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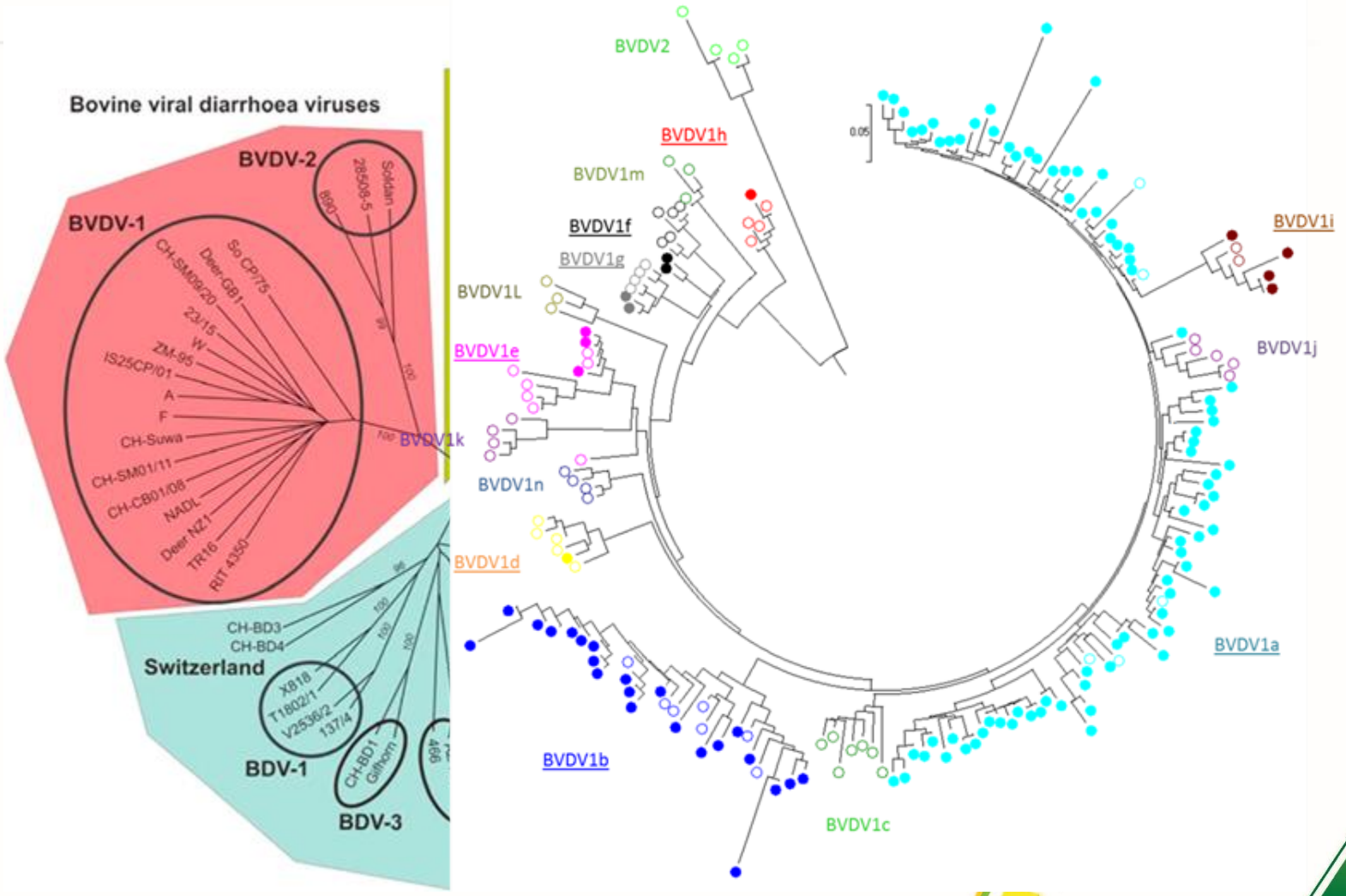
Contributing to a profitable and sustainable farming and agri-food sector through improved animal health

