Improving herd health by *eradicating* endemic diseases.

Submission to the European Commission's DG Agri – European Innovation Partnership (eip-agri) Focus Group for "The reduction of antibiotic use in the pig sector."

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Introduction:

Much of the time farmers will live with one or more enzootic infection in their pigs and try to control them with the use of antibiotics or vaccination, if available. Enzootic pneumonia (*Mycoplasma hyopneumoniae*), swine dysentery (*Brachyspira hyodysenteriae*), pleuropneumonia (*Actinobacillus pleuropneumoniae*), Streptococcal meningitis/arthritis (*Streptococcus suis*) and porcine reproductive and respiratory syndrome virus (PRRSV) are typical examples of such diseases. It is only when the weight of infection has increased and the profitability has suffered or when antibiotic resistance has become complete, especially in the case of swine dysentery, that they will consider complete **depopulation and repopulation**. This is an opportunity to restock with high-health herds, free of many of the above diseases. Repopulation with high-health stock does have its own issues, such as cost, associated with purchasing high-health stock, cleaning and disinfecting the farm and loss of production for 6-8 months. Other factors also include herd biosecurity and the risk of breaking down with endemic diseases in the future, especially in pig dense regions.

Partial depopulation techniques, usually of young stock (under 10 months of age) and a focus on the immune sow herds, where the incidence of infection is already low, to either treat them to eliminate *M. hyopneumoniae*, *A. pleuropneumoniae, B. hyodysenteriae* or multi-vaccinate to eliminate PRRSV, have all been described. The uptake of these initiatives is relatively low, even in only weaner producing herds, as the growing and finishing herds they supply are often of mixed health status, thus maintaining the *status quo* of low overall health and the need to routinely use antibiotics and vaccines, if available and effective.

The following sections look at opportunities to improve the success rate of eradication programmes, to improve their risk/benefit and thereby improve the health and productivity of pig herds.

1. Good existing practices/best practices underused or needing promotion

Eradication of respiratory infections

On its own enzootic pneumonia is generally mild in a herd. However, in many commercial situations the immune-system damaging effect of the disease allows other bacteria, especially *Pasteurella multocida*, to complicate the infection and cause secondary bronchopneumonia. As a result, vaccination against *M. hyopneumoniae* is widespread, approximately 70% of growing pigs in the UK (Williamson, 2013). Vaccines will generally keep the disease under control but will not eliminate the infectious agent. If this infection is coupled with other diseases such as the immune suppressing PRRSV and potentially acute *A. pleuropneumoniae* infection, the level of respiratory disease in the finishing pigs becomes overwhelming and difficult to control, without the extensive use of antibiotics. The circulation of swine influenza viruses may also add to this disease complex and increase the incidence of pneumonia and pleurisy.

Generally, eradication of these diseases is not practiced, especially by **depopulation/repopulation** with high health stock free of these diseases, as there can be a 6-8 month loss of production and income for the farmer.

Partial depopulation and medication does offer an optional alternative for breeder farms, especially in 2 and 3-site production systems and the focus of treatment can be on the breeder unit. There may be some minor disruption to production, especially if young stock need to be reared off site during the programme, until the clean piglets come through, but it does not usually result in a complete cessation of production.

Enzootic pneumonia (EP) (*Mycoplasma hyopneumoniae*)
Protocols for elimination of *M. hyopneumoniae* have been generated, using a number of antibiotics such as tiamulin, tiamulin plus chlortetracycline (Burch & Woolfenden, 2010), tilmicosin, tylvalosin plus tulathromycin and chlortetracycline on its own. All of these can eliminate the infection in immune sows greater than 10 months of age and where pneumonic lesions have primarily healed. The success rate is good, generally higher than 80% (Baekbo, 2006).

PRRSV infection
Protocols for eradicating the EU strain have been developed. The breeding herd is closed and vaccinated with a combination of killed and live vaccine administration (Burch & Woolfenden, 2010) or repeated live vaccination (Ridremont and Lebret, 2006) is used to eliminate field virus from the herd. Biosecurity needs to be examined in depth to stop the re-introduction of infection. Monitoring is also important to determine if the piglets are free from field virus and that there is no circulation going on in the sow herd. If the breeding herd is self contained i.e. breeding their own gilts, this is ideal, as the herd is more closed. Potentially, it takes several months for the virus to die out, so there are difficulties with gilt replacement and productivity during this phase. If buying in gilts, there needs to be an initial stocking of gilts (several months supply) so that they are incorporated into the vaccine programme and can maintain replacements over this period of time. Once the breeding herd is free then only PRRSV free gilts can be introduced. Semen needs to come from PRRSV negative boars.

