping and molecular epidemiology
- Risk assessment and disease intelligence
- Technical SOP development
- Epidemiological modelling
- Sequencing and lineage analysis
- Technical guidance to DAHD and states
- Technical dashboard management
- Expert deployment and training support

State Animal Husbandry Departments

Role: Operational Implementation Authority

Responsibilities:

- Activate the state incident command centre
- Conduct field surveillance
- Organize outbreak containment
- Implement vaccination and movement control
- Coordinate district veterinary teams
- Manage PPE, logistics, and manpower
- Submit daily SITREPs
- Maintain field communication network

District Incident Command Units

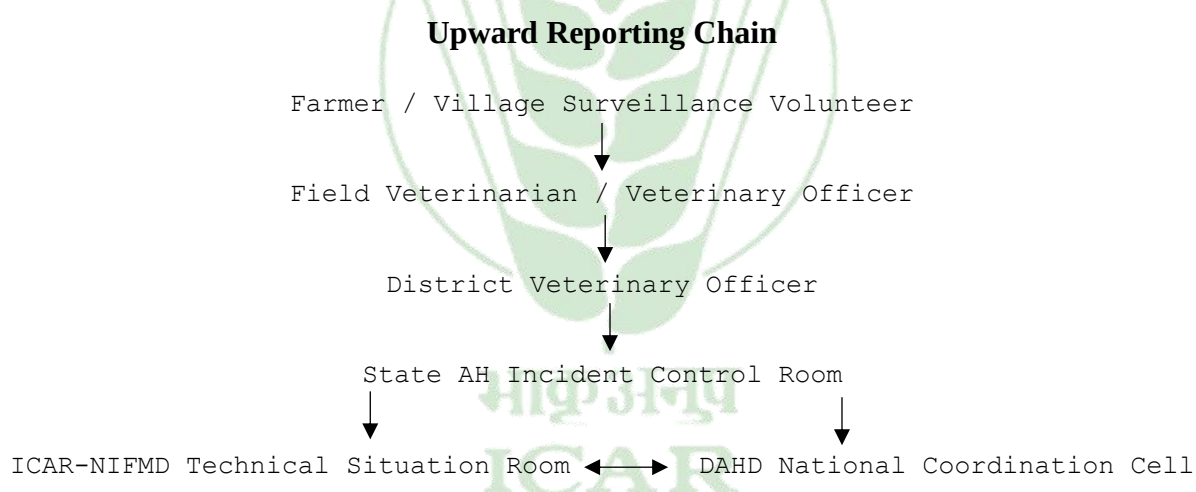
Responsibilities:

- Rapid outbreak investigation
- Field epidemiology
- Sample collection and dispatch
- Contact tracing
- Local quarantine enforcement
- GIS-based outbreak mapping
- Coordination with local administration

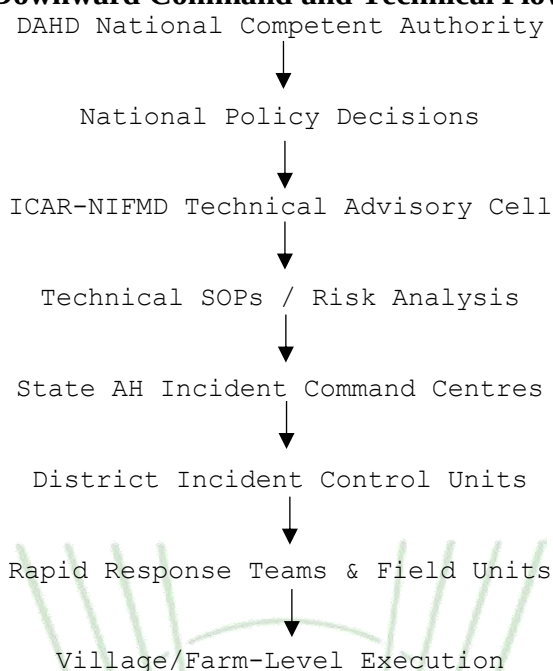
Rapid Response Teams (RRTs)

Responsibilities:

- Immediate field deployment
- Clinical investigation
- Biosecurity implementation
- Active surveillance
- Ring vaccination support
- Public awareness activities
- Disinfection operations



Downward Command and Technical Flow



Emergency Activation Levels

Level	Description	Operational Status
Level 1	Localized suspected outbreak	District response
Level 2	Confirmed outbreak with spread risk	State activation
Level 3	Multi-district/interstate spread	National coordination
Level 4	Exotic serotype/national emergency	Full national emergency response

Emergency Activation Triggers

The incident response system shall be activated upon:

- suspected SAT-1 compatible outbreak,
- laboratory-confirmed exotic serotype,
- unexplained vesicular disease clusters,
- border-associated outbreak,
- wildlife-linked transmission event,
- rapid increase in morbidity/mortality,
- interstate spread,
- or severe epidemiological risk alerts.

