DISCONTOOLS

Contagious Caprine Pleuropneumonia (CCPP)
Summary

Introduction
This note provides a brief summary of the Disease and Product analysis prepared by a DISCONTOOLS group of experts on <disease name>. They reviewed the current knowledge on the disease, considered the existing disease control tools, identified current gaps in the availability and quality of the control tools and finally determined the research necessary to develop new or improved tools. Full details are available on the web site at http://www.discontools.eu/.

Disease profile
CCPP is a severe, contagious respiratory disease of goats caused by *Mycoplasma capricolum* subsp. *capripneumoniae* (Mccp). It primarily affects domestic goats but has also been detected in several wild ungulate species, at least in captivity. Classical, acute CCPP is characterised by unilateral fibrinous pleuropneumonia and pleurisy, with morbidity and mortality often reaching 80-100% in naïve populations. It is regarded as one of the most serious mycoplasma infections of livestock and a key transboundary animal disease due to its capacity for rapid spread and its economic impact. For these reasons, CCPP is listed by the World Organisation for Animal Health (WOAH) as a notifiable disease.
CCPP occurs across Africa, Asia, and the Middle East. However, its true distribution and impact remain poorly understood because of limited surveillance and under-reporting. The disease is neglected despite its major consequences for animal health and livelihoods, particularly among smallholder farmers and pastoralists in low- and middle-income countries (LMICs). On the other hand, especially in Asia, some cases reported are in fact due to other mycoplasmas. Furthermore, significant discrepancies between official reports submitted to WOAH and findings in the published literature hamper an accurate understanding of its true distribution. More recently, CCPP has been reported in the Thrace region of European Turkey, posing a threat to the European Union.
Transmission occurs mainly through direct contact and inhalation of respiratory droplets from infected animals. Environmental survival of the pathogen is limited, but movement of infected goats facilitates long-distance spread. The disease is associated with extensive antibiotic use, frequently without veterinary oversight, which raises concerns about the emergence of antimicrobial resistance (AMR).

Risk
CCPP is regarded as a disease of high impact due to its high transmissibility, mortality, and economic cost. In endemic regions, trade restrictions and production losses due to death, reduced growth, milk yield, and reproductive performance contribute to major economic constraints for small livestock keepers.
The disease poses a growing risk of geographic expansion, driven by animal movements and possibly climate change. Owing to weak veterinary infrastructure and limited diagnostic capacity, outbreak data are often incomplete or delayed, resulting in inadequate early detection and control responses.
There is insufficient quantitative information about CCPP epidemiology. Key knowledge gaps include latency, infectious period, recovery rate, mortality under different husbandry conditions, and the persistence of possible carrier states. The role of co-infection with other pathogens, such as sheep and goat poxviruses and peste des petits ruminants (PPR) virus, requires further study to understand synergistic effects and implications for surveillance and control.

Diagnostics
There are currently no validated commercial diagnostic kits available for CCPP, either for molecular detection or serological screening, and no pen-side tests suitable for rapid diagnosis in the field. Laboratory diagnosis relies on PCR assays and traditional culture methods that are slow, technically demanding, and limited to specialised laboratories.

Further research is urgently needed to develop and validate highly sensitive and specific diagnostic tests. This includes OMICS studies on Mccp and related mycoplasmas to identify novel diagnostic targets that can distinguish Mccp from closely related species. Development of inexpensive, rapid, and portable field assays would greatly improve surveillance and support outbreak management, particularly in resource-limited contexts.
Market analysis is required to assess the affordability and expected uptake of new diagnostic tools, especially pen-side screening tests suitable for LMICs. Validation of diagnostic assays according to international standards is essential, as are the establishment of reference materials, standardised reagents, and qualified sample panels.

