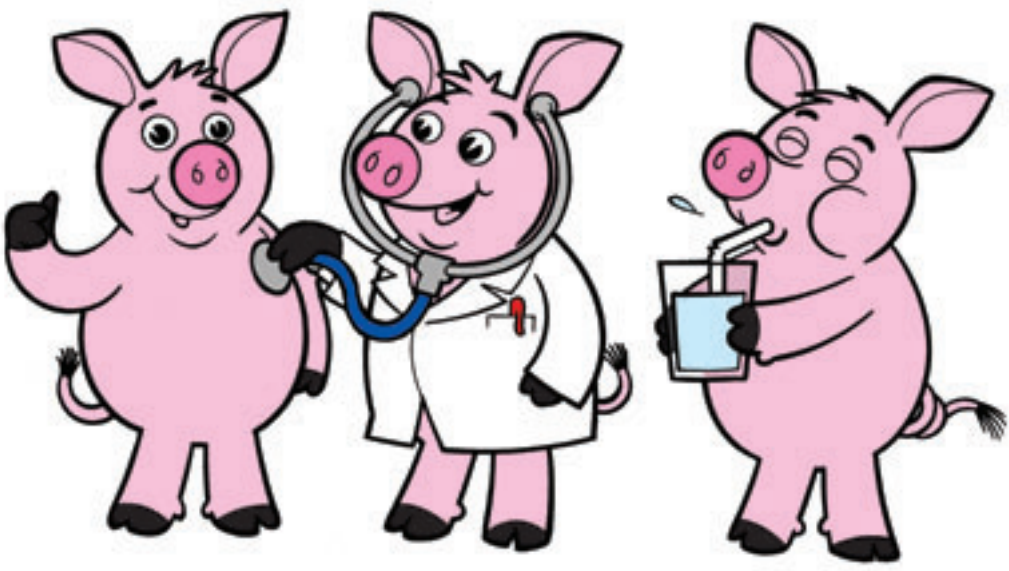
Serious about Salmonella
A guide for pig producers



ADAS

FOOD STANDARDS AGENCY

Serious about Salmonella – back to basics

Contents

Who is this information booklet for?

This information booklet is intended for use by all those involved in the pig production chain, such as farmers, hauliers, veterinary surgeons and abattoir operators. It aims to provide advice on how to improve practices on the farm to control *Salmonella* infection. The booklet is accompanied by a DVD, both of which can be used for education and training purposes.

Introduction

Lessons learnt from previous food scares have shown that the risks posed by widespread *Salmonella* contamination in our pig herd cannot be ignored. In addition to its potential to cause illness in humans, *Salmonella* can cause disease in animals, affecting their welfare. Eliminating *Salmonella* from a farm is a difficult task and it may be impossible to eradicate it from all farms in the UK. However, by following the back-to-basics protocols highlighted in this booklet infection can be controlled and *Salmonella* levels can be reduced; lowering the risk of it entering the food chain.

The UK is likely to come under increasing pressure to tackle *Salmonella*. In order to compete with our international counterparts the industry will need to take continuous action to tackle this food-borne pathogen.

Salmonella – background

What is Salmonella?

Salmonella organisms are bacteria that can infect a wide range of animals including mammals, birds and reptiles. The organism can cause salmonellosis in humans and is second only to *Campylobacter* as the most common cause of food poisoning in the UK[1]. Pork and pork products have been identified as a significant cause of salmonellosis and therefore a reduction of the *Salmonella* risks associated with these products will contribute to the protection of human health.

Salmonella survival and reproduction

The organism reproduces in the gut and in the faeces of pigs but can also be found on their skin or in manure. Carrying *Salmonella* in the gut or on the skin can lead to carcass contamination at the time of slaughter. *Salmonella* can survive for prolonged periods in the environment, for example in a manure heap or in dirty buildings. It≈can be passed directly from animal to animal, usually through the mouth, or via outside vectors such as birds and rodents. It can also be transmitted by consuming contaminated feed, water or faeces. Pig-to-pig transmission however, remains the most significant risk of infection.

