

# Classical Coronavirus infections (PEDV, TGEV, PRCV)

Importance, epidemiology and  
control

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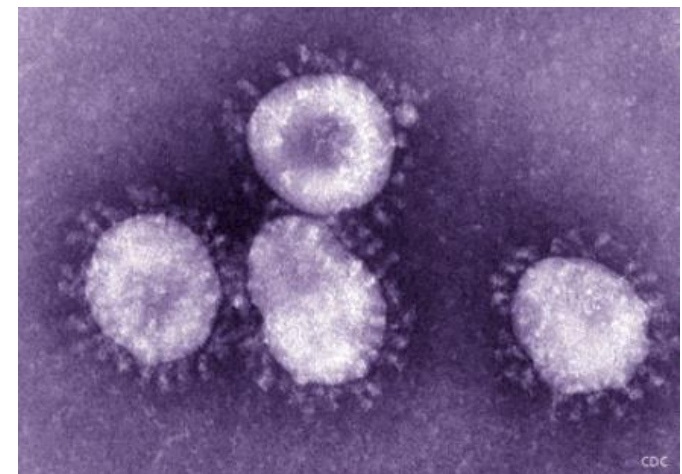
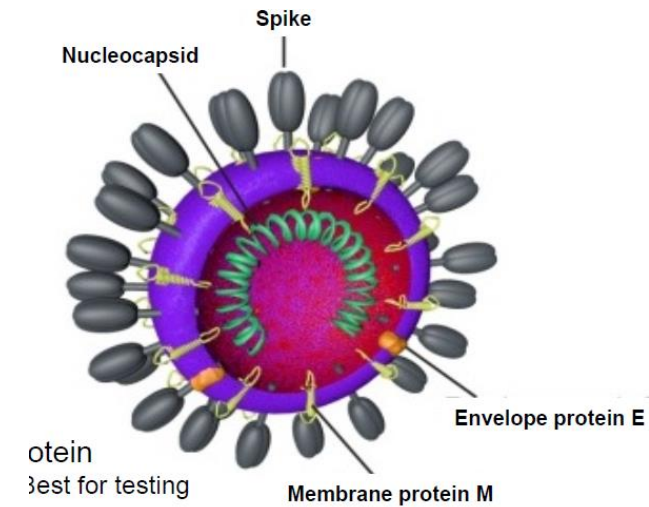
CPH Pig webinar January 28th, 2021

