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## Policy briefs and best practice guidelines

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**PROHEALTH** Sustainable pig and poultry production

## **Policy Briefs and Best Practice Guidelines**

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### PROHEALTH Coordinator's note



PROHEALTH: sustainable control of pig and poultry production diseases, was the largest ever project funded by the European Union on animal health and welfare. The project started in December 2013 and is concluding in November 2018 with an Industry focused workshop and a scientific symposium on 27-28 November 2018 in Ghent, Belgium.

The consortium that addressed the challenge of production diseases in pigs and poultry consisted of 22 partners, from 10 European Union countries and one associated country. The partners were a healthy mix of Industry and Academia; this helped us to retain the focus of the project throughout its duration. The PROHEALTH project aimed to contribute to the understanding of the multi-factorial dimension of animal pathologies linked to the intensification of production. Its results should help to provide effective control strategies to reduce the negative impact of production diseases on animal health and welfare. Some of these control strategies have already been implemented in practice and suggest substantial economic benefits, while maintaining pig and poultry health and welfare, in a quantifiable manner.

In this brochure, we have summarised some of the outcomes of the project on these issues in the form of Policy Briefs and Best Practice Guidelines that should be of relevance to a variety of stakeholders. This information is only a small sample of the output that resulted from PROHEALTH and this includes newsletters, scientific reports and peer reviewed papers.

You can find more information on these outputs on the website of the project: [www.fp7-prohealth.eu](http://www.fp7-prohealth.eu). I am pleased to report that the PROHEALTH website will be maintained and continue to report additional project outcomes until December 2020.

I have had the privilege of coordinating PROHEALTH since its inception and bringing it to its conclusion. It has been a wonderful journey, but like all good things in life, it must come to an end. PROHEALTH, however, will continue to influence the way we raise pigs and poultry in the European Union. The improvement in the health and welfare will be its long lasting legacy.

Enjoy the read.

Ilias Kyriazakis  
PROHEALTH Coordinator





## A better understanding of how consumers relate to food systems and transparent communication helps to improve trust in the food chain

Policy-makers should consider policies which control the use of antibiotics, ensure animal welfare standards and link policies and public perceptions in order to address the concerns of the public towards intensive animal production. Producers should consider applying preventative interventions to address production diseases, transparent communication, and working with independent bodies in order to improve public trust towards the food chain and the dialogue with the public concerning intensive production. Communication is important because many members of the public are unfamiliar with how the food they eat is produced.

### WHAT ARE PRODUCTION DISEASES?

Intensive, as well as other farming systems, are susceptible to production diseases, with potentially negative consequences for farm animal welfare and economic implications for producers. These diseases originate from a complex interaction of the viruses and bacteria present on farms, animal genetics, and the environment in which the animal is reared, including housing, feed and management practices used.

### WHY DOES PUBLIC PERCEPTION OF PRODUCTION DISEASES MATTER?

Previous research has demonstrated that the public are concerned about farm animal welfare, yet little is known about public attitudes towards production diseases, and interventions to reduce these diseases. A better understanding of public perceptions by industry and policy stakeholders can encourage increased consumer trust in animal production systems, better alignment between intensive farming practices and interventions, and the values, needs and expectations of society, as well as improved relationships between consumers, retailers and suppliers.

### RESEARCH SHOWS THE MAIN CONCERNS OF THE PUBLIC

Although the public sees the benefits of intensive production for consumers, the research carried out across five European countries (Finland, Germany, Poland, Spain and the UK) identified that:

- The public has concerns about modern animal production methods as they think it may breach two core concepts they perceive as essential for animal welfare: humane treatment and naturalness.
- The use of antibiotics, and the related issue of antimicrobial resistance, which could have implications for human health, are seen as problematic.
- All stakeholders involved with modern farming were viewed as responsible for animal health and welfare. This includes regulatory bodies, producers, veterinarians and even members of the public.
- Despite their concerns, the public perceives intensive systems as having benefits, primarily “anthropocentric” benefits (i.e. benefits to humans), such as reducing the cost and increasing the availability of animal-based products.
- Consumers are mostly unaware of where the animal products they consume come from, with the majority not attributing their purchases of animal products to having origins in intensive production systems. Many members of the public are unfamiliar with how the food they eat is produced.

“It is important to address the mistrust and misconceptions of consumers.”



### FURTHER INFORMATION

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### PROHEALTH Recommendations

It is important to address the mistrust and misconceptions the public have about production systems and interventions associated with production diseases.

#### Policy makers should consider:

- Designing regulation to continue to reduce the use of antibiotics. This should be communicated to the public as part of increased transparency to help address public concerns and misconceptions.
- Ensuring that the animal welfare legislation in place also addresses the concerns of those who do not purchase animal products e.g. vegetarians and vegans.
- Developing more formalised links between legislation and public perceptions such as consultations and surveys, with regular review processes, to ensure appropriate minimum standards are in place as public perceptions and preferences change over time.
- Guidance on clearer product labelling to inform consumers and to help their decision making.

#### Producers should consider:

- Working with independent and trusted bodies such as animal welfare organisations and quality assurance schemes to raise standards.
- The preference of consumers for the most “proactive” interventions to address production diseases, namely improved housing and hygiene measures.
- Providing information at industry level about when and why antibiotics or more reactive interventions are used, to help allay public concerns about human health and safety.
- Communicating transparent information by using company websites to convey information to those who wish to proactively seek it out, and being open to engaging in communications with consumers.
- Working with the media to highlight good practice, including examples of proactive management measures being used to prevent production diseases.
- Promoting better supply chain co-ordination and cooperation to ensure that all stakeholders are working together to support each other and convey consistent and accurate messages to the public.

### CONTACT

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## Genetic selection for maternal ability can reduce piglet mortality

**Selection for very high fertility sows has resulted in larger litter sizes and increased piglet mortality, but the problem can be reduced by revising animal breeding goals.**

Hyperprolific sows give birth to an increased number of piglets that weigh less than average at birth. These piglets are often afflicted by intrauterine growth restriction (IUGR) and they have an increased risk of dying because of the sow crushing them. Based on PROHEALTH research, 18.8% of IUGR piglets died during their early life compared to 8.3% of normal piglets.