Effect of Salmonella on pigs

The occurrence of the clinical disease caused by *Salmonella* is rare and the symptoms are often short lived. Weaners and growers are most commonly affected, with symptoms such as diarrhoea, dehydration, septicaemia and in some cases death. Sows may be more resistant to infection but can show similar signs and may also be at risk of abortion.

[1] Adak G.K., Meakins S.M., Yip H., Lopman B.A. and O'Brien S.J. (2005). Disease risks from foods, England and Wales, 1996-2000. *Emerging Infectious Diseases*, **11** (3).

The rarity of clinical signs and lack of impact on welfare makes it difficult to identify the majority of infected pigs. Problems will usually only occur when the level of infection (the number of organisms) in the animal reaches critical levels. However, pigs showing no outward sign of infection are the most likely route for *Salmonella* entering the food chain and often shed the organism into the environment and infect pen mates. It is these animals therefore, that need to be targeted for control.

The need to reduce levels of *Salmonella*

In January 2006 new EU Food Hygiene Legislation came into force[2]. This legislation places the onus on the food business operator to produce food safely through the application of good hygienic practices and food safety management procedures. This responsibility extends from the primary producer through the food chain up to the consumer (a farm to fork approach).

EU legislation[3] was introduced in 2003 governing what all Member States will do to minimise the levels of *Salmonella* in certain species reared for meat. This legislation is designed to ensure there is continual monitoring of zoonoses in livestock, including *Salmonella* in pigs. A 12-month survey, designed to establish baseline data on the incidence of *Salmonella* in slaughter pigs, began in every Member State in October 2006. The UK survey is run by the Department for Environment, Food and Rural Affairs (Defra) in partnership with the Food Standards Agency (FSA). The results of all the Member States' surveys are due to be published by the European Food Safety Authority (EFSA) in early 2008. The output is likely to form the basis of new legislation setting targets for the reduction of *Salmonella* and requiring the implementation of National Control Plans (NCP).

A 12-month survey of *Salmonella* in breeding pigs in all Member States is due to start in January 2008.

[2] Regulation EC No. 852/2004, Regulation EC No. 853/2004, Regulation EC No. 854/2004.
[3] Zoonoses Directive 2003/99/EC; Zoonoses Regulation 2160/2003/EC.

Targets for reducing *Salmonella*

The FSA's Strategic Plan 2005 – 2010 includes the aim to achieve a significant reduction in foodborne disease. Included within this is the specific target of working with industry to achieve a 50% reduction in the incidence of pigs testing positive for *Salmonella* at slaughter by 2010. The FSA supports a number of projects with the aim of reaching this target. Among these is the back-to-basics campaign, of which this booklet is a part, aimed at promoting the use of good hygiene and biosecurity practices on the farm. Support is also provided for the Zoonoses Action Plan (ZAP) *Salmonella* Monitoring Programme in addition to funding research and promoting best practice for the control and reduction of *Salmonella* at the slaughterhouse. Details of the research projects can be found online at, **www.food.gov.uk/science/research/researchinfo/foodborneillness/meathygieneresearch/m01prog/m01list/.**

In June 2002 the British Pig Executive (BPEX), in partnership with the FSA and Defra, launched the ZAP scheme which aims to monitor trends in the levels of *Salmonella* on pig farms so that action can be taken to reduce the prevalence in pigs at slaughter. To achieve this meat-juice samples are taken from pigs during the slaughtering process and tested for the presence of *Salmonella* antibodies. Assistance is available to producers who have high levels of antibodies through the Veterinary Laboratories Agency (VLA), the Scottish Agricultural College (SAC) and Veterinary Science Division (VSD) in planning *Salmonella* reduction strategies. The uptake however has been poor, particularly in England and Wales where levels of *Salmonella* are significantly higher than in Scotland and Northern Ireland.