UNIVERSITY OF COPENHAGEN



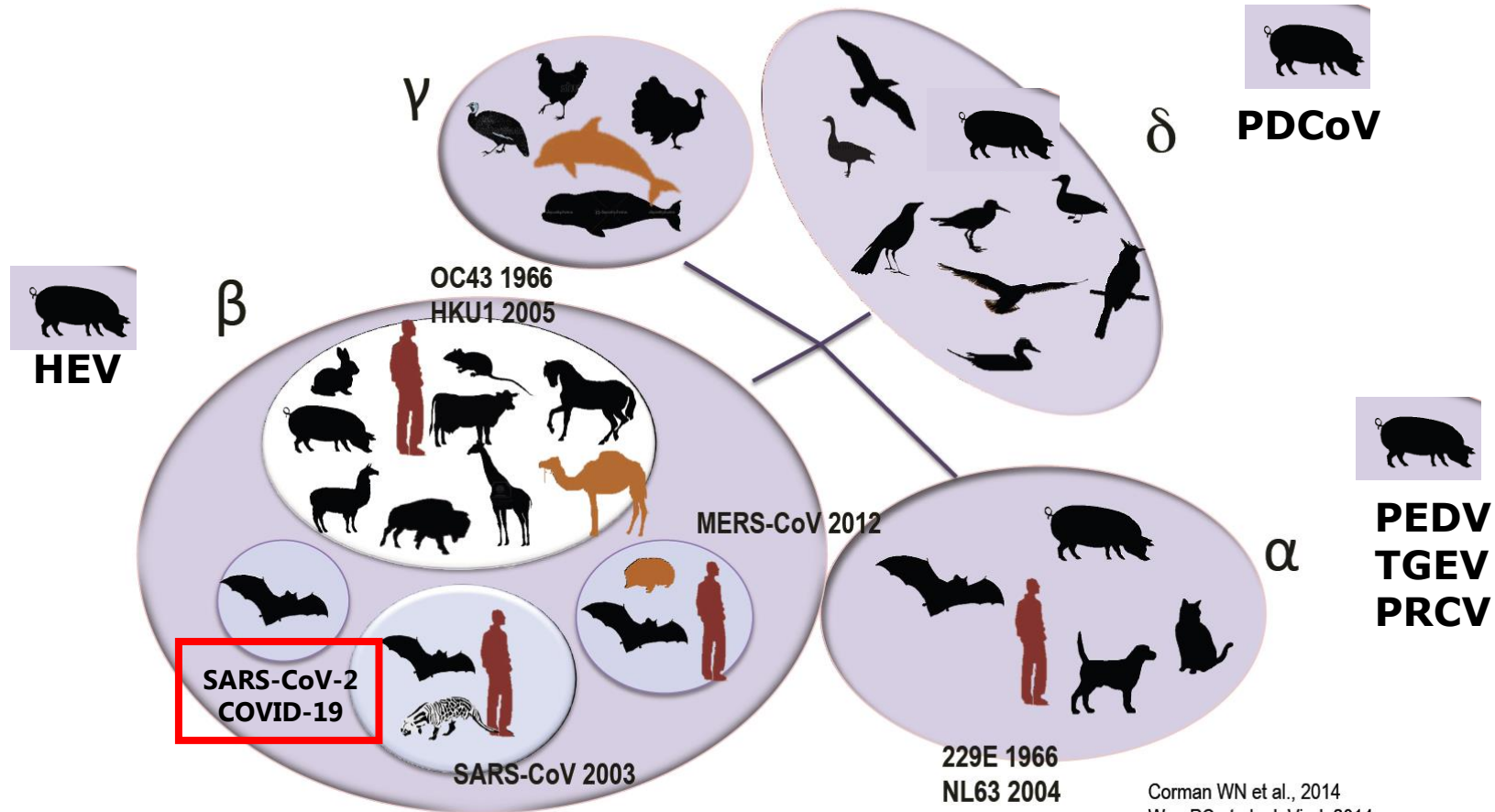
# Coronaviridae

- Enveloped, pleomorphic, 120-160nm
- Single stranded RNA, + sense, 25-31kb
- Club-shaped spike protein on the surface, "corona"
- High frequency of mutation and recombination  $\implies$  genetic diversity



# Coronavirus and their hosts

4 genera: alpha, beta, gamma & delta



Corman WN et al., 2014  
 Woo PC et al., J. Virol. 2014  
 Woo PC., EID 2014

# Diverse Coronaviruses

Alpha- and beta- coronaviruses mainly found in mammals  
e.g. PEDV, MERS CoV, SARS CoV, SARS-CoV-2

Gamma- and deltacoronaviruses mainly found in birds  
e.g. IBV, but also porcine deltacoronavirus

Generally the coronaviruses are rather host species specific

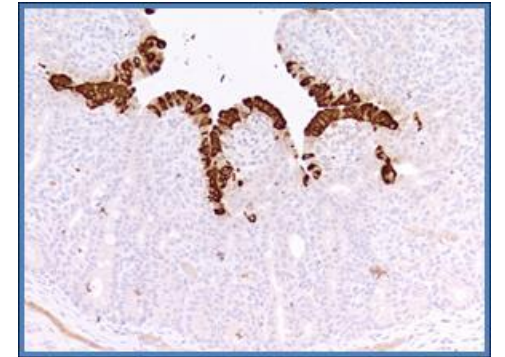
Can cause:

- Respiratory infections (e.g. PRCV, SARS-CoV, SARS-CoV-2, IBV)
- Enteric infections (PEDV, TGE, porcine deltacoronavirus)
- Or both