Technical Situation Room Functions

Responsibilities

- Real-time outbreak dashboard monitoring
- GIS-based spread analysis
- Epidemiological forecasting
- Sequencing and lineage analysis
- Risk-zone mapping
- Vaccine matching analysis
- Data integration and analytics
- SITREP consolidation
- International disease intelligence monitoring

Information Management and Communication

Communication Channels

Channel	Purpose
Official dashboard	Centralized monitoring
Mobile reporting app	Field reporting
SMS/secure messaging	Rapid alerts
Email notification	Formal communication
GIS dashboard	Spatial intelligence
Video conferencing	Coordination meetings

Biosecurity and Safety Oversight

Safety Officer Responsibilities

- PPE compliance
- Biosafety monitoring
- Field decontamination oversight
- Sample transport safety
- Waste disposal supervision
- Occupational exposure reporting

Recovery and De-escalation Framework

Post-Outbreak Activities

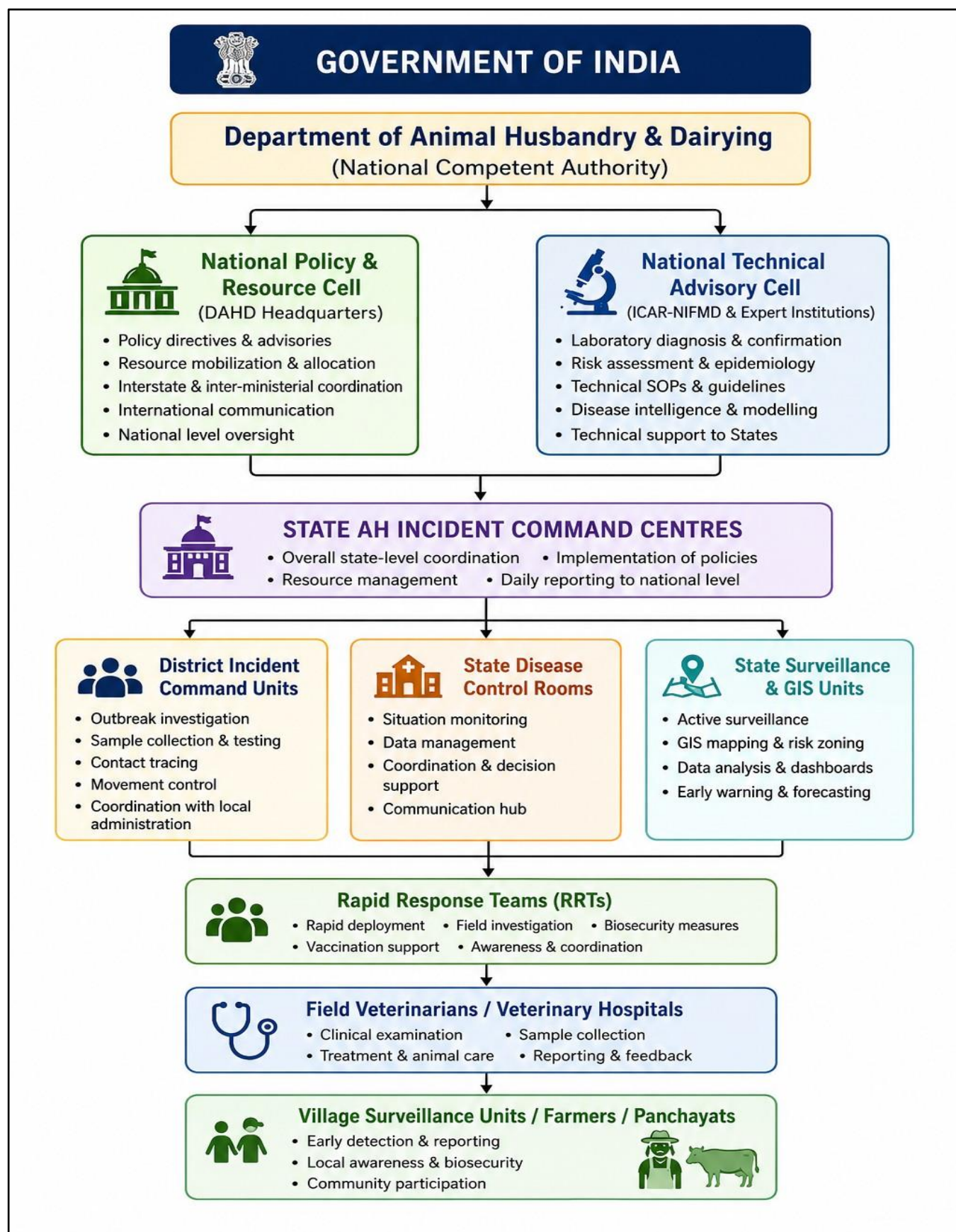
- Active surveillance continuation
- Post-vaccination monitoring
- Epidemiological review
- Resource replenishment
- Recovery support to farmers
- Outbreak audit and lessons learned
- SOP revision and corrective actions

International Reporting Framework

Confirmed transboundary disease events shall be communicated through:

- national competent authority channels,
- World Organisation for Animal Health reporting systems,
- regional disease intelligence networks,
- and emergency international notification mechanisms.