Farms involved in the ZAP Programme are assigned ZAP levels (either ZAP 1, 2 or 3) based on the number of samples testing positive for *Salmonella*. The ZAP categories in 2007 are:

ZAP 1 Less than 50% pigs positive
ZAP 2 50% – 75% pigs positive
ZAP 3 Over 75% pigs positive

Up to 49% of pigs in units at ZAP 1 are or have been infected with *Salmonella*. The wide ranges of results seen in ZAP 1 require very different *Salmonella* control strategies depending on the percentage of positives found. It is important that control procedures are not ignored by units on the basis of being assigned a ZAP 1 score, as action will need to be taken by producers with average positive scores over 10% to effectively reduce the national average of *Salmonella* in pigs. The ZAP scheme also has a number of other limitations in its current form, these include:

- ZAP scores do not necessarily give the current infection status but instead gives an indication of levels of infection on the unit in the previous 4 – 6 months.
- ZAP testing only includes herds entering the slaughtering process from farms who are members of Assurance Schemes.
- The scheme does not include any monitoring of breeding herds.

Over the last ten years the level of *Salmonella* has been reduced to reasonable levels in Denmark by the Danish Meat industry. Currently there has been no significant reduction in levels in UK assured pigs. A similar reduction to that seen in Denmark is unlikely to be achievable in the UK using the tools currently available. More information on the ZAP scheme, including the Annual Reports, can be found online at, **www.bpex-zap.org.uk/zap.**

Causes of *Salmonella* on the farm

Salmonella in the environment

The more pigs are exposed to the organism the more likely they are to become infected. Therefore, to avoid infection, levels of *Salmonella* in the environment should be kept to a minimum by maintaining good farm hygiene and biosecurity practices. Levels of *Salmonella* infection in pigs may increase for a number and combination of reasons, including:

- The introduction of infected pigs.
- Changes of feed or feed ingredients.
- Lapses in unit hygiene or pest control.

Stress

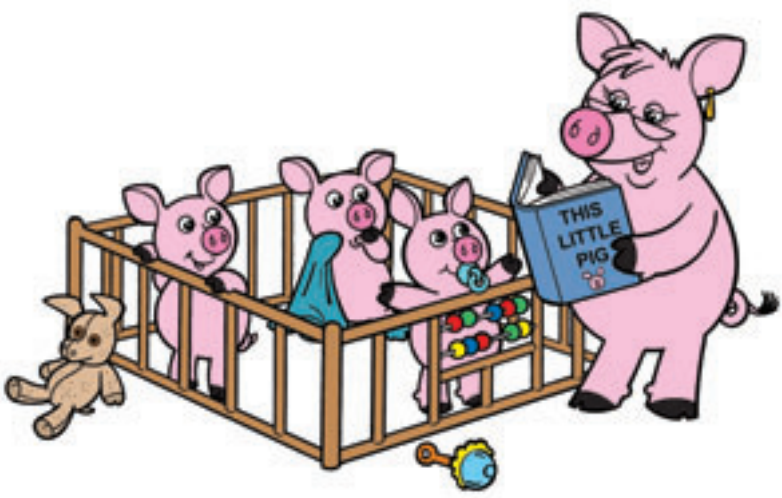
Stress increases both the animals' susceptibility to infection and the numbers of bacteria shed by carrier pigs. This has implications on management issues such as mixing groups of pigs and stocking densities, as well as housing policy and handling methods. Stress, caused by disease breakdown or a change in health status, can also increase the pigs' risk of contracting bacterial disease. Minimising the mixing of pigs from different batches or sources will reduce stress and limit the possibility of spreading *Salmonella* between groups. For details of where information on reducing stress can be found please refer to the Further information section on page 44.

Preventing *Salmonella* entering the unit

Implementing an effective on-farm biosecurity programme will control the routes by which *Salmonella* can enter the unit. Effective biosecurity means reducing the risk of disease occurring in, or spreading to other animals and can be achieved through a number of practices.

Incoming stock

Incoming stock represents a significant risk to the pig herd due to the risk of *Salmonella* transmission between pigs. This will include replacement gilts and boars on a breeding unit or weaners on a finishing site. Ideally stock should be sourced from a *Salmonella*-free unit and producers should be aware of the status of their source unit. To ensure incoming stock is from a *Salmonella*-free unit consider asking the vet to liaise with the supplier to request laboratory testing of faecal samples.