# Coronaviruses in pigs

## **TGE** (Transmissible gastroenteritis)

- Transmitted by fecal-oral route
- Replicates in enterocytes → atrophy of villi
- Watery diarrhoea and vomiting
- Pigs < 3 weeks,
- In newborn piglets mortality up to 100%
- TGE never detected in DK
- TGE is a notifiable disease and should be reported to FVST



# Coronaviruses in pigs

## **PRCV** (Porcine Respiratory Coronavirus)

- Non-pathogenic respiratory variant of TGEV
- Deletion variant of TGEV
- Spreading in the swine population in Europe in the 80's including Denmark and later in the USA and Asia
- Serological cross reaction to TGEV
- Cross protection to TGE
- Outbreaks of TGE rare after PRCV has become endemic
- Maternal antibodies from PRCV infected sows provides protection

# Porcine diarrhoea virus (PEDV)

PEDV initially identified in Europe in the early 1970's

Spread within Europe in 70's until the 90's

Reached Asia in the 1980's with large increase in PEDV cases in China after 2010

Introduced into USA in 2013, spread into Canada and South America

- Ca. 7 million piglets died in the US within 1 year (mild disease in sows)
- New PEDV strain
  
- New US PEDV variant in 2014-2016 also detected in EU:
  - EU incl. Germany, France, The Netherlands, Belgium, Italy, Spain
  
- PEDV never detected in Denmark



# Clinical signs - PED

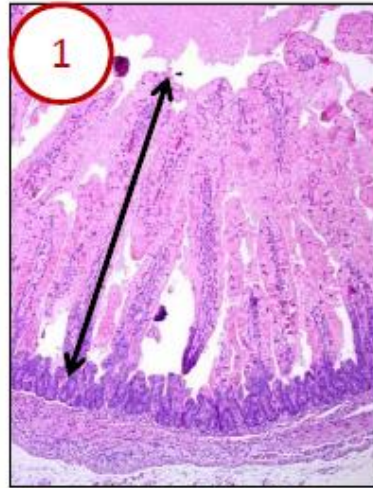
- Age dependent
  - Severe watery diarrhoea in suckling piglets
  - Vomiting
  - Adult animals usually only show mild or no disease
- Morbidity up to 100% in suckling piglets
- Up til 100% mortality in piglets <1 week
- Protection by maternal antibodies
- Do not cross react with TGEV and PRCV





# PEDV infects and damages the intestine

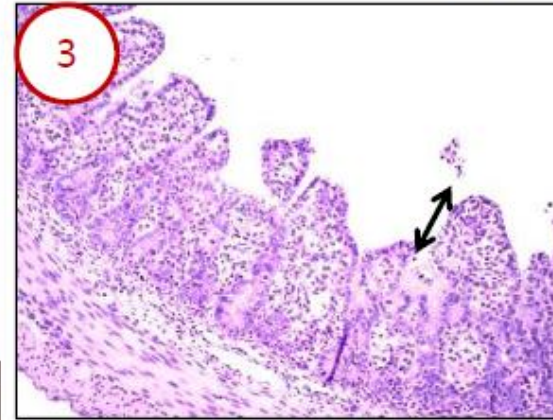
## Immunohistochemistry (IHC)



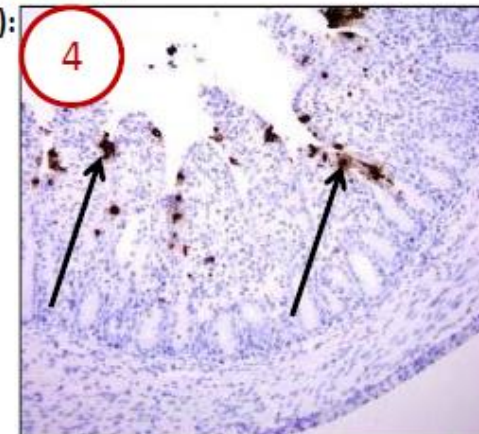
**Normal neonatal pig:**  
Healthy, long intestinal villi