Pig breeding programmes should take into account the proportion of IUGR piglets in a litter as this will increase the proportion of piglets surviving birth and early life. This should be done by adding a simple trait based on counting piglets with the characteristic IUGR headshape into the breeding index, while still maintaining litter size at current levels. Selecting new positive maternal traits helps improve the balance between increasing production efficiency, which reduces feeding costs and the environmental impact of pigmeat production, and safeguarding pigs' welfare.

### PIGLET MORTALITY REQUIRES NEW APPROACHES

15% to 20% of all piglets currently die during parturition and lactation. This rate increases with total litter size.

This level of loss is worrying both from the point of view of animal welfare as well as the economic sustainability of farming: associated financial losses range up to several euros per produced piglet, which at the European scale accounts for more than one billion euros per year. Current mitigation strategies rely on environmental and management interventions, such as the use of farrowing crates for the sow during parturition and lactation, but these may be challenged in the future because of animal welfare concerns. New approaches are needed to prepare for this.

### PIGLETS WITH A DOMED HEAD HAVE A REDUCED SURVIVAL RATE

An increased number of piglets in the womb results in increased competition for nutrients during development. This can result in intrauterine growth restriction (IUGR). These piglets weigh less at birth and face reduced prospects for survival, and can be easily recognised at birth by a domed shape of the head (Figure 1 and 2).

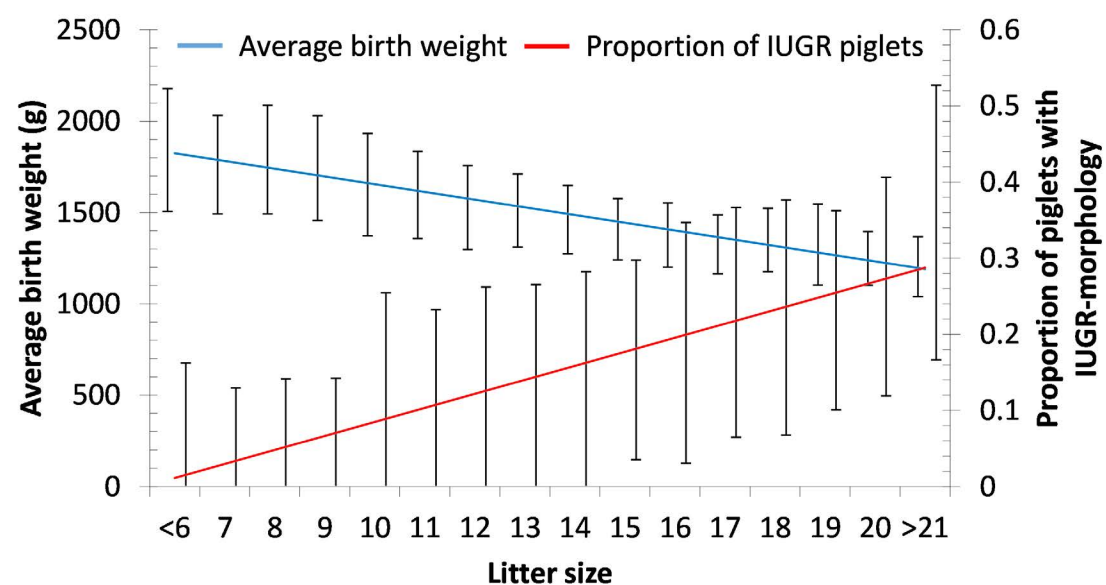


Figure 1. PROHEALTH study shows the effect of increasing litter size on the average individual birth weight of piglets and on the average proportion of litters with IUGR-morphology. Data taken from more than 1,500 litters.



Figure 2. These piglets have the same birthweight but the piglet on the right shows the characteristic domed headshape associated with IUGR. (Photo courtesy of Emma Baxter, SRUC)

A higher proportion of piglets suffering from IUGR (9.9%) are born dead when compared to normal piglets (5.0%). More IUGR piglets which are born alive will be dead within 24 hours (9.9%) when compared to normal piglets (3.3%). In total, 18.8% of IUGR piglets died during their early life compared to 8.3% of normal piglets.

Adopting new genetic approaches can make pigmeat production more sustainable. Genetic studies in the PROHEALTH project on more than 1,500 litters have shown that the maternal trait “proportion of IUGR piglets within a litter” is heritable at the sow level.<sup>1</sup> Selection against a high proportion of IUGR will result in lower litter proportions of IUGR piglets and increase piglets' survival.<sup>2</sup> Care must be taken to maintain current level of litter size when selecting against IUGR, however, as the proportion of IUGR piglets is positively genetically correlated with litter size.<sup>3</sup>

### SELECTION AGAINST IUGR REDUCES PIGLET CRUSHING

Crushing is the main cause of piglet deaths during the suckling period. The direct heritability for crushing by the sow is low (0.07) and attempts to develop novel traits based on the carefulness of the sow when lying down have not yet produced useful results. The genetic correlation between crushing and the proportion of IUGR (0.23) indicates that the selection against IUGR will also make crushing incidents less frequent.

1 A direct heritability of 0.20 for the proportion of IUGR piglet in the litter.

2 A genetic correlation of -0.80 between IUGR and piglet survival was observed.

3 A genetic correlation of 0.46 between the proportion of IUGR piglets and litter size.

### PROHEALTH Recommendations

- Pig breeding organisations should incorporate new beneficial maternal traits within their breeding index for selection of future lines.
- Pig breeding organisations should start counting piglets with the characteristic IUGR headshape, and include the proportion of IUGR piglets in a litter in the breeding programmes of the nucleus and multiplier herds. This will increase the number of piglets surviving because of improved piglet health and through a decrease in crushing events.
- Simultaneously, attention to maintain the current level of litter size will be necessary, so that the selection for fewer IUGR piglets would not reduce current breeding achievements.