Vaccines

CCPP vaccines remain critically underdeveloped and under-supplied. Only a few manufacturers produce them, and supply is insufficient to meet demand. Current inactivated vaccines are costly and technically challenging to produce due to the slow and fastidious growth of Mccp. As a consequence, many commercial products do not fully comply with WOAH standards and fail to induce consistent immune responses or adequate protection. Therefore, quality control requirements need to be reviewed in order to guarantee vaccine compliance.
Affordable, safe and stable vaccines providing good and long-lasting protection (at least one year) are needed. Full validation of new formulations based on fast-growing strains, inactivated and adjuvanted in oil emulsions, is required, as is the validation of subunit vaccines currently under development in China. The development of multivalent or co-formulated vaccines using oil adjuvants, compatible with major caprine diseases such as foot-and-mouth disease, could greatly improve affordability and uptake. Market studies will be necessary to support this approach. Alternatively, live vaccines could be combined in a single formulation (e.g., with PPR vaccines) to support integrated disease control programmes. However, the development of live attenuated vaccines is limited by Mccp's extreme thermosensitivity and by safety considerations.
Synthetic biology approaches could transform Mccp vaccine development by enabling the design of genetically stable strains that are easier to culture, have shorter generation times, and produce higher antigen yields. Such tools could also facilitate the creation of DIVA (Differentiating Infected from Vaccinated Animals) vaccines based on marked strains.
Investment in upgraded production facilities will be necessary to support research and large-scale manufacture of next-generation vaccines, including subunit, recombinant, and synthetic vaccines. New quality control procedures will also be needed, tailored to the characteristics of modern vaccine platforms.
Finally, regulatory frameworks and policies may require revision to accommodate vaccines derived from genetically modified organisms, ensuring both biosafety and public trust. In parallel, socio-economic research will be vital to inform vaccine adoption strategies, assess willingness to pay, and promote uptake among smallholders. Identifying biomarkers of protection could improve potency testing and reduce the need for animal challenge studies.

Pharmaceuticals

At present, antibiotics are widely used for CCPP control, though their use is often informal and not based on robust evidence. Data on the efficacy of specific antimicrobial agents against Mccp under controlled conditions are scarce.
There is an urgent need for robust experimental and field studies to evaluate antimicrobial performance and inform evidence-based treatment protocols. Standardised antimicrobial susceptibility testing (AST) procedures, using reference Mccp strains and harmonised methodologies, should be developed to support consistent interpretation and AMR surveillance.
Improved data would enable the drafting of rational antibiotic use guidelines, promoting responsible stewardship and reducing selection pressure for AMR. Transitioning from unregulated antibiotic use to controlled therapeutic regimens will require supportive legislation, veterinary training, farmer education, and coordinated communication campaigns.

Knowledge

Substantial information gaps persist across multiple domains, especially in relation to the pathogenesis and host immune response, as well as the epidemiology of the disease and its impact. Research is needed to fill these gaps, which are closely linked to the research requirements to develop more effective tools and strategies for the control of the disease.

A better understanding of the molecular and cellular mechanisms underlying host-pathogen interactions is needed to support the development of more effective vaccines and treatments. In particular, the correlates of protective immunity remain poorly defined and must be elucidated to guide rational vaccine design. Continued research is also required to identify novel therapeutic targets and to support the development of alternative interventions, including immunomodulatory approaches and host-directed strategies (e.g., the use of short-chain fatty acids to modulate host immunity and inflammation). Advanced *in vitro* infection models, such as multicellular co-cultures and organoids, are likely to be particularly valuable in addressing these knowledge gaps.

In epidemiology, key priorities include the development of mathematical models incorporating mobility, husbandry, and environmental data to predict transmission risk and identify surveillance hotspots. Reliable models could guide the timing of vaccination campaigns and focus field interventions.

Current data are inadequate to quantify the economic burden of CCPP. Few studies exist on direct production losses, market impacts, or indirect effects on trade and livelihoods. Applying rigorous analytical frameworks, similar to those used for foot-and-mouth disease or avian influenza, could provide much-needed insight into the economic case for disease control.

Surveillance and reporting remain inconsistent. Under-notification and passive data collection lead to significant underestimation of disease prevalence. When outbreaks are reported, details on timing, spatial extent, and management conditions are often missing. Improved reporting systems incorporating geo-referenced outbreak data, herd characteristics, and husbandry practices would support better spatio-temporal analysis and risk mapping.

Understanding the interplay between CCPP and co-endemic diseases, mobility patterns, and production systems will also assist in quantifying transmission parameters and disease persistence. Participatory epidemiology and community-based data collection could complement formal surveillance, especially in remote or resource-poor areas.

Conclusions

CCPP remains a neglected but economically and socially significant disease, particularly in LMICs. It causes substantial losses and undermines the livelihoods of small ruminant keepers, while contributing to unregulated antibiotic use and the emergence of AMR.

Effective control requires a comprehensive, evidence-based policy framework integrating antibiotic stewardship, vaccination, movement management, and targeted surveillance. Standardised AST protocols for Mccp are urgently needed to enable AMR monitoring, while improved diagnostic and vaccine tools will be key to long-term control and possible eradication.

Strengthening surveillance systems, stimulating vaccine innovation, and conducting integrated pilot control programmes combining vaccination, test-and-slaughter, and movement restrictions should be prioritised. Only through coordinated efforts across research, industry, and veterinary services can sustainable solutions for CCPP control be achieved.