BVDV: DISCONTOOLS- AN IRISH PERSPECTIVE

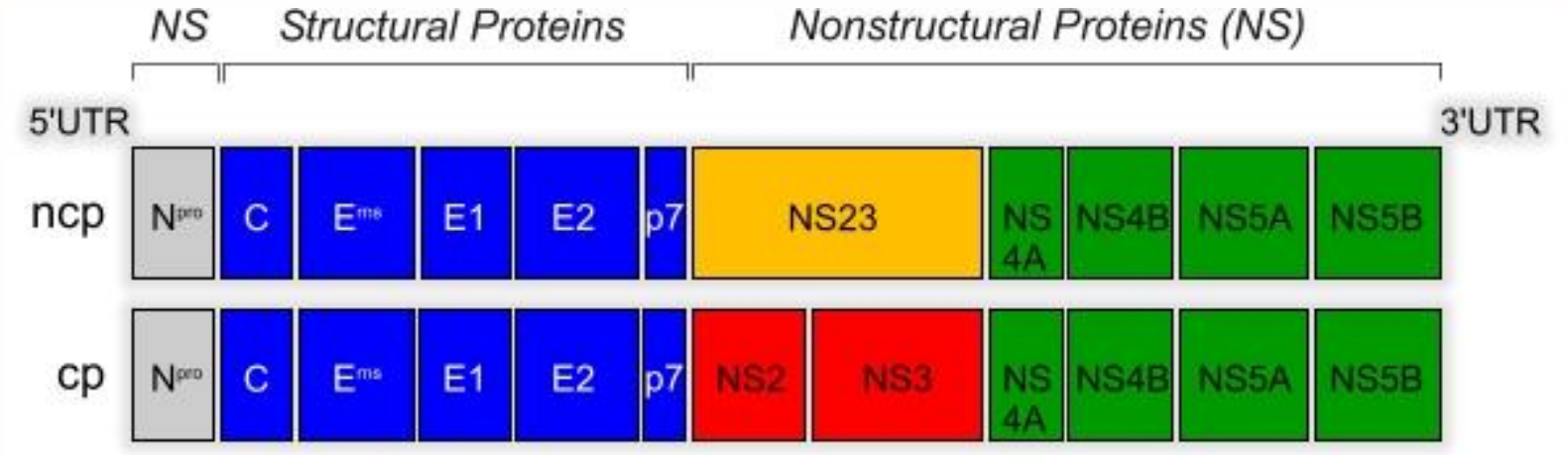
David Graham MVB PhD FRCVS

DISCONTOOLS Project Management Board
Dublin| 7th November 2018

Pestivirus classification



Biotypes

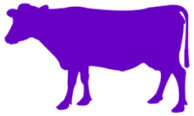


Pathogenesis

Infection

- Acute
- Persistent

Naive: Virus NEG Ab NEG

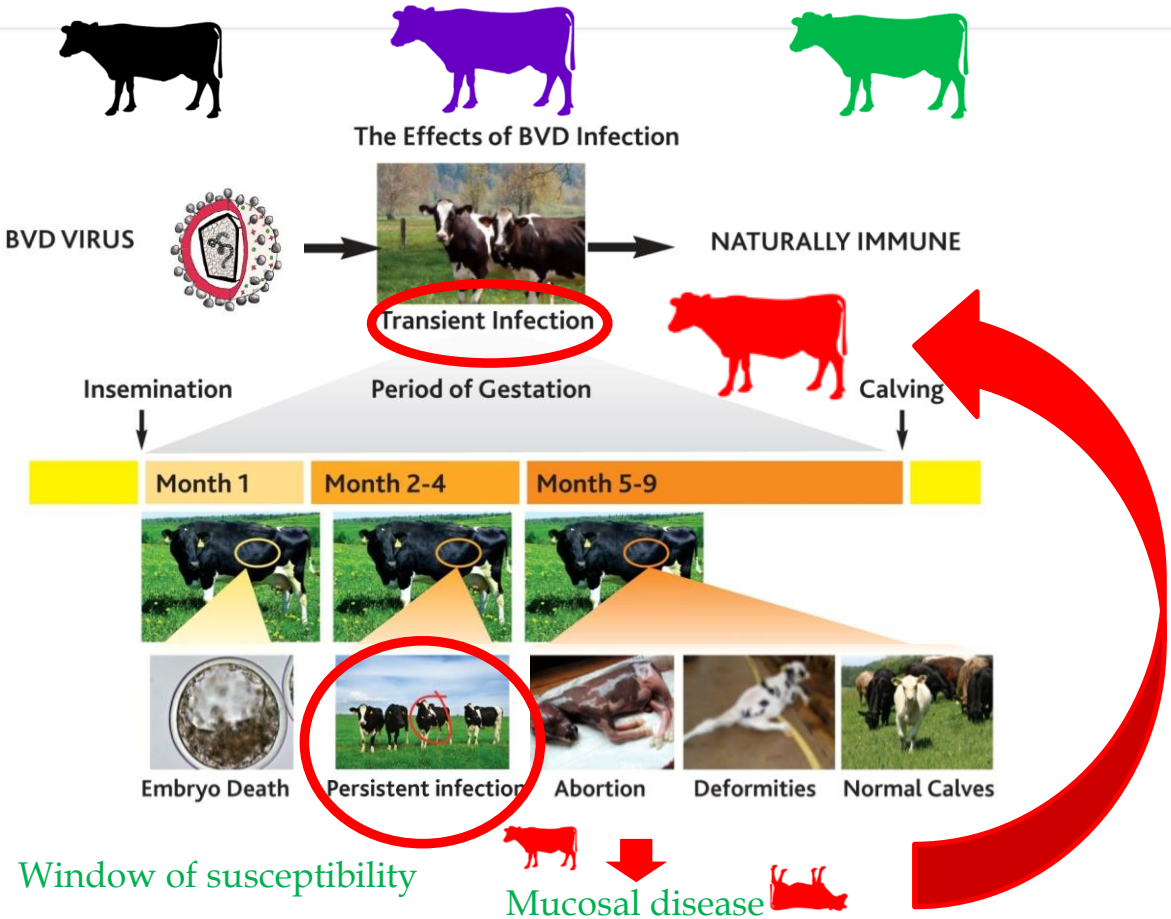


TI: Virus POS Ab NEG

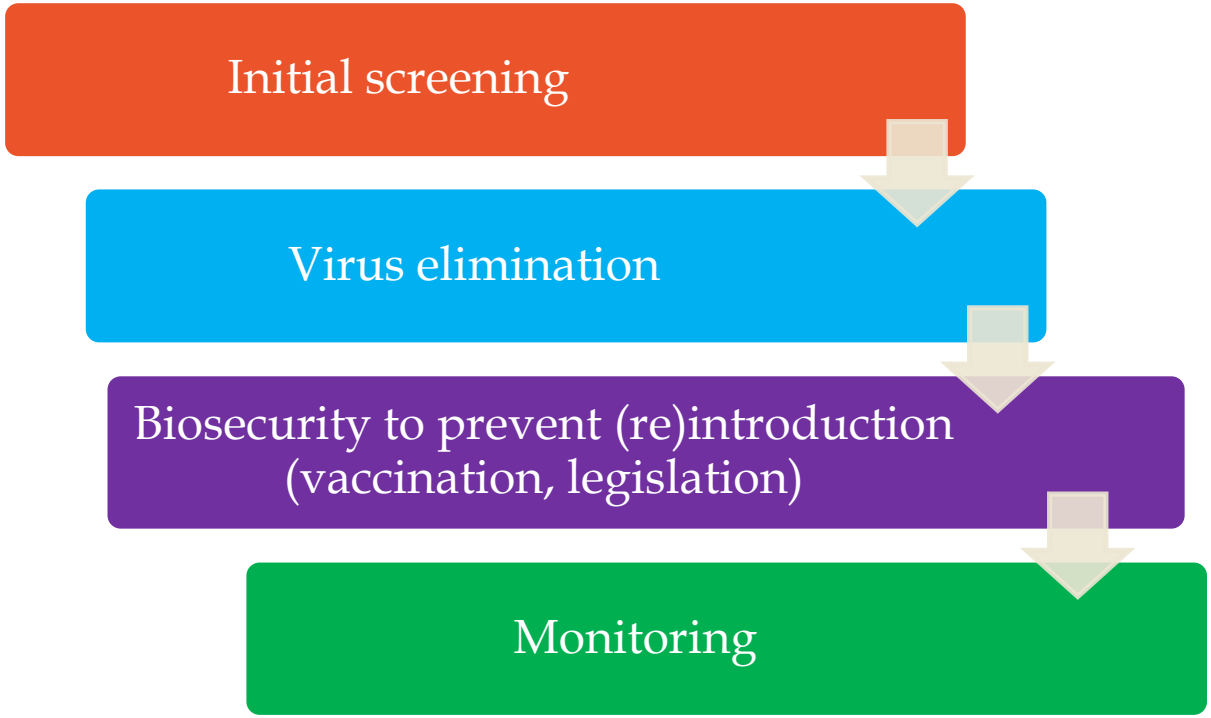
Virus NEG Ab POS

PI: Virus POS Ab NEG

Acute and persistent infection



Components of systematic control



Europe- current situation

Scandinavian model

Swiss model

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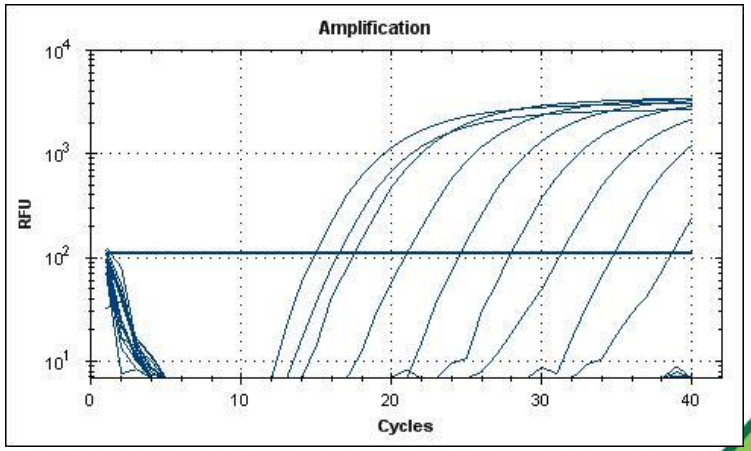
Irish Programme

