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A field manual for veterinarians

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Dedication

It is with profound sadness that we note the passing of the main author, Eeva Tuppurainen, before the publication of this manual. Eeva was not only a consummate professional and a brilliant scientist, but also a person of deep integrity and human values. Through her expertise, dedication, and generosity, she greatly advanced the understanding of sheep pox and goat pox and worked tirelessly to help countries confront and manage these diseases, in addition to lumpy skin disease.

This manual is dedicated to her memory, with gratitude for her knowledge, her commitment to animal health, and her kindness, which inspired all who had the privilege to work with her.

Acknowledgements

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Abbreviations

ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
BSL-3	biosecurity level 3
CaPV	capripoxvirus
CCPP	contagious caprine pleuropneumonia
DIVA	differentiation of infected from vaccinated animals
ECE	Economic Commission for Europe
EDTA	ethylenediaminetetraacetic acid
ELISA	enzyme-linked immunosorbent assay
EMPRES-i	Emergency Prevention System (EMPRES) Global Animal Disease Information System
EuFMD	European Commission for the Control of Foot-and-Mouth Disease
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FMD	foot-and-mouth disease
GPS	Global Positioning System
GTP	goat pox
GTPV	goat pox virus
IAEA	International Atomic Energy Agency
IATA	International Air Transport Association
ICTV	International Committee on Taxonomy of Viruses
IFAT	indirect fluorescent antibody test
IPMA	immunoperoxidase monolayer assay
LSD	lumpy skin disease
LSDV	lumpy skin disease virus
PCR	polymerase chain reaction
PPE	personal protective equipment
PPR	peste des petits ruminants
SPP	sheep pox
SPPV	sheep pox virus
TAD	transboundary animal disease
WOAH	World Organisation for Animal Health

Introduction

Sheep pox (SPP) and goat pox (GTP) are contagious, transboundary viral diseases of small ruminants. Sheep pox virus (SPPV) and goat pox virus (GTPV) are closely related DNA viruses, but are still different viruses. They are not species-specific with regards to infection, i.e. SPPV can infect goats, while GTPV can infect sheep. Interestingly, the disease name varies depending on the affected host, i.e. the disease in sheep will always be referred to as SPP, regardless of whether the sheep was infected by GTPV or SPPV. Both are widely spread and currently present (as of March 2024) across Africa (except Southern Africa), in the Near East and throughout Asia. Outbreaks have also been reported sporadically in Europe, namely in the Balkans and in Spain. In endemic countries, SPP and GTP outbreaks impose a significant burden on the small ruminant sector due to mortalities and reduction in meat and milk production, as well as by lowering the quality of wool, skins and hides. Local and international movement restrictions on live animals and their products hamper both national and international trade. All stakeholders in the small ruminant industry suffer income losses, however poor, small-scale and backyard farmers are most affected. The economic impacts are significant in countries that export live sheep and goats and their milk or milk products, meat, wool, skins and hides. SPP and GTP are considered major obstacles for the development of intensive sheep and goat production in endemic regions.

SPP and GTP are characterized by high fever, the appearance of macular, papular and pustular lesions on the skin, ulcerative lesions on the mucous membranes of the mouth and nasal cavity, and eyes, respiratory distress, as well as swelling of the superficial lymph nodes (Figure 1).

Transmission of SPPV or GTPV occurs easily by direct contact via respiratory droplets, saliva or nasal discharge, or indirectly via fomites (e.g. contaminated equipment, car wheels, boots). In most cases, the virus is introduced to a farm through newly purchased animals. Usually, by the time the disease suspicion is notified to the veterinary authorities,

FIGURE 1
Goat infected with goat pox virus in Nigeria

© D. Omoniwa

clinical signs are already present in several animals and the infection has spread throughout the herd.

The purpose of this manual is to raise awareness of SPP and GTP and to provide guidance on how to prevent, detect, control, and eventually eliminate the diseases. The manual is targeted to field veterinarians working with small ruminants, both official and private, but also to slaughterhouse personnel, veterinary paraprofessionals, and laboratory diagnosticians.

This field manual contains a general description of SPP and GTP, including their geographic distribution, epidemiology, host range, and transmission pathways. It then proceeds chronologically from the suspicion of the disease on a farm, describing the typical clinical signs and post-mortem findings of infected animals and reviewing the differential diagnoses, to the confirmation of the field diagnosis, through a brief review of laboratory diagnostic methods currently available. In addition, recommendations are given on the collection, handling, and the transport of samples from the farm to a national or international reference laboratory. The immediate control and eradication actions to take on a farm, following the suspicion or confirmation of SPP or GTP cases, are described separately. The manual also briefly covers aspects related to awareness-raising and post-outbreak surveillance.

SPP and GTP are categorized as notifiable diseases by the World Organisation for Animal Health (WOAH). This manual is one of a series prepared by FAO as an aid to preparedness for major transboundary animal diseases (TADs) of livestock. Indeed, SPP and GTP are classified as TADs due to their capability of rapidly spreading across national borders and of reaching epidemic proportions.

Epidemiology

The severity of SPP and GTP outbreaks depends largely on the virulence and pathogenicity of the virus strain, the size of the susceptible sheep and goat population, as well as the age and breed of animals, and herd management. There are also, of course, other external factors that impact an outbreak, like the capacity of the veterinary services or the structure of the small ruminant subsector. SPP and GTP outbreaks can occur throughout the year. Given the relatively short lifespan of sheep and goats, only a sufficiently large susceptible population can sustain endemic transmission of the virus following its introduction.

In naïve populations, high morbidity (70–90 percent) and mortality (up to 50 percent) are typical of SPP and GTP, causing significant losses to farmers. The case fatality rate in young stock may approach 100 percent.

In endemic countries, the morbidity, mortality and case fatality are usually lower. For example, during a recent GTP outbreak in Viet Nam, morbidity ranged between 11.8 and 17.5 percent, mortality ranged between 5.1 and 7.4 percent, and the case fatality rate was 35.3 to 63 percent (Pham *et al.*, 2020).

CAUSATIVE AGENT

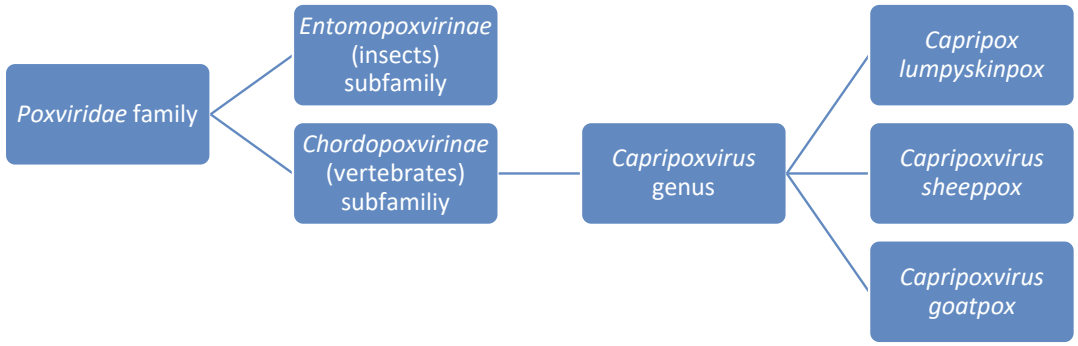
SPPV and GTPV, and lumpy skin disease virus (LSDV) are all members of the genus *Capripoxvirus* of the *Poxviridae* family. The viruses are closely related to each other, but still separate species. Capripoxviruses (CaPV) are large double-stranded DNA viruses that are very stable and have low genetic variation. Therefore, for SPP and GTP, it is not possible to monitor farm-to-farm spread by sequencing the virus isolates, as is done with some other TAD viruses, such as foot-and-mouth disease (FMD) virus. There is only one serological CaPV type, which means that all the members of the genus cross-react serologically. The virulence and pathogenicity of different SPPV and GTPV strains vary. Most strains can cause severe outbreaks if the target population has never been exposed to these viruses or vaccinated against them.

GEOGRAPHIC DISTRIBUTION

Historically, SPP and GTP have been endemic in most countries in northern, western, central and eastern Africa, across the Near East and the Indian subcontinent, Türkiye, the Islamic Republic of Iran, Iraq, the Russian Federation, Kyrgyzstan, Afghanistan, China, Viet Nam, Bhutan and Taiwan Province of China. Recent outbreaks were reported in Azerbaijan and Kazakhstan (2023) and in Mongolia and Georgia (2024).

Sporadic occurrences have been reported in Europe. Four SPP outbreaks occurred in Bulgaria and Greece between 2013 and 2015 and were swiftly controlled, however, these countries had further outbreaks between 2023 and 2025. SPP was also reported for the first time in Spain between 2022 and 2023, and in Romania in 2025. Both North and South America and Oceania are free from SPP and GTP infections.

FIGURE 2
***Capripoxvirus* taxonomy**



Source: **ICTV (International Committee on Taxonomy of Viruses).** 2023. *Taxonomy Browser.* [Accessed on 3 October 2025]. https://ictv.global/taxonomy/.

HOST RANGE

SPPV and GTPV are not zoonotic and do not infect humans. SPPV primarily causes clinical disease in sheep, while GTPV tends to infect goats. However, some strains can infect and cause disease in both species. Notably, SPPV or GTPV infections have never been reported in cattle. Capripoxviruses are traditionally named based on the host species from which they were isolated, but molecular analyses have revealed inconsistencies in this approach. For example, strains identified as SPPV have been shown to be GTPV, and vice versa. Additionally, the Kenya sheep-1 (KS-1) strain, originally isolated from sheep in Kenya, was later identified as a lumpy skin disease virus. These findings highlight the limitations of host-based naming and emphasize the necessity of molecular techniques for accurate virus identification.

