31st World Veterinary Congress
150th Anniversary of the World Veterinary Association
Prague, Czech Republic | 17–20 September 2013

Proceedings & Abstracts

PORCINE MEDICINE
INVITED SPEAKERS PROCEEDINGS
PORCINE MEDICINE CHANGING OVER TIME
FROM TREATING DISEASE TO MANAGING HEALTH AND WELFARE

Thomas Blaha, Professor of Epidemiology, Dipl. ECVPH and ECPHM
University of Veterinary Medicine Hannover, Field Station for Epidemiology,
Buescheler Str. 9, 49456 Bakum, Germany

The attitude of human societies towards food and food production changes with the degree of societal prosperity. This change can be illustrated by the gradual development in the attitude of the European consumers regarding food of animal origin after World War II. Three phases can clearly be distinguished that can be characterized by “Lack”, “Risks”, and “Guilt”.

Lack of food in general and craving for higher value animal protein food determined the objectives of the period of time from 1945 to the 1980’s: after times of food shortage, where especially food of animal origin was scarce, everybody wanted more meat, milk and eggs. The outcome of this was that everybody agreed on intensifying animal production: farm sizes grew, technologies were developed to increase the production while decreasing the labour. In this phase of overcoming the lack of food, nobody in the society criticized this development and there was a general consensus that public funds were spent to promote this process including supporting research for the development of more efficient production procedures. This resulted in husbandry systems exclusively oriented towards maximizing production and lowering costs with little awareness for the potential of food-borne risks that may have their origin in the primary production.

Risks to human health due to unsafe food came to the fore quite suddenly in the end of the 1980’s mainly triggered by the occurrence of BSE in the UK and later in several European countries, as well as by the steep increase of Salmonella Enteritidis cases in humans that could be traced back to eggs and poultry products. Both food-borne risks had the “new” characteristics that they could not get under control by the classical safety procedures of inspecting the food after harvest (e.g. meat inspection at slaughter). Recognizing this was kind of a wake-up call to have, additionally to traditional inspections of final products, also a closer look at the production procedures along the entire production chain – the concept of “from farm to table” was born. This paradigm shift evolved in the 1990’s and resulted in the Reg. (EC) 178/2002, which strengthened the responsibility of all food producers along the food production chain (including animal farming!) for the safety of the end products, and which implemented the “third eye” principle as quality assurance by neutral audits.

Guilt for real and perceived violations of ethical expectations in the area of producing food from and with animals started in the early 2000’s as a result of:

a) now abundant and affordable food in all European countries, and
b) simultaneously increasing investigations mostly by NGO’s into the production processes focusing at animal welfare, environmental protection and societal responsibility such as good neighbourhood, fair prices and wages for employees.

The societal debates have become increasingly harsh due to:

a) the slow adaptation of the producers at all production phases (farming, slaughter, processing) to adapt attitudes that address additional to efficiency food safety needs and ethical demands, and

b) the lack of knowledge about the needs and necessities of agricultural production in a steadily growing section of the society mainly due to urbanization.

Veterinarians in food animal production are in the wake of the described societal changes and, thus, of the growing criticism of modern animal production methods. The following graph illustrates the changes of the veterinary tasks in the food production chain from curing disease to preventing disease and further on to managing herd health as an active process of continuous improvement of animal health, animal welfare and pre-harvest food safety.

For the pig veterinarian this means that, although treating disease will maintain to be part of the veterinary care for pig herds, vaccination strategies, permanently improving the life conditions of the animals, strategically diagnosing not only clinical disease but also any latent infection for a health- and welfare-oriented organization of the production procedures and the daily animal care. Veterinarians have to become the leaders in developing new husbandry methods that allow for producing pork from pigs that are not adapted to low-cost and efficient husbandry systems (e.g. castration without anesthesia, and tail docking), but using production systems that are meeting the animals’ needs for a healthy life without any routine use of antibiotics, and that provides them life conditions that guarantee them the five freedoms that are the preconditions for an optimal animal wellbeing.
In contrast to many a modern activist that demand for reversing agriculture to an idyllic small-scale food production, the growing need to overcome the still unacceptably high number of hungry people in the world and to feed the growing world population, intensifying food production has no alternative. However, we have to learn how to produce food in a way that supplies everybody with abundant, wholesome, nutritious and safe food AND to simultaneously maintain our resources, protect our environment and keep animals for food production under conditions that allow them a decent life fulfilling their needs for animal wellbeing – in other words, the task is: building up an efficient and yet sustainable animal production for a societally accepted food supply feeding the world. In the framework of producing food from animals, the pig veterinarians are in the core of the necessary changes of how we produce pork, and they have a unique opportunity to get into the driver’s seat of this process.
EMERGING VIRAL INFECTIONS OF SWINE
Joaquim Segalés

Centre de Recerca en Sanitat Animal (CReSA), UAB-IRTA, Campus de la Universitat Autònoma de Barcelona and Departament de Sanitat i Anatomia Animals, Universitat Autònoma de Barcelona, 08193 Bellaterra, Barcelona, Spain

An emerging disease is the one that has appeared in a population for the first time or may have existed previously but is rapidly increasing in incidence or geographic range. Most of the emerging diseases in humans and animals are of infectious nature. Moreover, the number of new diseases in swine, included under the scope of emerging and re-emerging diseases, has increased importantly during last 20-30 years. Their transmissibility and maintenance into a population is favoured by a number of phenomena, including intensive rearing practices and globalized/international trading. Besides, the recognition of novel or re-emerging clinical problems, molecular biology techniques (PCR, microarrays, metagenomics, etc.) have accounted for this growing number of recognized new pathogens.

Although not all emerging diseases are of infectious origin, the infectious component usually guarantees, in the appropriate scenario, transmission and infection in a relatively large number of individuals. This concept is illustrated by the basic reproduction ratio ($R_0$), which represents the average number of secondary cases an infected individual can cause in a given population, assuming all individuals of the population are naïve. In consequence, if $R_0$ is higher than 1, the number of cases increases and an outbreak may follow. If $R_0$ is lower than 1, the number of cases decreases and eventually the pathogen may extinguish. Although $R_0$ also depends on the characteristics of the pathogen and the environment, swine reared under intensive conditions joins excellent conditions to transmit and maintain an infection that is introduced into the pig population. Once disease spreads into a population of naïve animals reared under intensive conditions, human action plays a major role in its evolution. First, management and treatment/control measures are established to limit the transmission of the pathogen. In these scenarios, over time, the infection can be endemically maintained causing minimal (subclinical) or sporadic disease. Eventually, the infection can be eradicated, creating again a population of susceptible animals.

The differentiation between infection and disease is relevant. In fact, a pathogen-exposed animal may eventually develop illness subjected to a number of factors. Factors influencing host susceptibility or resistance to disease include age, immunocompetency, vaccination status, genetic predisposition, concomitant disease problems, stress, environment, management, and nutritional status. Also, there is another factor that depends on the infectious agent, which is its intrinsic virulence (variable within types, serotypes or genotypes of a given pathogen). Several decades ago, the most important diseases affecting pigs were considered mostly “unifactorial”, in which the sole presence of the infectious agent was sufficient to trigger significant disease or production losses. In swine, most of these infectious diseases, such as classical swine fever (CSF), Aujeszky’s disease (pseudorabies), foot-
mouth disease or African swine fever (ASF), have been controlled or are under control in many parts of the world by means of vaccination programs. The control of these diseases increased the awareness of a number of not so devastating infections, but with significant impact on the economy of the swine industry, such as those caused by porcine reproductive and respiratory syndrome (PRRS) virus (PRRSV), and porcine circovirus type 2 (PCV2). Common to the latter ones is that they are considered “multifactorial” diseases, since the mere presence of the agent is not sufficient to trigger the disease. Moreover, other diseases have probably been there all the time, but their relevance increased mainly in the last two decades, such as swine influenza. Finally, there is a third category of infectious agents, from which their clinical significance on pig health is limited or uncertain (Table 1). Most of these viral agents are ubiquitous in the swine population worldwide, but the lack of scientific knowledge behind them implies a poorly understood epidemiology and pathogenicity. The list of new agents is growing almost every day, since the new technologies based on massive sequencing are expanding such numbers. In fact, it has been speculated that currently known viruses are no more than 5% of the existing viruses in the nature. Table 1 also includes viruses which are considered well-known pathogens, although of restricted geographic location.

Table 1. Summary of emerging swine viral infections and its likely pathogenicity.

<table>
<thead>
<tr>
<th>Virus</th>
<th>Year of first description</th>
<th>Pathogenicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porcine astrovirus (PAstV)</td>
<td>1980</td>
<td>Possible diarrhoea</td>
</tr>
<tr>
<td>Porcine rubulavirus (paramyxovirus)*</td>
<td>1988</td>
<td>Neurological, respiratory and reproductive disease</td>
</tr>
<tr>
<td>Swine hepatitis E virus (porcine HEV)</td>
<td>1997</td>
<td>Subclinical</td>
</tr>
<tr>
<td>Porcine endogenous retrovirus (PERV)</td>
<td>1997</td>
<td>Unknown</td>
</tr>
<tr>
<td>Menangle virus (paramyxovirus)*</td>
<td>1997</td>
<td>Reproductive disease</td>
</tr>
<tr>
<td>Porcine torovirus (PToV)</td>
<td>1998</td>
<td>Possible diarrhoea</td>
</tr>
<tr>
<td>Nipah virus (paramyxovirus)*</td>
<td>1998</td>
<td>Neurological, respiratory and reproductive disease</td>
</tr>
<tr>
<td>Porcine sapovirus (porcine SaV)</td>
<td>1999</td>
<td>Diarrhoea</td>
</tr>
<tr>
<td>Porcine lymphotropic herpesviruses (PLHV)</td>
<td>1999</td>
<td>Unknown</td>
</tr>
<tr>
<td>Torque teno sus virus (TTSuV)</td>
<td>1999</td>
<td>Unknown</td>
</tr>
<tr>
<td>Porcine hokovirus (PHoV), also named as porcine parvovirus 2</td>
<td>2001</td>
<td>Unknown</td>
</tr>
<tr>
<td>Bungowannah virus (pestivirus)*</td>
<td>2003</td>
<td>Reproductive disease</td>
</tr>
<tr>
<td>Porcine kobuvirus</td>
<td>2008</td>
<td>Unknown</td>
</tr>
<tr>
<td>Porcine bocavirus (PBoV)</td>
<td>2008</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Geographically restricted

The natural history of new infections is rather simple from a generic point of view, although the specific mechanisms by which they appear can be very difficult to elucidate from a scientific point of view. Traditionally, infectious diseases have been characterized by sudden, unpredictable outbreaks, sometimes of epidemic proportion. A number of scientific advances
occurred during 19th and 20th centuries, which resulted in the prevention and control of many infectious diseases (mainly in developed countries). Despite these improvements in health, outbreaks of infectious diseases still occur, and new infections have emerged and will probably continue emerging in the future.

The control of a given disease/infection might be very difficult *per se*, and sometimes to live with an endemic scenario could be worse than to eradicate it, although being threatened by the risk of re-infection. Such situation is especially important when dealing with pig diseases/infections, since the loss of production or competitiveness may cause significant economic disadvantages, not only for the producers but also for a country or region as a whole.
USE OF INACTIVATED MULTIVALENT VACCINE FOR BREEDING BOARS PRODUCING FARM RECOVERY FROM PRRS- FIELD STUDY

MVDr. Róbert Herchl

MVDr. Ivan Pšikal, CSc.

Introduction:

This study describes process of recovery breeding boars producing farm (Czech landrace) from PRRS by method of partial depopulation without producing process interruption. Farm is closed with continual breeding system. First aim was to achieve production of PRRS piglets from PRRS positive sows, second step was to reach PRRS free status of whole farm.

Material and methods:

In May 2011, based on demand of production of PRRS negative breeding boars, farm of 147 sows, 2000 total animas ask for coordination of process leading to setting production of PRRS negative offspring. Complete depopulation and repopulation of farm was impossible according to breeding value of animals on farm.

Based on results of preliminary serological examination by IDEXX ELISA (Table 1) searching for critical points in breeding chain, method of partial depopulation without producing process interruption was chosen.

Risky group of animals in age from 4 weeks to finishing period was sold or slaughtered to interrupt spreading of virus on farm. All stables and instruments was cleaned and disinfected.

All sows, gilts and boars on farm was vaccinated by Suivac PRRS-INe, bivalent inactivated vaccine containing 2 inactivated virus of EU type of PRRSV, 2 ml, twice in 4 weeks interval to achieve stabilisation immunity status of basic herd.

Production of breeding animals was temporarily moved to empty rented farm in 20 km distance to avoid contact with virus.

Gilts grooved on rented farm before introduction to basic herd was examined by IDEXX ELISA for PRRSV antibodies reaction. Negative gilts were twice vaccinated in 4 weeks interval by Suivac PRRS-INe. Two weeks after revaccination gilts were introduced to basic herd.