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## Fighting disease with big data

**Digitalization and the broad adoption of the Internet and its full potential offer vast possibilities for the farming industry. The main challenge is to ensure the interoperability and connectivity of different digital systems even in rural environments. PROHEALTH results show that big data and real-time monitoring of the rearing environment can reduce disease burden in intensive livestock production and improve sustainability.**

The livestock farming industry could benefit from the vast possibilities that digitalization and the Internet have to offer, but this requires better interoperability (meaning how different products or systems talk to each other) and connectivity of different intelligent systems and technologies. PROHEALTH research suggests that stakeholders should be encouraged to promote the development and on-farm adoption of sensor technologies and data analytics which facilitate earlier response to disease. When using novel technology and sophisticated digital monitoring tools, the occurrence of respiratory and enteric disease in nursery and grow-finish pigs can be anticipated a day, or even as early as a week, before clinical signs occur. This gives farmers and veterinarians crucial time to successfully contain the disease before it becomes a problem, as the following examples illustrate.

### REDUCING DISEASE COSTS TO FARMERS

Knowing when to take early action helps to reduce the negative impact of disease on animal health, growth, feed efficiency and mortality, as well as the number of

“Big data enables earlier response to disease and could even predict it.”

medicated animals. The potential benefits from avoiding a disease are substantial, financial losses due to respiratory diseases, for instance, can be up to €19 per fattening pig and due to enteric diseases up to €13 per pig, which means billions of euros for the EU pig producers.

### HOW THE MEASUREMENT SYSTEM WORKS

Certain animal diseases can be triggered by changes in barn conditions. Small, relatively cheap and high-resolution sensors can monitor environmental variables in the pig house. The data they collect can be used to adopt more thorough disease control, to start early treatment of the first symptoms and to eliminate stress factors, as PROHEALTH results illustrate. However, currently farmers do not use temperature or humidity measurements in real time due to bottlenecks in interoperability of systems. Measurements from the farm environment, an-

imal health and productivity should be integrated in a user-friendly real-time measurement system operated by farm staff to mitigate production diseases.

The recommended system is comprised of a network of sensors that record key environmental indicators and transmit the data to the cloud, and an automatic system which collects data about clinical diseases, medicine use and animal performance (Figure 3). The system should detect low temperature and high CO<sub>2</sub> concentration, which are indicators of poor barn ventilation and increase the risk of respiratory disease for nursery piglets and fattening pigs. Excessive air dryness, related to respiratory problems in fattening pigs, and high humidity in the nursery, should also be detected. These are easy to measure, but the challenge is to integrate data from different sources to provide real-time advice to farming.

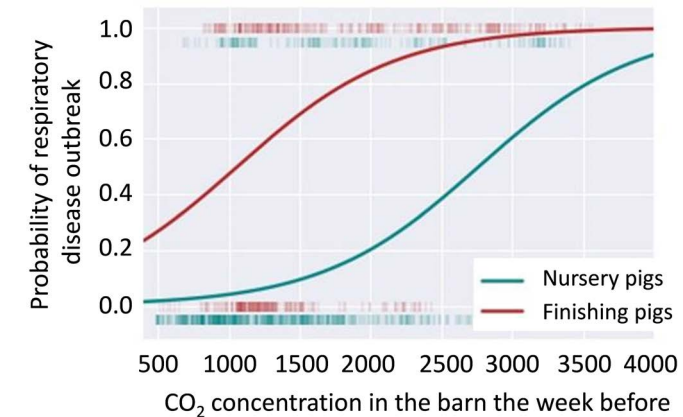


Figure 4. The probability of a respiratory outbreak grows with the CO<sub>2</sub> concentration of the living environment.

### MACHINE CAN LEARN TO DETECT A DISEASE

Policy and industry should encourage the development and on-farm adoption of sensor technologies which enable early detection and response to disease. These technologies can give farmers up to 7 days more time to mitigate the effects of respiratory diseases in pigs when compared to acting on the basis of clinical observations only. PROHEALTH research showed that a GRU-autoencoder, which is a type of neural network built using deep learning, can learn to reconstruct raw sensor data about factors that lead, or do not lead, to an increase in respiratory disease prevalence in pigs. This system outperformed state of the art disease alert techniques, and showed that a change in the pigs' living environment, measured by sensors, can indicate an increased number of pigs showing symptoms 1-7 days in the future.



Figure 3. A novel system for data collection together with data-analytics tools produces information that alerts when the risk of respiratory or enteric disease outbreak is elevated.

### PROHEALTH Recommendations

- To make the most of digitalization, the farming industry should implement new and more comprehensive standards for interoperability and connectivity. The EU and member states should collaborate to provide an appropriate framework for ensuring interoperability.
- Policy makers, industry professionals and farmers should promote the development and on-farm use of digital tools and sensors to monitor the barn environment. These data should be integrated and used for launching pre-defined early interventions to mitigate diseases or even predict them. Interventions can include adjustments to rearing environment, early treatment of the first symptoms and elimination of stress factors.

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## Enhanced biosecurity improves the performance of poultry flock

**Biosecurity is important in animal production. It affects flock performance and farm economy. Farmers are recommended to systematically evaluate and improve biosecurity on their farm**

Farmers are recommended to evaluate biosecurity systematically by using an assessment protocol. In broiler and laying hen farms, it is recommended that more attention should be given to prevent pathogens from entering the farm (external biosecurity). It should be ensured that visitors and staff entering the farm follow appropriate biosecurity procedures. In addition, enhancing management practices which prevent the spread of pathogens within the farm (internal biosecurity) is essential. Stakeholders should also provide training on the use of biosecurity procedures to their co-workers.

### BENCHMARKING FARM'S BIOSECURITY THROUGH SYSTEMATIC EVALUATION

The PROHEALTH biosecurity survey, which is based on the Biocheck™ questionnaire, provides a tool for benchmarking biosecurity between farms. In a survey conducted in five European countries, average biosecurity scores among farms were 20 to 40% below the maximum score of 100. These scores indicate that there is more potential to improve external than internal biosecurity (Figure 5).

In addition, the results of the survey highlighted a large variation in the level of biosecurity between farms. The coefficients of variation for the internal or external biosecurity score within the country can be up to 25%. These findings suggest a large potential to improve biosecurity in poultry farms.