National Incident Functional Components of the Incident Response System



Annexure-14

The International Framework

Level	Key Partners / Platforms	Primary Objectives	Key Activities	Information / Resource Exchange	Expected Output / Outcome
Global Level	WOAH, FAO, GF-TADs, Quadripartite, WOA/FAO Reference Laboratories, Vaccine Manufacturers, Antigen Banks, Private Sector Vaccine Suppliers	• Global early warning • Technical guidance • Laboratory networking • Capacity building • Vaccine access	• Global surveillance and risk assessment, International outbreak reporting • Reference diagnosis and virus characterization • Training and simulation support • Emergency technical assistance • Vaccine strain matching and deployment support	• WAHIS notifications • EMPRES-i alerts • Laboratory reports and sequencing data • Technical missions and guidance documents • Vaccine bank • Vaccine bank coordination mechanisms	• Timely risk alerts • Rapid laboratory confirmation • Access to SAT-1 expertise and resources • Harmonized preparedness standards • Access to emergency vaccines
Regional (South Asia)	SAARC CVO Forum, SAARC Agriculture Centre (SAC), Regional Support Unit (RSU-Nepal), FAO ECTAD, PCP-FMD Platforms, Regional Vaccine Manufacturers, Antigen Banks, and Vaccine Suppliers	• Harmonized surveillance • Information sharing • Joint preparedness • Coordinated disease control • Regional vaccine preparedness	• Joint risk assessments • Coordinated surveillance • Cross-border investigations • Simulation exercises • Outbreak intelligence sharing • Planning for vaccine access and emergency response	• Regional databases • Secure communication channels • Joint reports • Surveillance summaries • Vaccine preparedness information	• Early warning across borders • Reduced transboundary spread • Improved regional preparedness • Coordinated outbreak response
Bilateral / Neighbouring Countries	India–Nepal, India–Bhutan, India–Bangladesh, India–Myanmar, India–Pakistan (where feasible), China/Tibet interface authorities, Border Veterinary Services	• Cross-border surveillance • Risk communication • Livestock movement monitoring • Rapid response coordination	• Border disease monitoring • Hotspot surveillance • Joint field investigations • Cross-border meetings • Information sharing • Monitoring informal livestock movement routes	• Hotline communication • Joint databases • Meeting records • Laboratory findings • Movement alerts	• Controlled livestock movement • Rapid information exchange • Early detection near borders • Localized outbreak containment
Laboratory Network	Indian FMD laboratories network, National Laboratories, WOA/FAO Reference Laboratories, Regional Diagnostic Networks	• Rapid diagnosis • Sample sharing • Molecular characterization • Quality assurance	• Confirmatory testing • Strain identification, Sequencing and phylogenetic analysis • Inter-laboratory validation • Surge diagnostic support	• Diagnostic reports • Sequence data • Sample referral mechanisms • Laboratory SOPs	• Early detection and confirmation within 24–48 hours • Improved outbreak tracing • Evidence-based vaccine selection

Vaccine Preparedness Network	DAHD, ICAR-NIFMD, Vaccine Manufacturers, WOAHP Vaccine Banks, Proposed SAARC Vaccine Bank	• Assured vaccine availability • Emergency preparedness • Rapid deployment	• Antigen sourcing • Vaccine strain matching • Regulatory preparedness • Emergency procurement • Ring vaccination planning	• Antigen bank inventories • Vaccine efficacy data • Deployment plans • Regulatory approvals	• Rapid vaccine access • Timely outbreak containment • Reduced disease spread
National Coordination Framework	DAHD, ICAR-NIFMD, State AH Departments, District Veterinary Authorities, Rapid Response Teams	• Unified governance • Operational preparedness • Emergency response coordination	• Trigger-based response activation • Movement control • Quarantine implementation • Surveillance intensification • Outbreak management	• Situation reports • Surveillance data • Field investigation reports • Response directives	• Rapid decision-making • Coordinated national response • Effective containment measures
Preparedness and Simulation Network	DAHD, ICAR Institutes, State Governments, Neighbouring Countries, FAO/WOAH Technical Partners	• Readiness assessment • Capacity building • Operational testing	• National mock drills • Cross-border simulation exercises • Preparedness audits • Joint training programmes	• Exercise reports • Audit findings • Training materials • Lessons learned documents	• Improved readiness • Identification of operational gaps • Continuous system improvement
Digital Surveillance and Communication Platforms	WAHIS, EMPRES-i, National Surveillance Systems, GIS Platforms, State Surveillance Units	• Real-time monitoring • Early warning • Risk communication	• Outbreak dashboards • GIS mapping • Data integration • Automated alerts • Community reporting systems	• Real-time surveillance data • Geospatial information • Early warning notifications • Multilingual advisories	• Faster detection and reporting • Improved situational awareness • Enhanced decision support
Stakeholder and Community Interface	Farmers, Livestock Traders, Border Communities, Veterinary Field Staff, Local Administration	• Awareness generation • Early reporting • Biosecurity adoption	• Farmer awareness campaigns • Community-based surveillance • Biosecurity promotion • Reporting mechanisms	• Advisories • Alert messages • Educational materials • Community reports	• Increased disease awareness • Earlier outbreak reporting • Strengthened grassroots surveillance