Objective: eradication by end of 2020

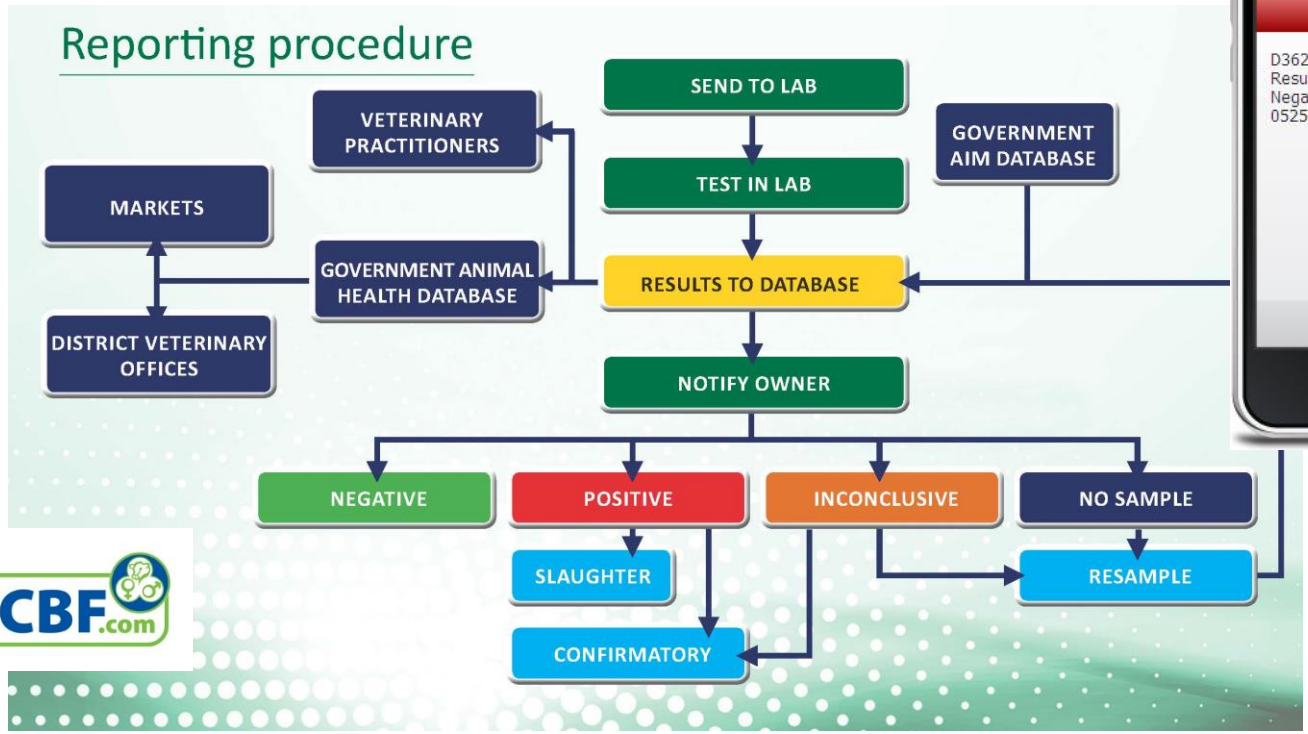
- Industry-led
- Co-ordinated by Animal Health Ireland
  - Technical Working Group
  - Cross-industry Implementation Group
- Tissue-sample-enabled official identity tag
- 2012 voluntary
- 2013-current: compulsory
  - Legislation

Virus testing: ELISA or RTPCR

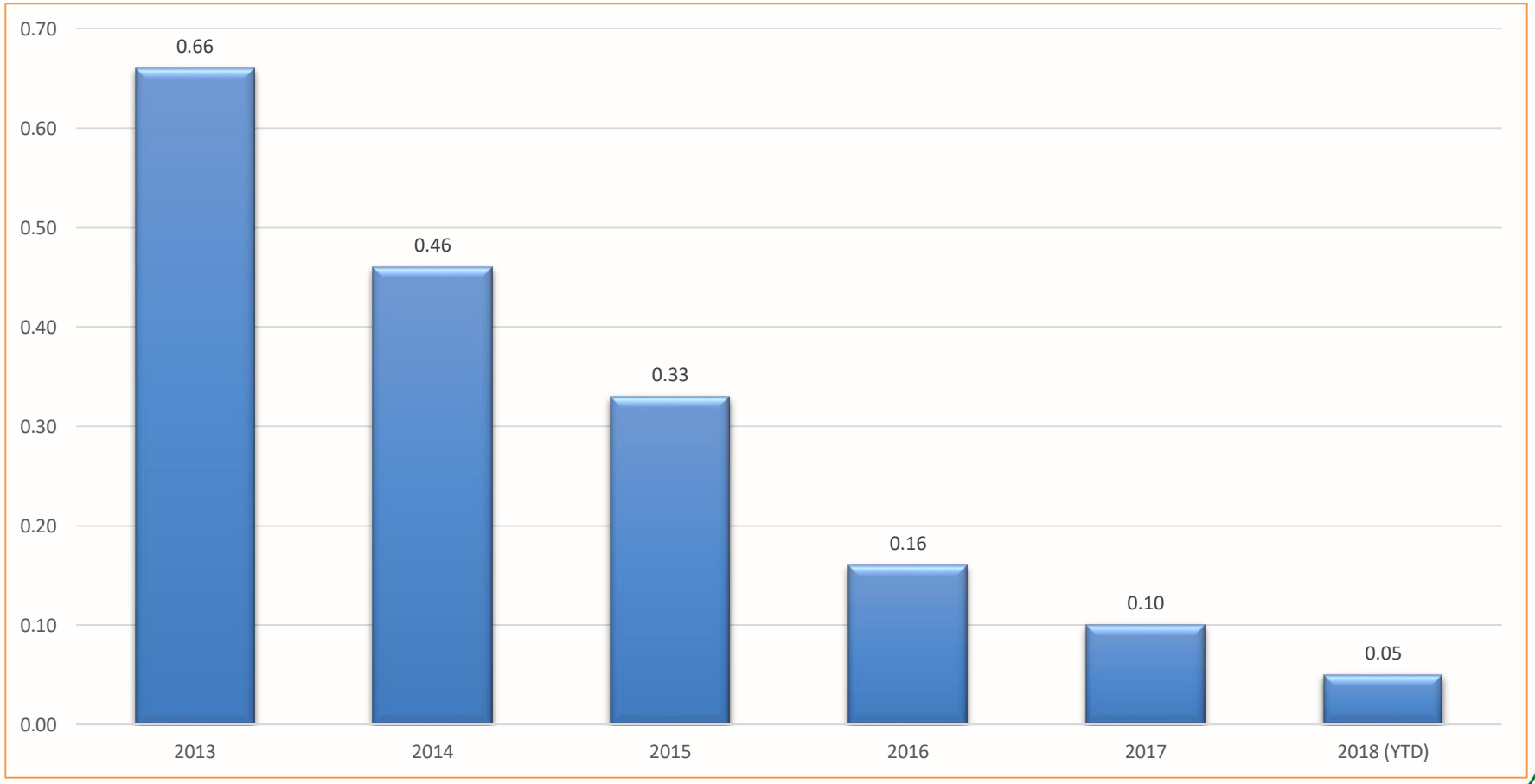
- ELISA-
  - Detects viral protein
  - "S-N" (higher = more)
    - Tissue
      - 0.2 – 0.3 inconclusive
      - >0.3 positive
    - Blood
      - >0.3 positive
    - Diagnostic gap
- RTPCR
  - Detects viral RNA
  - Ct value (lower = more)
  - Pooling (serum, milk, tissue)
    - Check with lab re limits, preservatives