Field diagnosis, while often straightforward, should be considered provisional. Suspected SPPV or GTPV samples must be sent to a laboratory for definitive diagnosis using molecular methods. A study in Ethiopia showed that GTPV alone was responsible for all outbreaks investigated in both sheep and goats (Gelaye *et al.*, 2015). Similar evidence on SPPV in goats in India has been published (Bhanuprakash *et al.*, 2010). European and Australian high-producing breeds are known to be more susceptible than indigenous African or Asian sheep and goats. This is one of the reasons why SPP and GTP are considered to be the major obstacles for improving the genetic basis of small ruminants and lifting production levels in endemic countries. During GTP outbreaks, typical skin lesions have been reported in dead wild ruminants, such as the Himalayan goral (Bora *et al.*, 2021) and the wild red serow (Dutta *et al.*, 2019). The findings were confirmed to be caused by the GTPV using laboratory analysis. Susceptible wild ruminants are likely to play a role, albeit variable, in the transmission of the disease if they show proper clinical signs including skin lesions that contain high virus titres. There are no published reports on clinical signs in wild ruminants caused by SPPV, but it is unclear if this is due to the nature of the virus or a lack of research.

TRANSMISSION

Transmission of SPPV and GTPV occurs by direct or indirect contact via aerosols and fomites (Figure 3).

Animal movements are a major driver of the virus spread. The disease is usually introduced to a farm via recently purchased animals from animal markets or from other infected source, e.g. breeding animals. Sheep and goats are most infectious after the appearance of the first papules and before the development of protective antibodies. Infected animals shed infectious virus in oral, nasal, and ocular secretions, which can contaminate animal feed and water. In experimental settings, animals can be infected via intravenous, intradermal, and subcutaneous inoculation.

FIGURE 3
Modes of transmission of sheep pox and goat pox viruses

Source: Authors' own elaboration.

Transmission easily occurs via direct contact between infected and susceptible animals, as the virus spreads through aerosols shed in saliva, and nasal and ocular discharge. Any damage to the buccal or nasal mucosa or abrasion of the skin can provide an entry point for the virus. Animal markets and overnight enclosures (i.e. kraaling) increase this type of close-contact transmission. No evidence has been published on transmission by natural mating or artificial insemination, but this cannot be ruled out. The same applies to transmission via contaminated milk.

Transmission can also occur indirectly, when the virus contaminates communal feeding or watering places or premises. Pieces of wool that get stuck on fences, trucks, etc., are very important source of the virus transmission, since SPP and GTP live viruses are very stable and may persist inside wool or dry scabs that form over skin lesions for up to three months. In addition, the virus may survive up to six months in shaded, dirty animal facilities and the environment, allowing indirect virus transmission to naïve animals orally or by skin rubbing. Indirect transmission may follow when animals are placed within infected premises, such as pens or yards, or vehicles (lorries, boats or trains).

Contaminated shearing clippers or milking machines can play an important role in transmission, if not thoroughly disinfected between animals. For example, clippers can easily scratch the skin and thus provide an entry point to the virus.

Similarly, iatrogenic intra- or inter-herd transmission may occur via contaminated needles during vaccination or other injections if needles are not changed between animals or herds. This may be of major significance during mass vaccination campaigns, underlining the importance of practicing proper needle hygiene.

Farm visitors or farmers themselves can transmit the virus via contaminated shoes or boots, clothing, medical and non-medical tools, equipment and vehicles.

Transmission through mechanical vectors has been demonstrated experimentally by biting stable flies (*Stomoxys calcitrans*) that feed on skin nodules, which contain high viral loads (Kitching and Mellor, 1986). The real importance of transmission by vectors in the field is not fully understood but cannot be excluded. Transmission through biological vectors has not been demonstrated.

Clinical signs of sheep pox and goat pox and postmortem findings

Clinical signs can range from mild to severe, depending on the host, its immune defence, age, and breed, as well as the pathogenicity of the circulating strain. Clinically, it is not possible to distinguish SPP from GTP based on visible clinical signs, lesions, or postmortem findings.

Following an incubation time that varies between 4 and 14 days, animals start showing non-specific clinical signs such as weakness, depression, loss of appetite and reduced milk production. High fever, from 40 °C to 42 °C, indicates the onset of viraemia. Animals in the early stages of infection may show depression and inappetence and remain separated from the rest of the flock.

Soon after becoming febrile, the first skin lesions start to appear around the eyes, in the eyelids, or around the lips and nares (Figure 4). Skin lesions are deep and go through all the layers of the skin. They can last for weeks, and scarring is permanent.

Skin lesions are more easily detected in areas where the hair coat is thinner, such as in the ears, on the face, and under the belly, groin, front legs and tail (Figure 5). In many cases, like in Figure 7 (left), even a visual inspection by an experienced veterinarian can raise a strong suspicion of the presence of the disease in the herd, leading to the implementation of temporary movement restrictions of live animals and their products.

Skin lesions start as erythematous macules (red patches of 20–30 mm in diameter) which soon turn into to firm papules. The centre of the papule then becomes necrotic, forming a pustule. Figure 6 illustrates the typical development process of skin lesions. With time, scabs form on top of the lesions. The scabs may persist for up to a month, and scars can often be seen on the head of recovered animals.

FIGURE 4
Goat pox lesions on the face of a goat (A) and sheep pox lesions on the face of a sheep (B)

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FIGURE 5
Sheep pox skin lesions on the udder of a sheep (A) and on the belly of a sheep (B)

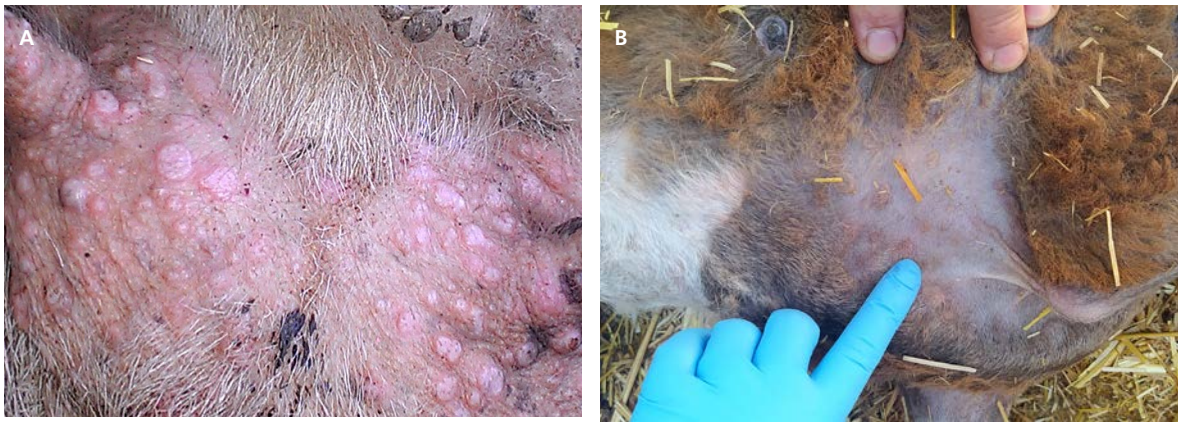
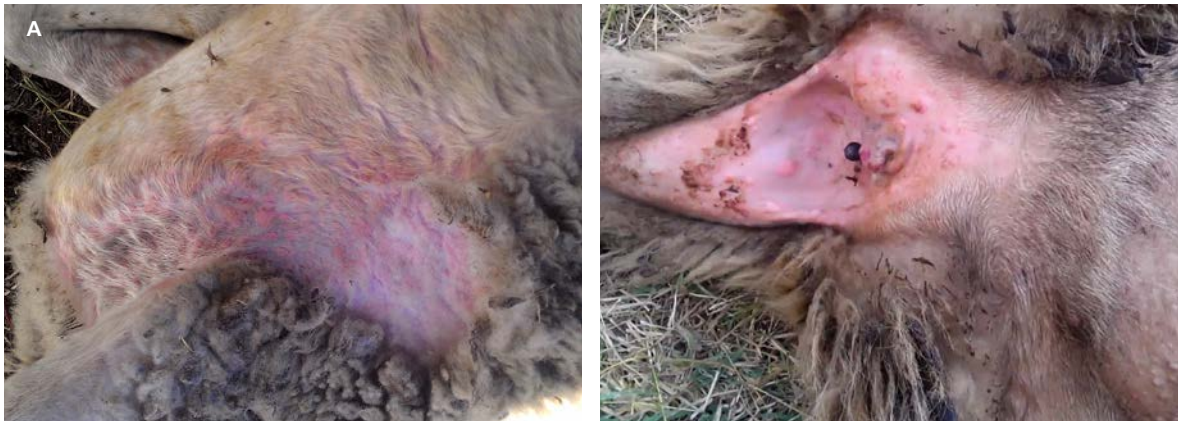
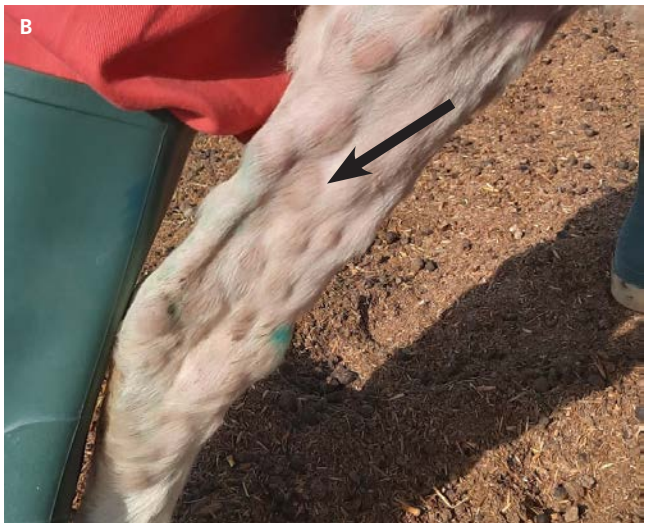