Basic herd was vaccinated continuously in day 60 to 80 of gravidity, all boars twice a year in 6 months period.
When whole basic herd pass thru 2 reproduction cycles with vaccination, group of 10 sentinel (ELISA negative -non vaccinated) gilts were introduced. Sentinel animals was examined monthly by IDEXX ELISA.

According to results of sentinel gilts, they remain ELISA Ab negative for whole reproduction period, production of weaners, gilts and breeding boars war removed back to farm.

Vaccination of gilts, sows and boars stopped (April 1012), current examination by IDEXX ELISA was done (Table 2).

With time old vaccinated sows are removed, all introduced gilts and produced breeding boars are examined by IDEXX ELISA. 60 % of basic herd is examined twice a year by IDEXX ELISA. All examined, non-vaccinated animals show negative levels of PRRS Ab.

Results:

Farm is producing PRRSV negative boars and gilts in these days (IDEXX ELISA). All process was done without important negative economical impact to farmer. As side effect of recovery from PRRSV farmer considers higher % of pregnant sows and gilts after mating comparing to year 2011 (85,4% vs. 77,6%), even % of gilts and sows to 2nd parity on farm is higher (46% vs. 34%). Lower presence of neonatal diarrhoea and respiratory symptoms are also described by owner(not recorded).

Conclusion and Discussion:

This study shows possible way of recovery producing farm with continual system of breeding from PRRSV by method of partial depopulation with using of inactivated vaccine to control virus spreading and stabilizing of immune status of basic herd. Study also shows importance of pointing critical phases of breeding process to set adequate system to interrupt virus spreading chain on farm.

References:
Table 1:

Table 2:
Porcine reproductive and respiratory syndrome virus (PRRSV) emerged as a swine pathogen in North America and Europe nearly simultaneously in the period 1980-1990. The European (EU) and North American (NA) prototypical isolates, Lelystad virus and VR-2332, defined Type 1 (PRRSV-1, EU genotype) and Type 2 (PRRSV-2, NA genotype). Initially, PRRSV-1 was thought to be genetically homogenous, but later studies established that PRRSV-1 is very diverse, at a level exceeding that of PRRSV-2. By molecular clock analysis, the most recent common ancestor for Type 1 and Type 2 PRRSV existed at least 100 years back in time, and the most recent common ancestor of Type 1 PRRSV emerged between 1947 and 1968.

Currently, genetic subtypes 1 (Lelystad virus-like), 2, 3 and 4 are recognized in PRRSV-1. Recently, it was shown that, in terms of antigenic characteristics and immunological responses following experimental infection, subtype 3 strains differ from other Type 1 strains. In the great majority of cases, subtyping based on ORF5 and ORF7 sequences yields equivalent phylogenetic results. Exceptions include a group of strains from the Russian Federation (subtype 1 based on ORF7, subtype 2 based on ORF5), and strains from Latvia (subtype 1 based on ORF7, and closer to a subtype 4 based on ORF5). These discrepancies may have arisen by recombination with breakpoints between the ORF5 and 7 genes.

There are striking differences in the geographical distribution of the PRRSV-1 subtypes, globally as well as locally in Europe. There appears to be a geographical demarcation running along the western border of the former Soviet Union, separating areas of low (Western and Central Europe) and high (Eastern Europe and Russian Federation) diversity of PRRSV-1.

Most studies reported none to low prevalence of PRRSV in wild boars or feral pigs. By contrast 16% of wild boars in different parts of Germany were RT-PCR positive, and 38% of wild boars in the Campania region of Italy were seropositive. In Lithuania, 6% PRRSV seropositivity was found in 1511 wild boar sera collected between 2008 and 2012 and 5 to 10% of serum and tissue samples were PCR positive. Six Lithuanian wild boar ORF5 sequences clustered in subtype 3, along with isolates from domestic pigs in the neighbouring Belarus. Interestingly, similar sequences have never been reported in Lithuanian domestic pigs.

Due to presumed ORF7 conservancy the gene has been commonly used as a target for PCR diagnostic methods. The ORF7 protein is also an important diagnostic antigen, since it is commonly used as coating antigen in ELISAs to detect exposure to PRRSV and determine herd PRRS status. The capsid protein sizes for PRRSV-1 and PRRSV-2 were described as being 128 and 123 amino acids, respectively. However, our findings showed that ORF7 size
differs between the PRRSV-1 subtypes; subtypes 1, 2 and 3 have deduced nucleocapsid protein sizes of 128, 125 and 124 amino acids, respectively. Significant but rare exceptions have been found from these subtype-prototypical nucleocapsid protein sizes. Thus, at present, the amino acid range of the nucleocapsid protein of PRRSV-1 is 124 to 132 residues. In contrast, for PRRSV-2, only three exceptions to the canonical 123 amino acid length has been reported in a single Mexican piglet nursery in which a 124 amino acid variant of ORF7 was observed.

The ORF7 size heterogeneity in PRRSV-1 is due to insertions/deletions internally in the protein, C-terminal truncations/extensions and a combination of the two. The genetic mechanism behind indels internally in ORFs is thought to include slippage of the RNA polymerase in regions of secondary structure. In contrast, the ORF7 protein C-terminal truncations/extensions are not associated with nucleotide deletions. Rather, single nucleotide mutations occur in "wobble" stop codons in the 3' end of ORF7. Interestingly, the pronounced plasticity of the Type 1 ORF7 is not seen in PRRSV-2 ORF7. It is unknown whether the sequence and size heterogeneity observed in the nucleocapsid protein of type 1 PRRSV has any functional implications.

In a recent RT-PCR ring trial comprising 7 European laboratories, 4 commercially available RT-PCR kits, and 8 in-house RT-PCR methods, divergent PRRSV-1 strains from Eastern Europe were observed to often produce false-negative results due to mutations in primer-binding sites. The Belarusian "Bor" strain (subtype 2), for example, was only detected by 69% of the RT-PCR assays.

All commercial ELISA kits are based on ORF7 antigens belonging to PRRSV-1 subtype 1 (Lelystad virus-like) or PRRSV-2 or both. We have observed that even relatively minor amino acid differences between the Type 1, subtype 2 and subtype 3 ORF7 proteins, are sufficient to affect the reactivity of swine antibodies. Nevertheless, it is important to stress that current data also supports that Lelystad-like nucleocapsid is an adequate ELISA antigen for detection of PRRSV antibodies in pigs infected with diverse PRRSV-1 strains.

The first report of PRRSV-2 in Europe came in 1995 after the introduction of the Ingelvac MLV (Boehringer Ingelheim). In most cases the PRRSV-2 sequences identified in Europe since then were similar (>98% identical in ORF5 or ORF7 nucleotide sequence) to the Ingelvac MLV vaccine. Additional introductions of PRRSV-2 not related to the vaccine has been documented in Hungary and Slovakia. Recently, we have found European PRRSV-2 sequences from independent farms in Germany likely originating from a common source, but not derived from Ingelvac MLV. Pairwise comparisons show a range of sequence difference from Ingelvac MLV of 6.5% to 7.5%.

Acknowledgements: The research was supported by grants from the Polish Ministry of Scientific Research and Information Technology N308265136, COST Action FA0902 (EuroPRRS.net), and FP7 245141 (PoRRSCon).
The development of sulfonamides by Gerhard Domagk and the discovery of penicillin by Alexander Fleming have been celebrated as milestones in mankind’s attempts to reduce premature death and pain and suffering due to disease. It can be argued that infectious diseases have been the major death causes for thousands of years. This is definitively true for the centuries when, due to an increase of human populations moving and commingling throughout Europa and to the start of urbanization without any coordinated sanitation, the main epidemics that killed millions of people were Plague, Cholera and Typhoid. These bacterial epidemics had an exponentially higher death toll than any viral epidemic. There are no hard data to prove or disprove, if not many a million of the many millions of deaths due to the 1918 Hongkong Flu epidemic were due to secondary bacterial infections that maybe dramatically increased the number of fatalities. There are speculations that the number of people that lost their lives in wars due to the direct effect of a weapon is manifold smaller than the number of wounded people that later died due to the bacterial infections caused by their being wounded.

Whereas in the early years of the availability of sulfonamides and antibiotics, only life-threatening infections of humans were treated, but soon more and more application areas were added: less harmful infections in humans, bacterial diseases in animals, more and more non-fatal diseases in humans up to the treatment of just “annoying” infections such as common colds, growth promotion (“non-therapeutic use”) in food animals, and the routine prophylactic and “metaphylactic” use in large scale food animal production units. This development of expanding the use of antimicrobial substances would have remained being undisputed, if there were not the phenomenon of acquired bacterial resistance.

The most important step in guiding medical and veterinary users of antimicrobial substances as treatment of bacterial infections was the development of the concept of the “prudent use of antibiotics”, which is defined as applying antimicrobials in a way that leads to the highest possible health effect in humans or animals and to the lowest possible resistance in the bacteria that are exposed to the antibiotic compounds. WHO, FAO and organizations such as FVE have issued guidelines on the prudent use of antibiotics. The following major basic principles are common for the prudent-use guidelines:

1. Use only licensed antimicrobials only as much and as long as necessary and as little and as short as possible;
b) select targeted antimicrobials according to the natural sensitivity of the identified bacterial species;

c) use the chosen antimicrobial compound in the highest possible dosage and over the shortest possible period of time, which is yet long enough to minimize the selection of resistant bacterial strains;

d) base this decision on laboratory results on the actual sensitivity (clinical breakpoint) of the disease-causing bacterial strains;

e) refrain from using broad-band antibiotics wherever possible;

f) refrain from using antimicrobial groups of critical importance for human medicine in non-life-threatening bacterial infections of humans and in veterinary medicine.

These guidelines for the prudent use of antibiotics are broadly accepted in the medical and veterinary professions and they have definitively led to a higher degree of compliance with practices that are known to reduce the development of bacterial resistance.

However, to which degree the magnitude of bacterial resistance in veterinary medicine has been influenced by the principles of the prudent use of antibiotics is more or less unknown, since the existing data on bacterial resistance are hardly comparable not only from country to country, but also over time.

Despite the prudent use rules, there are growing societal concerns expressed by public health authorities that are nowadays increasingly taken up by NGO’s criticizing modern animal production systems. And their “cause” is supported by the increase of multi-resistant Salmonella strains, MRSA in food producing animals (laMRSA), and ESBL. A quote from the Global Edition of the New York Times (March 23, 2011) illustrates the general perception of the use of antibiotics in general and especially in food producing animals: “…antibiotics are frequently misused – overprescribed or incorrectly taken by patients, and recklessly fed to farm animals”.

We have to accept that the rules for the prudent use of antibiotics are NOT able to address the reliance of animal production on the routine use of antimicrobials. If bacterial disease is occurring in any animal population, it is the ethical duty of veterinarians to apply antimicrobial substances, of course following the rules of prudent use. Not only unanimous experiences of veterinary pig practitioners, but also a growing number of scientific papers on the huge variability of the amount of antimicrobials used in pig herds, tell us that the animal health status of pig herds and the animal health awareness of farmers and their management skills determine the health status of the herd in question, which in turn, determines the necessary amount of antibiotics applied or prescribed by the veterinarian.

Concluding, the paper hypothesizes that there will be no significant reduction of the magnitude of bacterial resistance, if the rules of prudent use are not more strictly enforced AND if this is not accompanied by permanently monitoring and benchmarking the antibiotic use per herd to identify those farmers (and veterinarians), who use significantly more
antibiotics per animal than is used in the majority of all comparable farms. All in all, the attempt to reduce the amount of antimicrobials used in food animals by only measuring and penalizing high usage will potentially lead to more resistance (e.g. shorter treatments and lower dosages), unless farmers find new approaches to investing money in improving the health of their pig herds by optimizing the husbandry systems and hygiene procedures as well as paying veterinary services for maintaining the animals’ health rather than for curing their diseases.
Disease control has been, and still is, one of the primary objectives of porcine health management and represents one of the major challenges for practitioners and researchers. A high level of sanitary conditions is a prerequisite for economically sustainable production and for the safety of the derived food. Vaccination cannot completely replace the use of antibiotics in animal and human medicine because of the different target of their specific action. However, a more efficient and efficacious palette of vaccines could significantly help in reducing the use of antimicrobials. Vaccination can effectively prevent disease, and occasionally infection, but cannot completely replace the use of antibiotics for the intrinsic characteristics of the two different tools. Diseased animals must be treated with antimicrobials for ethical reasons. Even if they have been previously vaccinated, treatment is indicated in those conditions where vaccination cannot completely eliminate the occurrence of clinical signs, either due to non-complete protection, originating from multiple conditions, or to the complex etiology. In fact, in the last decades, improved knowledge about the etiology, pathogenesis and immune response of many diseases, as well as about vaccinology and therapeutics have led to new, combined approaches to the control of disease. These new strategies are aimed at more efficiently preventing infection and disease, leading also to the possible eradication of several important infections as well. Moreover, the elimination process (eradiacation?) of some infections can currently be realized by using vaccination, in particular by DIVA (differentiating infected and vaccinated animals) vaccines. Generally speaking, the approach to the control of infectious diseases is based mainly on four different actions: therapy, prevention, elimination/eradication. Vaccination has traditionally been the most efficient and inexpensive tool for disease prevention in animal and human medicine. Consequently, producers and veterinarians ask for vaccines with a high efficacy rate creating expectations in terms of clinical protection. Vaccine efficacy to a given infection can be complete, affording a very high preventive fraction in the treated population and giving the clear perception of the efficiency of the treatment adopted. Sometimes the vaccines can confer a partial protection only and, consequently, the perception of the efficacy is limited and frequently unsatisfactory. This can be due to the characteristics of the agent itself, the interaction between the causative agent and the immune system of the host, the technological limitations in the vaccine production, the availability of efficient adjuvants or the appropriateness of the route of administration. The result is that the vaccine seems to be inefficient. Vaccine efficacy or preventive fraction is measured by comparing the rates of disease between vaccinated and unvaccinated animals in clinical trials and it’s stated as the proportion of cases that are prevented by the treatment.

