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Chicago, Illinois, USA

# SURVEILLANCE AND CONTROL OF PED CORONAVIRUS IN PIGS IN ITALY

G. Loris ALBORALI, Beatrice BONIOTTI, Antonio LAVAZZA  
*IZSLER - Brescia - Italy*



ISTITUTO ZOOPROFILATTICO SPERIMENTALE  
DELLA LOMBARDIA E DELL'EMILIA ROMAGNA  
"BRUNO UBERTINI"  
ENTE SANITARIO DI DIRITTO PUBBLICO



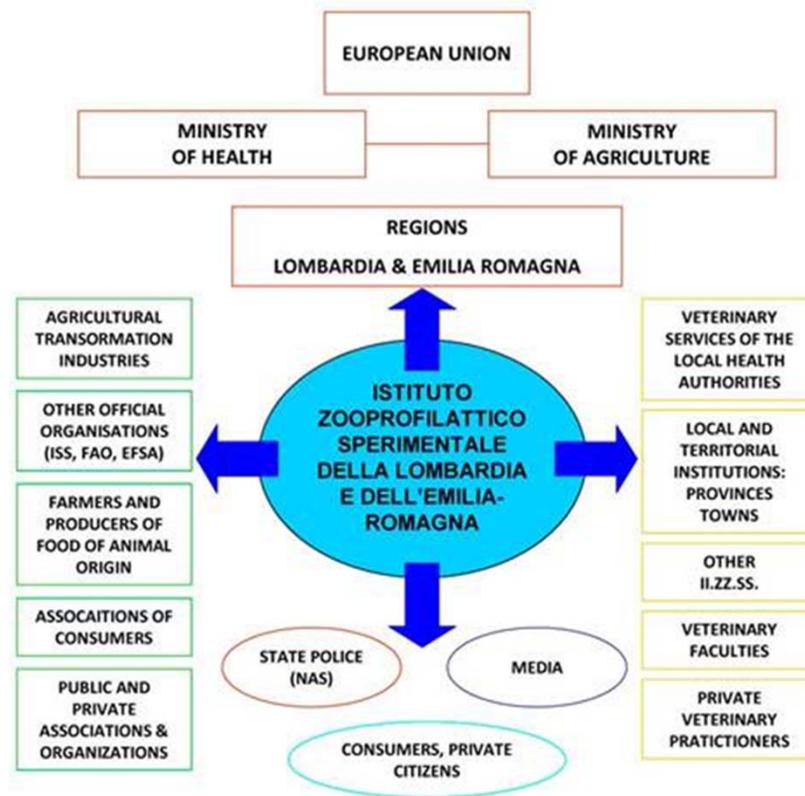
*Ministero della Salute*

# IZSLER

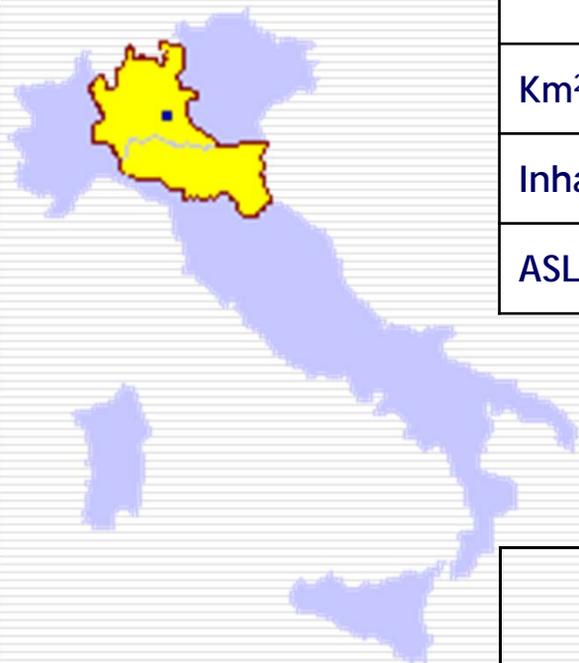


- ✘ It is a Public Institution, with autonomous technical and administrative management