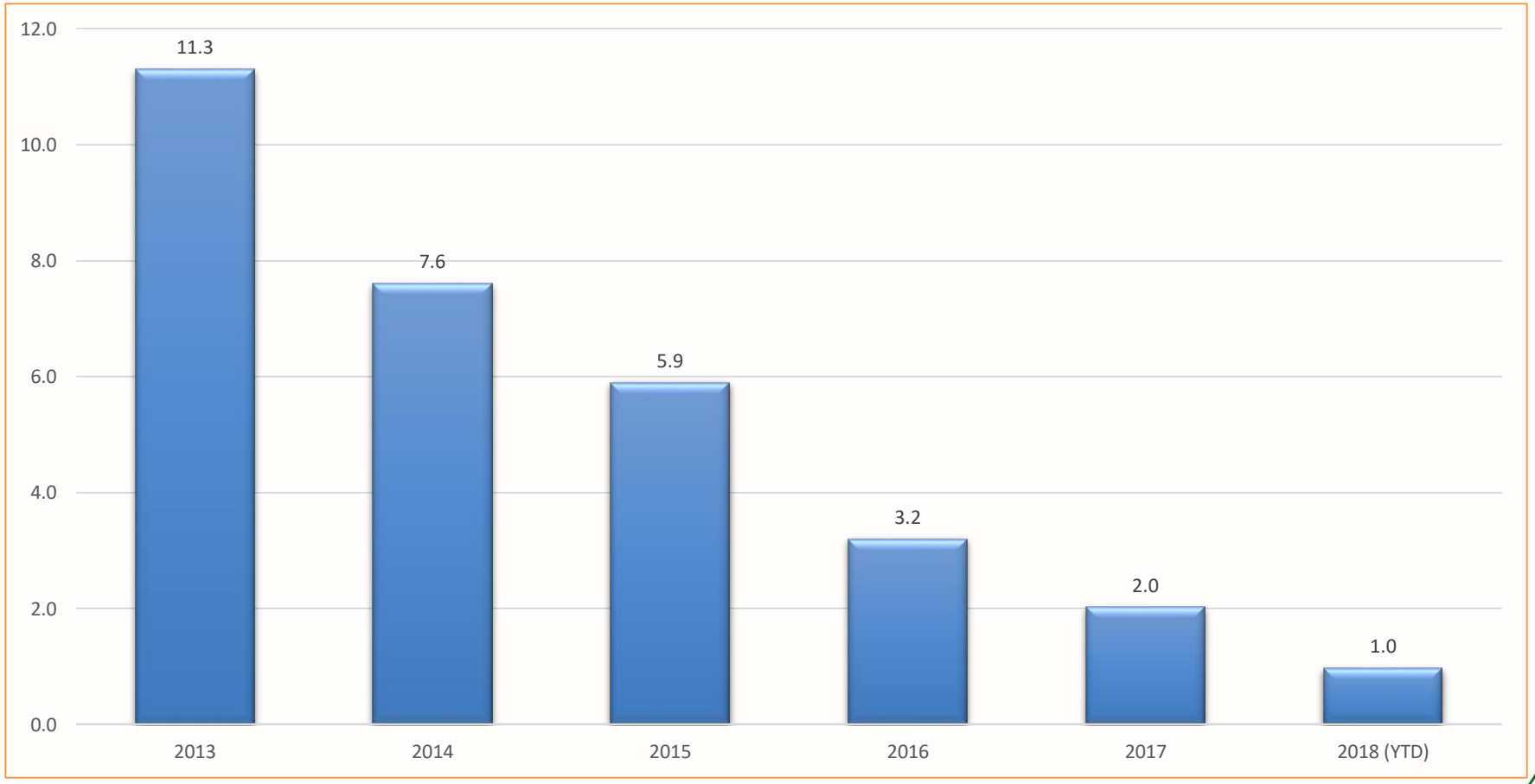
Data management



Progress-animal level (%)



Progress-herd level (%)



Economics of BVD eradication

	Suckler	Dairy	Beef	Total
Losses €m	27	55	20	102
Eradication costs €m	6	4	-	10
Benefit:cost	5	14	-	10
Payback period (Years)	1.15	0.42	-	0.53

Table 3: Summary of estimated losses (€m); benefit: cost and payback periods

Predicted costs and benefits of eradicating BVDV from Ireland

Irish Veterinary Journal 2012, 65:12 doi:10.1186/2046-0481-65-12

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Presentations in Cattle Markets

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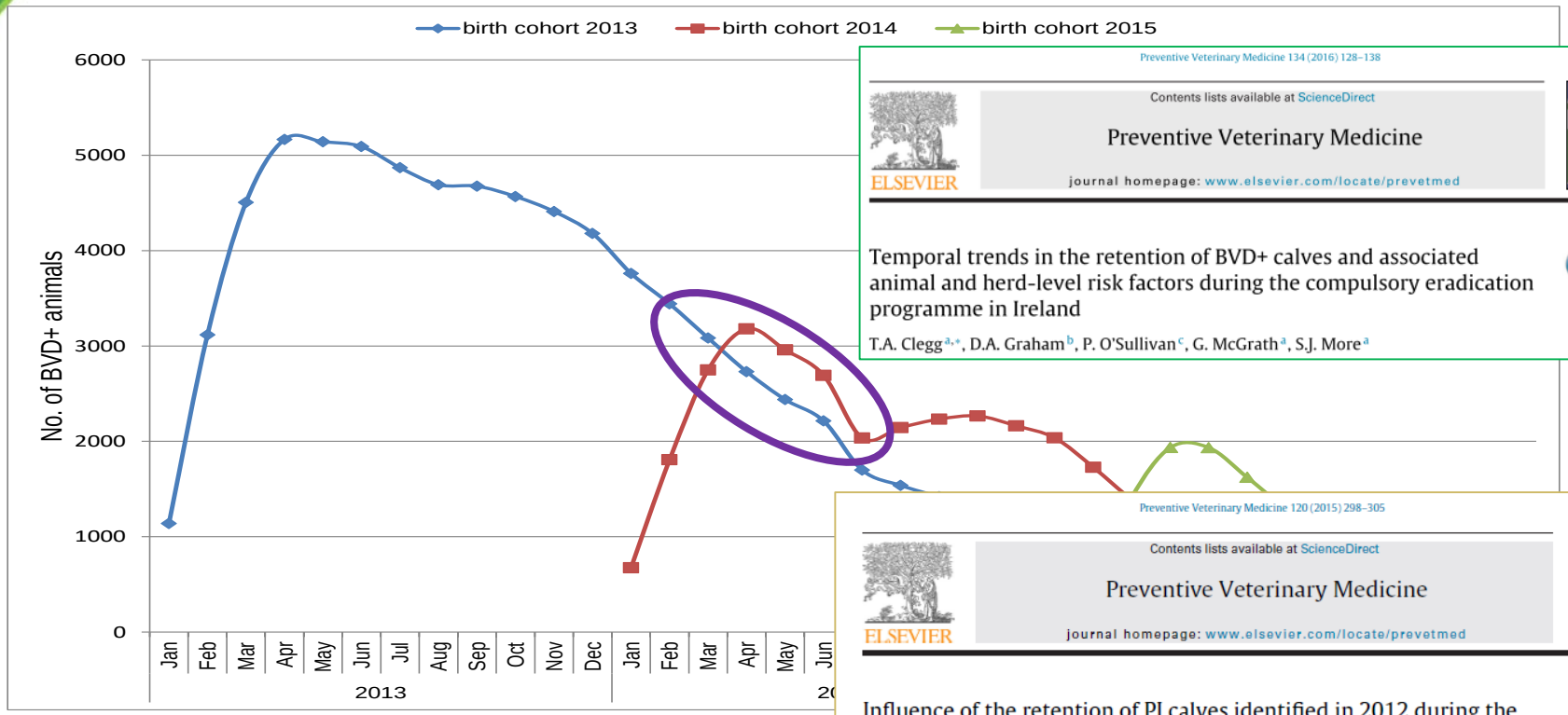
PI Retention- number alive each month by birth year