In livestock vaccinology, the major reasons that justify the use of a vaccine are: the presence of the infectious agent in the geographic area and the risk of infection, the presence and the
prevalence of the infection at herd level, the epidemiology of the infection (epizootic or enzootic), the effect of the infection in term of mortality, morbidity and the correlated economic impact on productivity. The decision to start vaccinating in a pig herd cannot ignore a precise economic evaluation based on the return on investment (ROI).

A vaccine must be safe (safety) and confers clinical protection (efficacy) against the disease caused by the agent(s) present as antigen(s) in the immunizing product. If safety is a precondition, efficacy is mandatory for immunization. Vaccination can be defined as the action of inoculating a vaccine via a defined route of administration, in a given time period of the life of the animal. In young pigs, vaccinations are used to protect them against infections occurring during the productive phase. The timing of vaccination is pivotal in those animals as, by definition, the administration has to anticipate the infection for the time period needed to mount an appropriate immune response. Vaccination in adults, sows and boars, is aimed at boosting previously primed immunity to obtain long lasting protection against the infection. In most cases, repeated vaccination of gestating sows is aimed at providing newborn piglets with a protective, passively acquired immunity.

In order to obtain the best performance from a vaccine, different conditions are necessary: the characteristics (efficacy) of the vaccine itself, the correctness of the administration and the appropriate route, the timing of vaccination taking into account the immune status of the animal, the potential interference of passively acquired immunity, if any, and the concurrent infections that can potentially affect immunogenicity. Immunogenicity gives an estimate of protection for some vaccines but does not definitively tell us if a pig is protected against disease, however it is an indication. The possibility of evaluating acquired immunity in a vaccinated population is one of the major issues correlated with vaccination. After immunization, the population has a “normal distribution” (“bell distribution”) with some pigs located in the two tails. The left tail is occupied by the “low responders”, having a suboptimal immune response, and the right tail comprises the proportion of the “high responders”. In many cases, the protection conferred by vaccination is not characterized by an increase of the antibodies we can measure with the routinely used laboratory investigations. The immune response following Mycoplasma hyopneumoniae vaccination is a clear example of this condition. In fact, vaccinated animals can or cannot mount an ELISA response without any correlation with clinical protection. It means that the antibodies we can detect by ELISA serology are not correlated with protection. Conversely, after Aujeszky’s Disease vaccination a good correlation between the amount of virus-neutralizing antibodies and protection has been demonstrated. Moreover, in this last case, the use of deleted vaccines allows to differentiate the vaccinated and the infected pigs. The use of DIVA vaccines is essential when vaccination is applied within an eradication process. The evaluation of the cellular immune response is not yet routinely available. Conversely, for research purposes, it has been possible to evaluate the cell-mediated immune response by using the ELISpot essay based on the measuring of the IFN-γ secreting cells. Another issue correlated with this topic is when it is time to stop vaccinating. Generally speaking, a vaccination can be stopped when the infection has disappeared thanks to the effects of the immunity on the population or the risk of infection in a given population or area is very low or absent, making the ROI of the
vaccine use no longer advantageous. When vaccination is applied within an eradication program, the decision to stop vaccinating is very challenging. It can be stopped when the risk of re-infection is very low or null implying the availability to detect the “last infected” animal by laboratory or epidemiological tools.

The duration of immunity (DOI) in relation to the timing of vaccination is a corner stone of a vaccine. Lifelong immunity is not always provided by either natural infection or vaccination so the duration of immunity varies among different infectious agents and vaccines. The recommended timing of vaccination aims at achieving the optimal immune response to protect the period in life when the susceptibility to the disease and the related economic effects are highest. All relatively new vaccines available today in pig medicine are continually updated regarding the length of time that they give protection. The duration of immunity varies depending on a wide range of factors, in particular the characteristics of the vaccine itself. The duration of immunity of two vaccines with the same antigen can be different in relation to the manufacturing conditions. In general terms, live vaccines induce a longer immunity than subunit or inactivated vaccines, which frequently require priming, followed by boosting administration. The route of administration is very important too. The advantages and disadvantages of the different options will be discussed.

Adjuvants are chemical substances that have been used to enhance the immune response either in term of magnitude and duration. Typically used “to help” the immunogenicity of inactivated, poorly immunogenic vaccines, currently adjuvants play an important role in the immunization process. Indeed, they are able to drive vaccine-derived immune responses in a specific direction to the innate and the adaptive immune cells in all types of vaccines. New adjuvants are available and in the near future this aspect of vaccinology will be significantly implemented thanks to the effort of research.
Most vaccines are administered by intramuscular or subcutaneous application. Recently, there is a growing interest in intradermal way of application. Skin is alternative site for a vaccine application not only for an ease access to the skin. Skin is, unlike subcutaneous or muscle tissue, place where the immune system is prepared for a penetration of the antigen. Skin is not only a coat protecting the body mechanically. Skin is composed from many different cells which can perform a wide range of immune-related functions. Based on histology and embryology, skin is divided into two basic compartments - epidermis and dermis. Epidermis is of ectodermal origin and keratinocytes are the main cell population. So-called Langerhans cells are representative of immune system cells. Dermis is of mesodermal origin and it is not so heavily populated by cells. The main cell population in dermis is represented by fibroblasts which produce components of extracellular matrix. There are also a lot of immune cells, including T-lymphocytes, mast cells and dermal dendritic cells.

Keratinocytes had been for a long time thought as passive cells which are involved only in a mechanical role of the skin. Now, it is clear that keratinocytes play also important role in immune reaction. They are able to recognize so called pathogen-associated molecular patterns by different receptor. Toll-like receptors are one of the most studied. Interaction between pathogens and receptors leads to production of proinflammatory cytokines and chemokines responsible for a recruitment of other cells. Keratinocytes are also producers of antibacterial peptides, including β-defensins.

Langerhans cells were described for the first time in 1868 as cells with dendritic processes. They were recognized as dendritic cells only in 1985. Langerhans cells orient their processes to different directions with the aim to cover as large area as possible. Inflammatory stimuli can lead to activation of Langerhans cells and their migration to draining lymph nodes. It is described that they are able to achieve lymph node during 3 days.

Another population of dendritic cells is represented by dermal dendritic cells. Dendritic cells in dermis were described relatively recently. They are less frequent when compared to Langerhans cells and information about them is limited. It is known from a mouse model that dermal dendritic cells - similarly to Langerhans cells - are able to migrate into draining lymph nodes. Speed of migration is faster - they were detected there after 18 hours after stimulation.

Both populations of dendritic cells belong to professional antigen-presenting cells responsible for a full activation of T-lymphocytes. They are able to collect antigens - including antigens
in vaccine. After full activation by *pathogen-associated molecular patterns* or by cytokines produced by surrounding cells, dendritic cells migrate into draining lymph nodes. Here, they interact with naive T-lymphocytes which can be fully activated only by the activated antigen-presenting cells. All this interaction is finely regulated by nature of antigen presented, surface molecules expressed on both these cells (for example MHC-I or MHC-II on dendritic cell and T-cell receptor on T-lymphocytes) and cytokine environment. This capacity can be influenced also by age of vaccinated subject. So, although intradermal application of vaccine is promising way of vaccination, there are still many questions to be responded regarding at least amount of antigen given or adjuvant used for an enhancing of immune response.

This work was supported by the Ministry of Education, Youth and Sports of the Czech Republic (AdmireVet; Grant No. CZ 1.05/2.1.00/01.0006 - ED 0006/01/01).
The process of the immune system ontogeny is not identical in all animal species. It has been generally accepted that the development of immune system structures in animals with a long gestation period takes place above all during intrauterine life, and foetuses in the second half of their development are capable of immune response to specific antigens (Symons et al., 1983).

Even though pigs are assigned to this group of animals because the average length of pregnancy in sows is 115 days, the development of the immune system is not completed at the time of birth of piglets, the neonates are not fully immunocompetent and various components of the immune system achieve maturation in the first days and weeks of life (Trebichavsky and Tlaskalova-Hogenova, 1998). The period from birth to 4 weeks of life has been described by several authors as a period of immunodeficiency – the active immune response of piglets is not comparable to that of the adults before 4 weeks of life. Moreover, porcine epitheliochorial placenta does not allow transplacental transfer of antibodies. Neonatal piglets are agammaglobulinemic and depend on the intake of antibodies from colostrum. Levels of these colostrum-derived antibodies gradually decrease in sera of growing piglets and according to the prevailing opinion they decline so much at a certain time point that they cannot protect the body against infection and even block the onset of active immunity. This period has been designated as the "immunity window" (Chappuis, 1998).

However, our previous studies and studies of other authors (Metzger et al., 1978; Symons et al., 1983; Kit et al., 1993; Nechvatalova et al., 2005) indicated that the ability of newborns to give an immune response to antigen develops earlier than generally supposed and specific inhibition by colostrum-derived antibodies only relates to the primary immune response; the secondary response is not usually inhibited as well as the cellular immune response. It seems that the "immunity window" could be overcome or shortened by properly timed vaccination, local administration of antigens (e.g. into the skin) and by the use of adjuvants.

The above mentioned intradermal (ID) route of immunization is an advanced but still a seldom used way of antigen administration in both human and veterinary medicine, although based on current knowledge of antigen processing and presentation by epidermal dendritic cells (Steinman and Pope, 2002), the skin tissue seems to be a better site for the induction of
immune responses than the muscle or subcutaneous tissues, also in the presence of the colostrum-derived antibodies.

This paper is a summary of results of studies carried out over the period 2007-2011, aimed at extending knowledge of ID vaccination in pigs from two aspects: investigation of the ability of antigens to induce immune responses after ID administration in the early postnatal period and induction of immune responses in both the presence and lack of antigen-specific colostrum-derived antibodies.

The trials were conducted with piglets with or without colostrum-derived antigen-specific antibodies. The animals were ID immunized (and 3 weeks later reimmunized) with a model antigen, Keyhole Limpet Hemocyanin (KLH) without or with adjuvant. Blood samples, nasal and bronchoalveolar lavage samples from all pigs were taken regularly for immunological examinations - isotype–specific indirect enzyme linked immunosorbent assays with purified antigens and for the KLH-driven lymphocyte transformation. Samples of skin were also taken for histology.

The piglets without KLH-specific colostrum-derived antibodies were able to give a quantifiable antibody immune response to ID vaccination with model antigens as early as at 3 days of life. The level of total antibodies after the first vaccination was lower in these piglets compared to piglets which were older at the time of vaccination. Above all, the onset of the immune response was initiated earlier with the increasing age; it was likely associated with the enlargement of the surface area, and the increasing height of epidermis and a rise in the numbers of dendritic cells (quantified immunohistochemically by detection of antigen CD1) with increasing age of piglets. No statistically significant differences in antibody levels between respective groups of piglets were recorded after revaccination.

ID vaccination induced especially cell-mediated immunity in piglets with high levels of colostrum-derived antibodies at the time of immunization. After revaccination, no significant differences were observed in the humoral immune responses of piglets with higher and lower levels of colostrum-derived antigen-specific antibodies at the time of primary vaccination.

The use of adjuvants in general enhanced the quality and quantity of the immune responses (accelerated the onset of the response and increased the level of antibodies as well as the intensity of cell-mediated immune response) and also influenced the duration of humoral immunity.

The present study confirmed that ID vaccination might be successful in piglets already in the early postnatal period, even in the presence of colostrum-derived antibodies at the time of vaccination, in accordance with other authors (Kit et al., 1993).

The study was supported by the project MZE 0002716202 and AdmireVet (CZ 1.05/2.1.00/01.0006 - ED 0006/01/0).


ID ADMINISTRATION OF DIFFERENT DOSES OF ANTIGEN

Bernardy, J.¹, Nechvátalová, K.², Krejčí, J.², Kudláčková, H.², Brázdová I.¹, Faldyna, M.²

¹ University of Veterinary and Pharmaceutical Sciences Brno, ² Veterinary Research Institute Brno, Czech Republic

The objective of the presented study was to describe different dynamics of humoral immune response to intradermally administered antigen and find out the lowest dose able to invoke measurable humoral reaction.