Weaners

The current ZAP scheme does not monitor *Salmonella* in breeding herds or weaners from those herds; however these will need to be included within the National Control Plan required by the European Commission. Weaners are recognised as a potential source of infection for finisher herds. Breeding herds therefore have an important role for the rest of the industry in ensuring suitable and appropriate steps are taken to minimise transmission of *Salmonella* through weaners.

Pig finishers should, where possible:

- Limit the number of different sources of weaners of differing health status.
- Select weaners from a minimum number of units with known health status.

Breeding stock

The following should be considered when bringing breeding stock onto the unit:

- Buy only from known *Salmonella*-free sources.
- Ask the vet to confirm the disease status of incoming animals.
- Ask the vendor to supply information on the health status of the herd and the herd's routine vaccination and other treatments or disease prevention measures.

Quarantine

On a breeding unit it is important to quarantine newly arrived breeding stock:

- Isolate and observe incoming stock.
- Quarantine should preferably last for a minimum of five weeks, with no cross contact between quarantine and the main unit.
- Where possible quarantined animals should be looked after by non-farm personnel.
- If farm staff do need to have contact with quarantined animals different clothing should be available to that worn on the rest of the farm and visits should take place at the beginning of the day.

Key message

Salmonella control starts with weaners

- Source and maintain *Salmonella* free breeding stock
- Know the *Salmonella* status of your weaners and manage pigs to control cross contamination

People (visitors or staff)

People have the potential to introduce *Salmonella* into herds from outside the farm and for causing cross-contamination within the farm. It is important to have a comprehensive and well thought out biosecurity policy that all staff understand and adhere to without prompting. The following should be considered:

- The provision of sufficient quantities of protective outerwear and boots for all visitors. Disposable overalls for visitors are a minimum requirement.
- Visitors must be authorised and should not enter pig accommodation unless it is essential.
- On-site car-parking areas should be located away from the main unit with a hygiene barrier on the farm perimeter, preferably with a changing room and hand washing facilities.
- Cleaning overalls should be done on site if possible.
- All staff and visitors must be able to practice good personal hygiene. This includes adequate provision of toilets that should be kept clean and hand wash areas with hot water and soap-sanitizer dispensers.

Vehicles

Incoming vehicles

Vehicles that visit other pig units should be kept off-site wherever possible. Where vehicles need to enter the unit the following should be considered:

- Feed bins should be situated on the unit perimeter to avoid the need for vehicles to enter the site.
- Essential incoming vehicles should be presented with a hygiene barrier which they cannot cross without wheel/wheel arch cleaning and disinfection, at the very least use a knapsack sprayer or preferably a power washer.
- Wheel dips can be used but they must be regularly maintained and disinfectant levels topped up.

Outgoing vehicles

It is essential to operate standards of biosecurity on livestock vehicles to cut down the risk of spreading *Salmonella*. This should include:

- Ensure hauliers arrive with a clean wagon, particularly if they have already visited an abattoir.
- Vehicles travelling from another farm, even if it is under the same ownership, should be properly cleaned before transporting pigs.
- Vehicles that go off-site must be cleaned and disinfected before they re-enter the farm site and should generally be kept as clean as possible.
- Stockwagon drivers should not be allowed onto the unit.
- Commercial hauliers as well as farmers' own vehicles should comply with the Transport of Animals (Cleansing and Disinfection) England (No. 3) Order 2003[4].

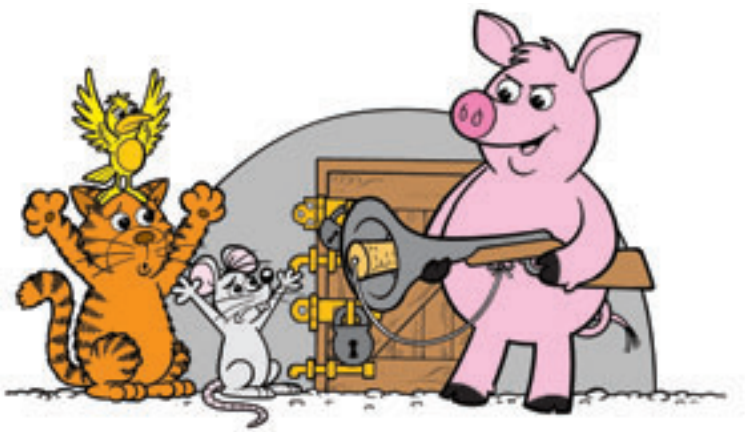
[4] Transport of Animals (Cleansing and Disinfection) Wales (No. 3) Order 2003; Transport of Animals (Cleansing and Disinfection) (Scotland) Regulations 2005; Transport of Animals and Poultry (Cleansing and Disinfection) Order (Northern Ireland) 2007.