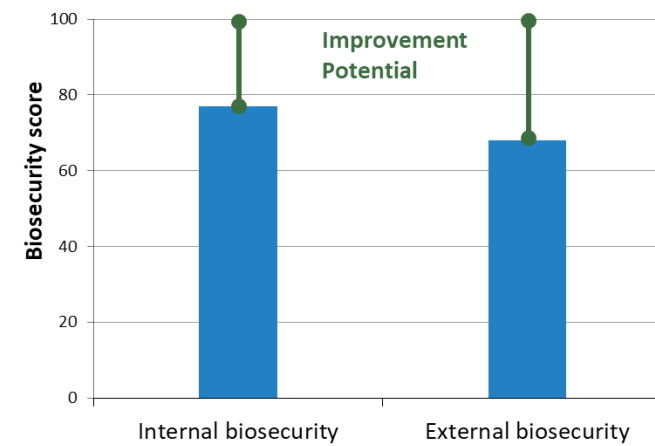


Figure 5. The mean scores for internal and external biosecurity in European broiler farms surveyed by PROHEALTH and potential for improvement indicated by the green bar.

### POULTRY FARMS NEED TO IMPROVE EXTERNAL BIOSECURITY

In broiler and laying hen farms, external biosecurity has more possibilities for improvement than internal biosecurity. Precautionary measures when visitors and staff enter the farm require more attention. Practices such as depopulating the broiler house and procedures around bringing in day-old chicks can also be improved.

Ten percent of the broiler farms which participated in the PROHEALTH survey could improve biosecurity measures by introducing a hygiene lock and clear separation between the clean and the dirty area. These procedures decrease the risk of spreading diseases to the farm.

“Ten percent of broiler farms can improve biosecurity by using a hygiene lock”

“There is a large potential to improve biosecurity in poultry farms”

### BIOSECURITY AND MANAGEMENT INFLUENCE PRODUCTION PERFORMANCE

Biosecurity limits the risk of pathogen spread, reduces morbidity and mortality and mitigates economic losses due to animal diseases. These losses can be substantial and they can impair flock performance.

Several examples on how biosecurity and management influence poultry flock performance in practice exist. PROHEALTH results show that, for instance, daily checks of the drinking and feeding system are associated with higher productivity in broilers and cracked broiler house floors are associated with elevated mortality. Better biosecurity also reduces the need for antibiotic use in birds.

### PROHEALTH Recommendations

- Farmers and their veterinarians should evaluate their farm's biosecurity regularly and by using a systematic assessment protocol in order to identify points of improvement.
- In broiler farms, overall measures to prevent the pathogens from entering the farm, in particular improving biosecurity and hygiene with visitors and staff entering the farm, practices upon depopulating the broiler house and when purchasing day-old chicks are to be improved.
- Stakeholder organizations and the public sector should provide regular training to farm workers on how to use biosecurity measures and consider additional incentives to ensure the adoption of rigorous biosecurity.

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## Systematic detection and prophylactic control of *E. coli* infections can prevent financial losses to European poultry farming

***E. coli* is the most common cause of mortality in modern broiler production and a significant cause for antibiotic usage and therefore antibiotic resistance. To reduce the occurrence of *E. coli* associated diseases in broiler chickens, a systematic and faster detection and preventive control of *E. coli*, paying closer attention to the cleanliness of the breeder eggs, is needed.**

*E. coli* infections are common and economically costly in broiler production causing mainly an inflammation in the upper genital tract (salpingitis) or serous membrane lining in the abdominal cavity (peritonitis<sup>4</sup>). PROHEALTH results show that 55% of the dead broiler breeders died due to bacterial infections and among these salpingitis and/or peritonitis were the dominant conditions. Salpingoperitonitis<sup>5</sup> can cause €0.50 financial loss per bird, which sums up to €700 million for the whole sector in Europe. This impact of *E. coli* could be reduced by improving the bird health and management.

### ***E. COLI* CAN TRANSFER FROM PARENT BIRDS TO THEIR OFFSPRING**

Measures to reduce the occurrence of disease-causing *E. coli* in the higher levels of the production pyramid (Figure 6) should be taken. Improving detection system for *E. coli* combined with separating eggs laid by breeders with a high and low occurrences of *E. coli* are recommended. The use of floor eggs in the hatchery is not recommended as they pose an infectious risk and increase transmission in the hatchery.

*E. coli* can be transferred from parent birds to their chickens, and it is the main cause of first week mortality in broilers. *E. coli* is transmitted from inflammation in the upper genital track (salpingitis) of the female broiler parents to their offspring and it is subsequently spread in the hatchery: In a PROHEALTH study, the bacterial flora of the cloaca<sup>6</sup> of newly hatched chicks was dominated

by *E. coli* which was transmitted from parent birds to chickens. There was also a tendency towards a higher prevalence of *E. coli* in broilers from older breeders.

To reduce the transmission in the hatchery, hatching eggs laid by breeders with a high level and low level *E. coli* occurrence should be separated, as with floor eggs and nest eggs. This requires a faster and more specific detection system of *E. coli* at the clonal level.

Interventions in the hatchery may also include the use of a form of probiotic to reduce the level of colonization of the broilers. *E. coli* vaccines (Poulvac<sup>®</sup> and autovaccines) may be another approach to reduce *E. coli*. There is a need to document how best to use these in combination with other measures in breeding birds to protect the parents and their offspring.

### **EGG DISINFECTION REDUCES THE RISK OF TRANSMISSION**

Because transmission of *E. coli* from breeders to the offspring may occur via the eggshell, a specified disinfection procedure can be used to influence the eggshell microbiome and to effectively reduce aerobic colony forming units (CFU<sup>7</sup>) in eggs. After the spray-disinfection carried out in a PROHEALTH study, both clean and dirty eggs had less than 10 CFU per sample, which is a highly satisfactory result in terms of egg sanitation. Future studies remain to investigate the impact of the disinfection procedure on trans-shell bacterial migration,<sup>8</sup> and how hatchery incubation affects the microflora of eggs, which are largely deprived of their natural protective bacteria (commensal flora) by the disinfection

“To reduce transmission in the hatchery, the detection of *E. coli* should be improved.”