Farm piglets without colostrum-derived antibodies against *Actinobacillus pleuropneumoniae* (APP) from herd without APP history and without symptoms of diseases were randomly selected. The sows were not vaccinated, and antibodies against lipopolysaccharid (LPS) antigen APP have not been detected in their blood before parturition by home-made ELISA. Weaned Large White piglets, age of 5 weeks, average body weight of 10.25 kg (SD=1.74), were housed in experimental stables under farm conditions. Average daily gain (ADG) was 0.46 kg (SD=0.13).

The protocol of the experiment followed the Czech guidelines for animal experimentation and was approved by the Branch Commission for Animal Welfare of the Ministry of Agriculture of the Czech Republic.

Experimental Design

The 42 piglets were allocated into 7 groups and stabled in pens (n=6). In groups marked 1/3, 1/9, 1/27 and 1/81 were intradermally (ID) administered doses of diluted antigen 3x, 9x, 27x and 81x respectively; diluted in 0.2 ml of adjuvant. As a vaccination site was used the retroauricular or dorso-lumbar part of each pig. Standard doses and routes of administration were used comparatively – ID and IM, and not vaccinated control cluster KO. Piglets were vaccinated and revaccinated under experimental protocol in age of 6 and 9 weeks respectively. Blood samples were taken weekly and antibody against administered antigen was evaluated by ELISA. IgM and IgG antibody values were measured.

Antigens and Injection Technique Used for Immunisation

Commercial ID and IM vaccine was used for comparative groups. For ID administration commercially available inactivated APP toxoid vaccine Suivac APP ID, designed for ID administration, and for IM administration, commercial vaccine Suivac APP IM, designed for IM administration, (producer Dyntec s.r.o., Czech Rep.) was used.

The vaccine contained proteins and lipopolysaccharids (LPS) and equal mixture of APX I,II,III inactivated toxins (APX toxoid) in quantity corresponding to amount of bacteria at initial cultivation $10^9$ CFU before inactivation at vaccination dose; 6.0 ug equal mixture of APX I,II,III toxins; 0.15 ml of oil emulsion as adjuvants; excipients contained thiomersal max.
0.1 mg; formaldehydum solutum max. 3.0 mg; saponinum max. 0.05 mg at each vaccination dose.

Dosage of intradermal variation of vaccine was 0.2 ml pro toto; dosage of intramuscular variation of vaccine was 2.0 ml pro toto.

Commercial adjuvant Emulsigen (MVP, USA), oil-in-water emulsion, the same as contained vaccine, was used for dilution of vaccination doses.

Statistical and graphical software Statistica v 7.1 (StatSoft, Inc. 1984-2005) was used for statistical evaluation of the data. Significance of between-group changes detected by ELISA and pathological findings were assessed with Kruskal-Wallis nonparametric test.

Results

The very low dose of antigen (diluted 27x) administered ID induced comparable immune response either in IgM, or IgG immune response. The lowest concentration (diluted 81x) showed delayed or less intense response to the first vaccination in IgM and IgG titer, but intense response to the booster vaccination, fully comparable to more concentrated vaccines. The results of different concentrations showed response to diluted doses does not fully match to the gradual dilution of antigen in a dose.

All dilutions of antigen, used in the trial, involved measurable and mostly strong immune response. The very low concentration, 1:81 dilution, seemed to be too low to stimulate any response after single administration, however booster vaccination involved response, comparable to other concentrations. The lowest dose of antigen APP, able to invoke immune reply after intradermal administration of antigen was not disclosed. In concentration 1:81, decided as very low, the IgG and IgM response was measured by ELISA. Results of the paper seemed to be promising for involving IgM and IgG immune response after administration of very small amount of APP antigen.
Graph 1: IgM antibody reply to administration of different dilution of APP inactivated antigen

Graph 2: IgG antibody reply to administration of different dilution of APP inactivated antigen
EFFECTS OF ADJUVANTS ON THE IMMUNE RESPONSE AFTER INTRADERMAL ADMINISTRATION OF ANTIGEN IN PIGS

Josef Krejci a, Katerina Nechvatalova a, Jan Bernardy b, V. Kummer a, Z. Orešković a, Martin Faldyna a

The intradermal route of antigen administration has several noticeable advantages. Besides the fact that a sufficient immune response can be induced with a limited amount of antigen, intradermal immunisation is able to induce mucosal and cell-mediated types of immune responses. These are the reasons for the increasing interest in this vaccination technique.

Common vaccines administered subcutaneously or intramuscularly are potentiated with mineral or lipid adjuvants. Their stimulating effects, together with some adverse reactions, have been previously documented. In contrast to these methods of administration, there is no information about the effects of adjuvants administered intradermally. The vast majority of previously described experiments have been made with pure antigen; only a small number has been performed with vaccines containing commercial adjuvants. As far as we know, no publication has yet investigated the role of adjuvants in the intensity and nature of immune responses induced by intradermal antigen administration.

The following short information is a recapitulation of our experiments comparing immune responses and local reactions induced by intradermal administration of the same doses of antigen stimulated with different adjuvants. The immune responses were compared with respect to the intensity of systemic and mucosal antibody responses, their isotype characterization and the intensity of cell-mediated immunity. Apart from this, the intensity and nature of local reactions were studied.

Six groups of piglets were immunised with keyhole limpet haemocyanin (KLH) antigen in combination with aluminium hydroxide or selected oil-based adjuvants (complete and incomplete Freund’s adjuvants, Montanide ISA 206 and Emulsigen). A group of animals immunised intradermally with KLH alone was used as controls. Systemic specific antibody responses were significantly increased following intradermal administration of antigen together with any of the adjuvants used. The cell-mediated immune responses and levels of local IgA antibodies in the respiratory mucosa were enhanced by oil-based vaccines only. A disadvantage of these adjuvants is the occurrence of relatively strong local post-vaccination reactions, particularly apparent after repeated administration.

The obtained results have documented the usefulness of oil-adjuvant potentiated intradermal immunisation for the stimulation of mucosal and CMI immune responses. The comparison of the immunostimulating effects of the adjuvants used in our study with the intensities of local reactions at the site of injection showed Montanide ISA 206 to be the most promising candidate for further development. It induced significantly lower local reactions to the repeated antigen/adjuvant administration in comparison with the other high-stimulating lipid adjuvants. The problem of too intense local reactions could be resolved by using the second
dose of antigen without adjuvant or administrating it with adjuvant, but by the intramuscular route. However, it is necessary to further investigate the efficiency of both procedures.

Another experiment, aimed at clarification of the nature of local reactions, demonstrated a high production of proinflammatory cytokines (IL-1, TNF, IL-8 and so) at the injection site, followed by a high influx of polymorphonuclear leukocytes and later also of lymphocytes. This morphological picture was most pronounced in piglets vaccinated with KLH antigen together with a lipid adjuvant.
Porcine circovirus type 2 (PCV2) is one of the smallest DNA viruses infecting mammals, with a non-enveloped virion particle of 12 to 23 nm in diameter. It belongs to the family Circoviridae, genus Circovirus, and has been linked to a number of diseases collectively named as porcine circovirus diseases (PCVDs). PCV2 is nowadays regarded as one of the most important pathogens for domestic swine worldwide, causing significant economic losses to the pig industry. In the last 4 years, vaccines against this virus have become ones of the most used in pigs, displaying high levels of efficacy and excellent return on investment.

The perception about PCV2 and its disease causality has radically changed in the last 16 years. Initial descriptions of PCV2-systemic disease (PCV2-SD), named as postweaning multisystemic wasting syndrome (PMWS), linked severe lymphoid lesions with a PCV-like agent. Subsequent molecular virology studies indicated that such agent was different from the well-known PCV (nowadays named as PCV type 1, PCV1) present in the continuous cell culture PK-15. However, the ubiquitous nature of PCV2, the retrospective evidence of this viral infection as early as in the 1960s, the multifactorial aetio-pathogenesis of PCV2-SD and the lack of consistent demonstration of Koch’s postulates using the “novel” virus in a pig model caused great controversy about the real causality of the disease by PCV2. In fact, and especially before the advent of PCV2 vaccines, a number of swine veterinarians and scientists believed that the introduction and subsequent spread of PCV2-SD was not associated with PCV2 but with another unidentified agent, sometimes referred as “agent X” in the literature.

From the very beginning, sequence analyses of different PCV2s around the world indicated close phylogenetic relationship, with a nucleotide sequence identity higher than 93%. The sequences with nucleotide diversity cut-off of 3.5% could be divided into two major groups, which have been so far designated PCV2 genotypes a and b. A third genotype, retrospectively reported from Denmark in the 1980s, has been described and named PCV2c. Another study, restricted to Chinese isolates, proposed a fourth one, and was named PCV2d. So far, main PCV2 genotypes (a and b) have been demonstrated to be virulent enough to trigger PCV2-SD in the appropriate pig experimental model.

PCV2a seems to be older from an evolutionary point of view than PCV2b. Several studies published in different countries (Canada, Denmark, Spain, Sweden, Switzerland and USA) have described a shift on genotype prevalence from PCV2a to b coinciding with the advent of the most severe outbreaks of PCV2-SD. Although such epidemiological data do not demonstrate that the appearance of epidemic outbreaks are caused by PCV2b strains, such
coincidence in time and space points out that the genotype prevalence shift is part of the puzzle of the evolution of PCVDs.

The interaction between PCV2 and its natural hosts (domestic pig and wild boar) is a complex process that starts with viral attachment and entry into host cells. Viral replication seem to take place in a number of cell types, mainly epithelial and endothelial cells as well as macrophages; however, the proportion of these cell types that shows unequivocal evidence of replication seems to be low or very low. Such fact might be in relation with the relatively long incubation period to develop disease (around 18-25 days). Since one of the main virological differences between PCV2-SD and PCV2-subclinical infection is viral load and PCV2 has quite a long replication cycle, it is probable that the virus needs such prolonged incubation time to reach high loads in serum and tissues. Interaction between the virus and the pig should culminate with the development of a specific adaptive response that clears the acute infection, although it may allow viral persistence, at least in a proportion of animals.

Host genetics also appears to play a major role on PCV2-SD development. Experimental studies have shown that Landrace pigs develop more severe lymphoid lesions, and eventually clinical disease, compared to Duroc, Large White and Pietrain pigs. Moreover, a field study described a significantly less often occurrence of PCV2-SD-like clinical signs in purebred conventional Hampshire boars than in purebred conventional Yorkshire or Landrace boars. In addition, the use of Pietrain as a less PCV2-SD-susceptible breed has yielded contradictory results under field studies. In summary, the abovementioned observations are consistent with a genetic background effect on PCV2-SD clinical expression, but so far there is no specific knowledge on the mechanisms of susceptibility or resistance against the disease.

PCV2-SD is a multifactorial disease in which PCV2 is the essential causal agent. To date, a number of factors have been identified as risks to suffer from the disease in a population of animals that get infection by the virus. PCV2-SD triggering factors can be summarized in three main groups:

- Virus-host related factors (timing of PCV2 infection, sow infectious and serological status, genetics, immune response, etc.)
- Management and husbandry related factors (housing, vaccination schemes, biosecurity, cross-fostering, etc.)
- Co-infections (porcine reproductive and respiratory syndrome virus, porcine parvovirus and *Mycoplasma hyopneumoniae*)

In spite of investigations during last 16 years, some key questions about how PCV2, an everlasting endemic pig pathogen, causes disease remain to be answered. One of these fundamental issues is the individual expression of the disease; in a given pen, only some individual pigs exhibit clinical signs, while others show no clinical signs and they maintain an apparently good performance. Such individual expression of the disease probably depends on: 1) host (genetic susceptibility and deficient humoral and cellular immune response in front of the infection), 2) infection timing (when maternal derived immunity is waned, early PCV2 infection and co-participation of infectious and non-infectious factors) and 3) virus
(PCV2 genotype). Another key question refers to the appearance of PCV2-SD in different countries around the world at almost the same time. Based on available data, it would not be surprising that international trading have accounted for the differential timing in appearance of the disease or a given PCV2 genotype in a country. Therefore, the combination of phylo-geographical analyses and statistics on the international trade of live pigs, the fact of PCV2a is evolutionarily older than PCV2b and the evidence of a genotype shift coinciding with the occurrence of major disease outbreaks in a number of countries, would explain why an endemic virus was able to cause overt and noticeable disease at a given time point. Besides, international trade of pigs might have facilitated the dissemination of more susceptible pig genetic lines as well at the same time period.
PCV2 DISEASES – UPDATES

Paolo Martelli* – Joaquim Segalés**

*Department of Veterinary Sciences – Parma University – Italy
**CReSA – Universitat Autonoma de Barcelona - Spain

PCV2 has been associated with multiple diseases known as porcine circovirus diseases (PCVDs) and it is one of the most important pathogens of domestic pigs worldwide. The main syndrome caused by the virus is the PCV2-systemic disease (PCV2-SD, formerly known as PMWS). PCV2-reproductive disease (PCV2-RD) and porcine dermatitis and nephropathy syndrome (PDNS) are also important. From a diagnostic point of view, other conditions such as PCV2-lung disease (PCV2-LD) and PCV2-enteric disease (PCV2-ED) are overlapping syndromes due to PCV2-SD. Currently, the most frequent form of PCV2 infection is a subclinical infection (PCV2-SI) characterized by no overt clinical signs and by improved productive parameters following PCV2 vaccination. Since 2004, vaccines have been used in both sows and piglets, causing significant reduction of the impact of PCV2-SD and PCV2-SI. It is also worth mentioning that the PCV2 vaccine has been the most used vaccine in the last 7 years in pigs worldwide, demonstrating an exceptional efficacy and return on investment.