**Early PEDv infection (~8 hrs PI):**  
Infected cells (brown stain) line the villi



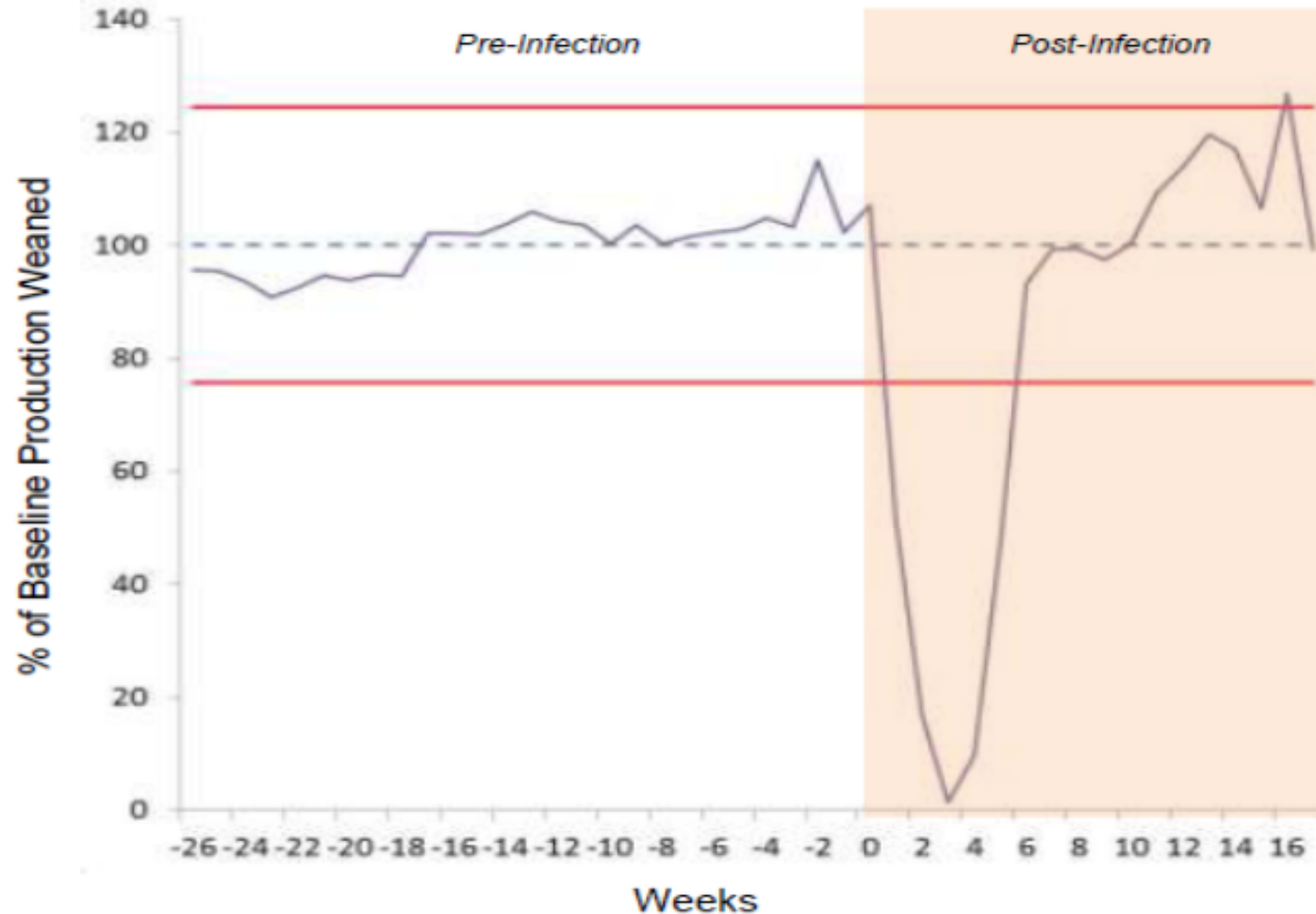
**Late PEDv infection (~36 hrs PI):**  
Severe villus atrophy & loss of  
absorptive epithelium