Preventive Veterinary Medicine 134 (2016) 128–138

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Temporal trends in the retention of BVD+ calves and associated animal and herd-level risk factors during the compulsory eradication programme in Ireland

T.A. Clegg[a,*], D.A. Graham[b], P. O'Sullivan[c], G. McGrath[a], S.J. More[a]

Preventive Veterinary Medicine 120 (2015) 298–305

Contents lists available at ScienceDirect

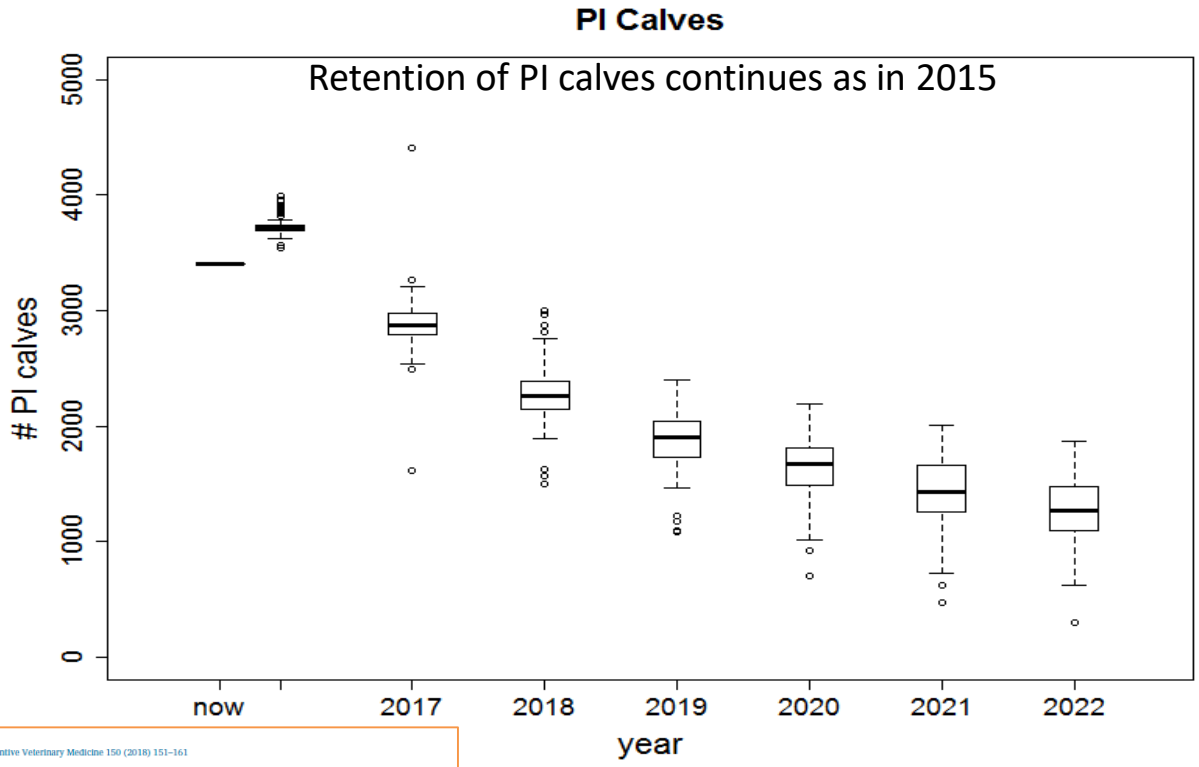
Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Influence of the retention of PI calves identified in 2012 during the voluntary phase of the Irish national bovine viral diarrhoea virus (BVDV) eradication programme on herd-level outcomes in 2013

D.A. Graham[a,*], T.A. Clegg[b], P. O'Sullivan[c], S.J. More[b]

IBM: IRISH BVD MODEL



Preventive Veterinary Medicine 150 (2018) 151–161

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Eradicating BVD, reviewing Irish programme data and model predictions to support prospective decision making

H.-H. Thulke[a,*], M. Lange[a], J.A. Tratalos[b], T.A. Clegg[b], G. McGrath[b], L. O'Grady[b], P. O'Sullivan[c], M.L. Doherty[b], D.A. Graham[d], S.J. More[b]

NATIONAL BVD ERADICATION PROGRAMME

BVDFree
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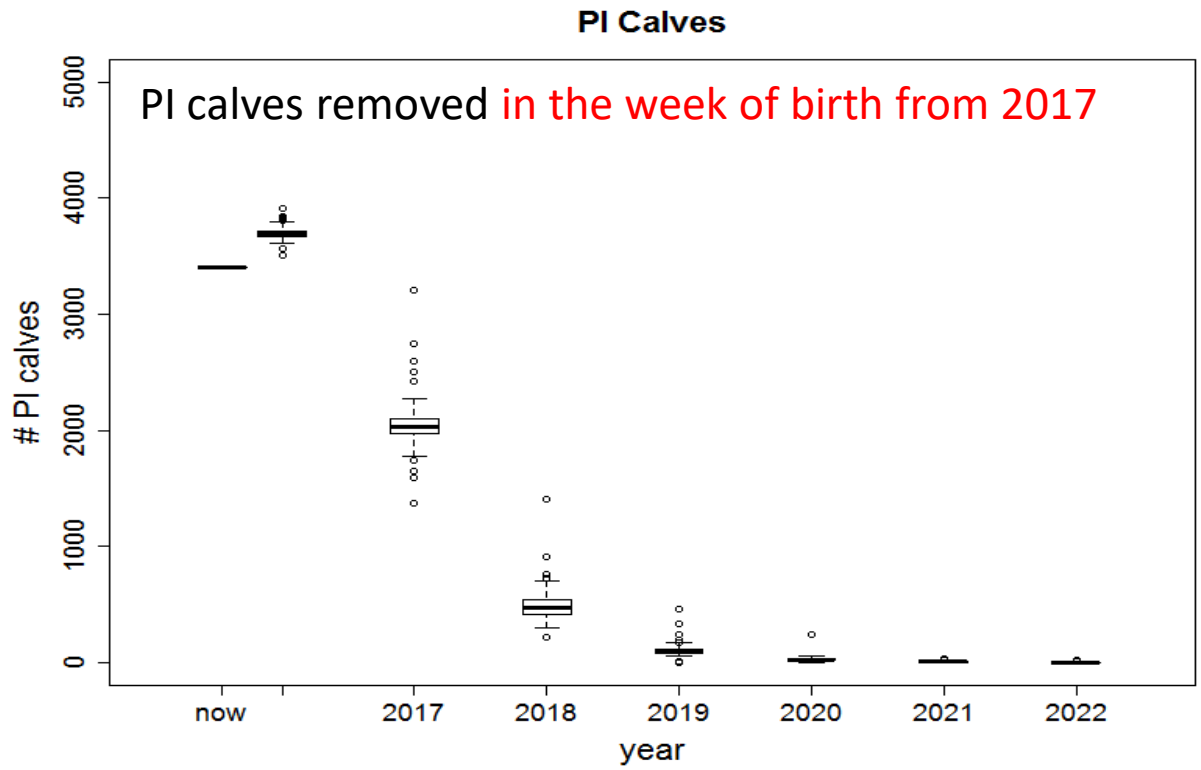
IBM: IRISH BVD MODEL