Equipment

Equipment should be kept clean and disinfected to reduce the risk of spreading *Salmonella*:

- Ensure equipment brought onto the unit has been cleaned, disinfected and dried and not used on another pig unit for a minimum period of time (ideally one week) to guarantee freedom from disease.
- Mucking-out equipment, such as muck scrapers, hand tools, shovels and brushes should be kept clean and, wherever possible, their use limited to specific buildings to avoid cross-contamination within the farm.

Pests and wildlife



Wild birds and vermin are known carriers of *Salmonella* and are a potential source of infection. Anything that can be done to reduce their numbers, for example by removing their shelter and food supply, will help lower the quantity of infection arriving on the unit. The practicality of applying control measures must be considered on each farm.

Effective control of vermin

The true level of vermin infestation must be assessed before effective counter-measures can be employed. Rat and mice populations should be monitored throughout the year, not just in autumn and winter. The farm and work practices most likely to encourage vermin must also be understood before issues can be addressed. If necessary seek professional assistance to develop the most effective control strategy for the farm situation to keep numbers to an absolute minimum and limit access to farm buildings and stock. Effective vermin control will involve the following:

- Identify problem areas and monitor these carefully, for example the straw stack/feed store.
- Avoid continuous baiting as this leads to a build up in resistance.
- Set unbaited traps/boxes at least three days prior to setting.
- Use plenty of points and enough bait to kill in one dose.
- Where an initial baiting has been successful do not regard this as a "job done" – follow up baiting will be required.
- Once vermin are dead, fill rat holes with concrete.
- Hygiene and feed management is essential. For example, do not leave stale feed behind in feed troughs and hoppers before cleaning and disinfecting buildings as this will encourage vermin back into the buildings.
- Remember more mice carry *Salmonella* than rats.
- Feed should be stored in vermin-proof feed bins/trailers or in closed bins. If stored in bags, protect them from tearing and sweep up any spilt feed left behind.

- Weeds, general rubbish, machinery and equipment left between and around buildings or close to hedgerows provide a safe environment for vermin, particularly rats. Removing the rubbish and resurfacing these areas with compressed stone will remove vermin nesting sites and make it easier to monitor infestation levels.

Bird control

Controlling wild bird populations is potentially more difficult than keeping rats and mice out, particularly for outdoor and extensive yard-based systems. Any steps taken to reduce bird numbers will help reduce the overall infection loading on the unit:

- Use a combined approach of withdrawing feed supplies, deterrence and shooting.
- Steps should be taken to exclude birds from buildings using netting.
- Cover feeders wherever possible, this is especially important where bird exclusion from buildings is not practical.
- Apply plastic strips to arc fronts to exclude small birds from gaining access to feeders as this will also help to control infection.

Cats and dogs

Cats and dogs may help control the population of mice and rats but they are also a potential source of *Salmonella* infection. Direct contact with pigs should be avoided and cats and dogs should be kept out of feed hoppers and grain and feed stores to prevent faeces and urine contaminating the feed.

Key message

Rodents, wild birds and cats carry *Salmonella*

Make sure pigs, buildings, feed and feed stores are protected, vermin controlled and cats excluded.

Bedding

Dirty bedding can lead to an increased chance of *Salmonella* contamination. Remember to:

- Source clean bedding, preferably from farms without livestock.
- Contamination of clean straw in storage by birds and vermin carries a high risk of transferring a range of infections, including *Salmonella*, to the stock. Baiting must be effective in all areas of the unit and birds discouraged.