FIGURE 6
Typical skin lesions at different developmental stages (A–E)



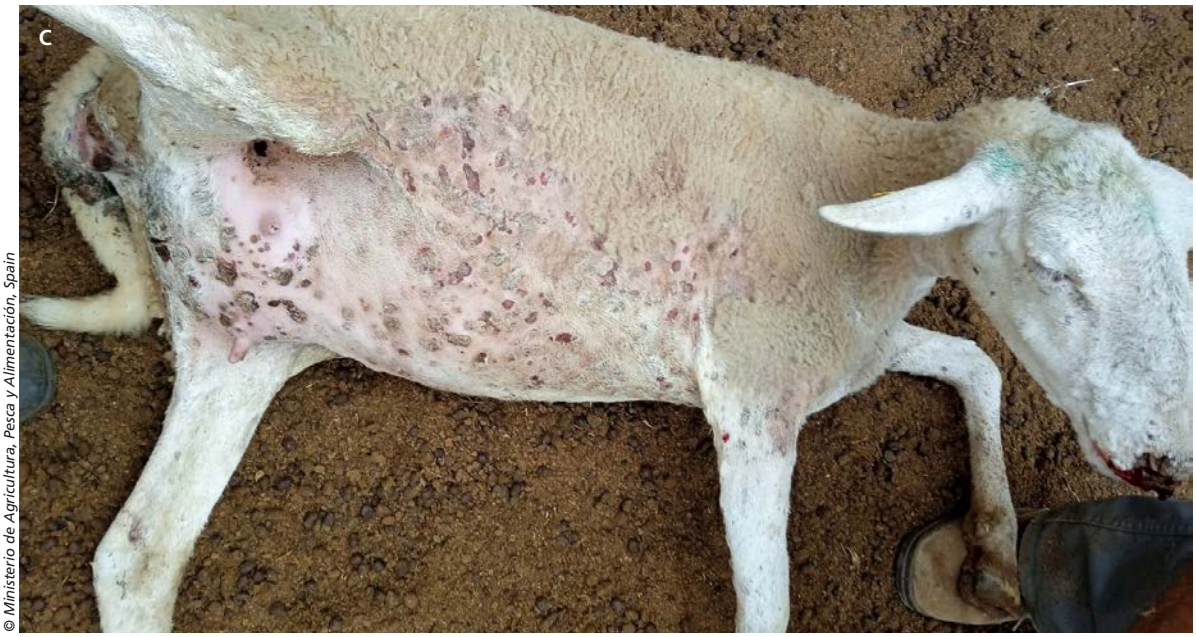
A. Fresh red erythematous papules of sheep pox in the groin (left) and under the tail (right).



B. Red circles start to develop around the skin lesions (black arrow).

(Cont.)

FIGURE 6 *(Continued)*
Typical skin lesions at different developmental stages (A–E)



C. The centres of the skin lesions become necrotic, leaving deep ulcers that dry out and become scabs. Infected animals may show skin lesions at different stages of development.

D. Healing skin lesions with scabs.

E. Scabs fall off leaving ulcers.

In severe cases, typical pox lesions appear all over the body (Figure 7) and on the mucous membranes of the mouth and nasal cavity (Figure 8). Affected animals may develop rhinitis and conjunctivitis, excreting infectious virus in nasal discharge and saliva.

Lambs and kids under three months of age may only show high fever and paralysis, with or without skin lesions, and may die without any other clinical signs (Figure 9). High mortality in lambs and kids may also be associated with secondary bacterial infections.

FIGURE 7
Goat showing skin lesions all over the body in Nigeria (A) and Uganda (B)

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FIGURE 8
Goat pox lesions in the mouth of an infected goat (A) and sheep (B–C)

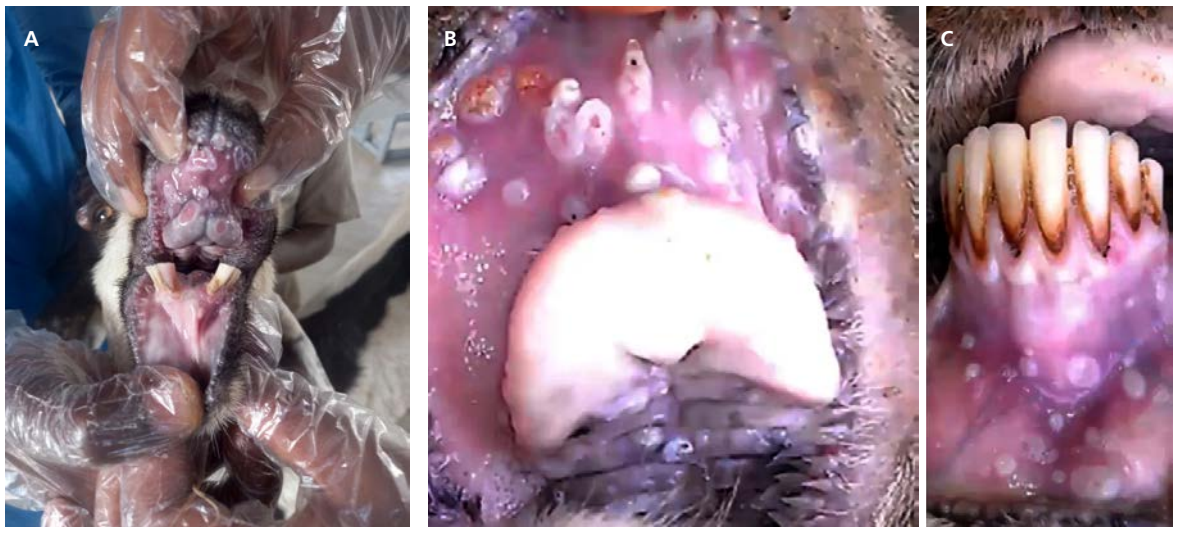

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FIGURE 9
Young lamb dead from sheep pox infection in Azerbaijan

© FAO, Azerbaijan

Dual infections of GTPV and peste des petits ruminants virus (PPRV) have been reported (Malik *et al.*, 2010; Adedeji *et al.*, 2019).

Postmortem findings are not as important in the field diagnosis of SPP and GTP as they are in other contagious diseases of small ruminants.

Due to the appearance of the highly characteristic clinical signs in several animals in the herd, suspicion is raised, and a tentative field diagnosis can usually made without the need to carry out a postmortem examination. Moreover, SPP and GTP cannot be visually differentiated based on postmortem examination and as stated earlier, it is not determined by the species affected.

Similar to the external skin lesions, internal pox lesions are observed on mucosal surfaces, lung, rumen, and abomasum (Figure 10). Lymph nodes, particularly the prescapular and submandibular ones, become enlarged and small pale subcapsular pox lesions are occasionally observed in the liver, kidneys, and the urinary bladder (Embury-Hyatt *et al.*, 2012). In severe cases, blister-like internal pox lesions can be found in the respiratory and digestive tracts or on the surface of almost any internal organ. Mucous membranes become necrotized and ulcerative.

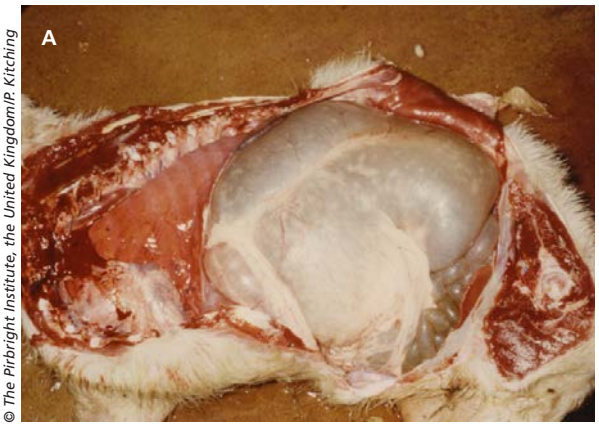
Lesions in the trachea and lung tissue can cause breathing difficulties or secondary bacterial pneumonia, which may prolong fever. If lesions occur in the intestine, affected animals may show diarrhoea. Pregnant animals may abort.

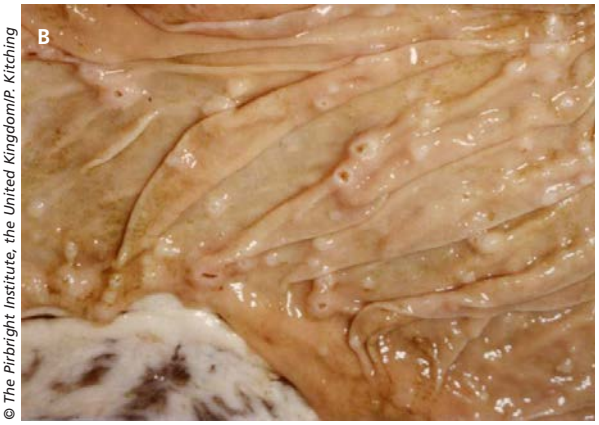
Histopathology can identify SPP and GTP, but the necessary equipment, expertise, and time are usually beyond the scope of routine laboratory diagnostics.