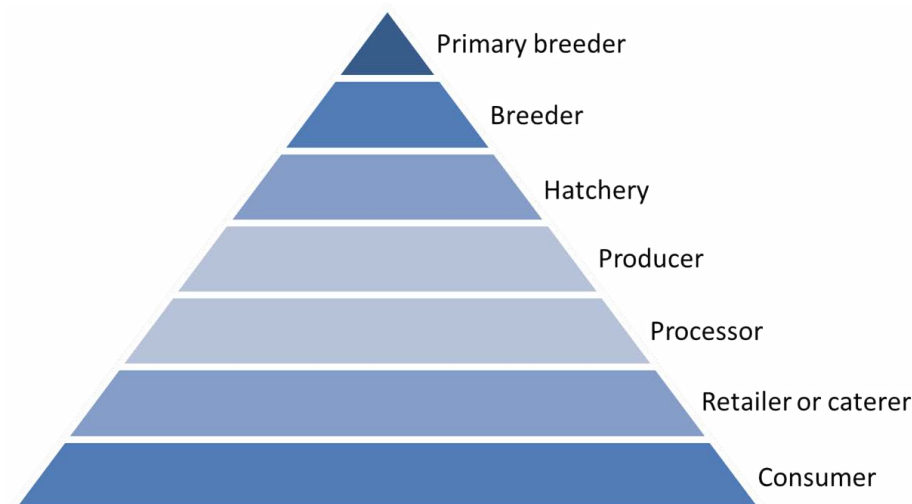


Figure 6. Broiler production pyramid.

4 Inflammation of the serous membrane lining the abdominal cavity.

5 Inflammation of the fallopian tube, perisalpinx, and peritoneum.

6 The common cavity that serves as the opening for the intestinal, genital, and urinary tracts.

7 In microbiology, a colony-forming unit (CFU) is a unit used to estimate the number of viable bacteria or fungal cells in a sample.

8 On the transport of potential beneficial bacteria into the egg.

### PROHEALTH Recommendations

In the light of the results of our research, we highly recommend the following approaches to reduce the occurrence of *E. coli* associated diseases in broiler chickens

- Systematic detection and prevention of *E. coli* including at higher levels of the production pyramid.
- A faster, more specific detection and identification system of *E. coli* for the most disease-causing strains.
- Separation of eggs laid by breeders with a high and low level of *E. coli* occurrence and discarding the use of floor eggs.
- Future studies to understand the efficacy of probiotics in the hatchery, evaluation of the effect of the currently used vaccines in production, and disinfection procedures of the hatching eggs.

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## Enhanced biosecurity improves pig herd performance

**Biosecurity is important in animal production. It affects herd performance and farm economy. Farmers are recommended to systematically evaluate and improve biosecurity on their farm**

Farmers are recommended to evaluate biosecurity systematically by using an assessment protocol. In pig farms, enhanced management practices which prevent the spread of pathogens within the farm (*internal biosecurity*) are recommended in fattening units, and also in the farrowing and nursery units. Besides internal biosecurity, measures to prevent the spread of pathogens to the farm (*external biosecurity*) are important. It should be ensured that visitors and staff entering the farm follow appropriate biosecurity procedures. Stakeholders should also provide training on the use of biosecurity procedures.



### BIOSECURITY AND SYSTEMATIC MANAGEMENT INFLUENCE PRODUCTION PERFORMANCE

Biosecurity limits the risk of pathogen spread, reduces morbidity and mortality and mitigates economic losses due to animal diseases. These losses can be substantial. For instance, porcine respiratory disease complex can cause financial loss of up to €19 and post-weaning enteric diseases up to €13 per pig.

Several examples exist of how systematic biosecurity and management influence herd performance in prac-

tice. PROHEALTH research shows that, for instance, the use of vaccination programmes is associated with increased number of live piglets and the use of standardised management practices is associated with lower re-insemination rate in sows. Better biosecurity also reduces the need to medicate animals.

### PIG FARMS HAVE THE POTENTIAL TO IMPROVE INTERNAL BIOSECURITY

The PROHEALTH biosecurity survey, which is based on the Biocheck™ questionnaire, provides a tool for benchmarking biosecurity between farms.

“There is a large potential to improve biosecurity in pig farms”

In a survey conducted in six European countries, average biosecurity scores among farms were 20 to 40% below the maximum score of 100. The scores indicate that in pig farms there is more potential to improve internal biosecurity than external biosecurity (Figure 7). In addition, there was a large variation in the level of biosecurity between farms. The coefficients of variation for the internal or external biosecurity score within a country were up to 26%. These findings suggest a large potential to improve biosecurity in pig farms.

In pig farms, the internal biosecurity should particularly be improved. Pig farms also need to consider enhancing management practices during the farrowing and nursery phase, to improve biosecurity between compartments and age groups and to adopt comprehensive cleaning and disinfection practices in the pig house. The management of fattening pigs could be improved, for instance, by using an all-in/all-out system and ensuring appropriate stocking density of pigs.

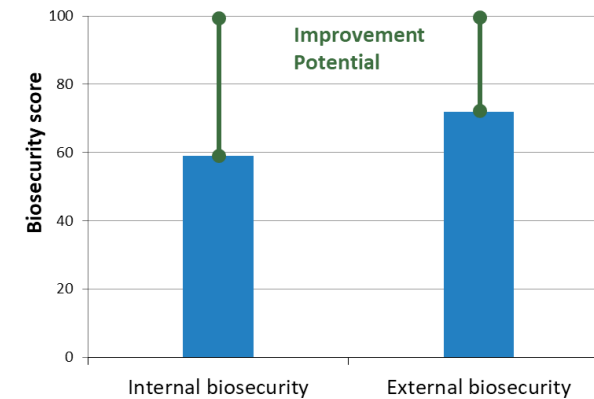


Figure 7. The mean scores for internal and external biosecurity in European pig farms surveyed by PROHEALTH and potential for improvement indicated by the green bar.