The success rate is quite low, due to failures normally in biosecurity. In the US they see a 40% breakdown of herds/year (Morrison & Torremorell, 2014). This has fallen to 20% this winter, possibly as a result of improved biosecurity due to outbreaks of porcine epidemic diarrhoea virus (PEDV) (Morrison, 2014 – personal communication) in many states.

The PRRSV programme is complex, but, if it can be coupled with an EP eradication, the process could be more worthwhile and increase the cost/benefit ratio.

There does not appear to be information on the US vaccine strain elimination or mixed EU/US PRRSV strain herds being successfully eradicated in the EU.

Pleuropneumonia (*Actinobacillus pleuropneumoniae*)
The original programmes using tilmicosin treatment of the breeding herd were less than 50% successful in eliminating *A. pleuropneumoniae* (Baekbo, 2006) but were more successful eliminating *M. hyopneumoniae* (greater than 80%). Eradication of both diseases would be good from a cost/benefit perspective and possibly this could be coordinated with PRRSV eradication too.

Improving the success rate of the *A. pleuropneumoniae* eradication would also be beneficial. The use of newer long-acting formulations of compounds such as marbofloxacin and tulathromycin by injection may increase the rate of success and these need to be looked at further.

Strep meningitis (*Streptococcus suis*)

This disease is an on-going problem in many herds and successful eradication is rarely reported (Strachan, et al, 2003). Possibly, 30% of herds in the UK use antimicrobial medication for this disease, mainly penicillins and occasionally vaccines are also used. Frequently, coupled with PRRSV infection, many herds continue to suffer from this problem.

Programmes for successful eradication need to be developed.

Eradication of enteric infections

Swine dysentery (*Brachyspira hyodysenteriae*)
This disease can be severely damaging to production and most farms that have it need to use antibiotic medication, as there are no suitable commercial vaccines available. Due to the severity of the disease many pig-producing companies will not tolerate it and will either eliminate the infection from their herds or will not buy in pigs for finishing or breeding that carry the infection. In the UK and EU, we are seeing an increase in multi-resistant strains of *B. hyodysenteriae* and farms therefore have to **depopulate**, clean up and disinfect the farm and **repopulate** with disease-free stock. This generally works well but it means the farm has to be left empty for a while (ideally 8 weeks) and cleaned, so that the bacterium dies out and cannot re-infect new stock when they come in. This can leave a long gap (several months) in income for the farmer.

Partial depopulation of stock less than 10 months of age from a breeding unit is preferred and medication has proven very effective, providing the isolate is proven susceptible (Burch and Howells, 2010). Medicating weaners has also been successful but treating finishers is uneconomic and usually fails. Tiamulin, valnemulin, lincomycin, tylvalosin have all been used but the susceptibility of the bacteria against the various antibiotics needs to be confirmed. Dysentery eradication can be coupled with enzootic pneumonia eradication, especially in the case of tiamulin. Medication usually lasts for several weeks to ensure the infection dies out in the buildings and environment, to prevent re-infection.

Porcine proliferative enteropathy – ileitis (*Lawsonia intracellularis*)
Ileitis has been eradicated from a number of herds (Szancer, 2008), but is much more difficult than swine dysentery, for example. Re-infection seems to be a major problem, which suggests surrounding sources such as insects, other animals and certainly replacement animals can all be carriers. Medication of boars and gilts used for a new start up herd has proven successful.

More work here is required to devise acceptable, more reliable programmes.

Conclusions

Eradication as a concept needs to be promoted as a way to achieve higher health status for a herd. Herds with higher health and a lack of enzootic disease use much less antimicrobial drugs and can reduce the need for continuous vaccination, e.g. enzootic pneumonia, again saving costs. There are requirements to develop more standardised protocols for various diseases to improve success rate and confidence in their application. There are opportunities to combine eradication programmes to include a number of diseases at the same time making the effort even more worthwhile.

This whole concept needs to be promoted to farmers on a cost/benefit basis, and to their vets to encourage them to initiate steps to improve pig herd health and thereby reduce antibiotic use.

2. Research results needing to be implemented or field tested

Enzootic pneumonia and **swine dysentery** eradication have been well documented and recorded.

The main focus for further work should be: -

PRRSV eradication – improve consistency of results and standardise protocols. Examine eradication in co-infected herds with EU virus and US vaccine virus strains. Risk assessment from re-infection from local farms, visiting traffic etc should be made.

A. pleuropneumoniae eradication – improve the success of eradication medication programmes by the use of new compounds either to support and improve existing programmes or develop new programmes and strategies.

Co-infection eradication e.g. PRRSV, enzootic pneumonia and possibly *A. pleuropneumoniae*, for example would also be beneficial and increase the returns made to compensate for the disruption to production.