- ✘ It offers diagnostic and consulting services to the Regional and National Veterinary Services (Ministry of Health), International organization (OIE, FAO, EU) Breeders and Consumers
- ✘ Areas: Animal health and welfare, food safety



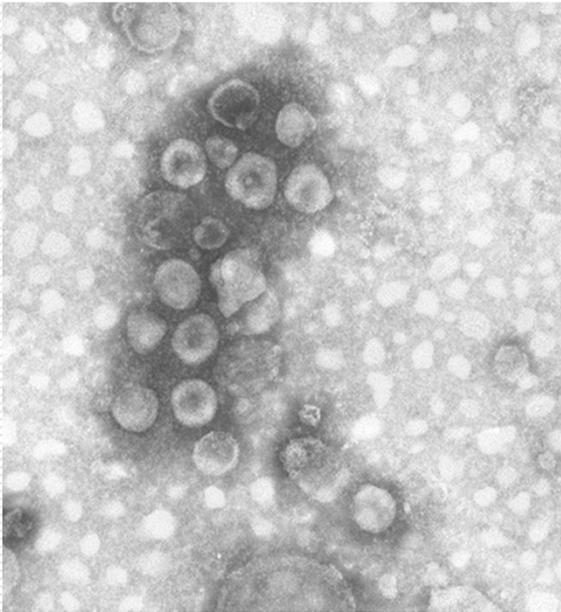
# Pig production in the territory of jurisdiction



| JURISDICTION AREA        | LOMBARDIA | EMILIA ROMAGNA |
|--------------------------|-----------|----------------|
| Km <sup>2</sup>          | 23,861    | 22,124         |
| Inhabitants              | 9,714,640 | 4,323,830      |
| ASL (Sanitary Districts) | 15        | 11             |

| PIGS              | LOMBARDIA | EMILIA ROMAGNA | ITALY      | % ON ITALY |
|-------------------|-----------|----------------|------------|------------|
| FARMS             | 6.7%      | 3.8%           | 113,337    | 10.5%      |
| HEAD              | 56.7%     | 14.4%          | 8,887,284  | 71.1%      |
| SLAUGHTERED HEADS | 4,733,883 | 3,530,793      | 13,616,438 | 60.7%      |

# Background/1



- ✘ In Italy, Porcine Epidemic Diarrhea (PED) is present since the early '90s
- ✘ Its diffusion increased with the simultaneous decline of Transmissible Gastroenteritis (TGE), another coronavirus pig enteritis widespread in the '70-'80s
- ✘ A severe epidemic wave of PED outbreaks occurred in the early '90s
- ✘ Then it became endemic with sporadic outbreaks i.e. **296 positives out of 2072 samples examined from 1994 to 2000**

## Background/2

- ✘ The last «big» epidemic outbreak occurred on 2005-2006 in pigs densely populated areas of the Po Valley North Italy

The **Veterinary Record**, March 8, 2008

PAPERS & ARTICLES

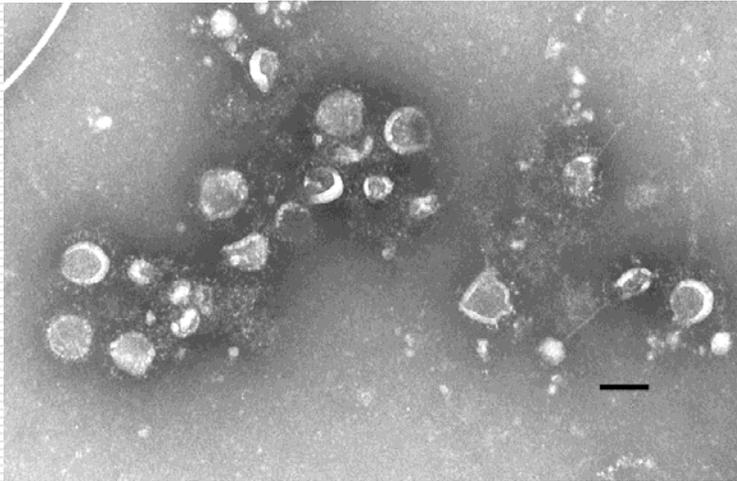
### **Epidemic of diarrhoea caused by porcine epidemic diarrhoea virus in Italy**