External biosecurity is critical to prevent the spread of infectious production diseases such as respiratory and enteric diseases in pigs as well as notifiable diseases such as African swine fever, which is threatening the pig production sector worldwide. There are possibilities to also improve external biosecurity in European pig farms. This is relevant especially regarding feed, water and equipment supply to pig farms, transport of animals to, and removal of manure and animals from pig farms.

### PROHEALTH Recommendations

- Farmers and their veterinarians should evaluate the farm’s biosecurity regularly and by using a systematic assessment protocol in order to identify points of improvement.
- Measures to prevent the spread of pathogens within the pig farm, in particular, enhanced management practices during the farrowing and nursery phase, greater biosecurity between compartments and age groups, and more comprehensive cleaning and disinfection practices, are recommended.
- Stakeholder organizations and the public sector should provide training to farm workers on how to use biosecurity measures and consider additional incentives to ensure the adoption of rigorous biosecurity.

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## Good hygiene increases fattening pigs' health and performance and benefits the farmer financially

### Ensuring a good hygiene standard improves pig health in the growing-finishing phase and increases pigs' weight at slaughter.

Poor housing hygiene and the lack of adhering to biosecurity recommendations are clear risk factors for pig health. Fattening pig farms should clean the pens before the piglets arrive and daily during the rearing, use all in-all out practice, and ensure good ventilation and the availability of enrichment material. Farms which do not yet apply good hygiene should be informed about the benefits of this. In a PROHEALTH trial pigs housed under poorer hygiene, suffered from 20 percent lower daily weight gain and yielded 15-25 euros lower financial margin per pig than pigs grown under better hygiene conditions. If scaled to the level of the European Union's pigmeat production, maintaining good hygiene can account for up to 3 billion euros in annual benefits.

#### A SANITARY CHALLENGE REVEALED THE IMPORTANCE OF GOOD HYGIENE

Poor hygiene, even if corrective measures were applied later, can reduce the growth rate and health of pigs in the long term and decrease pigs' body weight at slaughter when compared to pigs housed under good hygiene conditions. Although many pig farms apply good hygiene practices, there is potential for improvement. For instance, mixing of animals originating from different sources occurs, but it is not recommended due to the risk of diseases.

A PROHEALTH survey carried out in six countries suggested that some 10-15% of pig farms did not have a sanitary break to allow cleaning of the pen between suc-

cessive batches. About the same number of farms had a sanitary break that was less than three days. The farms should be informed about the importance of respecting basic hygienic practices: the cleaning and drying pens before a new batch of pigs arrives and, when possible, following all-in-all-out practice. The all-in-all-out practice reduces the risk of cross-contamination between pigs of different age cohorts and health status.

**"Pigs reared in dirty pens had 20 per cent lower growth rate than pigs in clean pens."**

Poor hygiene in the pen induces a systemic inflammatory response in pigs and increases the risk of respiratory lesions, such as inflammation in the lung tissue (pneumonia) or in the surrounding membrane (pleurisy). This was shown in a trial where fattening pigs were housed in cleaner or dirtier pens for the first six weeks of the growing period. Dirty pens were neither cleaned nor sanitized after the previous batch of pigs had left the room. By contrast, the rooms of clean housing were cleaned and disinfected between batches, an optimal aeration rate and temperature and strict biosecurity were applied.

#### PAY ATTENTION TO AIR QUALITY

In farms rearing pigs on slatted floors, it is essential to ensure good ventilation to reduce the impact of noxious gases, such as ammonia, carbon dioxide and hydrogen sulphide, and dust. These gases and the smallest particulates (particulate matter with a diameter of less than 2.5µm) weaken the respiratory tract making it more sensitive to opportunistic pathogens, and are harmful also for people working on the farm. Ammonia and carbon dioxide concentrations should not exceed 11 ppm and 1540, respectively (Murphy, 2011), and a chronic exposure to 10 ppm of H<sub>2</sub>S is considered as dangerous.

Maintaining pen cleanliness may be associated with the pigs having little enrichment. While maintaining pen cleanliness, it is also important to provide pigs with enrichment to prevent abnormal behaviours. However, manipulable and chewable objects must be hygienic and easy to clean or replace.



Figure 8. Pigs housed in dirty pens have an elevated incidence of respiratory lesions.

#### PROHEALTH Recommendations

- Facts regarding the benefits of good hygiene should be communicated to pig farmers.
- Use all in-all out practice, and avoid mixing pigs from different sources. Clean the pens before the arrival of each batch of piglets and daily during the rearing period. Pay attention to an adequate duration of cleaning break between batches.
- Ensure good ventilation and monitor air quality, and the cleanliness of enrichment, because these may indicate elevated risk of disease.

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## Providing special care and feeding improves performance of runt piglets by about one third

**Runt piglets can be identified at an early stage and management changes can be used to improve their performance and reduce their susceptibility to disease.**

PROHEALTH research has shown that piglets susceptible to low performance can be identified early by monitoring the serum immunoglobulin (IgG) content after colostrum intake. The performance of these piglets can be improved in the immediate post-weaning phase by grouping them and providing special health care and feed. This targeted intervention can reduce the need to use antimicrobials, whilst avoiding extra work and expense for the rest of the piglets.

### BETTER TARGETED CARE, LOWER COSTS

Currently, farmers cannot anticipate the emergence of poor performance in piglets. Hence, no specific care for the most susceptible animals is given and treatments are typically applied to the whole group. In addition, keeping susceptible and robust animals together facilitates the spread of diseases and increases medication costs.