**Late PEDv infection (~36 hrs PI):**  
Few infected cells remain (brown  
stain) & absorptive cells destroyed

# PED virus introduction - in a fully susceptible herd

## Production Impact Preliminary Results



### Summary of Results

n = 18 herds

TTBP (weeks)

Avg = 5.9

95% CI = 4.2-7.6

Loss (pigs/1000 sows)

Avg = 1688

95% CI = 1077-2299

### Legend

— Average %BP

- - - Average Baseline

— Baseline 95% CI (+/- 2SD)

Source: B. Morrison

# Transmission routes for PEDV

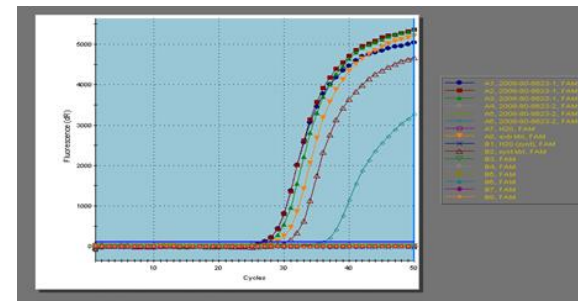
- Pigs
- **Feces**
- Vehicles for transport of pigs
- People/boots/utensils
- Feed (plasma)



# Diagnostics for PEDV, TGEV and PRCV

## Virus detection

- RT-qPCR

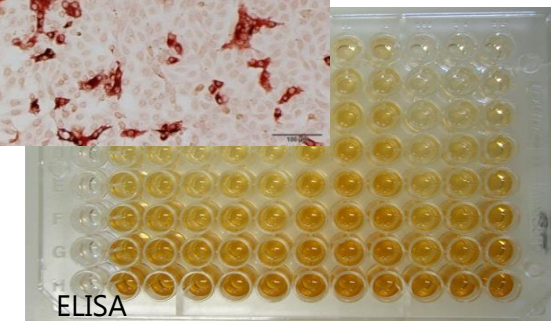
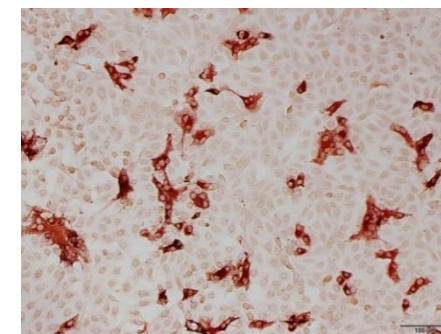


Fecal samples/swabs, intestinal contents (PEDV and TGEV)