P. MARTELLI, A. LAVAZZA, A. D. NIGRELLI, G. MERIALDI, L. G. ALBORALI, M. B. PENZAERT

There was an epidemic of diarrhoea affecting pigs of all ages in Italy between May 2005 and June 2006. In 63 herds the cause was confirmed as porcine epidemic diarrhoea virus by electron microscopy, immunoelectron microscopy, PCR and serology. Watery diarrhoea without mucus and blood was usually associated with a reduction of feed consumption. In farrowing-to-weaning herds, diarrhoea affected the sows and suckling piglets, and the mortality in newborn piglets was up to 34 per cent. In growers and fatteners the morbidity ranged from 20 to 80 per cent, but there was either no mortality or it was very low. Depending on the size of the herd and the type of operation, the clinical disease lasted for weeks or months.

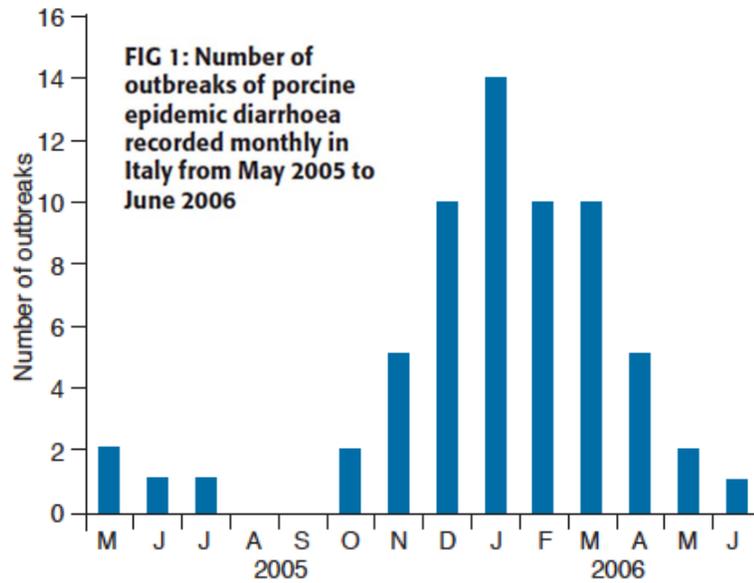


IEM with anti-PEDV hyperimmune serum. Negative staining with 2 per cent sodium phosphotungstate. Bar=100 nm