Abbreviations: WOAHP – World Organisation for Animal Health; FAO – Food and Agriculture Organization; GF-TADs – Global Framework for the Progressive Control of Transboundary Animal Diseases; PCP-FMD – Progressive Control Pathway for FMD; EMPRES-i – Emergency Prevention System for Animal Health Information System; WAHIS – WOAHP World Animal Health Information System; ECTAD – Emergency Centre for Transboundary Animal Diseases; RSU – Regional Support Unit; DAHD – Department of Animal Husbandry and Dairying.

Trigger-Based International Coordination and Response Escalation Matrix for Suspected Incursion of FMDV Serotype SAT-1 into India

Response Level	Trigger / Criteria	Objective	Key Actions (International & National)	Lead Agencies / Partners	Indicative Timeline
LEVEL 1 – ALERT (Enhanced Preparedness)	• SAT-1 reported in a neighbouring country or region • Increased transboundary risk due to livestock movement, trade, or wildlife interface • Significant SAT-1 epidemiological developments in South Asia or adjoining regions	Strengthen preparedness, early warning, and border surveillance	• Intensify surveillance in border districts and high-risk areas • Enhance monitoring of livestock movement and trade corridors • Activate information-sharing mechanisms with neighbouring countries • Review national preparedness plans and contingency arrangements • Assess diagnostic readiness and laboratory surge capacity • Review vaccine procurement and antigen availability options • Issue risk communication advisories to stakeholders	• DAHD (India) • State Animal Husbandry Departments • Border and Quarantine Authorities • ICAR-NIFMD • Neighbouring Country Veterinary Authorities • WOA and FAO (information support)	Immediate and ongoing (weeks to months)
LEVEL 2 – SUSPICION (Enhanced Response)	• Suspected SAT-1 case identified in India based on clinical and epidemiological evidence • Positive screening or inconclusive laboratory findings requiring confirmation • Cluster of unusual FMD outbreaks in vaccinated populations	Rapid confirmation and prevention of further spread	• Immediate sample collection and priority laboratory testing • Activate Rapid Response Teams (RRTs) • Implement provisional movement restrictions in affected areas • Intensify epidemiological investigations and tracing activities • Notify DAHD and relevant State authorities • Initiate preliminary information exchange with neighbouring countries and international partners, as appropriate • Review emergency vaccine access mechanisms and preparedness plans • Strengthen risk communication and stakeholder awareness	• State Animal Husbandry Departments • DAHD (Livestock Health Division) • ICAR-NIFMD and designated laboratories • District Veterinary Authorities • Border Agencies • Neighbouring Country Veterinary Authorities (as appropriate)	Within 0–72 hours

LEVEL 3 – CONFIRMED OUTBREAK (Containment and Control)	• Laboratory confirmation of FMDV serotype SAT-1 in India • Evidence of local transmission or spread	Contain outbreak, prevent national and transboundary spread, and minimize socio-economic impact	• Establish infected, protection, and surveillance zones as per national policy • Implement movement control and quarantine measures • Conduct enhanced surveillance, tracing, and epidemiological investigations • Implement emergency vaccination strategy, where approved • Deploy additional diagnostic and field response resources • Official notification through WOA and relevant international reporting systems • Share epidemiological and laboratory information with regional partners • Seek technical support, strain matching, or vaccine assistance if required • Provide regular situation reports and risk communication updates	• DAHD (Lead Authority) • State Animal Husbandry Departments • ICAR-NIFMD (Technical Lead) • District Administration and Veterinary Services • Border and Security Agencies • WOA and FAO • Neighbouring Country Veterinary Authorities	Immediate and continued until the outbreak is controlled
---	---	--	---	---	---

Note: All actions shall be implemented in accordance with the WOA Terrestrial Animal Health Code, GF-TADs principles, PCP-FMD framework, national FMD contingency plans, and applicable Government of India regulations. International notifications and information sharing should follow established national protocols and diplomatic channels where required.