PCV2 is ubiquitous and domestic and feral swine are the natural hosts. Initial sequence analyses of different PCV2 viruses indicated a high nucleotide sequence identity (>93%) (Mankertz et al., 2004). The sequences with a nucleotide diversity cut-off of 3.5% could be divided into two major groups: PCV2 genotypes a (suggested to be the older one) and b (currently the most predominant in diseased pigs). A recent study showed that both genotypes are likely to have emerged from a common ancestor approximately 100 years ago and have been on independent evolutionary courses since that time, despite co-circulating in the same host species and geographic regions (Firth et al., 2009). A third genotype, retrospectively reported from Denmark in the 1980s, has been described and named PCV2c (Segalés et al., 2008). Another study, restricted to Chinese isolates, proposed a fourth genotype, named PCV2d, never reported outside China (Segalés et al., 2008; Guo et al., 2010). Preliminary data suggest that a another genotype may exist in wild boars from Europe and South America. Different PCV2 isolates of the same or different genotype can be detected in the same pig. In vivo and in vitro studies have provided evidence of potential viral recombination. The emergence of new genotypes could be the result of recombination between strains coexisting in the same animal. Antigenic cross-reactivity between different genotypes has also been shown by challenge studies and by the exceptional efficacy of current PCV2 vaccines, all based on PCV2a.

In order to explain the severe epidemics of the disease in the late ‘90s-beginning of 2000s, it has been hypothesized that the overall prevalence of PCV2a in previous years was mainly responsible for subclinical infection and sporadic disease. Then, at a certain, undefined point in time, PCV2b increased its prevalence causing the severe outbreaks of PCVD (Grau-Roma...
et al., 2008; Wiederkehr et al., 2009). Moreover, the international trade of potentially more susceptible pig genetic lines might have contributed in such epidemics (Rose et al., 2012). PCV2 has been found in mice and rats from pig farms, but not in rodents that were collected outside swine herds, suggesting the possibility of these animals acting as potential active or physical reservoirs.

Oro-nasal route is considered the most important route of transmission, but PCV2 has been found in the secretions from the nose, tonsils, bronchi and eyes, in faeces, saliva, urine, colostrum, milk and semen. Vertical transmission of PCV2 has been experimentally described in trans-placental infection after intra-nasal inoculation, and following artificial insemination (AI) with semen spiked with PCV2. Several studies have reported rare or negligible occurrence of abortion, while others have indicated high percentages (13-46%) of aborted foetuses and/or stillborns infected by PCV2. A usually low percentage of sows and piglets may be viremic during the lactating period, which also supports the possible transmission of virus from sows to nursing piglets and also highlights a potential route for vertical transmission.

Current knowledge of the adaptive immune response against PCV2 infection suggests that cell-mediated response, measurable as IFN-γ-SC, together with a significant neutralising antibody response, is mainly responsible for viral clearance in infected animals. It is hypothesized that a failure in one of the two or both responses might result in PCV2-SD.

PCV2-SD most commonly affects pigs at 2 to 4 months of age, but the occurrence of the disease in older pigs cannot be excluded. Morbidity in affected farms is commonly 4 to 30% (occasionally 50 to 60%) and mortality ranges from 4 to 20% (Segalés e Domingo, 2002). PCV2-SD is characterized by wasting, anaemia, respiratory distress, fever, diarrhoea, and occasionally icterus. Enlarged subcutaneous lymph nodes are a common finding in the early phases of PCV2-SD. In recent years, the extensive use of PCV2 vaccines has highlighted the importance of PCV2-SI characterized by decreased average daily gain only (Young et al., 2011). PDNS affects nursing, growing, and adult pigs. The prevalence of the syndrome is usually very low (<1%). Mortality approaches approximately 50% of affected younger pigs versus 100% in pigs older than 3 months of age. Severe, acutely affected pigs die within a few days after the onset of clinical signs (Segalés et al., 1998). PCV2-RD (late term abortions and stillbirths) under field conditions seems to be rare (Pensaert et al., 2004). This is probably due to the fact that the sero-prevalence of PCV2 in adult pigs is high and, therefore, most breeding herds are not susceptible to the disease (Segalés, 2012). Although the use of vaccines to prevent PCV2-RD is very limited worldwide, there are reports indicating that the use of PCV2 vaccines in gilts and sows can prevent the occurrence of abortions and increase fertility.

In situ hybridization (ISH) and immunohistochemistry (IHC) are the most widely used tests for the diagnosis of PCVDs. A correlation between the amount of PCV2 in tissues and the severity of microscopic lymphoid lesions in PCV2-SD has been demonstrated. Since the amount of PCV2 is the major difference between PCV2-SD affected and PCV2-SI pigs, techniques allowing PCV2 quantification in tissues and/or serum could potentially be used to
diagnose PCV2-SD. However, quantitative PCR lacks of high levels of both specificity and sensitivity on individual sample basis. Therefore, quantitative PCR seems to be a reliable technique to diagnose PCV2-SD on a population basis and not appropriate to substitute histopathology plus detection of PCV2 in tissues for the individual PCV2-SD diagnosis (Segalés, 2012). Recently, the antibody dynamics against PCV2 has become of major interest for the monitoring of PCV2 vaccination and the potential assessment of maternal immunity interference with vaccination. By definition, a PCV2 subclinically infected herd can be diagnosed by the following criteria: 1) lack of overt clinical signs; 2) no or minimal histopathological lesions (mainly in lymphoid tissues) and 3) low amount of PCV2 in few (lymphoid) tissues. The diagnosis of PCV2-RD should include three criteria: 1) late-term abortions and stillbirths, 2) heart lesions characterized by extensive myocarditis, and 3) presence of high amounts of PCV2 in myocardial lesions and other foetal tissues.

PCV2 vaccines are the most cost-effective tool to control the disease. Before the use of PCV2 vaccines, control measures were based on reducing the effects of co-factors and triggers involved on individual farms (e.g. “Madec’s 20-point plan”). Therefore, measures capable of increasing maternal immunity and decreasing sow viremia at farrowing should diminish piglet PCV2-SD mortality in the post-weaning period. A considerable reduction in PCV2-associated productive losses has been observed in growing pigs that have either been vaccinated or which originated from vaccinated breeding herds. Piglet vaccination improved PCV2-SD associated mortality and morbidity, average daily gain (10 to 40 g/day in vaccinated pigs compared to non-vaccinated controls), feed conversion rate and groups homogeneity (Martelli et al. 2011). Moreover, decreased co-infections and use of antibiotics have been shown to be additional benefits of PCV2 vaccination. PCVs are not considered a public health concern. However, a significant worldwide social alarm was recently generated when two vaccines against human rotaviruses for use in children were found to be contaminated with PCV DNA.

References

EFFECT OF LIVE YEASTS SACCHAROMYCES CEREVISIAE ON INTESTINAL INFECTIONS IN PRE-WEANING PIGLETS

J. Bernardy, D. Kumprechtova, E. Auclair

University of Veterinary and Pharmaceutical Sciences, Palackeho 1, 61242, Brno, Czech Republic

LFA, Lille, France

Introduction

Piglets, born without immunoglobulin in sera, due to the epithelio-hemochorial type of swine placenta receive all the specific immunoglobulin found in blood of newborn piglets from mother’s colostrum. The persisting milk immunoglobulin protect the intestinal content by means of lactogenic immunity. Piglets fed milk supplemented with Saccharomyces cerevisiae (SC) showed an increased post-weaning growth and reduced TNF-α expression in the intestinal and liver tissues, suggesting an important immunomodulatory role of the combined treatment (1). The influence of SC β-glucan supplementation on the immune function in pigs was also studied. It was found that β-glucan can selectively influence performance and exert some beneficial effects on the somatotropic axis and immune functions in weaned piglets challenged with E.coli lipopolysaccharides. E. van Heugten et al. tried to evaluate the effects of live yeast supplementation on faecal microflora and ascertain whether live yeast could replace antibiotics and growth-promoting concentrations of Zn and Cu in nursery pigs. They found variable responses, and determined the conditions under which a response might be expected (2). Hurnik et al. found that purified β-glucans increased passive transfer of antibodies onto piglets, increased humoral response to PRRS virus and Mycoplasma hyo and determined effects on piglet survival (3). The ability to compete with some pathogenic intestinal microflora (hemolytic E.coli and Clostridium perfringens type A) in pre-weaning piglets was investigated in this study.

Material and Methods

64 sows and litters (total 722 piglets) were allocated to 4 groups fed diets medicated with or without Saccharomyces cerevisiae Sc47 (Lesaffre Feed Additives, France), at a dose of 1kg per 1 ton of feed. Group 1 received the medicated feed either sows and piglets, Group 2 received sows only, Group 3 piglets only and Group 4 was not medicated. Piglets and sows were swabbed regularly – sows before and after the farrowing and piglets every week until the weaning at 28 days of age. The data were evaluated by non-parametric ANOVA Kruskal-Wallis test and visualized by Statistica v.8 software.
Results

The microbiological findings confirm that hemolytic *E.coli*, a major cause of intestinal disorders in piglets, and mortality tended to be lower in the groups where either sows or piglets or both received SC (Figure 1), and higher in the controls without the dietary addition of SC. A significantly lower mortality was found in the groups 1 and 3 (*p > 0.05*), where the sows and piglets (1), or the sows only (3) received SC. Pre-weaning mortality and number of piglets weaned by groups fed different diets is shown in Figure 2. Number of pre-weaning deaths and number of live weaned piglets differed significantly (*p > 0.05*).

Discussion

Lower mortality and better results in the groups fed by the diet medicated by SC can be attributed to the effect of SC on hemolytic *E.coli*, particularly in both groups, where sows were fed the SC supplemented diet. There was a statistically proven evidence of 1.9 more piglets weaned in the group, where both the sows and piglets were supplemented with SC. The suppressive effect of SC on entero-pathogenic *E.coli* and *C. perfringens* type A was not obvious, however, a reduction in hemolytic *E.coli* counts was observed in the groups fed SC enriched diets.

References

Figure 1: Hemolytic E.coli in groups medicated by SC and control

Figure 2: Preweaning mortality in groups medicated by SC and control
BACTERIAL RESPIRATORY DISEASES IN PIGS

Prof. Dr. Heiko Nathues, Ph.D., DVM, Dipl.ECPHM, FTA Schwein

Clinic for Swine, Department of Clinical Veterinary Medicine, Vetsuisse Faculty, University of Berne, Switzerland

The role of bacterial pathogens in the development of respiratory diseases in pigs

Actually, no significant amount of viable bacteria should be found in the lower airways of any pig. If bacteria are present in the lung and if there are symptoms of respiratory disease at the same time, instantly the question arises whether these bacteria could be the primary cause of the particular lung disease or whether they have to be judged as secondary invaders or even commensals. Compared to viruses, only very few bacterial species are known to act as primary pathogen in the pig’s respiratory tract [1]:

- *Actinobacillus pleuropneumoniae*
- *Bordetella bronchiseptica*
- *Mycoplasma hyopneumoniae*
- *Pasteurella multocida*

Noteworthy, serious infections usually occur only in juvenile pigs and rarely cause symptoms in adult animals even though these often harbour subclinical infections and are able to transmit the pathogens to their own progeny, pen mates, etc. Suckling and nursery pigs, whenever affected, most often are infected with either *B. bronchiseptica* or *H. parasuis* or *S. suis*. The latter two bacteria usually require the presence of additional (primary) pathogens and/or risk factors in order to be involved in any type of respiratory disease [2-4].

Pneumonia in fattening pigs, if primarily caused by bacterial infection, usually can be attributed to either *A. pleuropneumoniae* or *M. hyopneumoniae*. Both pathogens significantly contribute to the porcine respiratory disease complex (PRCD), where porcine reproductive and respiratory syndrome virus (PRRSV) and swine influenza viruses (SIV) also play a significant role and have to be considered as primary cause of respiratory disease in growing and finishing pigs [5]. Secondary infections with other bacteria including *B. bronchiseptica*, *P. multocida* and others frequently occur. Mono-infections with toxin producing *P. multocida* can lead to progressive atrophic Rhinitis (PAR) in pigs at nearly every age.

