

# Emerging and reemerging infectious diseases of sheep and goats

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## Abstract

Respiratory and gastrointestinal disease are common causes of morbidity and mortality in sheep and goats. They are particularly common in animals experiencing transport stress and/or comingling of animals from multiple sources. This session will focus on a number of viral and bacterial pathogens that are emerging or reemerging as microbes of concern in sheep and goat flocks.

## Introduction

Infectious diseases, particularly those that are highly contagious, can have significant impacts on small ruminant herds through mortality and loss of production. Respiratory and gastrointestinal disease (excluding parasites and enterotoxaemia) account for ~10% of non-predation losses in sheep and goats in the 2015 NAHMS.<sup>10,15</sup> These reports do not address non mortality production losses. Herds that are involved in livestock exhibition (Smith 2021, under review), that comingle animals for multiple sources on grazing land, and animals impacted by the effects of natural disasters, are likely at higher risk for development of infectious diseases.<sup>4,8,13</sup> Additionally, in areas where there are wildlife-domestic animal interfaces, these diseases can cross over into wild small ruminants with devastating effects. This session will be focused on three pathogens, coronavirus, respiratory syncytial virus and *Mycoplasma ovipneumoniae*, that should be considered emerging or re-emerging in small ruminants and warrant further consideration both from a research and clinical point-of-view.

## Discussion

Coronaviruses (CoV) have known tropism for both the respiratory and gastrointestinal tract. They are very well described in cattle as causing neonatal diarrhea and winter dysentery, as well as being part of respiratory disease complex.<sup>5</sup> The significance in small ruminants is less well characterized. CoV has been associated with diarrheal disease in captive adults and neonatal wild ruminants.<sup>1</sup> CoV have been isolated from diarrhetic lambs and adult sheep, but CoV as a definitive cause of morbidity in sheep is not well established.<sup>2</sup> In goats, CoV is not considered a pathogen of significance in neonatal diarrhea,<sup>12,14</sup> however, a recent large diarrheal outbreak in adult goats was associated with fecal CoV PCR positivity (Smith 2021, under review) and subsequent herd level seroconversion (Buktenica, unpublished). While the outbreak had a negligible mortality rate, it had a negative impact on milk production as well as lost milk for treatment withholding periods. The major clinical signs were change in fecal consistency, decreased milk production and anorexia, with a small number reporting fever and cough (Smith 2021, under review). Subsequently, several other similar outbreaks have occurred following large goat exhibitions which again resulted in affected animals being CoV PCR-positive (unpublished) at much higher incidence than has been reported in healthy goat populations.<sup>6</sup> Coronaviruses appear to

be associated with diarrheal outbreaks in adult goats and may represent an emerging infectious disease in goats.

Respiratory syncytial viruses are known to cause respiratory disease in a multitude of species. Both neonatal bovine and ovine RSV have been used as animal models of human disease as human RSV can cause severe and life-threatening disease in neonatal humans.<sup>3</sup> Very little has been reported in the literature on the impact of RSV on domestic sheep and goat operations. Spontaneous RSV causing significant mortality has been reported in goat kids in Spain. Clinical signs typically include high fever, increased respiratory rate, spontaneous coughing and nasal discharge; severe cases can develop subcutaneous edema from bullous rupture in the lung. The virus attacks the mucous-producing cells of the respiratory epithelium, damaging the muco-ciliary apparatus, and predispose animals to secondary bacterial infection. RSV has been documented in several spontaneous outbreaks of severe respiratory disease in 8-10-month-old doelings in Northern California. Clinical signs were characterized by high fevers (>104°F), increased respiratory rate, adventitial lung sounds, fetal loss and death. Post-mortem examination revealed broncho-interstitial pneumonia, fibrinous, acute, with severe diffuse type II pneumocyte hyperplasia and pulmonary edema. The lungs were both PCR-positive for RSV using bovine RSV primers and immunohistochemistry was positive for RSV (unpublished). Further research is needed to characterize naturally occurring RSV infectious in sheep and goats, but clinical and pathologic findings suggest that RSV can cause significant morbidity and mortality.

*Mycoplasma ovipneumoniae* is a respiratory pathogen that has been globally documented in sheep and goat populations. While it has been well-described in Asian, African and European small ruminant populations, it was not until recently that prevalence in U.S. domestic sheep operations have been investigated. It is often found in polymicrobial lung infections in both wild bighorn and domestic sheep, along with the Pasteurellaceae family bacteria, *Truiperella pyogenes* and *Fusobacterium necrophorum*. Both the 2011 NAHMS Sheep study and the 2019 NAHMS Goat study included sampling for *M. ovipneumoniae*. The results from the 2011 Sheep study were recently published and found the prevalence of *M. ovipneumoniae*-positive flocks was 88.5%, however, within herd prevalence varied widely, with overall prevalence in individual animals being 29.4%.<sup>13</sup> The study found that *M. ovipneumoniae* has a negative impact with an annual reduction of 4.3% in lamb production.<sup>13</sup> Unpublished data from several studies on domestic goats report a premise prevalence of 12-44% and 2.5-8% animal prevalence rate of *M. ovipneumoniae*.<sup>16</sup> More comprehensive data will be available soon from the 2019 NAHMS Goat study. A recent European study showed a re-emergence of *M. ovipneumoniae* in both sheep and goats not associated with antimicrobial resistance.<sup>11</sup> Experimental exposure of lambs to *M. ovipneumoniae* resulted in increased lung microscopic lesions, lower daily rate of gain and lower yield grade carcasses as compared to unexposed lambs.<sup>4</sup> Interaction between domestic and wild Caprinae

subfamily members may put wild populations at greater risk for colonization with *M. ovipneumoniae* with potentially devastating effects on population of protect/endangered subspecies such as the peninsular bighorn sheep in southern California.<sup>7</sup> Unfortunately, a chronic carrier state is one mechanism by which *M. ovipneumoniae* persists in populations of sheep. Interestingly, for both wild and domestic flocks, a recent study showed removing *M. ovipneumoniae* PCR-positive ewes from bighorn flocks reduced mortality hazard in lambs by 72% compared to populations where chronic shedders were not removed.<sup>9</sup> The importance of *M. ovipneumoniae* as a pathogen cannot be underestimated and is likely negatively affecting production in U.S. sheep populations.

## Conclusion

Identification of important infectious of respiratory and gastrointestinal diseases in small ruminant populations is very important if we are going to be able to enact control and prevention strategies. Here, we briefly cover several pathogens that until recently have been poorly described or not identified in US sheep and goat populations.

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