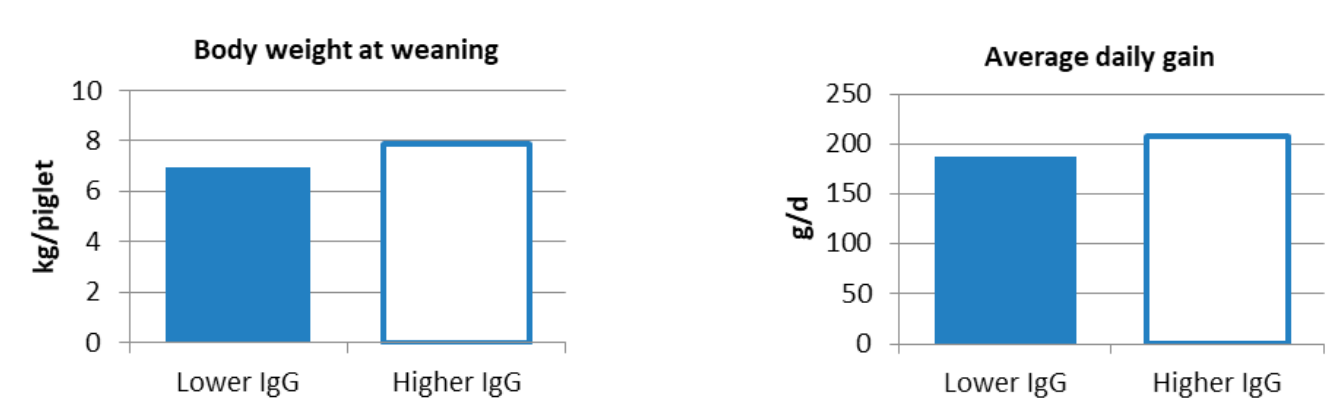


Figure 9. Piglets with higher IgG in serum (<35.6 mg/ml) after colostrum intake were heavier at weaning (figure on the left) and had a higher average daily gain (on the right) in the suckling period than piglets with lower IgG serum.

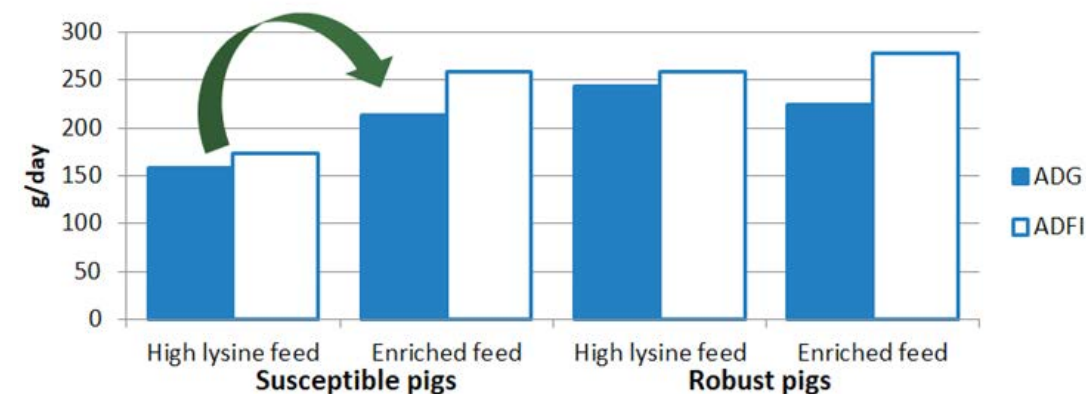


Figure 10. Average daily gain (ADG) and average daily feed intake (ADFI) of piglets susceptible to poor performance were increased when they were fed with an enriched-feed in the pre-starter phase (in the first two weeks after weaning).

PROHEALTH study shows that piglets with higher serum IgG at 24h (>35.6 mg/ml) averaged 21 g per day higher growth rate and were about one kilogram heavier at weaning (Figure 9). Hence, low serum IgG content after colostrum intake is a marker that helps to detect disease-susceptible, poorly growing animals at an early stage.

The weight gain of piglets susceptible to poor performance can be improved in the immediate post-weaning phase, by about one third, through feeding which supports mucosa integrity, immune system response and increased appetite (Figure 10). Other management changes such as a targeted vaccination plan or better environmental control may also help. The recommended feed contains additional:

- Tryptophan and threonine for protein synthesis and to promote appetite regulation (tryptophan), gut integrity (threonine), immune response and health maintenance.
- Glutamine which is essential for gut health and tight junction integrity
- Arginine which reduces intestinal inflammation and increases villus height and crypt depth ratio, improving nutrient absorption.

“The recommendation is easy to apply in commercial production”

This recommendation is easy to apply in commercial production. When targeted to susceptible piglets only, the performance of piglets can be improved at a lower cost and with less use of antimicrobials than an intervention applied to all piglets.

### PROHEALTH Recommendations

- Veterinarians and farmers should develop a farm-level plan on how to provide special care targeted to susceptible piglets only.
- Farmers should consider the grouping of piglets and providing targeted health care for the susceptible piglets. This work would be avoided with the rest of the piglet population.
- Feed manufacturers should examine possibilities to develop affordable feeds that are suited for piglets susceptible to poor performance, and provide the piglets with additional tryptophan, threonine, glutamine and arginine.
- A quick method to measure piglet serum IgG content should be developed.

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## PROHEALTH Partners

The PROHEALTH Consortium has expertise in veterinary science and epidemiology, physiology and immunology, genetics, nutrition, socio-economics, welfare and production science of pigs and poultry.



### Newcastle University

Agriculture, at the School of Natural and Environmental Sciences (SNES) is the UK's leading institution for education and research into pig and poultry systems, and has acted as the British Pig Executive's Centre for National Pig Development Research. SNES is a member of the UK Centre for Innovation Excellence in Livestock and hosts a purpose built Centre for Digital Innovation Applied to Livestock (C-DIAL).

The focus of the livestock research is on the consequences of management for animal health welfare and performance, the development of novel diagnostic and digital technologies, and the assessment of environmental impact of monogastric livestock systems. Research is conducted in purpose-built facilities and in collaboration with UK- and EU-based livestock industries.



### accelopment AG

accelopment is an EU project management company with long-standing experience in project dissemination and exploitation of results in industry-driven projects. The company is specialised in European research, development and innovation support programmes such as Horizon 2020 and EUREKA/Eurostars.



### Aviagen Group

Aviagen is a primary breeder of meat chicken and turkeys. The source of genetic progress comes from balanced breeding of a wide range of pedigree lines improving health, welfare, production and environmental impact simultaneously and with a safe and secure supply of healthy birds.