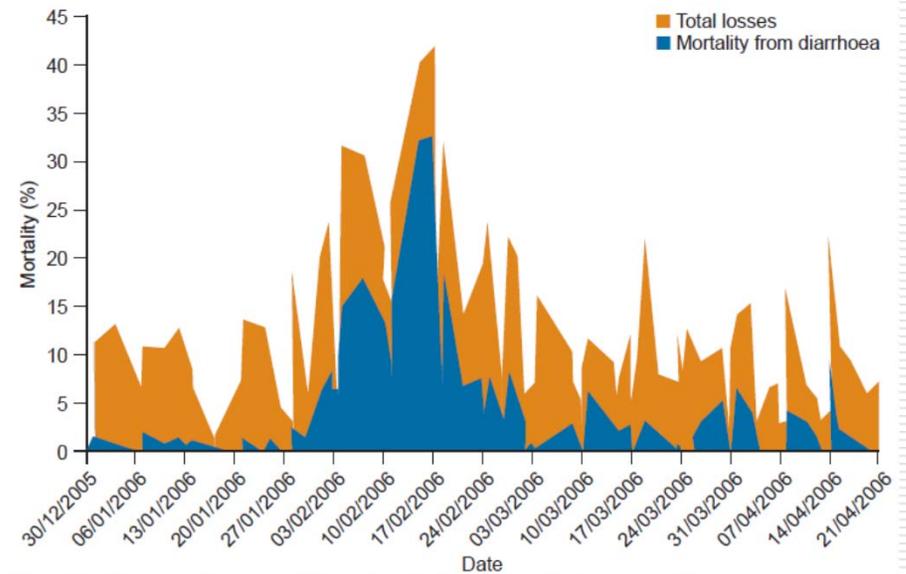


**TABLE 1: Numbers of confirmed outbreaks of porcine epidemic diarrhoea on different types of pig farm in Italy in 2005 and 2006**

| Type of operation | Number of outbreaks |      |
|-------------------|---------------------|------|
|                   | 2005                | 2006 |
| Farrow-to-finish  | 5                   | 18   |
| Weaners           | 2                   | 2    |
| Finisher          | 14                  | 22   |



**FIG 1: Number of outbreaks of porcine epidemic diarrhoea recorded monthly in Italy from May 2005 to June 2006**



**FIG 2: Total preweaning mortality and mortality due to diarrhoea on a farrow-to-weaner herd with 2500 sows in northern Italy between December 2005 and April 2006**

# Clinical signs in outbreaks

The clinical signs involved pigs of all ages, but mortality was registered only in piglets and lasted 3-4 weeks

1. *On farms with **only finisher pigs**, diarrhea was acute, watery, without evidence of mucus and blood*
2. *On **farrow to weaner** or **farrow to finisher** herds, pregnant sows suffered from watery diarrhea*
3. *Vomiting and diarrhea were prominent in **suckling pigs** and death from dehydration usually occurred after 3-4 days of sickness.*





## In the last years ....

- ✘ From 2008 to 2014 only sporadic outbreaks were observed in growers and finishers herds:

| Year         | n° cases examined | n° positive cases | n° positive farms |
|--------------|-------------------|-------------------|-------------------|
| 2008         | 252               | 4                 | 3                 |
| 2009         | 193               | 23                | 16                |
| 2010         | 157               | 21                | 19                |
| 2011         | 204               | 9                 | 9                 |
| 2012         | 373               | 10                | 9                 |
| 2013         | 294               | 4                 | 2                 |
| 2014         | 165               | 2                 | 2                 |
| <b>TOTAL</b> | <b>1638</b>       | <b>73</b>         | <b>60</b>         |