Streptococcus suis eradication - this is almost starting from scratch as success rates are low. Any new ways to eliminate the infection from the pig would be beneficial. Tonsilar colonisation seems to be a major issue, so that it is very hard to remove the organisms from the pig with the use of an antibiotic. A better understanding of the survival of the bacterium in the pig would be helpful.

Ileitis (*L. intracellularis*) eradication – again this needs more research to resolve immunological and therapeutic issues. Is the organism actually eliminated from the pig? It is an intra-cellular bacterium so treatment and elimination may be difficult. If/when removed, what are the routes of re-infection and how can they be prevented. A more reliable and repeatable programme needs to be developed.

3. Needs for practical sustainable innovation, research innovation and research

Innovation is always difficult especially in conservative farming communities. There needs to be a drive forward, which is usually economic, to make any changes. An advantage in the cost of production is a clear message and incentive but frequently it is only when margins are so small that a decision to improve is taken or alternatively, to get out of the business. Hence there is a real need to demonstrate a real cost/benefit for each programme or uptake and real innovation will not happen. The other potential alternative is to limit antimicrobial use to such an extent that changes in disease status has to be made but in the interim, however this is thought that it would have a damaging effect on pig health and welfare in many Member States.

Regarding research innovation, improvement in diagnostic techniques, as have been seen as a result of the recent PEDV outbreak in North America (Sundberg, 2014; Yoon, 2014), has made a huge difference to monitoring and screening for the disease. Some of these genetic techniques could be helpful, particularly with PRRSV eradication and monitoring and tracing sources of breakdown.

A close review of the activity of antimicrobials on the elimination of bacteria from tissues like the tonsil would also be helpful for diseases such as *S. suis* and *A. pleuropneumoniae*. In most pharmaceutical development work one is looking for improvement in clinical responses and hopefully reduction in infectious agents but elimination is not always achieved. Suitable dose rates and suitable antibiotics with good tissue penetration could be evaluated further, to achieve elimination.

Techniques to improve our understanding of the immune system and how it can be used to support the elimination of infection from a body may give us some clues how to improve our eradication programmes. Vaccination can be a useful tool to reduce the effects of infectious agents and some infections can be eliminated e.g. PRRSV. Unfortunately, many of them are helpful in reducing clinical infections, such as porcine circovirus type 2 (PCV2) and parvovirus, but they may not eliminate infections. Mycoplasma hyopneumoniae vaccines are only 40-75% effective in reducing lung lesions in the field (Martinon et al. 1998; Andreasen et al. 2006). In some cases there are no commercial vaccines available, e.g. *B. hyodysenteriae*, which makes it more difficult to control without the use of antibiotics.

4. Operational groups and practical ideas for future action projects

Some of this work is already on-going. In England, groups have been set up to try to stop the spread of swine dysentery and try to eliminate it on a regional basis. In some regions, it has been successful, especially with the cooperation and collaboration of all parties involved from the farm down to the transport of feed and pigs but in some cases the support has been poor and the results are also poor. In Scotland, there is a regional group considering the attempted elimination of respiratory infections such as PRRSV, enzootic pneumonia and *A. pleuropneumoniae*, increased resources might allow this to develop more fully. In the north of the Netherlands, in a not pig-dense region, Utrecht University is looking at PRRSV eradication in a number of herds. Denmark, France, Ireland, Spain and Hungary are all also looking at PRRS eradication on a regional or national basis. It is felt that the promotion of these concepts via DG Agri and the EIP and their new website will attract and encourage new operational groups to form regional eradication programmes.

5. Other issues

Promotion of the concepts of enzootic disease eradication plus monetary support on a regional and EU basis through the EIP programme could help move many of these programmes forward and encourage producers to try to eliminate these infections that they have had to live with, possibly, for many years and thereby have the opportunity to improve the health status of their herds. As a result antimicrobial use should fall.

6. Summary/general recommendations

The eradication of enzootic diseases should become a priority to move herd health and productivity forward on one hand but at the same time help reduce the use of antimicrobials on the other, as has been achieved in Denmark. Vaccines alone are not the only answer in many cases, but if the disease is not present either on a farm or region or on a national basis, then it is not an issue to herd health. We have seen the invasion of African Swine Fever (ASF) into the eastern parts of the EU from Russia and Byelorussia and as it is a notifiable disease it will (certainly should) attract a lot of interest to prevent further incursions and eliminate the disease and the infected animals. Money and resources are available to do this, as it is a notifiable disease. However, the enzootic diseases go on year after year, eroding the efficiency and profitability of pig production in Europe and it is exciting to think that at last funding might be made available to help eliminate these infections on a group basis and at the same time potentially reduce the use of antibiotics, which currently are widely used to help maintain production in the face of these diseases.

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