

## Coronaviruses in pigs Summary

### Introduction

1. This note provides a brief summary of disease and product analyses prepared by a DISCONTTOOLS group of experts on coronaviruses (CoVs) in pigs. They reviewed the current knowledge on CoV diseases in pigs, 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

2. There are currently six known CoVs circulating in the global pig population: (1) porcine respiratory coronavirus (PRCV), (2) transmissible gastroenteritis virus (TGEV), (3) porcine epidemic diarrhoea virus (PEDV), (4) swine enteric coronavirus (SeACoV), (5) porcine hemagglutinating encephalomyelitis virus (pHEV) and (6) porcine deltacoronavirus (PDCoV). Enteric coronaviruses (TGEV, PEDV, SeACoV, PDCoV) cause very similar clinical signs and cannot be distinguished without virus detection and characterization. Clinical signs depend amongst others on virus strain and age of the infected animal and can include profuse diarrhoea and vomiting with commonly only piglets severely affected. Morbidities and mortalities can be as high as 100% in PEDV infected piglets. PRCV causes respiratory symptoms but the infection is mostly subclinical. pHEV presents in two main clinical forms in piglets: vomiting and wasting disease or acute encephalomyelitis with motoric disorders.

### Risk

3. CoVs are generally highly infectious but the spread and clinical signs depend largely on factors such as environmental conditions, biosecurity, stocking densities and immune status such as previous exposure (vaccine or field infection) or concurrent infections. The impact of PEDV on a naïve population has been demonstrated when it was introduced into the North American pig population in May of 2013. Within its first year in North America, PEDV was associated with the death of 8 million suckling piglets, severely affecting the animal welfare. In addition to its impact on the entire pork supply chain in a region/country/continent, PEDV introduction also leads to trade issues between PEDV infected and free countries. The impact of TGEV, SeACoV, pHEV PDCoV and especially PRCV is currently seen as less important. However, the evolution of the more recently identified PDCoV and SeACoV in this aspect remains to be better investigated and monitored. No infection of humans with these swine specific CoVs has been reported to date.

### Diagnostics

4. Commercial test kits include antibody detection via ELISAs and RNA detection via PCR. Lateral flow devices have been described but are currently not commercially available. Most commercial serology assays are based on utilizing serum samples. There is a need to investigate other sample types such as enteric content, oral fluid or milk/colostrum.

5. No commercial assays are currently in place to test pigs for SeACoV or PHEV.

6. In the past screening for TGEV via antibody assays in meat-juices obtained from routine abattoir collections was routinely done. These surveillance programmes have been reduced due to decreasing prevalence of TGEV, but it may be useful to be resumed to also detect other CoVs. Surveillance programmes should be capable to quickly detect mutants.

7. More on-farm monitoring/testing may be beneficial as this would reduce the overall cost for farmers and also would allow the detection of unexpected CoV strains in real time. Currently there are no commercial pen site tests available in Europe. In general, knowledge on circulating CoVs would be greatly facilitated by a novel multiplex test kit that includes all CoV targets in association with routine sequencing to identify new pig CoV variants early.

8. More inter-laboratory comparisons and sharing control samples would be of great benefit to improve diagnosis.

### **Vaccines**

9. There are currently no pig CoV vaccines used in Europe. In North America and Asia both inactivated, recombinant and live attenuated vaccines are commercially available for PEDV. Live and attenuated vaccines are available for TGEV. Bivalent vaccines including both TGEV and PEDV are also used in Asia. Efficacy against European strains of TGEV and PEDV is unknown.

10. TGEV is disappearing (not very prevalent) and few commercial vaccines are available. For PEDV several vaccines, all containing similar strains, are available. Cross-protection among genogroups 1 and 2 is suspected to be limited. As PEDV continues to evolve, potentially giving rise to new, more pathogenic strains, it is important to continue to survey for novel PEDV variants that may emerge locally or globally.

11. Vaccine platforms that allow a rapid change of strain should be promoted as a precaution. This goes hand-in-hand with a need for rapid regulatory approval if new or variant strains with higher pathogenic potential are being discovered.

### **Pharmaceuticals**

12. No antivirals are available and would only be useful when they are cheap, applicable via drinking water or feed and have a very short withdrawal period. As CoV can evolve rapidly, drug-resistance could emerge quickly.

13. In Asia and North America, chicken egg yolk antibodies have been developed and utilized in pigs to protect pigs in ongoing PEDV outbreaks (especially naïve herds). This method has attracted considerable attention as an alternative to antibiotics to maintain swine health and performance.

### **Knowledge**

14. Side by side experimental pig infections may be useful to further clarify if there are clinical differences, differences in viral shedding, in immune response and in mortality for different CoVs and CoV strains.

15. More work is needed to assess the potential importance of SeACoVs.

16. Cellular immunity is almost never determined when assessing CoV infections although considered important. Currently fresh blood needs to be processed within a few hours after collection and there are only few labs that can do the testing. Easier tests or appropriate on farm preservation methods of samples to determine and understand cell-mediated immunity need to be developed.

### **Conclusions**

17. CoV infection in pigs can cause devastating disease in naïve populations. CoV strains that can cause massive disease outbreaks are present in many pig populations in certain geographic areas. Trade and traffic can easily promote virus transmission and introduction in distant regions at any time. Preparedness for introduction of new strains or CoVs is important and should be based on (i) having appropriate CoV molecular and serological diagnostic tools in place for routine surveillance and (ii) having vaccine platforms ready to rapidly respond to novel strains and to upscale vaccine production when needed.