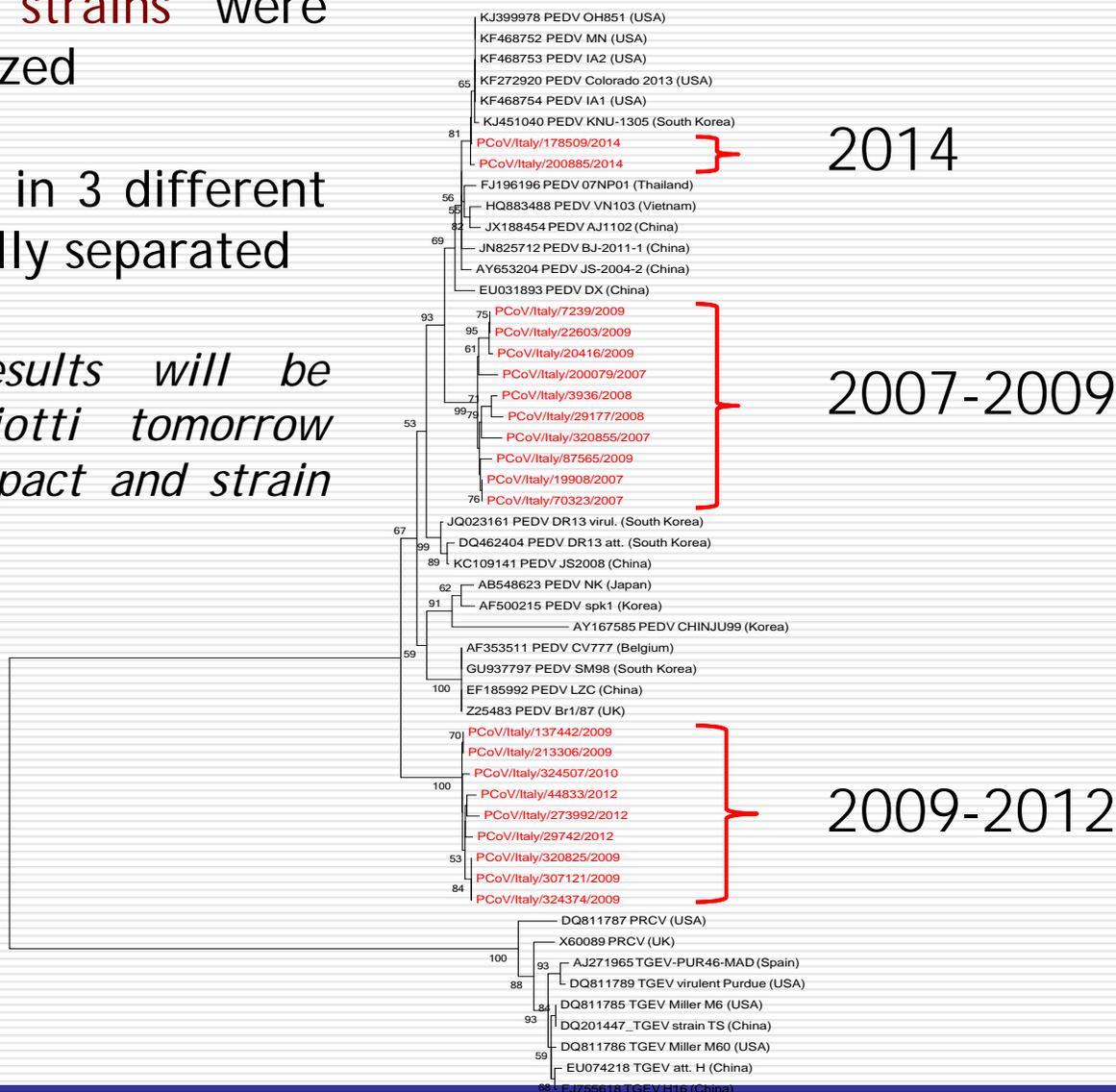
- *73 PED cases*
- *from 60 different farms*
- *out of 1638 cases of enteritis (4.46%)*

- ✘ Clinical signs and epidemiological patterns were comparable to the cases observed before 2005
- ✘ No severe cases, low increase of mortality rates were observed

# In the last years ....

- ✗ A total of 28 strains were genetically analyzed
- ✗ they are divided in 3 different clusters temporally separated
- ✗ *The detailed results will be presented by Boniotti tomorrow in session B " Impact and strain variations "*

S1(553 nt)



# Serosurveillance

- ✘ Serological surveys performed initially on 2007 and then sporadically in the following years confirmed the endemic presence of the infection in pig farms in North Italy [Sozzi et al., 2007]

## ....and during 2014

- ✘ A serosurvey confirmed the still active circulation of PEDV.

| N° FARM | PROVINCE | POSITIVE/TOTAL | %    |
|---------|----------|----------------|------|
| 1       | Mantova  | 31/59          | 52,5 |
| 2       | Cremona  | 6/29           | 20,7 |
| 3       | Mantova  | 10/24          | 41,7 |
| 4       | Mantova  | 7/27           | 25,9 |
| 5       | Brescia  | 20/55          | 36,3 |
| 6       | Brescia  | 8/28           | 35,7 |
| 7       | Cremona  | 5/29           | 17,2 |
| 8       | Cremona  | 2/30           | 6,7  |
| 9       | Cremona  | 3/29           | 10,3 |
| 10      | Mantova  | 6/29           | 20,7 |
| 11      | Modena   | 13/59          | 22,0 |