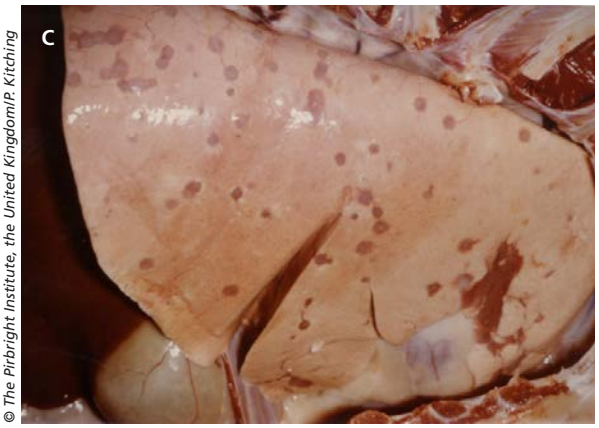
Common histopathological findings include thickening in the epidermis prior the development of papules. Small blood vessels of the skin lesions become blocked by thrombi, leading to necrosis and scab formation on top of the skin lesion.

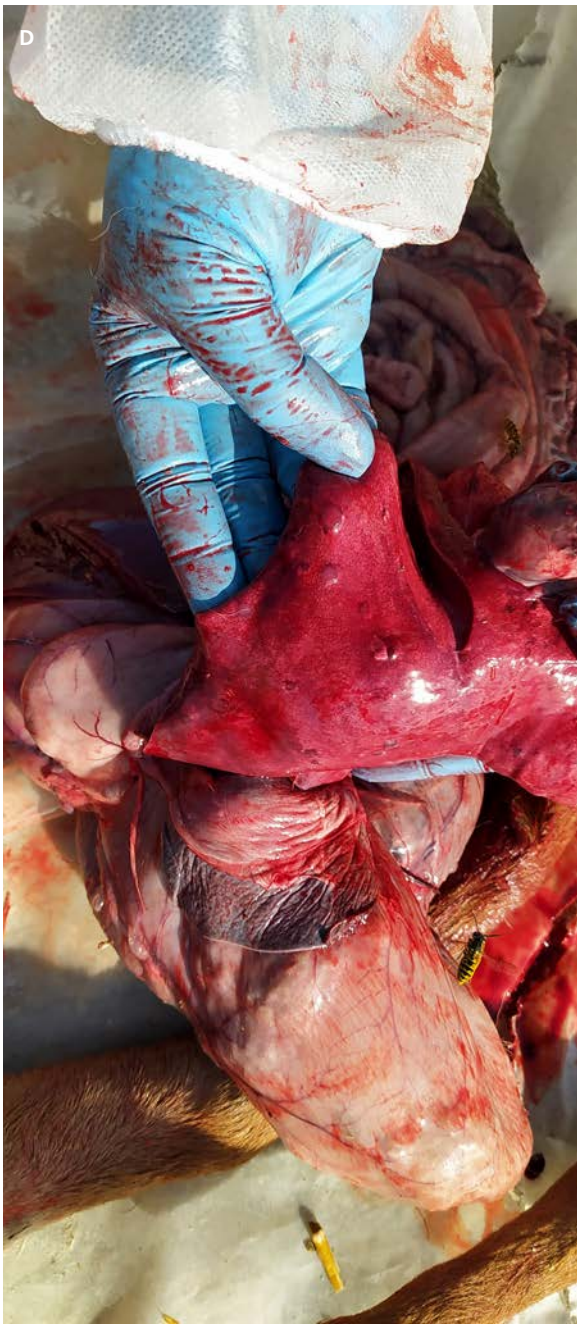
Typically, eosinophilic intracytoplasmic inclusion bodies can be detected in infected mononuclear cells in stained histological sections of skin lesions. So-called "sheep pox cells" (cellules claveleuses) are a typical microscopic finding in the skin lesions of sheep and goats infected with SPPV or GTPV. These cells have a characteristic morphology, including vacuolated cytoplasm and nuclei with marginated chromatin and multiple cytoplasmic inclusion bodies. Inflammatory cells may produce micro-abscesses in the lymph nodes. In early skin lesions, the epidermis can be mildly hyperplastic and later, epithelial necrosis can be present (Embury-Hyatt *et al.*, 2012).

FIGURE 10
Pathological changes of sheep pox in the abdomen (A), digestive tract (B) and lung (C–D)









Differential diagnosis

The clinical signs of SPP and GTP are readily recognizable in severely infected animals, but early stages – when signs are non-specific and skin lesions are few – detection can be difficult. For this reason, samples should be collected for laboratory testing from all suspected cases, including severely affected animals, to confirm or rule out the presence SPPV or GTPV by laboratory testing.

Most often, SPP and GTP are mistaken for contagious pustular dermatitis (contagious ecthyma, also known as orf), which is caused by a parapoxvirus. Real-time PCR assays are available for differential diagnosis of pox-like diseases in small ruminants (Gelaye *et al.*, 2017).

Other viral diseases should also be considered. Early bluetongue cases with swelling of the head may resemble SPP or GTP. The respiratory symptoms of PPR can look like those of SPP and GTP. It should also be kept in mind that simultaneous infections of SPP and PPR have been reported (Adeji *et al.*, 2019; Malik *et al.*, 2011).

Among bacterial diseases, dermatophilosis (streptothricosis), a zoonotic skin infection caused by *Dermatophilus congolensis*, should also be considered. Dermatophilosis usually affects immunosuppressed animals and those under excessive stress caused by extremely wet weather or poor management.

Caseous lymphadenitis of sheep and goats is also often listed as a differential diagnosis for SPP and GTP. Caused by *Corynebacterium pseudotuberculosis*, it causes swelling in lymph nodes.

Insect bites and allergic reactions such as urticaria and photosensitization can cause skin nodules that can be mistaken for SPP or GTP skin lesions.

Parasitic infections such as sheep scab and mange (sarcoptic and psoroptic mange) cause nodule-like changes in the skin.

Respiratory distress caused by parasitic pneumonia, pasteurellosis, contagious caprine pleuropneumonia (CCPP) and peste des petits ruminants (PPR) may also resemble SPP or GTP. There is a PCR for the differential diagnosis of all these respiratory pathogens in small ruminants (Settypalli *et al.* 2016).

General principles for conducting outbreak and epidemiological investigations

The availability of accurate data on SPP and GTP outbreaks is crucial for an effective disease control or eradication strategy.

Before starting an outbreak or epidemiological investigation, it is necessary to clearly define the population at risk, what is meant by a suspected and confirmed case of SPP or GTP, and what is considered to be an epidemiological unit.

The investigators also need to consider in advance who are the best sources of the required information, such as whether and when the vaccinations have been carried out, and details of recently bought and sold animals. For example, in an intensive sheep or goat unit, the farm manager and workers often have more daily contact with the animals than the farm owner. Conducting an epidemiological interview requires special skills and sensitivity in circumstances where farmers are likely to be highly stressed.

Outbreak and epidemiological investigations aim to find out:

- the possible source(s) of infection (i.e. trace-back investigation);
- how long the disease has been present;
- the extent of the outbreak, including the number of suspected and confirmed cases according to the definitions of epidemiological units and population at risk; and
- where the disease may have spread to (i.e. trace-forward investigation), including information on the movements of animals, people, vehicles, or other fomites that may have spread the disease.

It is useful to draw a map of the farm or area, showing the location of animal enclosures and different animal groups, entry and exit points, as well as boundaries with neighbouring farms.

The following data should be collected:

- number of susceptible animals, sick animals and those that died from the disease;
- origin, age, sex, breed, production type and vaccination status of suspected animals;
- contacts with domestic small ruminants and use of common grazing areas;
- contacts with wild ruminants;
- animal movement records – new animals recently introduced to the herd and their origin; animals that have left the herd and their destination;
- use of breeding animals;
- movements of farm workers and other visitors;
- recent veterinary treatments and health records;
- vehicle visits to the farm for milk collection, animal trade, or slaughterhouse transport, veterinarian and other service providers. It is important to find out about any farms visited before and after;
- road network, other geographic and weather and climatic data; and
- potential vector activity.

Actions on the farm in case of suspicion*

The earlier the disease suspicion is raised and reported to the veterinary authorities, the higher the chances of taking swift control actions and containing the spread of the disease. All individuals working along the small ruminant value chain should be aware of the importance of reporting suspected cases to the veterinary authorities, including owners, herdsmen, animal care staff, traders, and slaughterhouse personnel. The same applies to private veterinarians, paraveterinarians or extension officers, and animal health laboratory personnel.

Official veterinarians or veterinary teams are responsible for visiting the farm and for initiating an official outbreak investigation to confirm or rule out the presence of the SPP and GTP infection by collecting samples from suspected animals. Before leaving the office, the investigation team must ensure that everything needed for outbreak investigation, sample collection and transport, including personal protection equipment (PPE), disinfectants and detergents are readily available. A special "emergency" kit should be kept in each district veterinary office so that the attending veterinarian or outbreak investigation team can set off to visit the suspect farm with minimum delay. The equipment should include a digital camera, a Global Positioning System (GPS) unit and means of rapid communication (often a mobile phone, but could be a radio), as well as consumables and materials to collect and transport samples (FAO, 2011).