The role of other bacteria in the context of respiratory disease in pigs still has not been ultimately clarified. Some studies highlight *Mycoplasma hyorhinis* or *Chlamydia suis* as potential pathogens of the porcine respiratory tract [6-8]. However, evidences (e.g. fulfilling Koch’s or Evan’s postulates) are still lacking and thus no emerging of bacterial respiratory disease in pigs could be confirmed.
Diagnostic measures to identify bacteria as cause of pneumonia and other respiratory disorders

The diagnosis of respiratory diseases in groups of pigs is relatively easy in terms of identifying localisation and character of the disease. Usually a few of such pigs showing typical symptoms of the corresponding disease are examined by necropsy, where alterations can be evaluated and tissue samples can be taken for further analysis including the cultural isolation and identification of bacterial pathogens. Clinical cases become more complicated, when aetiological diagnosis has to be performed on pigs alive. There are different sample sites (Tab. 1), where material for direct detection of bacteria should be obtained, whereas it has been shown that the detection of bacteria in other sites is often a result of either contamination or natural commensalism.

Beside this traditional approach of ‘diagnosing an infection’, the indirect detection, i.e. demonstration of antibodies, has become very popular in recent years. With regard to bacterial respiratory disease, only the detection of antibodies against M. hyopneumoniae in combination with the assessment of other parameters (e.g. coughing index) has been proven to sufficiently support a diagnosis [9, 10], whereas the presence of antibodies against A. pleuropneumoniae or H. parasuis in pigs’ sera often is not correlated with any disease [11, 12]. This fact has major implication for the suitability and reliability of serology under field conditions and - unfortunately - often is not considered when detecting corresponding antibodies either on pig- or on herd-level.

Therapy & prevention programmes including vaccination

It should be taken into account that the detection of various bacteria in one of the mentioned sample sites does not automatically imply any involvement in a present disease, i.e. it does not confirm causality regarding a respiratory disorder. Hence, neither antibiotic treatment nor any prevention plan should be solely based on a simple ‘finding’ of some bacteria in the respiratory tract of pigs. Moreover to this, multiple infections with different species and/or different strains of the same species have to be considered when planning therapy and prevention measures [13-15].

The use of vaccines can aid in reducing the disease impact, but often there is no induction of sterile immunity and vaccinated animals still become infected. This highlights the need of implementing good hygiene measures, adopted ventilation, strict all-in-all-out management and an appropriate separation of different age- and production-groups in pig herds in order to combat bacterial respiratory disease; whether these are emerging or re-emerging.
Table 1: Primary bacterial pathogens causing significant respiratory diseases in pigs and their optimal sampling site for direct detection by either cultural examination or polymerase chain reaction (PCR)

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Nasal swab</th>
<th>Bronchoalveolar lavage fluid</th>
<th>Lung tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Actinobacillus pleuropneumoniae</em></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><em>Bordetella bronchiseptica</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Haemophilus parasuis</em></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Mycoplasma hyopneumoniae</em></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><em>Pasteurella multocida</em></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><em>Streptococcus suis</em></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

*Secondary invader / seen as primary pathogen only when found in sucking/nursery pigs

References

INTRODUCTION

According to the WHO definition, health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity. This definition can also be applied to animals. Although it is well known that health is much more than absence of disease, the health status of pig herds is often measured or defined in terms of absence of specific diseases. The WHO defines an emerging or re-emerging disease as one that has appeared in a population for the first time, or that may have existed previously but is rapidly increasing in incidence or geographic range. Such diseases, mostly infectious diseases, have increased during the last decades. This paper will discuss the importance of emerging diseases, transmission routes of pig diseases, and control and prevention measures.

EMERGING VIRUSES AND THE HUMAN-ANIMAL INTERFACE

There are currently about 1,000 known animal pathogens: 600 of livestock and 400 of domestic carnivores. Forty and 70% respectively are zoonotic, and 18% and 11% respectively are viral. By contrast, of all emerging pathogens, 55% (domestic livestock) and 59% (domestic carnivores) are viruses. During the last 30 years, approximately 90 novel human pathogens were discovered, averaging 3 per year; 66% of which were viruses and more than 80% of these, RNA viruses. Most are potentially zoonotic. RNA and single stranded DNA viruses are the most likely to emerge because of their small genome, rapid rate of replication and polymerase enzymes that lack proof-reading capability. These characteristics facilitate recombination, reassortment and inter-species transmission if the appropriate conditions exist. The “One world-One health” principle addresses the threat that such agents represent for public health.

IMPORTANCE AND SPREAD OF PIG DISEASES

Pig diseases may be ‘important’ for several reasons: 1) Emergence or introduction of certain pathogens into free areas, where they may cause epizootic diseases e.g. swine fever, foot-and-mouth disease. 2) Having a major impact on public health such as the zoonoses e.g. Salmonella, but also all diseases leading to increased antimicrobial use. 3) Endemic diseases with a direct economic impact for the farmer. Many pathogens e.g. PRRS, PCV2-associated diseases, M. hyopneumoniae, E. coli, Brachyspira and Streptococcus spp. belong to this group.
The globalization of trade and production systems, climate change, intensification of farm animal production, and changing human-animal interfaces contribute to emerging and re-emerging pig diseases. Possible sources of pathogenic infections and transmission routes are very numerous e.g. sow-to-pig, pig-to-pig, via semen and embryo transfer, aerosol, people, rodents, insects, domestic and feral non-swine animals, birds, fomites, carcasses and vehicles. In intensive systems, a large number of animals are kept on one production site or share the same airspace. It is obvious that in this situation, “diseases are easy to gain, and hard to lose”.

**General control measures**

Proper biosecurity measures may interrupt or limit the spread of infections. Studies indicate large variations in biosecurity between pig herds, suggesting that there is room for improvement. Scoring of biosecurity is very helpful for sensitizing pig producers and for benchmarking, which are essential for improving the situation. Nutrition may also help to improve animal health and control endemic disease e.g. E. coli post-weaning, Brachyspira and Salmonella. In addition, due to the increased prolificacy of sows, stillbirth and piglet mortality have increased, average birth weight and colostrum intake per pig decreased, and sow longevity decreased. These factors contribute to more disease problems, and increased antimicrobial use. Consequently, the price of increased productivity is partially paid by more health problems and antimicrobial use in suckling and recently weaned pigs.

Vaccination is a very helpful tool to control infectious diseases. However, vaccines are available for only specific diseases, most of them only provide a partial protection and do not prevent infection, and the decision whether or not to vaccinate is not always straightforward. Antimicrobials will remain necessary for proper treatment of bacterial infections and animal welfare. They should however be used judiciously to avoid or limit the risk for antimicrobial resistance. Repeated prophylactic use of antimicrobials without sufficient diagnostic data or using antimicrobials as a substitute for improper management cannot longer be justified.

**Levels of disease prevention**

Control of infectious diseases may take place at three different levels: primary, secondary and tertiary prevention. Primary prevention aims to prevent introduction of the pathogen in a herd. It is the most effective strategy, on the condition that the pathogen-free status can be maintained for a sufficiently long period. Secondary prevention aims to maintain a balance between the infection level and the herd immunity. This is the case for most pig herds and pathogens. However, also subclinical infections cause performance losses. Although decreased performance/pig is lower in subclinically than in clinically infected animals, at a population level, and from an economic perspective, the impact of subclinical infections is likely to be of much greater significance to the pig production industry than the effect of clinical disease. Tertiary prevention means that clinically diseased pigs should be treated quickly and properly. This will remain important, but in general terms, the rule of thumb is that “prevention is better than cure”.
Conclusion

Several emerging and re-emerging pig diseases have been described during the last decades. They constitute a real challenge for pig veterinarians and all stakeholders of pig production because they decrease profitability, affect animal health and welfare and hinder the production of safe and wholesome animal products. Biosecurity, management and health monitoring have become critical. Measures should not only focus on the primary production, but include all parts of the pork production chain i.e. from farm to fork, or from food to feed. The proverb “a chain is no stronger than its weakest link” is particularly applicable to animal health of pigs and food safety of pork.
Food safety, animal health, and food security are substantial goals in producing food from animal origin worldwide. Depending on the prosperity of a country, the priorities of these concerns can vary and additional concerns like animal welfare, regionality and sustainability can be included.

The European food safety strategy pursues three main and equally important goals, which are a) improving food safety, b) optimizing animal health and c) increasing animal welfare quality (Reg. (EC) No. 178/2002). To achieve these goals a paradigm shift needs to take place along the whole food chain. The “traditional meat inspection”, which is not able to control subclinical or asymptomatic zoonotic diseases by inspecting, palpating and incising carcasses and organs (Hathaway and Richards, 1993), is replaced by the so-called “risk-based meat inspection”. The core elements of this risk-based approach are strengthened responsibility of the food producers including primary production, prevention and process-optimization, risk-orientation and continuous pre- and post-harvest improvement measures.

In contrast to just condemning carcasses and organs at the slaughter line, the new goal is to assure production processes at farm level that result in healthy animals for slaughter (pre-harvest food safety) as well as in improved slaughter and processing methods (post-harvest food safety).

According to the World Health Organization a quarter of deaths worldwide are due to infectious diseases and two out of three infectious diseases are caused by zoonotic agents.

Furthermore, zoonotic infections in humans associated with direct contact to pigs or consumption of pork products are of global public health importance. The number of human infections with e.g. Salmonellosis or with *Taenia solium* is worldwide still high particularly due to limited clinical symptoms in pigs. However, parts of the world or single countries managed to be free from Cysticercosis and even from *Salmonella* spp. in pigs because of implementing meat inspection procedures, systematic surveillance and/or control programmes.

In the last ten years various zoonoses are emerging or re-emerging in pigs and in humans with partly uncertain epidemiology. In 2009, a novel pig-origin influenza A Virus, subtyped as H1N1, caused a pandemic with more than 200 countries included and millions of people infected all over the world (CDC, 2010). Another emerging zoonotic agent is the so-called “livestock-associated Methicillin-resistant *Staphylococcus aureus*” (laMRSA), which was firstly isolated from pigs in 2005 in the Netherlands (Voss et al., 2005). Subsequently, laMRSA was isolated in pigs, other animals and in humans both as subclinical colonizer of
mucosa and as causative agent of clinical infections like dermatitis or sepsis in other countries all over the world.

In the „Scientific opinion on the public health hazards to be covered by inspection of meat“ from 2011, the European Food Safety Authority (EFSA) underlined the importance of serological monitoring programmes for subclinical zoonoses in pigs (EFSA, 2011) and ranked the following zoonotic pathogens as the most important public health hazards due to the consumption of pork in Europe: Salmonella spp., Trichinella spp., Yersinia enterocolitica and Toxoplasma gondii. Although national serological salmonella monitoring systems are established in some European countries like Denmark, The Netherlands and Germany, information about other important zoonotic pathogens in pigs is missing. Consequently, the future food production system demands for new diagnostic strategies for zoonotic agents in food animals. One cost-efficient monitoring concept is the “meat juice multi-serology” (Meemken and Blaha, 2011). Within this concept, meat juice samples (or blood serum samples) are simultaneously tested via microarrays for antibodies against zoonoses and production diseases. Because the number of tested targets in the microarray system has hardly any effect on the prize, emerging zoonoses, neglected production diseases as well as notifiable diseases can be added to the test panel.

Literature

CDC (2010): Centers for Disease Control and Prevention. From the National Center for Immunization and Respiratory Diseases, Division of Viral Diseases.


DIAGNOSTIC APPROACH IN PIG DISEASES

Joaquim Segalés

Centre de Recerca en Sanitat Animal (CReSA), UAB-IRTA, Campus de la Universitat Autònoma de Barcelona and Departament de Sanitat i Anatomia Animals, Universitat Autònoma de Barcelona, 08193 Bellaterra, Barcelona, Spain

Diagnosis consists of identification of the nature of anything, either by analytical methods or processes of elimination. Application of logic and experience is a plus trying to determine the cause and effect relationships. Efforts focused on identifying the nature of problems (understood mainly as diseases or poor-production scenarios in the case of pig health and production) and the establishment of curative or preventive solutions are intrinsic components of the diagnostic procedure. Therefore, the pig veterinarian represents, in essence, a diagnostician.

The diagnostic work starts as soon as the veterinarian visits the farm and tries to establish all the components of a potential problem. The most important step to diagnose a potential problem/disease is the on-farm clinical investigation. The first step on whatever farm investigation is inductive, since it tries to answer the simple questions of “who, what, where, when, since when, how and how many”. In general terms, it is a descriptive phase in which the veterinarian must be as precise as possible, trying to separate what is perception from reality. Obviously, correct data record is compulsory for the reliability of whatever diagnostic procedure. The second step is the one called deductive, since the veterinarian must combine knowledge, experience and logic to approach the most likely clinical diagnosis. In order to establish a definitive diagnosis, Veterinary Diagnostic Laboratory (VDLs) can help identifying agents potentially involved in a disease outbreak or poor-production problem. However, a potential danger in the whole diagnostic process is to excessively rely on laboratory analyses. At the very end, the importance of pathogens relative to other host, management, and environmental factors must be determined by the submitting veterinarian.