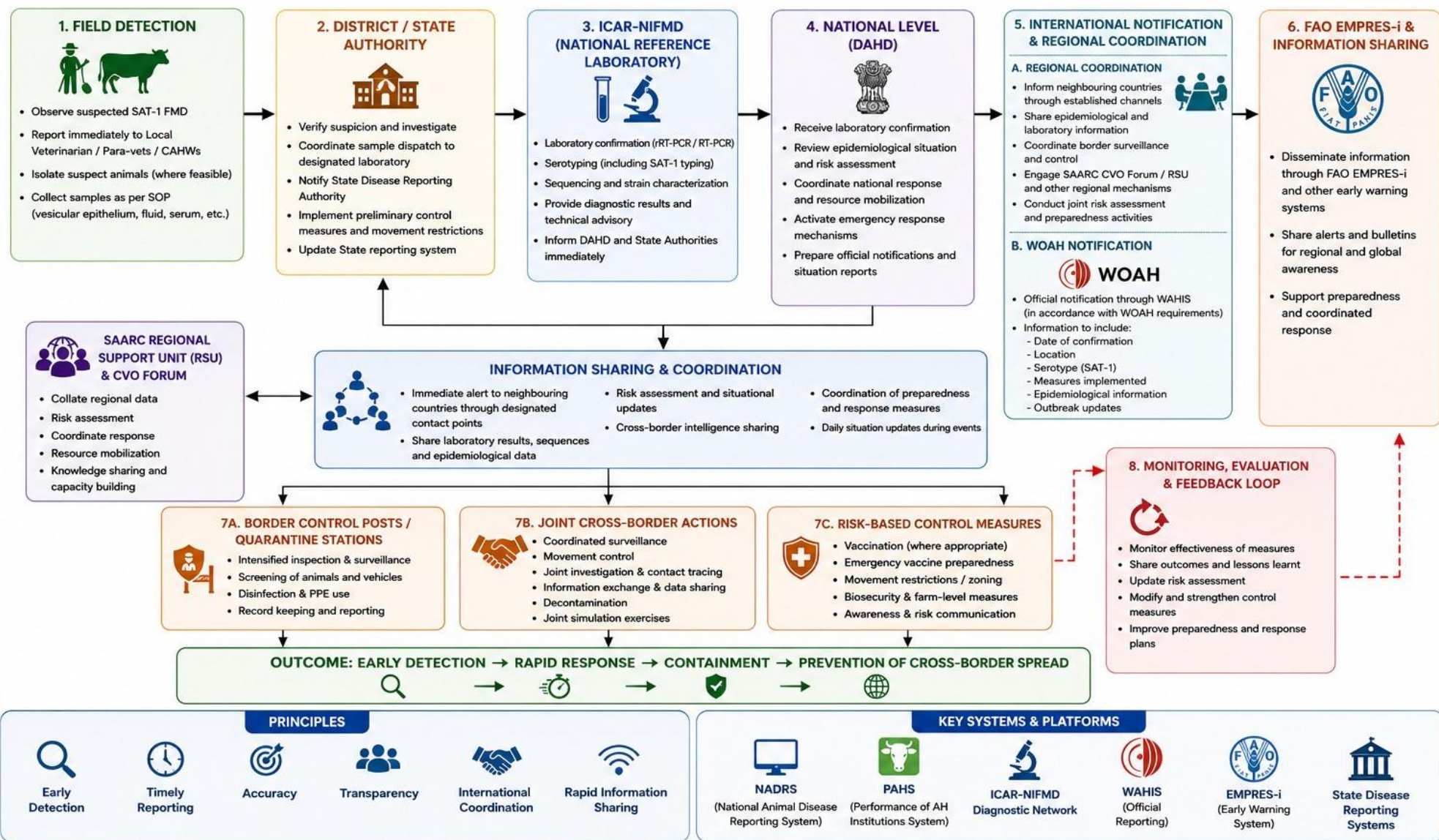
Indicative Risk-Based Operational and Trade Considerations Matrix