Immediate actions to take at a farm suspected of being infected with SPPV or GTPV:

- On arrival to the holding, put on personal protective equipment (PPE), i.e. disposable coveralls, boot covers and gloves.
- Interview the farmer or appropriate staff member(s) and record the following information:
  - When the non-specific symptoms, such as apathy, loss of appetite and decrease in milk production were first noticed.
  - When the onset of specific clinical signs, such as fever and typical skin lesions, started to appear.
  - If and when any new animals have been introduced to the herd and from where.
  - Whether any animals have been sold after the disease onset, and if so, their destination.
- Instruct the farmer to separate the suspected case(s) from the rest of the herd if not already done.
- Use a prepared clinical examination form to help record the findings efficiently. If many animals are present, prioritize which animals you examine. Change protective clothing between the groups.
- Starting from the farm subunits that are believed not to be infected yet, carry out clinical or visual examinations of animals and systematically record the findings. Note: taking the rectal temperature may help to determine if some animals can be suspected of incubating the disease.
- Continue to examine and collect samples from suspected cases or isolation units. If several animals are showing clinical signs, samples from four or five of the most severe cases should be sufficient for diagnosis.
- Collect the different types of samples (detailed instructions are given in the sample collection and shipping section of this manual):
  - blood in EDTA (ethylenediaminetetraacetic acid, an anticoagulant) tubes for PCR;
  - serum samples for ELISA (enzyme-linked immunosorbent assay) in plain tubes without anticoagulant;
  - saliva and nasal swabs for PCR testing and viral isolation; and
  - skin lesions or scabs for PCR testing and viral isolation.
- Keep the samples chilled and organize the fastest way to transport them to the national animal health diagnostic laboratory.
- After sampling the infected animals, disinfect your hands using any common disinfectant, and change to clean protective clothing.
- Inform the competent authority on your findings, and the animal health laboratory that you are going to send samples containing potentially infectious SPP or GTP virus. Indicate the number of samples you are sending and estimated time when the samples should arrive.
- When leaving the farm, keep in mind that SPP and GTP, like many other diseases, spread easily via fomites. Consider all PPE as contaminated material and disinfect or dispose of it accordingly. Wash with detergent and then disinfect your hands, all used

* Adapted from **Tuppurainen, E., Alexandrov, T. & Beltrán-Alcrudo, D.** 2017. *Lumpy skin disease field manual – A manual for veterinarians.* FAO Animal Production and Health Manual No. 20. Rome.

equipment and materials, as well as your boots and the wheels of your vehicle. When back at home/the office, wash your work clothing at +60 °C. Biosecurity measures are described in detail in a separate section of this manual.
- If possible, transferred the rest of the day's veterinary farm visits to a colleague.

Any contacts, such as neighbouring farmers or those who have recently bought or sold animals to/from the suspected farm, should be notified by the district veterinarian about the suspected outbreak. This will allow them to monitor their animals and report if clinical signs are detected, as well as take preventive measures, e.g. additional biosecurity. These holdings should be placed under intensified disease surveillance

Temporary restrictions should be implemented on the suspected holding until the laboratory results confirm or rule out SPP and GTP:
- Animals should be kept away from neighbouring herds by being fed on the property and not grazing in communal pastures.
- All sheep and goat movements to and from the farm must be stopped.
- Farm visitors should be limited to essential services.

A census of small ruminants must be carried out in suspected and infected holdings and the epidemiological unit. The holding and animal ID data should be checked on each visit to the farm and, if needed, updated. The number of animals in the following categories must be recorded and checked during each visit to the farm:
- total number of sheep and goats;
- animals showing clinical signs and those tested positive;
- animals that died from the disease;
- susceptible animals at-risk; and
- animals born or those that died due to other reasons during the period of suspicion.

In general, animal owners should keep updated records on the number and origin of sheep and goats in their holding, which can be shared with the veterinary authorities upon request.

Ideally, all lambs and kids (particularly if they have been purchased or are intended to be sold) should be marked in such a manner that their farm of origin and vaccination status can be traced.

During an outbreak, veterinarians involved in official control measures should keep copies of animal movement, health, and vaccination certificates, which may be valuable to trace-back and trace-forward the spread of the disease.

Sample collection and transport*

Sufficient material and equipment must be taken to cover the estimated number of animals to be sampled, plus a margin to account for materials that may be damaged or become unusable.

Samples should be taken by appropriately trained staff, using techniques that avoid undue stress, pain or injury to animals, or harm to the sample collector.

Diagnostic laboratories require that the field samples are clearly labelled with permanent ink, accompanied by a thoroughly completed submission form, and handled in such a way that they arrive to the laboratory in good condition.

Samples collected from suspected farms should be considered infected and handled accordingly. If submission of samples to a regional or international laboratory is foreseen, it is advisable to collect samples in duplicates, so that one set can be submitted while the other can be safely stored.

All materials used during sampling should be disposed of safely and according to local biosecurity regulations, e.g. bagged and transported back to the laboratory for autoclaving or appropriate disposal.

Box 1 gives an example of the list of materials and equipment needed for the first visit to a farm suspected of being infected with SPPV or GTPV (adapted from Tuppurainen *et al.*, 2017).

BOX 1

Materials and equipment needed for the first visit to a farm suspected to be infected with sheep pox virus or goat pox virus

General materials

- labels and permanent markers;
- data collection forms, pens, clipboards;
- medical sharps container for needle and scalpel disposal; and
- autoclavable disposal bags.

Personal protective equipment (PPE requirements will vary e.g. surveillance vs. outbreak investigation)

- dedicated clothing (coveralls)
- rubber boots
- disposable boot covers
- disposable gloves
- facemasks
- safety glasses for eye protection and hair covers (optional)
- disinfectant for hands
- disinfectant for boots
- buckets for disinfectant and detergent solution

Materials for sample transport (always maintain a 'triple-layer' structure when transporting samples)

- primary containers/tubes/vials (preferably plastic) for collecting and storing samples from each animal
- absorbent material;
- secondary and outer packaging must be leakproof, airtight, sealable containers or bags; and
- cool box (+4 °C), either electric that can plug into a car (preferable) or other, e.g. Styrofoam box filled with cooling materials (wet ice, frozen water bottles or cold packs, as appropriate).

Sampling materials for live animals

- equipment for restraining animals;
- cotton wool and disinfectant to clean sampling site;
- sterile vacutainers (4 ml or 10 ml) without anticoagulant (red stoppers) for serum collection;
- sterile vacutainers (4 ml or 10 ml) with EDTA (purple stoppers) for whole-blood collection;
- vacutainer holders and vacutainer needles or 10–20 ml syringes. Different sizes of needles should be sufficient to avoid haemolysis;
- swabs; and
- injectable local anaesthetic (or sedatives, if needed), disposable biopsy punches or scalpels, and suture material if full-thickness skin samples are to be collected from live animals.

Materials for postmortem sampling

- sample racks or boxes for vials;
- sterile cryovials of appropriate size for organ collection;
- knives, knife sharpeners, shears, scalpels and blades, forceps, and scissors;
- containers with disinfectant for disinfecting knives, scissors, etc. to avoid cross contamination between organs and between carcasses;
- securely sealable plastic pots with 10% neutral buffered formalin (1:10 organ volume: formalin volume ratio); and
- appropriate materials for carcass disposal.

Source: Adapted from **Tuppurainen, E., Alexandrov, T. & Beltrán-Alcrudo, D.** 2017. *Lumpy skin disease field manual – A manual for veterinarians.* FAO Animal Production and Health Manual No. 20. Rome.

* Adapted from **Tuppurainen, E., Alexandrov, T. & Beltrán-Alcrudo, D.** 2017. *Lumpy skin disease field manual – A manual for veterinarians.* FAO Animal Production and Health Manual No. 20. Rome.

PREFERRED SAMPLE TYPES

Skin lesions, scabs, saliva or nasal swabs are the best samples for the primary diagnostics to confirm or rule out the presence SPPV or GTPV in suspected animals.

Scabs are excellent samples because they are easy to collect, survive well in long transport at different temperatures, and do not usually require local anaesthesia or sedation of the animal. Scabs usually contain high loads of viral DNA and are ideal for PCR assays as they remain positive for a long period of time. However, the virus inside the scabs may not always be infective.

Biopsy specimen collection requires sedation and should include samples from two or three lesions at the papular or later stage.

For virus isolation, it is recommended to use skin lesions, scabs and, in some cases, swab samples (provided they are collected and stored properly). Blood can also be collected into EDTA or heparin tubes (depending on the method), however, viraemia only lasts about a week after the appearance of clinical signs. Therefore, samples should be collected from early febrile cases and the level of viraemia can be low, making blood samples less convenient.

To detect seroconversion, serum is separated from whole blood samples that are collected in tubes without anticoagulant. Serum should be collected from at least three animals presenting early clinical signs and three more advanced cases, i.e. with multiple skin lesions. The levels of neutralizing antibodies start to rise approximately one week after detection of clinical signs, and affected animals reach the highest antibody levels approximately two to three weeks later. The antibody levels then begin to slowly decline, eventually falling below detectable amounts in a year or so.