### CCPA GROUP

Specialized in animal nutrition and health, the CCPA GROUP has established itself as a benchmark player in France and abroad, with a turnover of €94 million and 264 employees. The CCPA GROUP offers varied products and services ranges worldwide: premixes and feed additives, dietetic feeds, analysis laboratory, feed formulation, nutritionists support, plant manufacturing support



### COREN S.C.G.

Coren is a Spanish leading cooperative involved in Animal Production. In the Poultry Division, Coren has an integrated production with broiler breeders farms: 810,000 animals/y, hatcheries, broiler chickens farms: 48.2 million animals/y, slaughterhouses and feed meals 0.95 million ton/y. There are also facilities for an Experimental Farm and Pathology Laboratory.



### European Forum of Farm Animal Breeders (EFFAB)

EFFAB is a platform for organisations active in the farm animal breeding and reproduction sector, which work on genetic improvement of terrestrial and aquatic animal species. EFFAB creates an environment which supports sustainable development in the sector and promotes R&I through FABRE-TP. It is also involved in EU projects in knowledge exchange and transfer.



### French National Institute for Agricultural Research (INRA)

INRA is the largest European public institute which carries out mission-oriented research for high-quality foods, competitive and sustainable agriculture and a preserved environment. For the PROHEALTH project, INRA mobilizes its expertise on animal breeding and genetics, physiology, nutrition, immunology, animal health and bioinformatics.



### JSR Genetics Ltd

JSR Genetics Ltd are part of the group of agriculture-based companies that comprise the family-owned JSR Farming Group established in 1958. The supply of technical support and pure lines to global partners ensures the JSR name is synonymous with quality pig genetics across four continents.



### Natural Resources Institute Finland (Luke)

Luke is the leading Finnish institute promoting bioeconomy and sustainable use of renewable natural resources. It has a strong expertise in solving problems related to consumer well-being, sustainable use of natural resources and the competitiveness and quality of production through state-of-art biological economic and other research and new innovations.



### PigCHAMP Pro Europa S.L.

PigCHAMP Pro Europa S.L. is a company dedicated to swine data management, analysis and improvement of productivity, reproductive audits, implementation of real-time biosecurity control systems, research by contract as well as training and education. In PROHEALTH, PigCHAMP has led the study on the role of the farm environment on the temporal expression of diseases.



### Poultry Health Services Ltd

PHS provides a comprehensive poultry veterinary service from 7 locations in the UK. We have long-term working relationships with a broad range of organisations including poultry companies, individual farms, breeding organisations, hatcheries and regularly liaise with researchers and government bodies.



### SEGES P/S: Danish Pig Research Centre

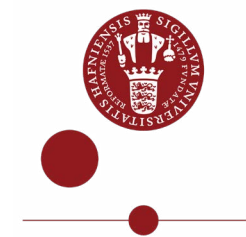
The aim of the Danish Pig Research Centre (PRC) is to develop, test and recommend the best technologies for production of pigs, so that the Danish pig producers maintain their competitiveness in the global market. PRC is also engaged in ensuring the Danish pig producers as good conditions as possible – and on increasing the acceptance of the production from the society.



# TIVIX

## Tivix Inc.

Tivix is located in Wroclaw, Poland. The company's primary focus is the agile development of web, cloud, and mobile software applications. Tivix reduce development risk for clients by offering rapid time-to-market, while delivering standards-based software code that is well-structured and well-documented.



UNIVERSITY OF  
COPENHAGEN

## University of Copenhagen

The group involved in PROHEALTH group focuses on common bacterial infections of poultry and hatching eggs. Bacteria present in any production system such as E.coli and Gram positive cocci account for mortality in all types of poultry flocks. However, in intensified production systems these types of infections may be responsible for the majority of infections.



## University of Ghent

The Unit of Porcine Health Management is internationally renowned for research on different issues related to pig medicine and epidemiology. The research group focusses on diseases that are important from an economic, public health and/or animal welfare viewpoint. The Veterinary Epidemiology research group focusses on quantitative epidemiology and control of zoonoses.



UNITED KINGDOM · CHINA · MALAYSIA

## Nottingham University

The group involved in PROHEALTH was responsible Microbiology and Immunology study. It provides 'state of the art' genomic mapping of pigs and poultry in intensive farming systems and studied changes in the intestinal biota, immune status and whole genome of animals, in different farming environments and with different disease status, from many sites across the European Union.



## University of Reading

The University of Reading (UREAD) is represented by the Centre for Agricultural Strategy (CAS). CAS was established in 1975 to identify important issues in food and agriculture and to ensure they are subjected to informed debate. Its staff have particular expertise in farmer and consumer behaviour.



## Vedanko BVBA

Vedanko is a group of 8 veterinarians specialized in pig veterinary medicine. We do veterinary consultancy and provide veterinary services to pig farmers all over Belgium. We are also responsible for the health of all the pigs in group Danis, Belgium.



## Veterinary Research Institute

VRI was responsible for analysing the composition of gut microbiota of poultry and pigs. The samples were collected either from experimental animals kept under different zoohygienic conditions, or from animals in commercial production but displaying clearly different performance.



## VitaTrace Nutrition Ltd

### Vitatrace Nutrition Ltd

Our company is based on the island of Cyprus and produces vitamin and mineral premixes, macropremixes, water soluble vitamin preparations and trades in various nutritional products for livestock feed. Our company also distributes the Zoetis range in Cyprus.



## Warsaw University of Life Sciences (SGGW)

SGGW, the largest university in Poland, is a modern agricultural university with research and educational cooperation with over 275 foreign universities from 50 countries in the world. The Division of Avian Diseases at the Faculty of Veterinary Medicine has a strong tradition (from 1968) in conducting didactic classes and scientific research.



## Zoetis Inc.

Zoetis is the leading animal health company, dedicated to supporting its customers and their businesses. Building on more than 60 years of experience in animal health, Zoetis discovers, develops, manufactures and markets veterinary vaccines and medicines, complemented by diagnostic products and genetic tests and supported by a range of services.

## Key Facts

22 European partners:  
12 industry, 10 academic  
Project duration: 01.12.2013 – 30.11.2018  
Project coordinator: Prof Ilias Kyriazakis,  
Newcastle University, UK

## Disclaimer

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