Scenario / Situation	Epidemiological Status	Indicative Operational Measures	Potential Trade / Movement Considerations*	Indicative Risk Level	Recommended Preparedness Considerations
No Case – At Risk Area	No SAT-1 detected; increased risk due to proximity, animal movement, or regional outbreaks	Enhanced surveillance, border monitoring, biosecurity awareness, preparedness planning	Routine trade and movement may continue subject to existing regulations	Low	Maintain preparedness, strengthen surveillance, review contingency plans
Suspected Case in Border Area	Suspected SAT-1 under investigation; laboratory confirmation pending	Quarantine of suspect premises, sample collection, epidemiological investigation, localized movement precautions	Competent authorities may consider temporary risk-based movement controls pending investigation	Moderate	Activate rapid response mechanisms, enhance communication and risk assessment
Confirmed Localized Outbreak	Laboratory-confirmed SAT-1 in a limited geographic area	Containment zones, surveillance zones, tracing, enhanced surveillance, emergency vaccination if approved	Competent authorities may consider zoning and risk-based movement restrictions in affected areas	High	Intensify surveillance, implement containment measures, strengthen stakeholder communication
Multiple Linked Outbreaks / Regional Spread	Evidence of wider transmission across multiple locations	Regional response plan, enhanced surveillance, vaccination strategies as approved, broader movement controls	Authorities may evaluate additional movement or trade-related risk mitigation measures	Very High	Strengthen coordination, resource mobilization, and inter-state/international communication
Outbreak Under Control	No new epidemiologically linked cases detected for a defined period; control measures effective	Continued surveillance, phased relaxation of controls, monitoring and verification	Authorities may consider progressive easing of restrictions based on risk assessment	Moderate to Low	Continue monitoring, document lessons learned, verify effectiveness of controls
Recovery Phase	Sustained absence of disease with effective surveillance and risk mitigation measures	Ongoing surveillance, prevention of re-introduction, preparedness review	Restoration of normal activities subject to applicable national and international requirements	Low	Maintain vigilance, strengthen long-term preparedness and border biosecurity

Trade, movement, zoning, compartmentalization, disease-status recognition, and recovery-related decisions are subject to the authority of the Government of India and relevant competent authorities. The entries in this matrix are indicative considerations only and should not be interpreted as regulatory guidance.

SAT-1 INTERNATIONAL SURVEILLANCE, COORDINATION AND RESPONSE FRAMEWORK

(Early Detection → Timely Reporting → Rapid Response → Containment → Prevention of Cross-Border Spread)



Note: All actions to be implemented in accordance with WOAHP Terrestrial Animal Health Code, GF-TADs principles, PCP-FMD framework, national FMD contingency plan and relevant Government of India regulations.

Annexure 15

FMDV SAT-1 Preparedness Training and Capacity Building Framework

Component	Key Elements	Expected Outcome
Training Objectives	Early recognition of suspected SAT-1 infection; differentiation from endemic FMD outbreaks; outbreak investigation; biosecurity implementation; emergency vaccination preparedness; rapid containment and reporting.	Improved preparedness and rapid response capacity.
Target Participants	State AH Department veterinarians, para-veterinarians, livestock inspectors, surveillance personnel; laboratory staff; epidemiologists; emergency response teams; Forest Department and wildlife officials; customs, quarantine and border enforcement agencies; district administration, police, transport authorities, and other relevant stakeholders.	Multi-sectoral One Health preparedness and coordinated response.
SAT-1 Epidemiology and Risk Assessment	Global and regional epidemiology; transmission pathways; transboundary spread; wildlife-livestock interface; risk factors; border and trade-associated risks.	Improved understanding of SAT-1 introduction pathways and risk mitigation strategies.
Clinical Recognition and Differential Diagnosis	Clinical signs of FMD-like disease; differential diagnosis; severe disease in vaccinated herds; recognition in cattle, buffalo, sheep, goats, pigs, and wildlife; image-based diagnostic exercises.	Early identification and reporting of suspected SAT-1 cases.
Surveillance and Reporting Systems	Passive and active surveillance; syndromic surveillance; trigger-based reporting; standard reporting formats; NADRS and other digital reporting platforms; GIS-based outbreak mapping.	Timely detection, reporting, and communication of suspected outbreaks.
Sample Collection and Laboratory Preparedness	Selection of appropriate samples; PPE use; labelling; cold-chain maintenance; packaging and transport; biosafety; submission procedures; diagnostic testing workflow.	Reliable laboratory confirmation and reduced sample rejection rates.
Biosecurity and Containment Measures	Isolation procedures; quarantine; movement restriction; disinfection protocols; personnel hygiene; vehicle and equipment decontamination; farm-level biosecurity.	Reduced risk of disease spread during investigations and outbreaks.
Outbreak Response SOPs	Notification procedures; quarantine; movement control; zoning and surveillance; incident response activation; resource mobilization; inter-agency coordination.	Rapid containment of suspected or confirmed SAT-1 outbreaks.
Vaccine Preparedness and Emergency Vaccination	SAT-1 vaccine concepts; emergency vaccine procurement mechanisms; cold-chain requirements; ring vaccination principles; vaccination logistics; post-vaccination monitoring.	Improved readiness for emergency vaccination campaigns.