Antibodies were found in:

- *11 out of 21 farms*
- *7% to 52% tested animals*

# Diagnostic tools

- ✘ Two immunoassays were developed, based on Monoclonal antibodies (MAbs) produced against the European CV777 reference strain
- ✘ They were set up for the detection of both:
  - ANTIGEN (*sandwich-AgELISA and immuno-electron-microscopy-IEM and*)
  - ANTIBODIES (*competitive AbELISA and immune-peroxidase monolayer assay-IPMA*)



Comparison of enzyme-linked immunosorbent assay and RT-PCR for the detection of porcine epidemic diarrhoea virus

Enrica Sozzi\*, Andrea Luppi, Davide Lelli, Ana Moreno Martin, Elena Canelli, Emiliana Brocchi, Antonio Lavazza, Paolo Cordioli

Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna "B. Uberini", via Bianchi 7/9, 25124 Brescia, Italy

- ✓ Virological identifications were also confirmed by RT-PCRs (pan coronavirus and PEDV specific)

*Viruses* **2013**, *5*, 2679-2689; doi:10.3390/v5112679

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**viruses**

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Brief Report

**Detection of Coronaviruses in Bats of Various Species in Italy**

Davide Lelli <sup>1,†,\*</sup>, Alice Papetti <sup>1,†</sup>, Cristiano Sabelli <sup>2</sup>, Enrica Rosti <sup>3</sup>, Ana Moreno <sup>1</sup> and Maria B. Boniotti <sup>1</sup>

| Type                 | Detection European PEDV (CV777) | Detection American PEDV | Reference         |
|----------------------|---------------------------------|-------------------------|-------------------|
| Pan-coronavirus      | Yes                             | Yes                     | Lelli et al. 2013 |
| PEDV/TGEV specific   | Yes                             | —                       | unpublished       |
| M PEDV/TGEV specific | Yes                             | Yes                     | Unpublished       |
| S1 PEDV specific     | Yes                             | Yes                     | Kim et al., 2001  |



# Biosecurity and control plans

- ✘ Biosecurity programs between and within herds were proved to be essential for the control of the PED
  
- ✘ Key elements/tools for preventing PED:
  - traceability of animal movements
  - control of transports of pigs and feed
  - the cleaning and disinfection of trucks after each load and their certification
  - speed up the clinical and lab diagnosis of outbreaks

## Summarising.....

- ✘ Persistence of PED in Italian farms since '90
- ✘ Sporadic clinical cases
- ✘ PEDV was early included in the differential diagnosis of enteric disorders of pigs
- ✘ Most PEDV were detected during surveillance of such clinical cases
- ✘ Last big epidemic wave was in 2005-06
- ✘ Afterwards an high seroprevalence has been detected in most farms and it appears stable
- ✘ Low yearly incidence of mild clinical cases since 2007 to nowadays

## Conclusions

- ✘ A continuous **surveillance** for PEDV is in force in Italy, in association with strict **biosecurity** measures
- ✘ The use of a **combined set of screening and confirmatory diagnostic methods** (cELISA, DAS-ELISA, IEM, pan-coronavirus RT-PCR, PEDV RT-PCR) guarantees an early detection and the possibility to identify even new viruses (delta coronavirus, TGEV, PRCV, others?)
- ✘ Sequencing (including whole genome sequencing) are employed for the study of **genetic variability** (results described in Boniotti's presentation)



- ✘ In memory of the friend and colleague **Paolo Cordioli**, who very recently passed away at the age of 58
- ✘ A skilful, brilliant, charismatic vet and researcher in the field of “classical” virology. Head of the Virology Lab. at IZSLER for over 25 years

## Acknowledgements

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Ana Moreno, Emiliana Brocchi, Andrea Luppi

***Thanks for your attention!***