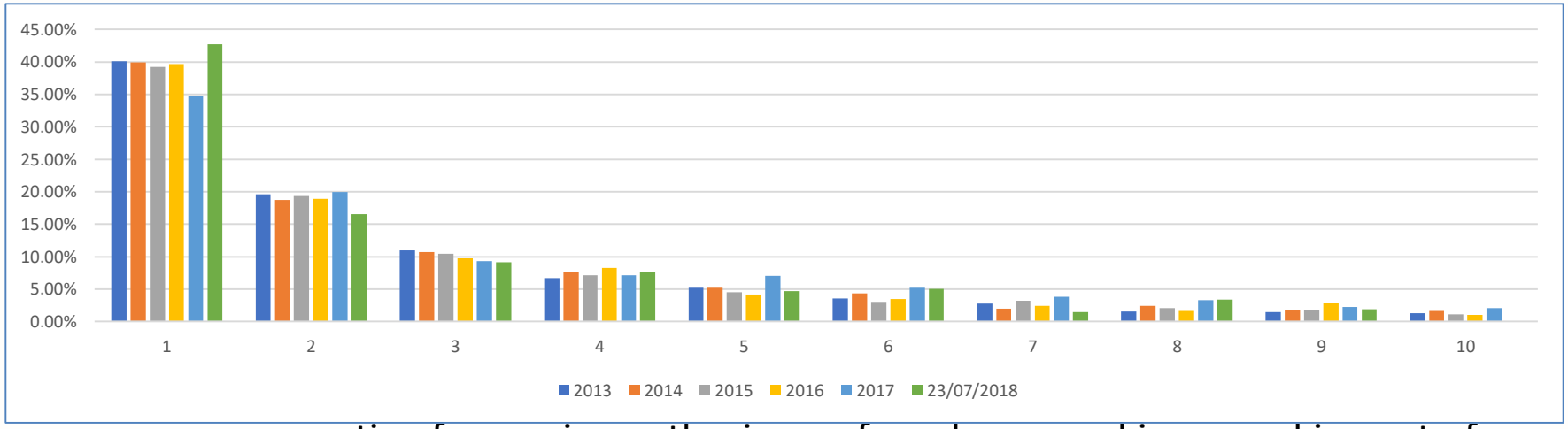


BVDV DISCONTOOLS

Key conclusions

- Obstacles are not on the tool side. Rather, the main obstacles can be found in the attitudes and priorities of influential individuals/groups within the industry, academia and authorities.
- There is often lack of awareness among farmers and veterinarians, and because in many countries the producers will bear the cost of BVD control, the producer “buy-in” is critical.
- A trustful relationship between farmers, practitioners and governmental authorities is a prerequisite, and commitment of all involved parties is necessary.

Main critical gaps:



program accounting for waning enthusiasm of producers and increased impact of infection as control programs result in naïve herds that are fully susceptible.

- Establishing consistent national protocols for the different testing and vaccination procedures. Individual farmers and veterinarians often have their own different protocols, which can be confusing.

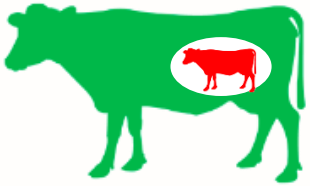
Control Tools: Diagnostics availability

Commercial diagnostic kits available Europe/worldwide	☑
Diagnostic kits validated	☑
Diagnostic methods described	☑
Commercial potential in Europe	☑
DIVA tests required/available	☑/☒
Opportunities for new developments	☑

Control Tools: Diagnostics availability

Commercial kits available worldwide/Europe- Gaps

- Validation of kits to detect/differentiate antibodies/antigen/RNA of all known species/genotypes/sub-genotypes
- Serological differentiation by ELISA instead of cross-SNT
- The availability of pestivirus-positive reference material with low and high viral load (e.g. semen, serum, milk) is a limiting factor in test validation
- Lack of central co-ordination of approval of test kits and batch release certification results in duplication of efforts between member states.
- Lack of serological assays (and vaccines) with DIVA capability
- Lack of diagnostic methods to identify dams carrying PI foetuses



Control Tools: Diagnostics availability
Opportunities for new developments- Gaps

- Identifying the most cost-effective diagnostic test strategy for individual herds.
- Clearly communicating to farmers what diagnostic test results mean in terms of herd disease status and risk.
- The high sensitivity of RT-PCR sometimes yields results difficult to interpret, as transient infections are detected as well. In addition, there are PI animals with a high Ct (>30), and transiently infected animals with a low Ct (<25).
- Freedom from virus in a population can only be guaranteed in terms of statistical probability.