Traceability and Epidemiological Investigation	Animal movement history collection; source and contact tracing; livestock market investigations; transport-route assessment; migratory grazing pathway assessment; identification of epidemiological links.	Improved outbreak source identification and risk assessment.
Wildlife–Livestock Interface Assessment	Identification of wildlife contact points; shared grazing areas; common water sources; wildlife mortality reporting; wildlife sampling considerations; Forest Department coordination.	Enhanced understanding of potential wildlife-associated transmission pathways.
Risk Communication and Community Awareness	Communication of clinical signs and reporting triggers; farmer awareness; engagement with traders and transporters; misinformation management; stakeholder communication.	Improved early reporting and community participation in response efforts.
International and Cross-Border Coordination	Information sharing mechanisms; regional cooperation platforms; reporting pathways; communication with neighbouring countries; WOA and FAO awareness.	Strengthened coordination and information exchange during transboundary disease events.
Simulation Exercises and Mock Drills	Tabletop exercises; field simulations; inter-agency coordination exercises; laboratory response testing; movement-control simulations; emergency vaccination exercises.	Validation of preparedness plans and identification of operational gaps.
Monitoring, Evaluation and Continuous Improvement	Pre- and post-training assessments; reporting timeliness; diagnostic accuracy; sample quality; SOP compliance; coordination effectiveness; corrective action planning; competency certification where applicable.	Continuous improvement of preparedness capacity and workforce competency.



Recommended Three-Day Structured Training Programme:

Day	Session	Major Topics
1	SAT-1 Epidemiology and Risk Assessment	Global and regional epidemiology, transmission pathways, transboundary risks, wildlife-livestock interface, risk assessment.
	Clinical Recognition and Differential Diagnosis	Clinical signs in different species, differential diagnosis, case studies, image-based exercises.
2	Surveillance and Reporting Systems	Passive and active surveillance, trigger-based reporting, digital surveillance platforms, reporting pathways.
	Sample Collection and Laboratory Procedures (Practical)	PPE use, sample collection, packaging, cold chain, transport, laboratory submission procedures.
3	Biosecurity and Outbreak Response Measures	Quarantine, movement control, zoning, disinfection, incident response activation, inter-agency coordination.
	Vaccine Preparedness and Emergency Vaccination	Vaccine preparedness, ring vaccination principles, logistics, cold-chain management.
	Mock Drills and Simulation Exercises	Table-top exercises, field simulations, outbreak investigation, communication, coordination, and response evaluation.

Note: The training programme should be tailored to the roles and responsibilities of different stakeholder groups. While all participants should receive a general overview of SAT-1 epidemiology, surveillance, reporting pathways, biosecurity principles, and emergency response frameworks, the depth and emphasis of individual training modules should be adapted according to operational requirements. For example, field veterinarians and para-veterinarians may require greater emphasis on clinical recognition, outbreak investigation, sample collection, and field response; laboratory personnel on diagnostics, biosafety, and laboratory preparedness; wildlife and forest officials on wildlife surveillance and wildlife–livestock interface assessment; and border, quarantine, customs, and enforcement personnel on movement control, inspection procedures, and transboundary risk mitigation. Such stakeholder-specific customization will enhance operational effectiveness while maintaining a common understanding of the overall SAT-1 preparedness and response framework.

References:

1. Food and Agriculture Organization of the United Nations (FAO). *The Progressive Control Pathway for Foot-and-Mouth Disease (PCP-FMD): Principles, Stage Requirements and Assessment Guidelines*. Rome: FAO.
2. Food and Agriculture Organization of the United Nations (FAO). *Rapid Risk Assessment: Foot-and-Mouth Disease Virus Serotype SAT-1*. Rome: FAO.
3. Food and Agriculture Organization of the United Nations (FAO). *FAO Emergency Prevention System (EMPRES) for Transboundary Animal and Plant Pests and Diseases (EMPRES Animal Health)*.
4. FAO and WOA. *Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs): Strategy and Action Plans*.
5. World Organisation for Animal Health (WOAH). *Terrestrial Animal Health Code*. Latest edition.
6. World Organisation for Animal Health (WOAH). *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*. Chapter on Foot-and-Mouth Disease. Latest edition.
7. World Organisation for Animal Health (WOAH). *A Field Manual for Animal Disease Outbreak Investigation and Management*.
8. World Organisation for Animal Health (WOAH). *Guidelines for Emergency Preparedness and Response to Animal Disease Emergencies*.
9. World Organisation for Animal Health (WOAH). *WAHIS User Manual and Disease Notification Guidelines*.
10. EuFMD Commission (FAO). *The European Foot-and-Mouth Disease Reference Laboratory (WRLFMD) Standard Operating Procedures and Technical Guidance Documents*.
11. European Commission for the Control of Foot-and-Mouth Disease (EuFMD). *Real Time Training Programme Resources and Emergency Preparedness Manuals*.
12. World Reference Laboratory for Foot-and-Mouth Disease (WRLFMD), Pirbright Institute, United Kingdom. Technical Reports, Reference Material and Global Surveillance Updates.
13. The Pirbright Institute. *Foot-and-Mouth Disease Virus Laboratory Manuals, Diagnostic Protocols and Reference Material*.
14. United States Department of Agriculture (USDA APHIS). *Foreign Animal Disease Preparedness and Response Plan (FAD PRP): Foot-and-Mouth Disease Response Plan*.
15. Australian Veterinary Emergency Plan (AUSVETPLAN). *Disease Strategy: Foot-and-Mouth Disease*.
16. Department for Environment, Food and Rural Affairs (DEFRA), United Kingdom. *Foot-and-Mouth Disease Contingency Plan*.
17. Government of India. Department of Animal Husbandry & Dairying (DAHD). *Livestock Health and Disease Control Programme (LHDCCP): Operational Guidelines*.
18. Government of India. Department of Animal Husbandry & Dairying (DAHD). *National Animal Disease Control Programme (Historical Documents and Operational Frameworks)*.
19. Government of India. National Disaster Management Authority (NDMA). *National Disaster Management Plan* and related Incident Response System guidelines.
20. Government of India. National Centre for Disease Control (NCDC). *National One Health Framework for India* and associated guidance documents.
21. Government of India. Ministry of Environment, Forest and Climate Change (MoEFCC). Guidelines relating to wildlife disease surveillance, wildlife rescue operations and protected area management.
22. ICAR–National Institute on Foot-and-Mouth Disease (ICAR-NIFMD). *Standard Operating Procedures, Diagnostic Manuals, Surveillance Reports and Institutional Publications*.
23. ICAR–National Institute of High Security Animal Diseases (ICAR-NIHSAD). *Laboratory manuals and emergency disease investigation protocols*.
24. Indian Council of Agricultural Research (ICAR). Technical publications relating to transboundary animal diseases, veterinary epidemiology and emergency preparedness.

25. Alexandersen S., Zhang Z., Donaldson A.I., Garland A.J.M. (2003). *The Pathogenesis and Diagnosis of Foot-and-Mouth Disease*. Journal of Comparative Pathology.
26. Grubman M.J. & Baxt B. (2004). *Foot-and-Mouth Disease*. Clinical Microbiology Reviews.
27. Knight-Jones T.J.D. & Rushton J. (2013). *The Economic Impacts of Foot and Mouth Disease—What are They, How Big are They and Where do They Occur?* Preventive Veterinary Medicine.
28. Jamal S.M. & Belsham G.J. (2013). *Foot-and-Mouth Disease: Past, Present and Future*. Veterinary Research.
29. Domingo E., Baranowski E., Escarmís C. and Sobrino F. Publications on Foot-and-Mouth Disease virus evolution, epidemiology and molecular biology.
30. Scientific publications, situation reports, surveillance updates and technical communications issued by FAO, WOA, EuFMD, WRLFMD, national veterinary authorities and peer-reviewed scientific journals available up to the date of publication.

Note: This document has been prepared using information synthesized from international standards, scientific literature, technical manuals, standard operating procedures, official surveillance reports and guidance documents published by FAO, WOA, EuFMD, WRLFMD, Government of India agencies, ICAR institutes and other competent authorities available up to the date of publication. Readers are encouraged to consult the latest editions of these publications and official notifications for updated recommendations and disease information.





Emergency Response to Suspected Incursion of Foot and Mouth Disease Virus Serotype SAT-1 in India

Foot and Mouth Disease Virus (FMDV) serotype SAT-1 has recently expanded beyond its historical African range into the Middle East, Europe, and Asia, creating an unprecedented transboundary threat to countries with immunologically naïve livestock populations, including India. The absence of protective immunity against SAT-1 virus in the Indian livestock population and the lack of cross-protection from the currently used trivalent FMD vaccine make early preparedness essential to prevent rapid disease establishment and widespread socio-economic losses. This document provides a comprehensive national preparedness framework for the suspected incursion of FMDV serotype SAT-1 into India. It integrates risk assessment, early warning indicators, surveillance, outbreak investigation, laboratory diagnosis, emergency response, vaccination preparedness, wildlife–livestock interface management, logistics, risk communication, data management, and post-outbreak recovery within a coordinated One Health approach. Drawing upon lessons from recent transboundary animal disease incursions and the evolving global epidemiological situation, the document emphasizes rapid detection, coordinated decision-making, inter-agency collaboration, and evidence-based preparedness to strengthen India's capacity to prevent the establishment and spread of this exotic serotype and safeguard national livestock health, food security, and economic resilience.



ICAR-NIFMD
Steering Evidence-Based FMD Control in India

ISBN: 978-81-689-5390-1



9 788168 953901