Due to the population concept of medicine in livestock animals, infectious diseases are very often considered a potential cause of a given problem, or at least a component of the differential diagnosis list. In these scenarios, the veterinarian might use laboratory testing as an aid to establish a definitive diagnosis. Therefore, clinicians are users of laboratory tests performed at VDLs to investigate on health, productivity and reproductive status in individual animals and herds. Besides those laboratory tests detecting infectious agents or evidence of seroconversion against them, there is a broader spectrum of laboratory techniques: detection of toxins and nutritional deficiencies are also important in population medicine. Overall, these laboratorial tests are mainly focused to:

- Detect pathogens or toxins that are responsible (or not) for disease outbreaks or suboptimal production
- Evaluate the infection/exposure status of individual pigs
- Determine whether a herd was infected with or exposed to a pathogen and, if so, which age or production groups were affected
- Estimate the percentage of herd or pigs with antibodies to an infectious agent
- Monitor a herd’s serological response to vaccination
- Monitor the progress and success of disease control or eradication programs

The abovementioned diagnostic purposes are aimed to answer the fundamental question: “what am I interested to confirm or rule out?” To sample correctly and request for the adequate tests help the veterinarian obtaining the right answer. Importantly, such question must be formulated in a way that the VDL can really answer it. Laboratory tests may confirm whether a certain infectious agent or toxin is present in a given sample or samples in a pig or group of pigs, but they cannot establish if this agent or toxin is the major one involved in a particular herd problem or if the treatment strategy against the organism will solve the situation.

Several criteria should be applied to decide which laboratorial test to use in each particular disease problem, such as the cost and the rapidity in which the test is performed and the results communicated. However, other criteria should also be considered:

- Own features of the test (sensitivity, specificity, predictive values and accuracy). A cheap, rapid, easy-to-do test with 100% sensitivity and 100% specificity does not exist. All tests are imperfect
- Resources and abilities of the laboratory: “all laboratories cannot test all”. This situation demands a really deep contact and relationship between the veterinarian and the laboratory
- Do not test for something with doubtful interpretation (i.e., serology for a certain infectious agent of a single pig, PCR of a single pig, etc.)

To choose one or another laboratorial test must be based on the advantages and disadvantages that each technique offer, which are crucial for the adequate interpretation of results. This situation implies that the wide availability of laboratory tests is parallel with certain lack of information regarding which test should be used in each particular situation. Pig veterinarians must know also strengths and weaknesses of laboratorial tests in order to address the fundamental question raised above. As an example, sometimes less sensitive techniques (such as the immunofluorescence antibody test in frozen tissues to detect a pathogen) are more useful to determine the cause of a clinical problem than more sensitive and specific techniques (such as a polymerase chain reaction (PCR) method).

Highly sensitive tests are not necessarily the best option to diagnose a clinical disease problem. New high-tech modern techniques (especially molecular biology techniques) have open new and challenging scenarios on diagnostic capabilities. Molecular techniques, in comparison with classical microbiological methods, have many advantages in the sense that they are becoming less expensive, more rapid and sensitive, have high throughput, do not require viable agent and offer more portability of the generated data. However, a number of these techniques are still poorly available in VDLs across the world. Moreover, in some
cases, the availability of the technique is not accompanied by the sufficient expertise to exploit adequately the outcome of the technique. An example would be sequencing as a molecular tool for epidemiological investigations. The capability of sequencing does not imply the availability of a diagnostic test unless proper handling and interpretation of bioinformatic sound data is feasible. At the end, and even the arsenal of diagnostic tools is expanding, the rational attitude of the pig veterinarian regarding laboratory analyses is to request those tests for the most probable differential diagnoses, and not for all of the possibilities, including the most remote ones.

There are two quotes that apply very specifically when dealing with the diagnostic process. These sentences were given by Dr. Steve Henry (Abilene Animal Hospital, KS, USA) at the American Association of Swine Veterinarians meeting in 2003: “A diagnosis is a matter of facts; it is not a matter of opinion” and “For each mistake we make by not knowing, we will make ten mistakes by not looking”. Please, keep them in mind!!!
SLAUGHTER CHECKS FOR SYSTEMATICALLY IMPROVING PIG HERD HEALTH

Dr. Diana Meemken, Assistant Professor for Food-Borne Zoonoses

University of Veterinary Medicine Hannover, Institute for Food Safety and Food Quality, Bischofsholer Damm 15, 30173 Hannover, Germany

Slaughter checks as control of success for herd health improvement measures and as additional diagnostics of acute disease outbreaks are sporadically performed by veterinary practitioners only for herds under their care. In the framework of the new European food safety strategy, official meat inspectors are to evaluate lesions such as pneumonia, pleurisy, pericarditis as well as abscesses at slaughter for every slaughter pig herd. Such a routine slaughter check strategy aims at informing farmers and their veterinary practitioners about current herd health deficiencies. According to the European Regulation No. 853/2004, systematic slaughter check results are to have an impact on the intensity of the meat inspection method (visual vs. intensified) and have to be used as benchmarking tool for improving herd health and animal welfare in pig herds. Due to the improvement potential of benchmarking systems, farmers, food business operators, as well as practicing and state veterinarians have a growing interest in valid and reliable official slaughter check results. Studies regarding aspects of the validity and comparability of slaughter check results have recently been conducted in Austria and Germany (Eckhardt et al., 2008; Hoischen-Taubner et al., 2011). And although in both countries objective scoring systems for pneumonia, pleurisy, pericarditis and hepatitis parasitaria are prescribed by national regulations, significant differences between abattoirs in evaluating pathological lesions, especially pathological lung lesions, were reported. The score on which the mandatory lung score system in Germany and Austria is based on was developed by Blaha (1994). It assesses pathological-anatomical lung lesions according to the estimated expansion of the inflammatory lung affection in proportion to the surface of the whole lung on both sides. This lung lesion score (Tab. 1) differentiates pneumonia lesions between “low” (lesions ≤ 10%, pneumonia 1), to “medium” (lesions 11-30%, pneumonia 2) and “high” (lesions > 30, pneumonia 3).

Tab. 1: Evaluation scheme of lung lesions (Blaha, 1994, modified)

<table>
<thead>
<tr>
<th>Alteration extent</th>
<th>Alteration grade</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤10%</td>
<td>low</td>
<td>pneumonia 1</td>
</tr>
<tr>
<td>11-30%</td>
<td>medium</td>
<td>pneumonia 2</td>
</tr>
<tr>
<td>≥30%</td>
<td>high</td>
<td>pneumonia 3</td>
</tr>
</tbody>
</table>

The advantages of this system is that it classifies lung lesions in just three different alteration grades, which offers the possibility to apply this scoring system under industrialized slaughter conditions. Furthermore, conclusions regarding the impact of pneumonia can directly be drawn by the information about the percentage of affected lung surface. One disadvantage of
this and all other evaluation systems made for the usage in abattoirs is, that only suppurative, fibrinous, embolic, hemorrhagic and necrotizing pneumonia are detectable with a relative high reliability in contrast to interstitial pneumonias which are hardly to detect without histological methods. Another disadvantage of this evaluating system is that due to the threshold definition of affected lung surface in proportion to the whole surface, a consistent visually performed classification is a challenging task especially if the lesions are distributed over more than one lung lobe (Fig. 1).

The scoring system of Madec and Kobisch (1982) compensates this problem by an imagined subdivision of each lung lobe into quarters and consequently scoring pneumonic lesions from zero to four points per lung lobe. The drawback of this system is that the relationship between the score points and the extent of the affected lung surface is not representing a realistic lung proportion, i.e. a totally affected apical lobe and a totally affected diaphragmatic lobe results both in four points although the realistic proportions are differing. In the scoring system of Blaha (1994) a totally affected apical lobe results in “pneumonia 1” and a totally affected diaphragmatic lung lobe results in “pneumonia 2”.

An auxiliary method for lung score systems which measures the surface of the affected lung parts in proportion to the whole lung surface is the method developed by Straw et al. (1986) which is shown in Figure 2. By using this method, a measurement of lung lesions could be facilitated which could be proven in first pilot projects in three different abattoirs in Germany.

In summary, it can be concluded that official slaughter check results, continuously summarized per herd for benchmarking purposes, are an important part of modern herd health management systems if assessed in a standardized way. In terms of comparability of slaughter check results an official international standard for evaluating pathological lesions during slaughter should be defined and included in quality assurance systems.
**Literature**


A veterinary surgeon - specialises on porcine medicine, experience changing and evolving branch more rapidly along with the increasingly difficult situation of pork producers. On the one hand, global pig meat production continues to grow, and tripled over the last 30 years. On the other hand, there is a shift of pathogenicity of previously often opportunistic pathogens. High feed costs concentrate pigmeat production into the major grain growing areas, not only here but throughout the world. It results in the continuing increase of the concentration of pigs in the densely populated areas.

The current health care of pigs concentrated in large herds focuses on the ability to keep pigs disease free and prevent spreading of mutual porcine pathogens. It changes the veterinary perspective on the issue, the dynamics of the disease, and the importance of biosecurity, creating mathematical models of risk calculations, statistically based number of samples, necessary to examine the health situation and providing preventive measures. Individual diagnostics and disease - oriented view of traditional veterinary medicine is substituted by mass or herd diagnosis and detection of statistically based models of health of groups of animals. One of the important methods remains a post-mortem examination. It includes rapid screening tests, scoring of different symptoms (limping, obesity, parasitic infestation, ileitis and examination of respiratory apparatus.

Lung scoring is inexpensive and without diagnostic difficulties, however basic experience is required, along with time demanding trips to slaughterhouse. Assessment involve fast appraisal especially of the larger defects, as the time allotted to explore is about 20 seconds in large abattoirs and recording the scheme of the lung palpable changes and resolution of focal consistency. Degree of damage in per cent of the lung volume and the type of change has to be recorded in the scheme.

The characteristic primary lesions can be summarized in several groups of diseases: pneumonia, pleurisies (adhesions), the occurrence of abscesses and pericarditis. Available data of slaughter lung scoring can be used as a ground for defining the state of the disease in animals and herds, and allows to obtain adequate diagnostic forecasts.\textsuperscript{1,2}

Diagnoses determined from examined lungs could be estimated – actinobacillosis indicated by characteristic pleurisy, local and systemic changes induced by Pasteurella multocida and Haemophilus parasuis, Mycoplasma hyopneumoniae characteristic condensed lesions, interstitial oedema suggesting viral infections\textsuperscript{3,4}. Some false positive signs could mislead to incorrect diagnose. Changes of lungs raised from steamed water, agony changes, inhaled blood etc are more or less signs of animal welfare disorders than diseases and should be recognised and differentiated.
Lung disorders should be interpreted cautiously, due to the biased nature of the sample and a number of other factors affecting the incidence and evaluation of lesions at slaughter. Individual differences in the assessment and scoring are often based on observer individual classification, reported at various monitoring and reporting programs in the USA and Europe\(^5\), although there are training programs, manuals and comparisons of the performance assessors at slaughter\(^6\).


IS BIOSECURITY FOR PIG FARMERS PROFITABLE?

1Doc. MVDr. Pavel Novák, CSc., 2Ing. Gariela Malá, Ph.D., 1Ing. Karel Tittl

1Tekro, spol. s r.o., Prague, Czech Republic
2Institute of Animal Science, Prague Uhřineves, Czech Republic

Introduction

Biosecurity management practices are designed to prevent the spread of diseases by minimizing the movement of biologic organisms and their vectors (viruses, bacteria, rodents, flies, etc.) into and within the farm. At present time the biosecurity programme consists of three major components: isolation (a strategy to keep infectious agents and discharges away from susceptible animals), resistance (nutritional, environmental, pharmacological and immunological practices that improve the animal’s ability to resist disease) and sanitation (key factor in minimizing spread and limiting the course of infectious diseases - disinfection of any potentially contaminated equipment or facilities) focused on the complex influence of pathogen – animal – environment interaction (Buhman et al., 2000). Individual Programme of farm biosecurity presents a complex of preventive measures designed to individual pig farms intended to prevent the introduction of infectious agents into these breeding and its dissemination by person’s, animals, feed, transport (cars and trucks) and technological systems in order to prevent threat animal health or product quality.

Animals, materials and methods

The aim of our work was to express the effect of biosecurity precautions in pig farm with the average monthly number around 4000 fattening pigs after implementation the TEKROCID system and after repopulation of the pig farm from the animal health and economical point of view. The study was carried out in stables with total slotted floor with dry feed to the group feeders. The stable was thermal insulated with regulated system of forced ventilation. Biosecurity programme TEKROCID operates in conjunction with a material prepared by Fotheringham (1995); Novak et al. (2005) and Tittl and Novak (2009).

Results and discussion

The results are summarised in following table.