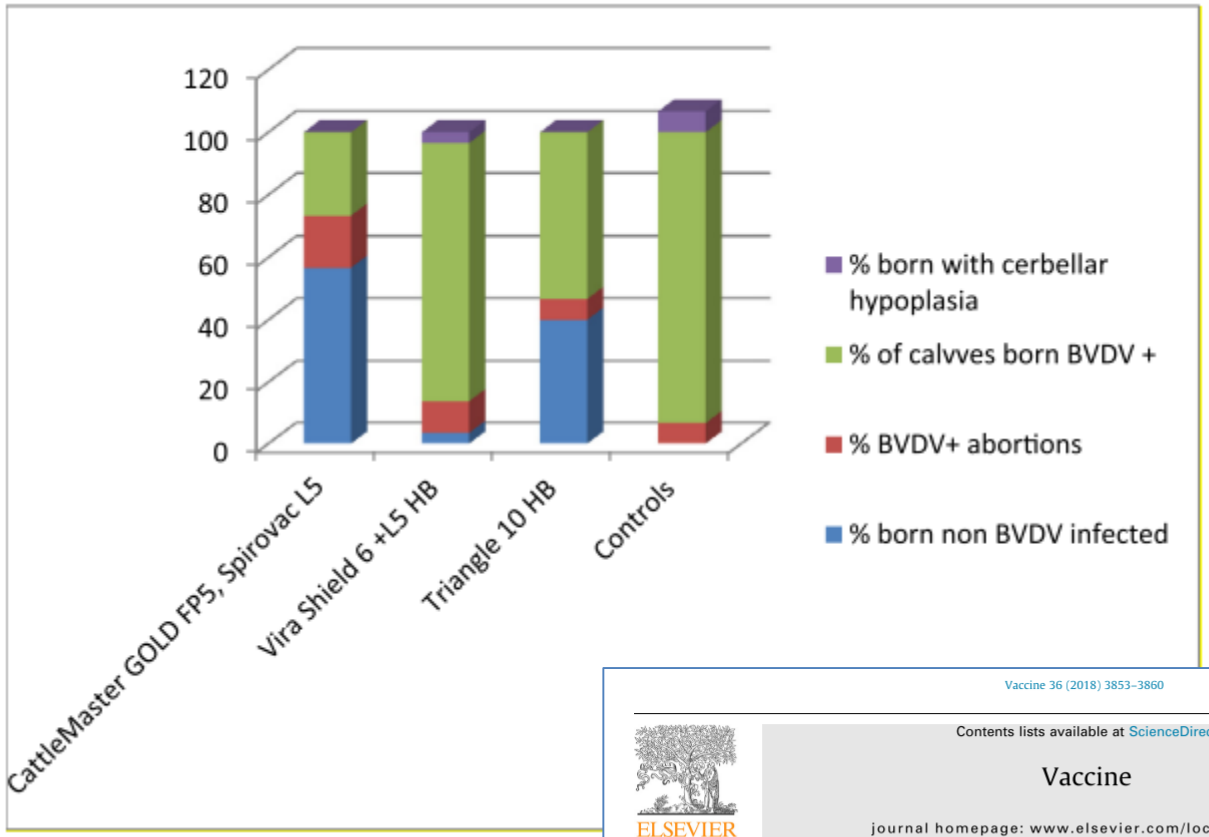
Control Tools: Vaccines availability

Commercial vaccine available Europe/worldwide	☑
Marker vaccines available Europe/worldwide	☒
Effectiveness/shortcomings	☑ ☒
Commercial potential in Europe	☑
Regulatory challenges to approval	☑
Commercial feasibility	☑
Opportunities for new developments	☑

Control Tools: Vaccines availability

Availability globally/Europe- Gaps

- Safe MLV vaccines, suitable for pregnant animals, non-immunosuppressive
- Cross protection and duration of immunity for heterologous field strains/genotypes largely unknown for current vaccines
- Vaccine components to reflect subgenotypes and genotypes circulating in different regions
- Alternative production cell lines may be needed to emerging bovine pestiviruses to the titers required for vaccine production
- Evaluation of the efficacy/cost-efficiency of different vaccines/vaccination strategies under field conditions and in different herd settings



Vaccine 36 (2018) 3853–3860

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Comparison of reproductive protection against bovine viral diarrhea virus provided by multivalent viral vaccines containing inactivated fractions of bovine viral diarrhea virus 1 and 2

Paul H. Walz [a], Kay P. Riddell [a], Benjamin W. Newcomer [a], John D. Neill [b], Shollie M. Falkenberg [b], Victor S. Cortese [c,*], Daniel W. Scruggs [d], Thomas H. Short [d]

Disease details: Description and characteristics

Pathogen- Gaps

- Further investigations of the host tropism, geographical distribution and clinical importance of recognised and emerging pestiviruses in both ruminant and non-ruminant species, and the potential reservoir role of wildlife species.
- Systematic screening and characterisation of pestiviruses, with particular focus on areas that have been poorly investigated and that may have a major influence on other parts of the world, e.g. due to export of FCS or semen.

Disease details: Description and characteristics

Variability of the disease- Gaps

- Gaps remain in the understanding of virulence factors, the role of many of the pestivirus proteins and the mechanism of adaptation of viruses to different hosts (important in determining impact of wildlife infections on control programs and infections with Border disease virus [BDV] in cattle).
- The real impact from a production and welfare point of view is somehow still not clear.
- The impact of infection on the developing bovine immune system is poorly understood as is the interaction of these viruses with other pathogens in the development of the bovine respiratory disease complex.

Disease details: Description and characteristics

Stability of the agent/pathogen in the environment- Gaps

- The practical importance of prolonged survival of the virus under cold wet conditions, and in hair, desiccated tissues, beddings and fomites on equipment used to house, handle, process and transport animals and the risk of mechanical transmission e.g. via flies are unknown.
- The risk of spread of BVDV from contaminated vaccines, semen, pooled colostrum and materials used in embryo transplant has been demonstrated, but the stability of the virus in such media is unknown.
- Further work on environmental stability (half life) under different conditions (e.g. temperature, humidity, matrix) is required.
- Little information is available regarding the contamination rates of personnel, vehicles, and equipment after visiting BVD positive farms

Disease details: Species involved

Animal infected/carrier/disease- Gaps

Preventive Veterinary Medicine 152 (2018) 65–73

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

ELSEVIER

Quantifying the role of Trojan dams in the between-herd spread of bovine viral diarrhoea virus (BVDv) in Ireland

Fiona Reardon[a,*], David A. Graham[b], Tracy A. Clegg[a], Jamie A. Tratalos[a], Padraig O'Sullivan[c], Simon J. More[a]

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- The contribution of pregn
spread of infection betwe
further investigation.

Preventive Veterinary Medicine 157 (2018) 78–85

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

ELSEVIER

Potential infection-control benefit of measures to mitigate the risk posed by Trojan dams in the Irish BVD eradication programme

Fiona Reardon[a,*], David Graham[b], Tracy A. Clegg[a], Jamie Tratalos[a], Padraig O'Sullivan[c], Simon J. More[a]

Disease details: Species involved

Animal infected/carrier/disease- Gaps

- The ability of the virus to circulate in herds for extended periods in the absence of PI animals also needs clarification.
- New-born calves infected early in life appear to be a possible problem. Virus in serum might may be detectable for a prolonged time even in the presence of maternal antibodies (by RT-PCR, often with high Ct values). These animals are not PI, but under field situation, such a farm is often restricted until clear results are available. But whether they really can transmit the virus is unknown.
- Prepubescently infected cattle may develop and chronic infection of reproductive tissues. In some cases infectious virus can be isolated while in others virus is detectable by PCR. The risk of transmission of virus by these animals is largely unknown (Cumulus).

Disease details: Species involved

Reservoir (animal, environment)- Gaps

Graham *et al. Irish Veterinary Journal* (2017) 70:13
DOI 10.1186/s13620-017-0091-z

Irish Veterinary Journal

RESEARCH Open Access

CrossMark

A survey of free-ranging deer in Ireland for serological evidence of exposure to bovine viral diarrhoea virus, bovine herpes virus-1, bluetongue virus and Schmallenberg virus

David A. Graham[1*], Clare Gallagher[1], Ruth F. Carden[3], Jose-Maria Lozano[2], John Moriarty[2] and Ronan O'Neill[2]

Disease details: Description of infection & disease in natural hosts

Transmissibility - Gaps

- Risk of spread of virus between domestic and wildlife species needs to be assessed.
- Risk of spreading virus via embryo transplant due to use of contaminated FCS needs to be assessed.
- Risk of spreading through natural insemination from infected bulls also not always clear.
- Risk of spreading virus via MLV due to use of contaminated FCS in manufacturing process needs to be assessed.
- Transmission parameters poorly understood with regards to interspecies transmission and transmission by vehicles, equipment and people (influence of contact rates, infectious dose etc.).
- How quickly virus spreads within individual herds and role of level of herd immunity in promoting self-clearance of BVDV.