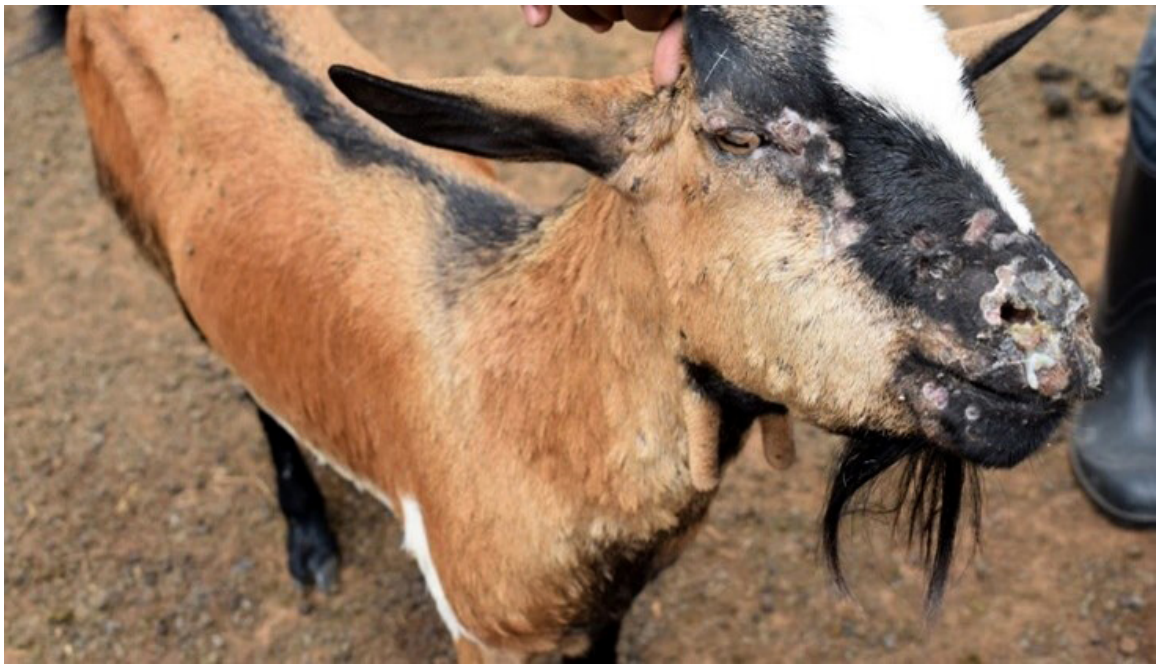
If postmortem examination is considered necessary, one or two of the most severely affected animals should be selected. Specimens should include skin lesions, nasal turbinates and the trachea, lungs and enlarged lymph nodes. Also, any other internal organ showing lesions can be sampled.

GENERAL RULES FOR SAMPLE COLLECTION

Because the clinical signs of SPP and GTP are very typical, a postmortem examination is not always necessary in the field. The indications listed below therefore refer to the sampling of live animals.

The sampling team should use disposable PPE and change it between groups of animals that are suspected to be infected and those that are healthy. If deemed necessary, restraints or sedation can be used to avoid stress, pain or injury to animals or danger to operators. Sampling must be carried out aseptically, in accordance with good sampling practices, to prevent cross-contamination between samples and the spread of the virus from infected to healthy animals.

FIGURE 11
Scabs, saliva, ocular and nasal discharge samples are easy to collect from infected animals without sedation or local anaesthesia



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Measures to take during sample collection are as follows:

- Disinfect the sample collection site.
- Use clean needles, scalpels, gloves, etc.
- Use sterile swabs to collect saliva and nasal samples and transport the swabs in appropriate sized tubes or containers, with or without transport medium.
- Collect scabs in a sterile container. Scabs are excellent samples.
- When collecting skin lesions, the surrounding skin should be clipped and cleansed with a non-disinfectant soap and rinsed with water. Local ring-block anaesthesia is recommended when full-thickness skin samples are surgically collected. Also, disposable biopsy punches 6–8 mm or less in diameter can be used. Transport the biopsy samples in commercially available virus transport media or phosphate buffered saline (PPS) with antibiotics.
- Collect blood samples from the jugular vein in sufficient volumes: a minimum of 4 ml of vacutainer EDTA (purple top) is needed for PCR testing (Note: heparin may hamper the PCR reaction).
- Collect serum samples in tubes without anticoagulant or in special serum collection tubes. The tubes should be filled as recommended by the manufacturer.
- After collection, blood tubes without anticoagulant should be allowed to stand upright at room temperature for at least 1–2 hours to allow the clot to contract. The clot can then be removed with a sterile rod and if needed the tubes can be stored at 4 °C for up to 12 hours. Remove the serum using a pipette or decant into fresh tubes. If it is still necessary to clear the serum, the samples can be centrifuged at slow speed (1000 g/2000 rpm) for 15 minutes.
- For pathology, preserve portions of the collected tissue in 10 percent buffered formalin and forward to the laboratory unfrozen.

TRANSPORT AND STORAGE OF SAMPLES

Swift laboratory confirmation of suspected SPP and GTP cases in the field is fundamental for timely disease control.

It is important to collect the right type of samples and send accurately labelled and correctly packaged samples to the nearest laboratory at the right temperature, using the fastest practical mode of transport by the most direct route.

Specimens must be accompanied by a sample submission form. The information required varies depending on the laboratory, but should contain the following information:

- number and type of samples and the animal species;
- sample ID numbers (Note: one must be able to cross-reference each sample to the source animal);
- owner, name of farm, type of farming system;
- sampling location (address, county, district, province, country of origin, as appropriate);
- name of the person submitting samples;
- name(s) of the person(s) to whom results are being sent;
- if the samples are being sent for the purpose of vaccine selection, it should be mentioned in the sample submission form;
- suspected disease, observed clinical signs, and gross lesions (if postmortem has been carried out);
- short epidemiological description: morbidity, mortality, number of affected animals, history, animals involved; and
- potential differential diagnoses.

It is advisable to contact the laboratory prior to sampling to ensure that you follow submission procedures correctly. The laboratory staff should also be informed of the number of samples being sent and when they are expected to arrive.

National transport

National regulations must be followed when transporting samples to the nearest laboratory, even if samples are transported by the staff of the veterinary services. Triple packaging is recommended, even for road transport (see more details under the next section on international transport).

Samples should reach the laboratory as soon as possible to prevent them from deteriorating and to ensure a reliable result. Precautions should be taken to prevent the samples and the environment from being contaminated during transport.

Shipped samples must be packaged with adequate amounts of cooling materials such as ice packs. Samples that arrive at the testing laboratory within 24 hours can be cooled using wet ice. If the transport takes more than one day, then specimens must be packed in dry ice, using appropriate transport medium.

Checklist for sample transport:

- Sample submission form is filled in and included in the package.
- Samples are individually marked with a waterproof marker and labels are securely attached to sample containers that are suitable for storage at – 20 °C to 80 °C.
- Samples are kept cool during transport to the laboratory by using a cool box with wet/dry ice or freezer blocks.
- Samples are sent in leakproof, preferably triple-layer packaging, with absorbent material inside.

Blood, saliva swabs and tissue samples should be kept at 2–6 °C if the shipment takes less than 48 hours and at – 20 °C if it takes more than 48 hours.

Serum samples. Ideally, the serum should be separated before sending the samples. However, this is not always possible. If transport takes less than five days, samples can be kept in a refrigerator at 2–8 °C degrees. If transport is

likely to take more than five days, the serum should be separated, and the clot removed. Serum samples can be safely stored at – 20 °C.

International transport

Due to the heavily regulated, costly, and time-consuming nature of international shipping of infectious material, central veterinary authorities usually assess whether the samples must be sent to an international reference laboratory for confirmation or for sequencing of the circulating strain. The national reference laboratory is responsible for organizing the transport of samples with a courier specialized in the transfer of dangerous goods.

General guidance for sample transport is provided in the WOAH *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (WOAH, 2024). For road transport within Europe, the applicable framework is in the *Agreement on the International Carriage of Dangerous Goods by Road* (ADR), adopted under the auspices of the Economic Commission for Europe (ECE, 2023). In other regions, national regulations for road transport must be followed. According to the International Air Transport Association (IATA) Dangerous Goods Regulations, Packing Instruction 650, samples suspected to be infected with SPPV or GTPV are classified as Biological Substances Class B (Division 6.2), Category B (UN3373). They must be packaged and transported in accordance with PI650, and carriage in checked or carry-on baggage is strictly prohibited (IATA, 2024). Prior to the dispatch of samples, the reference laboratory must be informed of the shipment and shipment details must be agreed upon. An import permit must be obtained from the reference laboratory and included with the sample transfer documents.

The receiving reference laboratory requires the following data:

- flight number/air waybill number;
- courier tracking number;
- date and time of expected arrival at the airport or the laboratory;
- two contact persons for potential queries, and details of those to whom test results should be sent (name, telephone number, fax number, e-mail address); and
- a completed sample submission form/cover letter.

The following documents must be enclosed with the sample package in a waterproof envelope, between the secondary and outer packaging, and also taped to the outside of the package:

- import permit of the receiving laboratory;
- submission form/covering letter;
- list of contents, including the sample type(s), numbers, and volumes;
- air waybill; and
- pro forma invoice – indicating that the samples are of no commercial value.

Dry ice is usually required to keep the samples frozen since international transport, including customs procedures, usually takes more than five days.

Category B samples to must be transported inside triple-layer packaging. The primary (leakproof, water resistant and sterile) container holds the sample. The lid of each sample container must be sealed with adhesive tape or parafilm and wrapped with absorbent material. Several sealed, wrapped primary containers may be placed in one secondary container.