Nasal swabs or lung tissue for PRCV

## Serology

- ELISA
- Differentiating ELISA for TGEV/PRCV
- IPT as confirmatory test



# PEDV surveillance in Denmark

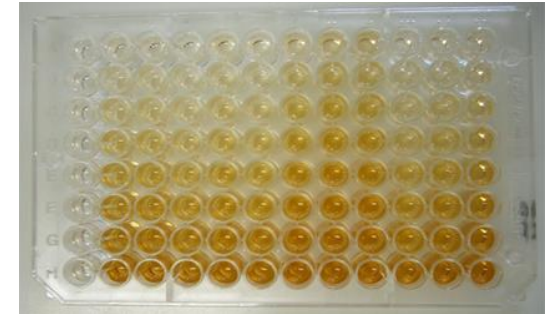
## Serological surveillance

- 2000 – 2006: 2500 sera/year
- 2014 -2015: 2400-4000 sera/year

## Early warning program since 2016

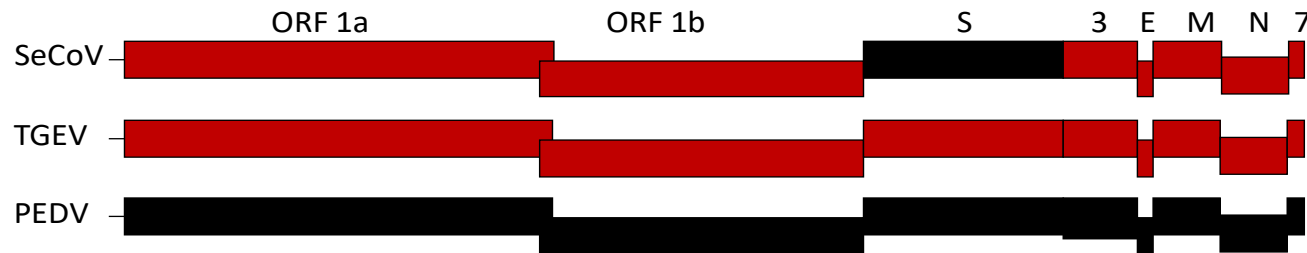
- Fecal swabs from from suspect PED cases selected among material submitted to SEGES's laboratory tested by RT-qPCR (ca 10-12 samples/month)
- Financed by the pig industry (SEGES)

All samples tested with negative result

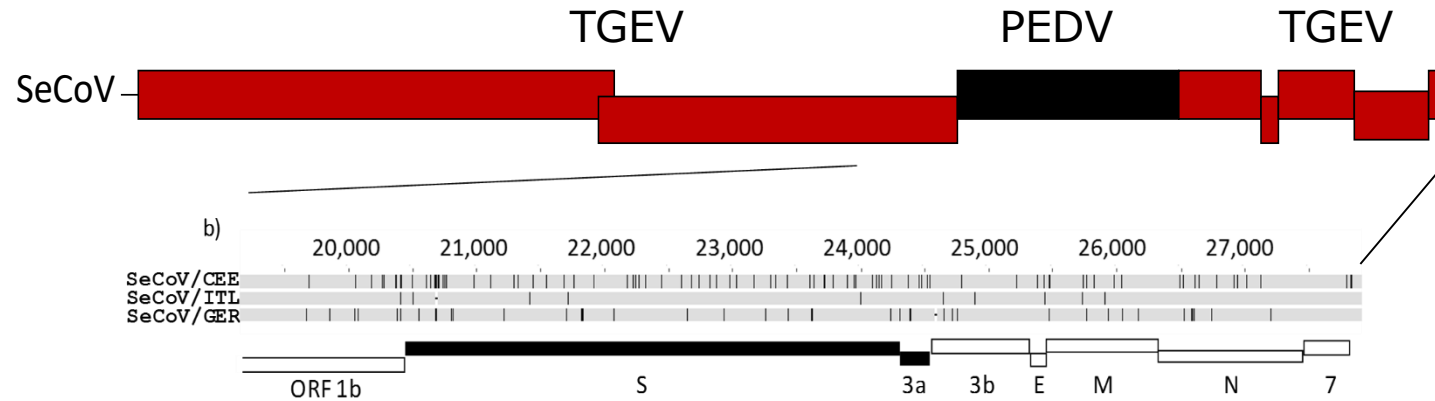


# Characterization of a Novel Chimeric Swine Enteric Coronavirus (SeCoV), 2016

- Samples from large pig herd within Eastern Europe ,experienced severe clinical disease including diarrhea, vomiting and about 10% mortality
- By PEDV RT-PCR fecal samples from the herd tested positive
- Sequencing of the S gene, indicated a very close similarity to recently described chimeric viruses termed swine enteric coronaviruses (SeCoVs) detected in archived samples from Italy (2009-12) and Germany (2012)
- SeCoV is a recombinant virus with the PEDV S gene (and 3a) in a TGEV backbone



## Sequence from the 3'-end of the SeCoV genome (9kb)



- The TGEV derived part of the sequenced region is 96% identical to known TGEV
- The level of sequence identity of the S-gene to known PEDV is only ca.91%
- The actual parental PEDV responsible for donating the S gene portion of the SeCoVs is not yet apparent

## Control of coronavirus infections in pigs

- So far biosecurity and management applied in Danish swine production have been able to keep out the enteric coronaviruses
- Let us hope these measures can also keep out ASF



Thanks for your attention

Any questions?