Disease details: Description of infection & disease in natural hosts

Signs/Morbidity - Gaps

- The role of chronic or prolonged infections (associated with stress or presence of secondary pathogens) not well understood.
- Impact and mechanism of synergy between BVDV and other pathogens due to immunosuppression, that results in reduced production (milk, growth) and/or clinical disease not fully understood. Provides additional economic and public health motivation to control disease.
- Longitudinal studies on the effect on production in endemically infected herds needed on population level. Focus not only on reproductive parameters but also on general calf health, including long term impact of transient infections in neonates on endocrine and immune tissues (particularly thymus tissues).
- The effect of congenital infection on calf development (especially neuro-invasion and neuropathology) and production has not been well studied and quantified.
- For modelling better quantification at all levels are required.

Disease details: Description of infection & disease in natural hosts

Shedding kinetic patterns - Gaps

- The extent of shedding in PI animals under influence of maternal antibodies and its influence on the within-herd transmission is poorly understood.
- The importance of shed hair from PI animals as a source of infection unknown.
- The survival of these viruses on equipment and in the environment is largely unknown. The risk of sharing grazing lands is largely unknown. Risk quantification needed.
- The role of shedding of virus from acutely infected animals in maintaining infection within a population (herd) in the absence of PI animals needs further investigation.

Disease details: Impact on animal welfare and biodiversity

Both disease and prevention/control measures related - Gaps

- Calf health is often severely impaired in infected herds but the impact of this for farm economy, animal welfare etc is poorly described/discussed/understood. Too much focus on reproductive disorders instead of overall reproductive efficiency (also including young stock survival and replacement). The impact of the disease in different production settings is poorly understood.
- The impact of immunosuppression on herd health leading to increased use of antibiotics is largely unexplored.

- Endangered wild species affected or not (estimation for Europe / worldwide)
- Extent of problem in captive (zoos, parks and preserves) and free ranging wildlife (e.g. chamois) needs further investigations.

Disease details: Main means of prevention, detection and control

Surveillance- Gaps

- Efficient and sensitive methods and strategies for PI surveillance is missing.
- Effective diagnostic tools for identification of pregnant dams carrying PI foetuses (PI carriers) are missing.
- Role of molecular epidemiology as a potential contact tracing tool to assist surveillance and control efforts.
- Surveillance strategies for post-eradication period to rapidly identify re-introductions

Disease details: Main means of prevention, detection and control

Cost of above measures- Gaps

- Publication of ex-post cost-benefit assessments needed. This needs to be done in more detail within different eradication schemes, as the economic benefit of BVDV eradication is there but is not as obvious as initially expected.
- Publications relating to efficiency calculations, in particular at national and regional level, are rare.
- Publications of the benefits of such measures on the market are missing.
- Separating costs of BVDV for herds from other concurrent animal health problems (i.e. there could be many reasons why a herd has poor reproductive performance besides BVDV so may underestimate how much effect controlling for BVDV will have on improving herd performance).

Disease details: Socio-economic impact

Direct impact (a) on production- Gaps

- Good estimates of the impact in endemically infected populations lacking.
- A better understanding of the economic impact under different farming conditions is needed.
- More studies are needed, which analyse the impact of BVDV such as between case and control herds or within herds before and after the eradication.

Disease details: Socio-economic impact

Direct impact (b) cost of private and public control measures- Gaps

- Good estimates of impact lacking.
- A better understanding of the economic impact under different farming conditions is needed.
- The relative importance of different motivators in making farmers engage in BVDV control – economic aspects are only one not well understood.

Disease details: Trade implications

Impact on EU intra-community trade

Impact on national trade - Gaps

- Good studies on impact on trade, involving economists and political scientist needed.
- Role of national animal policy (e.g. declaring herd status and/or requiring pre-movement testing) in mitigating risk of animals spreading disease from BVDV positive herds to minimize impact on national trade.

STOC free

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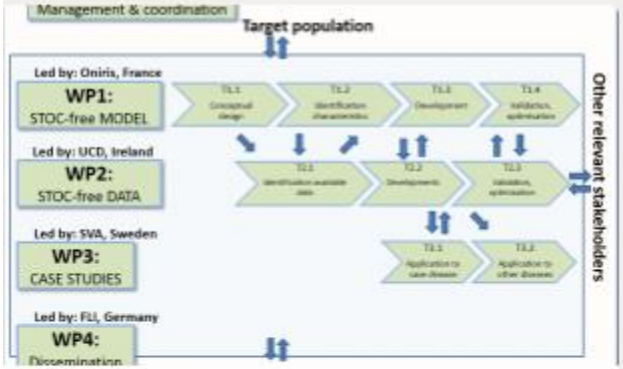
Surveillance analysis Tool for Outcome-based Comparison of the confidence of FREEdom from infection

Project | Work packages | Partners | Results | News & Events | Links



Work packages

The project is organized into **five work packages**, each consisting of several tasks.

STOC free partners

Oniris, INRA, UCD, AHI, UU, GD, FLI, SVA and SRUC

Kick-off meeting

during the SVEPM Conference in 2017.

SOUND Control

NATIONAL BVD ERADICATION PROGRAMME

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Transboundary and Emerging Diseases

Global knowledge gaps in the prevention and control of bovine viral diarrhoea virus (BVD)

Journal:	*Transboundary and Emerging Diseases*
Manuscript ID	TBED-RW-604-18
Manuscript Type:	Review
Date Submitted by the Author:	24-Sep-2018
Complete List of Authors:	Evans, Caitlin; Massey University, School of Veterinary Science, EpiCentre Pinior, Beate; Univ Vet Med Vienna, Institute for Veterinary Public Health Larska, Magdalena; National Veterinary Research Institute, Virology Department Graham, David; Animal Health Ireland Schweizer, Matthias ; Länggass-Str. Institute of Virology and Immunology: University of Bern, Department of Infectious Diseases and Pathobiology Guidarini, Christian; Boehringer Ingelheim Vetmedica GmbH Decaro, Nicola; University of Bari, dept of Veterinary Public Health Ridpath, Julia; USDA-ARS National Animal Disease Center, Ruminant Disease and Immunology Research Unit Gates, M. Carolyn; Massey University, School of Veterinary Science
Subject Area:	Diagnostics, Bovine viral diarrhoea virus, Genetic diversity, Pathogenesis, Disease control, Vaccination

Key conclusions

- Obstacles are not on the tool side. Rather, the main obstacles can be found in the attitudes and priorities of influential individuals/groups within the industry, academia and authorities.
- There is often lack of awareness among farmers and veterinarians, and because in many countries the producers will bear the cost of BVD control, the producer “buy-in” is critical.
- A trustful relationship between farmers, practitioners and governmental authorities is a prerequisite, and commitment of all involved parties is necessary.

Expert Group

- Julia Ridpath, Independent consultant (former USDA), USA - [Leader]
- Magdalena Larska, National Veterinary Research Institute, Poland
- Matthias Schweizer, Federal Food Safety and Veterinary Office and Institute of Virology and Immunology, University of Bern, Switzerland
- Peter Kirkland, Elizabeth Macarthur Agriculture Institute, Australia
- Carolyn Gates, Massey University, New Zealand
- Nicola Decaro, University of Bari, Italy
- Beate Pinior, University of Veterinary Medicine Vienna, Austria
- Christian Guidarini, Boehringer Ingelheim Vetmedica GmbH, Germany
- David Graham, Animal Health Ireland, Ireland