FIGURE 12
Official UN hazard labels used for international transfer of infectious substances

UN 3373 – Biological Substance, Category B (left);
Class 6.2 – Infectious Substance, affecting humans/animals (centre); and
Class 9 – Miscellaneous Dangerous Substances and Articles (right)

Source: **ECE (Economic Commission for Europe).** 2025. Recommendations on the Transport of Dangerous Goods – Model Regulations, 24th revised edition. New York & Geneva: United Nations. https://unece.org/transport/dangerous-goods/un-model-regulations-rev-24.

The secondary leakproof container should contain a sufficient amount of absorbent material. It may be made of either plastic or metal but needs to meet IATA requirements. Dry ice cannot be placed inside the secondary container due to the risk of explosion.

Required labels must be fixed to the rigid outer (third) layer, with sufficient cushioning. The following labels should be attached:

1. Infectious substance/hazard label stating that the package contains a "Biological Substance, Category B" Animal Diagnostic Specimen of no Commercial Value (Hazard to animal health, not human health);
2. Full name, address, and telephone number of sender;
3. Full name, address, and telephone number of addressee;
4. Full name and telephone number of a responsible person knowledgeable about the shipment. RESPONSIBLE PERSON: First name LAST NAME, +123 4567 890;
5. Label reading "conserve at 4 °C" or "conserve at – 70 °C", as appropriate;
6. Label for dry ice (if used) and the proper shipping name of the dry ice followed by the words "AS COOLANT". The net quantity of dry ice (in kilograms) must be clearly indicated; and
7. UN number.

Diagnostic tools

At the time of the writing of this manual, no pen-side tests were commercially available, so all the diagnostic techniques described are performed at a laboratory.

VIRUS DETECTION

Primary diagnostic tests

National animal health laboratories that perform diagnostic tests for SPP and GTP should participate in the annual inter-laboratory proficiency test trials organized by international reference laboratories or other appropriate institutes.

Persistence of the virus in different matrixes is described by EFSA Scientific Opinion on sheep pox and goat pox (EFSA, 2014).

Several highly sensitive, well-validated, real-time, and gel-based PCR methods are available and widely used to detect the presence of CaPV DNA (Haegeman *et al.*, 2020b). In general, the performance of real-time and conventional PCR tests is excellent. However, molecular assays cannot indicate whether the virus is still infectious or not.

Electron microscopy examination can also be used for primary diagnostics although it is uncommon.

It is not possible or necessary for all animal health laboratories to have the capacity to isolate live viruses because it requires working with cell cultures in level 3 biosecurity facilities (BSL-3). Isolation of circulating field isolates is usually only needed for whole genome sequencing, experimental vaccine challenge trials, or for the development of a vaccine seed. Live SPPV or GTPV can be isolated using various cell cultures of bovine, ovine or caprine origin, with primary cells being more sensitive.

Differentiation between sheep pox virus and goat pox virus

Sometimes, clinical signs are observed in both sheep and goats in mixed herds. Since homologous vaccines provide the best protection, it is important to identify whether the outbreak is caused by SPPV or GTPV to be able to select the most effective vaccine. Several species-specific PCR methods are published which differentiate between LSDV, SPPV and GTPV (Lamien *et al.*, 2011a; Lamien *et al.*, 2011b; Le Goff *et al.*, 2009; Gelaye *et al.*, 2013) and a PCR method that differentiates between eight pox viruses of medical and veterinary importance (Gelaye *et al.*, 2017). These species-specific assays are also valuable tools if typical clinical signs of SPP or GTP are detected in wild ruminants in a country where all members of the *Capripoxvirus* genus (i.e. LSD, SPP and GTP) are endemic.

ANTIBODY DETECTION

During or shortly after an outbreak (up to one year), most infected animals seroconvert and serum samples can be tested using serum/virus neutralization, immunoperoxidase monolayer assay (IPMA) (Haegeman *et al.*, 2020a) or indirect fluorescent antibody test (IFAT) (Gari *et al.*, 2008). At present, an enzyme linked immunosorbent assay (ELISA) is also commercially available.

During inter-epizootic periods (i.e. the quiet periods between epidemics) serum antibody levels alone may give a misleading picture of the immune status of a naturally infected or vaccinated animal. Seronegative animals may indeed be fully susceptible, but they may also have been previously infected and now rely mainly on cell-mediated immunity, with antibody levels having declined below the detection threshold of available tests. Likewise, some vaccinated animals may show only a weak or short-lived antibody response.

In summary, commercially available serological tests may lack the sensitivity to detect mild infections and those that occurred more than one year before, due to waning antibody levels. There are no well-validated tests available to measure cell-mediated immunity for SPP and GTP, making a full assessment of immune responses to these viruses limited.

National and international reference laboratories

Rapid laboratory confirmation is essential in the successful control of SPP and GTP outbreaks. Diagnostic capacity to carry out primary detection of SPP and GTP should be in place in all affected and at-risk countries.

Reference laboratories have special expertise in the designated diseases. They can assist when confirmation of the primary diagnosis is needed or in solving scientific problems, often related to whole or partial sequencing of the local field isolate. Reference laboratories can also provide guidance in vaccine selection. They organize annual inter-laboratory proficiency testing (ring trials), as well as training of laboratory personnel.

International reference laboratories for SPP and GTP contact information (valid as of the time of publishing).

European Union and WOAH reference laboratory for SPP and GTP

Sciensano, Belgium
Dr Nick De Regge
(nick.deregge@sciensano.be)
Groeselenberg 99
1180 Uccle
Belgium
Tel: +32 23790514
E-mail: eurl.capripox@sciensano.be

WOAH reference laboratories for SPP and GTP

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Control and prevention of sheep pox and goat pox

AWARENESS

A key aspect for the implementation of any prevention or control measure is the deployment of effective awareness campaigns. Campaigns should target official and private veterinarians, both in the field and abattoirs, veterinary students, farmers, herdsmen, animal traders and drivers of animal transport vehicles. These professionals should be able to recognize infected animals and report any clinical suspicion to the competent veterinary authorities as soon as possible. Farmers also need to learn how to protect their animals against infection and the importance of complying with the regulations, restrictions and instructions of authorities.

FARM BIOSECURITY

At farm level, general biosecurity rules apply. Most importantly, when the disease is circulating in the area, the introduction of new animals should be avoided. If necessary, they should only be brought in from trusted sources and examined and deemed to be free of clinical signs of SPP or GTP prior to movement from the farm of origin and on arrival at the new farm. New animals must be kept in quarantine (i.e. separated from the herd) for 21 days. Ideally, new animals should be vaccinated 21 days before being introduced to a holding.

Visitors and vehicles entering farms should be limited to only those that are essential and must follow thorough personal biosecurity, and cleaning and disinfection protocols. Enforcing other biosecurity measures can also help in preventing outbreaks. Such measures may include disinfection barriers; dedicated clothing for workers; disposable clothing and boot covers for visitors; regular and thorough cleaning and disinfection of the premises, equipment and tools (particularly if they are shared between different farms, which should be avoided); proper fencing; and regular training of workers.

In affected villages, sheep and goats should be kept separate from other herds by avoiding communal grazing. This should be done only if animal welfare issues do not arise, especially related to the feeding of animals. In many cases the whole village forms a single epidemiological unit, therefore the feasibility of separation must be evaluated on a case-by-case basis.

VACCINATION STRATEGIES

In case of increased risk of SPP or GTP introduction, the best protection comes from prophylactic vaccination of the entire sheep and goat population, carried out in at-risk areas well in advance. Commercially available, live attenuated vaccines are safe and provide good, long-lasting protection. Often, endemic countries have vaccine production of their own, so vaccines are readily available in the event of an outbreak. Regionally harmonized, cross-border vaccination campaigns are highly recommended. Currently, no DIVA (differentiation of infected from vaccinated animals) vaccines are available against SPP or GTP. However, depending on the choice of vaccine, molecular DIVA may be feasible (Chibssa *et al.*, 2018; 2019). Additionally, while further validation may be needed, an ELISA has been developed to detect antibodies against SPPV field strains, but not all vaccine strains (Berguido *et al.*, 2024).

The use of an attenuated live vaccine in a disease-free but high-risk country usually requires special authorization. The authorization process takes time and may delay the start of the vaccination campaign.

Many SPPV strains only infect sheep and GTPV strains only infect goats. A homologous vaccine is the best vaccine choice. When an outbreak occurs in a mixed herd and the strain infects both sheep and goats, it is important to identify if the causative strain is SPPV or GTPV and select the vaccine accordingly.

Annual vaccination is usually recommended in affected countries, and harmonized vaccination campaigns across regions or countries provide the best protection.

In the event of an outbreak, lambs and kids from naïve dams should be vaccinated at any age, while young animals from vaccinated or naturally infected mothers should be vaccinated at three to four months of age.

Sheep and goats must be vaccinated 21 days before any movements. As an example, prior to moving animals to summer/winter pastures or to be sold in animal markets. Movements of vaccinated animals in a given zone can be allowed 21 days after vaccination with a vaccine shown to be effective, ensuring that immunity is fully established.

Live, attenuated SPP and GTP vaccines do not usually cause significant adverse reactions in animals. A small local reaction may be observed at the vaccination site, which is acceptable as it indicates that the attenuated vaccine virus is replicating and providing good protection.

FIGURE 13
Authorized transport of a goat in a small vehicle

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Vaccination of pregnant animals is usually safe, but because there are so many different products on the market, the manufacturers' recommendations must be checked and followed.