Table: Economical evaluation of biosecurity precautions in pig fattening farm

<table>
<thead>
<tr>
<th>State</th>
<th>The average number</th>
<th>Mortality pcs</th>
<th>%</th>
<th>Medication costs (€) Preventive</th>
<th>Therapeutic</th>
<th>Vaccination costs (€)</th>
<th>Medicine costs (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Tekrocid</td>
<td>4 184</td>
<td>36</td>
<td>0.860</td>
<td>1 487.5</td>
<td>1 792.0</td>
<td>1 593.8</td>
<td>5 982.4</td>
</tr>
<tr>
<td>After Tekrocid</td>
<td>2 984</td>
<td>25</td>
<td>0.837</td>
<td>532.2</td>
<td>977.6</td>
<td>91.7</td>
<td>1 868.1</td>
</tr>
<tr>
<td>After repopulation</td>
<td>3 161</td>
<td>16</td>
<td>0.506</td>
<td>781.2</td>
<td>0</td>
<td>0</td>
<td>1 081.4</td>
</tr>
</tbody>
</table>
The achieved results showed the positive effect of implementation of the TEKROCID biosecurity system in the farm for fattening pigs. The average monthly number of dead pigs decreased after the introduction of TEKROCID to 68.0% and to the 43.9% after repopulation of the farm compared to the values before the start of observation. Cost of preventive medication significantly decreased to 38.8% after the introduction of the biosecurity system, whereas the repopulation declined only to 52.5% from its initial state. Interesting results were achieved in the section of the costs of therapeutic medication, which decreased to 54.6% after the introduction of the biosecurity system. After the eradication of the farm the therapeutic medication was not necessary at all during one year after repopulation of the farm. Decreasing of the pharmaceutical costs as the indicator of health was more significant after the introduction of the biosecurity and reached 31.2% of the original values. After the repopulation the pharmaceutical costs decreased even to only 8.1% of the costs paid by the farmer before the start of our field experiment.

Dirty, less hygienic environment increases the level of immunological stress and depresses growth and performance of pigs (Johnson, 1996). Microbial contamination of the environment in stables develops to an important factor affecting the picture of infections in breeds. Animal health status depends on the capability of the animals to resist the infection pressure of microorganisms in the environment (Tielen, 1987). Disease control is only one part of a successful management program. Treatment of disease is not as effective or as economical as prevention (Purdue University, 2007).

Conclusions

Good management of pig livestock should be based on two fundamental principles, the fulfilment of basic animal needs and biosecurity practices. A good biosecurity program helps to decrease the risk of pathogens being transferred from farm to farm and simultaneously increase the economic efficiency of the farmer.

Appropriate hygiene standards on a farm are a prerequisite for maintaining good health and a high level of productive and reproductive performance of farm animals. Compliance with the general principles of biosecurity is a prerequisite for production of healthy and biologically wholesome raw materials and foodstuffs of animal origin as one of important indicators of improved competitiveness and economic viability of a livestock operation.

An effective and well-planned biosecurity plan on a farm is an important part of the herd health program to secure sustainable production. The stock manager, along with the veterinarian should strive to develop and implement a biological safety plan tailored to the farm as part of the overall management strategy of health, production and reproduction.

Acknowledgements

The study was supported by company Tekro and the Ministry of Agriculture Project No. MZE0002701404.
References


THE EUROPEAN COLLEGE OF PORCINE HEALTH AND MANAGEMENT

Joaquim Segalés\textsuperscript{1}, Paolo Martelli\textsuperscript{2}, Heiko Nathues\textsuperscript{3}, Mari Heinonen\textsuperscript{4}, Alexander Tucker\textsuperscript{5}, Carlos Piñeiro\textsuperscript{6}, Cinta Prieto\textsuperscript{7}, Olli Peltoniemi\textsuperscript{4}, Dominiek Maes\textsuperscript{8}

\textsuperscript{1}CReSA and Universitat Autònoma de Barcelona, Spain; \textsuperscript{2}University of Parma, Italy; \textsuperscript{3}University of Bern, Switzerland; \textsuperscript{4}University of Helsinki, Finland; \textsuperscript{5}University of Cambridge, United Kingdom; \textsuperscript{6}PigChamp ProEuropa, Spain; \textsuperscript{7}Università Complutense de Madrid, Spain; \textsuperscript{8}University of Ghent, Belgium

The European College of Porcine Health and Management (ECPHM) is a non-profit pan-European organization founded in 2004. The primary objective of the ECPHM is to advance health oriented porcine production management in the herd context as well as at the population level in Europe and increase the competency of veterinarians who practice in this field. Such main objective is pursued by means of different actions, namely:

- To establish guidelines and standards of training for postgraduate education and experience prerequisite to become a specialist in porcine health management
- To examine and authenticate veterinarians as specialists in porcine herd health management to serve health and welfare of the animals, the economic outcome of the herd, and the production of safe quality products for consumers in a sustainable animal production by providing expert care for pigs
- To encourage research and other contributions to the science and practice of porcine herd health management including husbandry, reproductive management at herd level, epidemiology, pathogenesis, diagnosis, therapy, prevention, and control of diseases directly or indirectly affecting pigs and the maintenance of healthy and productive pig herds. Porcine health management also includes the impact on quality and safety of pork products and gives special consideration to herd health and production, production systems and targets and the management of pig populations
- To promote communication and dissemination of knowledge related to above mentioned items

The ECPHM is under the umbrella of the European Board of Veterinary Specialisation (EBVS), whose main objectives and duties include the recognition of new specialty Colleges, to maintain a register of European veterinary specialists, to assure the quality of these specialists by monitoring the Colleges and to encourage and promote speciality services to the public and veterinary profession. The ECPHM is a medium-sized college and one of the 23 specialty colleges within EBVS.

The College was founded by 13 European veterinarians (founding Diplomates) recognized as international specialists in the field of porcine health and management. This initiative emerged as a response to the increasing demand of specialized veterinary services on swine production and the need to harmonize the post-graduate education across Europe in this field.
Once founded and according to EBVS rules, the ECPHM opened a 5-year period (2004-09) to recognize specialists all over Europe with the objective to increase the critical mass of Diplomates (*de facto* Diplomates). *De facto* acceptation followed strict criteria based on national and international professional relevance, including their scientific-technical communication skills through peer-reviewed publications. Such a scenario allowed the College to grow (up to 141 specialists from 19 different countries) and, very importantly, to start promoting the creation of advanced education programmes (residencies). In fact, the only way to access the Diplomate status since 2010 is by following a residency training and passing an exam organized by the ECPHM. The most common residency programme is the one organized by education establishments (Veterinary Schools), which is called standard residency programme. Alternative residency programmes are not coordinated in the framework of a Veterinary School, and they should have the same quality level as standard residency programs. The major difference is that alternative programs are tailor-made for the resident under proper supervision of Diplomates. Standard residency programs are re-evaluated every 5 years by the ECPHM. Currently, there are 14 standard residency programmes in Europe (Table 1), and a total of 43 veterinarians pursuing residency training. General educative contents of the residency programme are summarized in Table 2. The duration of a standard residency period is typically 2.5-3 years, and is preceded by an internship on swine health and production of 1.5-1 year duration. The full education period (internship and residency) must be at least 4 years. The internship is a less strictly prescribed, introductory education period on the subject of porcine health and production.

**Table 1.** Summary of the existing residency programmes across Europe, including the name of the program director and contact e-mail.

<table>
<thead>
<tr>
<th>Residency program (Country)</th>
<th>Director</th>
<th>E-mail de contacto</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Hannover (Germany)</td>
<td>Tomas Blaha</td>
<td><a href="mailto:thomas.blaha@tiho-hannover.de">thomas.blaha@tiho-hannover.de</a></td>
</tr>
<tr>
<td>Univ. of Viena (Austria) and Munich (Germany)</td>
<td>Mathias Ritzmann</td>
<td><a href="mailto:mathias.ritzmann@vu-wien.ac.at">mathias.ritzmann@vu-wien.ac.at</a></td>
</tr>
<tr>
<td>Ghent University (Belgium)</td>
<td>Dominiek Maes</td>
<td><a href="mailto:dominiek.maes@ugent.be">dominiek.maes@ugent.be</a></td>
</tr>
<tr>
<td>University of Copenhagen (Denmark)</td>
<td>Jens Peter Nielsen</td>
<td><a href="mailto:jpn@life.ku.dk">jpn@life.ku.dk</a></td>
</tr>
<tr>
<td>Univ. Autònoma Barcelona and Zaragoza (Spain)</td>
<td>Joaquim Segalés</td>
<td><a href="mailto:joaquim.segales@uab.cat">joaquim.segales@uab.cat</a></td>
</tr>
<tr>
<td>Univ. of Murcia and Córdoba (Spain)</td>
<td>F.J. Pallarés</td>
<td><a href="mailto:pallares@um.es">pallares@um.es</a></td>
</tr>
<tr>
<td>University of Helsinki (Finland)</td>
<td>Olli Peltoniemi</td>
<td><a href="mailto:olli.peltoniemi@helsinki.fi">olli.peltoniemi@helsinki.fi</a></td>
</tr>
<tr>
<td>University of Utrecht (The Netherlands)</td>
<td>Jan A. Stegeman</td>
<td><a href="mailto:j.a.stegeman@uu.nl">j.a.stegeman@uu.nl</a></td>
</tr>
<tr>
<td>University of Parma (Italy)</td>
<td>Paolo Martelli</td>
<td><a href="mailto:paolo.martelli@unipr.it">paolo.martelli@unipr.it</a></td>
</tr>
<tr>
<td>University of Cambridge (United Kingdom)</td>
<td>Alexander Tucker</td>
<td><a href="mailto:awt1000@cam.ac.uk">awt1000@cam.ac.uk</a></td>
</tr>
<tr>
<td>University of Nottingham (United Kingdom)</td>
<td>Steven McOrist</td>
<td><a href="mailto:steven.mcorist@nottingham.ac.uk">steven.mcorist@nottingham.ac.uk</a></td>
</tr>
<tr>
<td>Univ. of Uppsala (Sweden) and Oslo (Norway)</td>
<td>Claes Fellstrom</td>
<td><a href="mailto:claes.fellstrom@slu.se">claes.fellstrom@slu.se</a></td>
</tr>
<tr>
<td>University of Bern (Switzerland)</td>
<td>Heiko Nathues</td>
<td><a href="mailto:heiko.nathues@vetsuisse.unibe.ch">heiko.nathues@vetsuisse.unibe.ch</a></td>
</tr>
<tr>
<td>University of Toulouse and Nantes (France)</td>
<td>G.P. Martineau</td>
<td><a href="mailto:g.martineau@envt.fr">g.martineau@envt.fr</a></td>
</tr>
</tbody>
</table>
Currently there are 148 Diplomates within the ECPHM and all Diplomates must be re-evaluated for eligibility on a 5-yearly professional activity basis. For the proper functioning of the College there is a governing body (board) and a number of committees dealing with different responsibilities: Credentials, Education, Examination and Nomination Committees. All board and committee members are Diplomates that are elected by their College peers at the corresponding annual general meetings of the ECPHM.

The ECPHM works closely together with the European Association of Porcine Health Management (EAPHM). This association was founded in 2010 and represents the community of pig veterinarians in Europe. Its objective is to provide European practitioners with a platform for sharing information and developing and improving their skills and competences. Unlike the College, the Association is open to non-Diplomates, since not everybody is willing or able to follow a residency training program and sit the ECPHM exam. In this regard, the Association has a much broader base than the college and, in some ways, the College can be considered as being embedded in the Association.

In summary, the ECPHM is a European association that recognizes and validates the specialist title in the field of porcine health management. However, the main driver of the College is the continuous education programme as the basis of post-graduate specialization. Such high European level of knowledge and expertise in the field of swine medicine is already opening the door to fulfil important international positions in industry, academy and advisory boards by a new generation of highly educated professionals. More details about the College, residency programmes, education, exam and symposium (co-organized with the EAPHM) can be found at the ECPHM website (www.ecphm.org).
Table 2. General educative contents of the residency programmes of the ECPHM.

| Infectious and non-infectious diseases | • General herd health management issues  
• Viral, bacterial and parasitical diseases and syndromes of swine  
• Zoonosis  
• Diagnostic methods (at individual and herd levels)  
• Immunity and vaccination programs  
• Biosecurity and infectious/non-infectious disease control methods  
• Notifiable diseases and all related appropriate EU legislation |
| Reproduction | • Physiology of reproduction  
• Reproductive technology and management  
• Reproductive record interpretation  
• Reproductive failure |
| Epidemiology | • Principles, methods and techniques of epidemiology  
• Biostatistics (principal basis)  
• Information and communication technologies |
| Animal production | • Economy  
• Genetics  
• Facilities and acclimatization  
• Nutrition |
| Animal welfare and ethics | • Welfare and ethics: normal behavioural patterns and their alterations  
• Transport and slaughter  
• Use of pig an experimentation animal and biomedical model  
• EU related legislation |
| Food safety | • Pre-harvest food safety measures  
• Meat inspection data and slaughter checks  
• Herd health planning  
• Quality assurance schemes |
| Drugs | • Clinical studies  
• Therapeutics and medicines control, prudent use of antibiotics  
• EU medicine legislation  
• Administration of medicines and their strategic use |
| Surgery and anaesthesia | • Basic knowledge of common methods and procedures |
| Reporting and communication | • Scientific writing  
• Presentation of reports  
• Report writing for clients  
• Communication skills |