Additional generic guidance on the implementation of vaccination campaigns can be found in the FAO guidelines on the topic (Ferrari and Mariano, 2022).

SHEEP AND GOAT MOVEMENT CONTROLS

During an outbreak, movement of unvaccinated sheep and goats presents the greatest risk factor for disease spread and should be strictly regulated or totally banned, particularly for breeding animals. In practice, the effective control of animal movements can be difficult as small ruminants are easily transported in different types of vehicles (Figure 13). Appropriate legal powers must be given to veterinary authorities so that they may organize effective control measures on animal movements. These powers also provide a legal basis for actions when illegal transport of sheep and goats is detected or suspected. During an outbreak, authorized sheep and goat movements should be accompanied by a veterinary certificate, indicating animal identification, farm of origin, vaccination status and results of clinical examination confirming the absence of any clinical signs of SPP or GTP.

In many regions, unauthorized cross-border trade takes place despite implemented restrictions, underlining the importance of regional (i.e. coordinated) vaccination. Smuggling of sheep and goats should be subject to severe penalties.

If SPP or GTP is suspected on a farm, sheep and goats must be immediately isolated to their living quarters and the movement of small ruminants or their products to or from the premises should not be allowed. Animal movement restrictions should remain in place until laboratory results are available that either confirm or exclude the presence of SPP or GTP infection. Because the restrictions are likely to cause

financial and other practical problems for the farmer, a contingency plan must indicate the maximum period for which the restrictions based on suspicion can remain in force.

In an outbreak situation, movement of unvaccinated animals is not permitted. Animal markets and trade in live unvaccinated sheep and goats, as well as the movement of breeding animals, should not be allowed in the region.

Movement of vaccinated animals can, however, be allowed in a well-defined zone. Before transport, sheep and goats must wait until 21 days after vaccination to develop full immunity. This waiting period after vaccination also applies to nomadic and seasonal farming practices.

Slaughter of small ruminants should be allowed only in slaughterhouses inside the restricted zone. Sending unvaccinated animals from an infected area to a slaughterhouse in a disease-free area is very risky. Animal transport vehicles can carry the virus on their surfaces, and slaughterhouse workers can also spread it. If unvaccinated animals are allowed to rest during the transport or kept in open pens before the slaughter, the virus can escape and infect nearby farms. Still, sometimes animals must be moved for emergency slaughter outside the vaccinated or infected zone if slaughter is not possible on-site and no slaughterhouse exists within the zone. Emergency slaughter can be allowed in a slaughterhouse outside the infected or vaccinated zone if the following requirements are met:

- Transport is authorized by an official veterinarian.
- No sheep or goats showing clinical signs of SPP or GTP are detected in a clinical examination on the holding of origin.
- The slaughterhouse is designated for the purpose by veterinary authorities.
- Transport of the animal directly to the slaughterhouse is done out under official veterinary supervision, following strict biosecurity rules.
- The official veterinarian responsible for the slaughterhouse is informed in advance.

STAMPING-OUT POLICIES AND DISPOSAL OF CARCASSES

Culling animals showing clinical signs of SPP or GTP is recommended in order to eliminate the primary source of infection and stop the spread of the disease to other animals. Sheep and goats showing clinical signs of SPP or GTP do not qualify for slaughter for human consumption and the value of their skins and hides may have been degraded by permanent scarring.

For the European Union Member States, implementation of the total stamping-out policy – meaning the killing and safe disposal of all infected and in-contact animals in the epidemiological unit – is obligatory. This requirement is set out in the European Union (EU) *Animal Health Law* (Regulation (EU) 2016/429) (European Union, 2016), and detailed further in the *Commission Delegated Regulation* (EU) 2020/687) on rules for the prevention and control of certain listed diseases (European Union, 2020).

If the stamping-out measure is practiced because of the local legal framework, farmers must receive fair and timely compensation covering the costs of loss of the animals. Without adequate compensation, farm owners are likely to object to the measure, leading to reduced reporting and the dissemination of the disease through illegal movements of infected animals.

In many regions where the disease has been endemic for a long time, despite the lack of official compensation available, sheep and goat farmers often prefer to remove sick animals from the herd as soon as possible at their own cost, after the first clinical signs appear and suspicion of SPP or GTP is raised. The effect of partial stamping out of small ruminants on farmers' livelihoods is likely to be less severe than allowing infected animals to spread the disease in the herd and in the region.

When stamping out is dictated by the veterinary authorities, public perception and media involvement should be considered before taking any decisions. The official stamping-out measure is usually carried out by the local culling teams appointed by the veterinary services. The number of members on the culling team should be adjusted to the number of animals to be culled at the farm and/or in the region. Before culling starts, all necessary epidemiological data and samples must be collected and recorded.

Appropriate methods for culling sheep and goats include: 1) injection with overdose of barbiturates or other appropriate lethal drugs; 2) penetrative captive bolt; and 3) in rare occasions, free bullet. The chosen culling method needs to ensure the welfare and minimum suffering of the animals and the safety of the staff and farmers.

Infected animals should be destroyed on the spot, under the supervision of the culling team, to reduce the risk of virus spread. Carcasses can be disposed of by burial, burning, rendering or composting, depending on nationally approved procedures, the number of carcasses, as well as equipment, environmental, and logistical considerations. These aspects of culling are discussed in depth in the FAO *Carcass management guidelines* (FAO, 2020). Waste, animal feed, litter, manure, or slurry must be treated as potentially contaminated material and disposed of together with the carcasses according to the regulations and advice of official veterinary authorities.

The market value of the animals should be evaluated by the veterinary authority and agreed upon with the farmer. The agreement must be officially documented and signed by all parties. There are different compensation modalities, e.g. monetary or live-immunized replacement animals, which are not discussed in this manual. The only key requirement is for compensation to be fair and paid in a timely manner.

As the SPP and GTP viruses are highly contagious and stable, they can persist for long periods in the environment or, in theory, be transmitted by insect vectors. Unprotected replacement animals are at risk of being infected if they are introduced to previously infected premises too soon. Ideally, farmers should be provided with healthy and immunized animals. Nevertheless, restocking should not be permitted until at least 21 days after completion of cleaning and disinfection of the infected premises. To have full protection from the vaccine, the replacement animals should be vaccinated at least 21 days before moving to the thoroughly cleaned and disinfected premises.

CLEANING AND DISINFECTION OF PREMISES AND THE ENVIRONMENT

SPPV and GTPV are very stable and survive even in cold and dry environments within a pH range of 6.3–8.3. Infected animals shed scabs from skin lesions and inside the scabs the virus may remain infectious for several months.

Cleaning and disinfection must be carried out in accordance with the guidance provided by official veterinarians, ensuring that all infectious agents are destroyed. Cleaning and disinfection must comprise premises, vehicles, equipment and tools, personnel's clothing and footwear, and any other potentially contaminated environment. Any substance or waste, such as animal feed, litter, manure, or slurry, which is liable to be contaminated should be destroyed or treated appropriately.

Cleaning (i.e. the mechanical removal of surface material such as dirt, manure, hay, and straw) is required before the disinfection of stables and animal facilities takes place.

Disinfectants must be approved by the veterinary authorities and used according to the manufacturer's instructions for concentration and contact time.

FAO provides practical recommendations for decontamination of premises, equipment, and the environment in the *Manual on procedures for disease eradication by stamping out* (FAO, 2001).

Surveillance programmes

Surveillance programmes are based on active and passive clinical surveillance and laboratory testing of blood samples, nasal and saliva swabs, and skin biopsies collected from suspected cases.

Seroconversion after SPP and GTP outbreaks has been described in this manual in the section regarding diagnostic tests. Serosurveillance can be used when investigating outbreaks in disease-free regions with unvaccinated sheep and goats that border or are near outbreak regions. In such areas, the presence of seropositive animals can be considered an indication of recent infection. As there are no DIVA vaccines against SPP or GTP, serological surveillance is of limited use in affected areas where the entire sheep and goat population is vaccinated.

Serosurveillance can also be a tool to monitor the efficacy of the vaccine or effectiveness of the vaccination campaign. It should be carried out one to two months after the vaccination campaign, when the seroconversion in vaccinated animals is at the highest level, and combined with clinical surveillance.

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Sheeppox and goatpox are among the most economically devastating poxvirus diseases of small ruminants, threatening rural livelihoods, food security and trade across Africa, the Middle East, Europe and Asia. This field manual provides veterinarians and animal health professionals with clear, practical guidance for the early detection, control and prevention of these transboundary diseases in endemic and at-risk countries.

Developed by the Food and Agriculture Organization of the United Nations (FAO) as part of its global effort to strengthen animal health systems, the manual translates complex scientific knowledge into operational tools that can be directly applied in the field. It describes the epidemiology and clinical signs of sheeppox and goatpox, standard diagnostic approaches, outbreak investigation procedures, biosecurity measures, and vaccination strategies. Illustrated with detailed photos and case examples, it serves as both a reference and a training resource for field veterinarians, laboratory staff and animal health technicians.

By promoting harmonized surveillance, reporting and control practices, this manual supports the progressive control of sheeppox and goatpox and contributes to reducing the burden of small ruminant diseases globally. It complements FAO's broader initiatives on transboundary animal disease management and sustainable livestock production. The manual is intended for veterinary authorities, field practitioners, educators and partners engaged in improving animal health, productivity and resilience in small ruminant value chains.

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