Feed and water

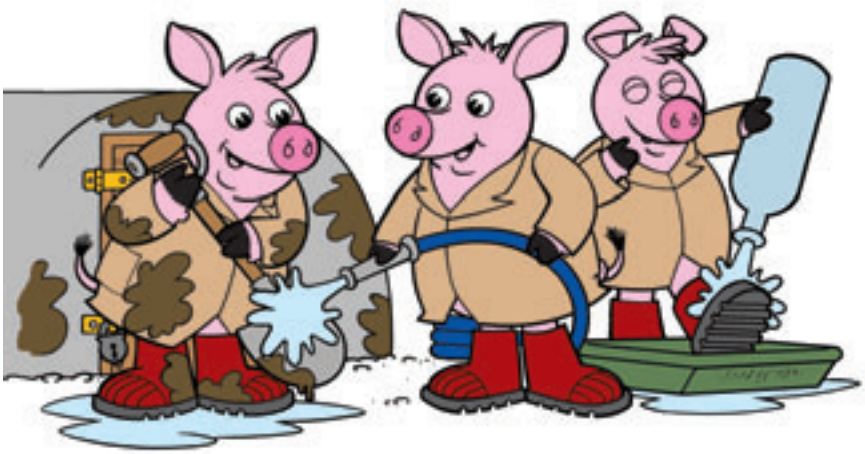
Contaminated feed and water supplies are a potential source of *Salmonella* infection on the farm. To limit the risk of contamination from this source the following actions should be taken:

- Confirm that feed is purchased from a supplier who takes anti-*Salmonella* measures in their manufacturing and storage processes.
- If the water supply is from a private source, such as borehole, it must be tested regularly.
- Make sure septic tanks on or near the unit are working properly as they are a potential source of contamination.

Controlling *Salmonella* on the unit

Total elimination of *Salmonella* is unlikely to be achievable on most units. No single treatment or management technique is going to provide total control; a range of options will need to be considered, many of which will be challenging to implement in practical terms. Not all control methods will work in all situations and some may only work for a time, therefore control plans will need to be reviewed and updated. Producers need to stay abreast of new developments and share best practice advice with other producers on emerging control strategies.

In the poultry industry vaccination has provided a good basis for control, however at present there are no *Salmonella* vaccines licensed for use in pigs in the UK. Limited trials of a vaccine for pigs are underway but more work is needed in this area. Any vaccine is unlikely to provide total protection against *Salmonella* infection and its use will have to be combined with improved on-farm hygiene.



Operating a high standard of hygiene on the farm is most important but this is not guaranteed to reduce *Salmonella* infection in every farm situation. Clean and well managed units can still have a *Salmonella* problem that will require additional control measures to support the farm hygiene programme. Any action that can be taken to reduce the number of organisms present on the unit will lower the chance of slaughter pigs carrying *Salmonella*.

Farm hygiene – back-to-basics

Poor farm hygiene can be a major contributor to disease outbreaks and increasing levels of *Salmonella* infection on the farm. Heavily soiled areas can contain high levels of the organism, leading to an increased risk of infection due to the higher numbers of bacteria present. The risk of infection and disease outbreaks is also increased if a pool of infection survives in dirty pens and buildings or if staff or equipment comes into contact with heavily contaminated areas on the unit. It is vitally important that levels of *Salmonella* within the unit are kept to a minimum to limit the risk of cross-contamination.

Work practices

There is a risk of staff bringing *Salmonella* onto the unit and of them transmitting it around the unit. To avoid spreading *Salmonella* within the farm, staff should understand the work practices most likely to spread the infection so that effective counter measures can be taken.

- Good hygiene extends from the stock-keeper. It is important to wash hands, wear clean clothing and keep boots as clean as possible and disinfect them regularly.
- Maintain good staff facilities. It is particularly important to provide clean toilets and hand washing facilities.

Key message

Farm hygiene and biosecurity can prevent *Salmonella* infection

Keep buildings, overalls, boots and farm equipment clean and disinfected and control visitors and vermin.

Machinery and equipment

Machinery and equipment are a common source of infection. Vehicles, muck scraping equipment and other tools, such as shovels, are likely to be contaminated with *Salmonella*. It is therefore important to include these items in a regular cleaning programme.

To maintain good hygiene on the farm the following practices should be adopted:

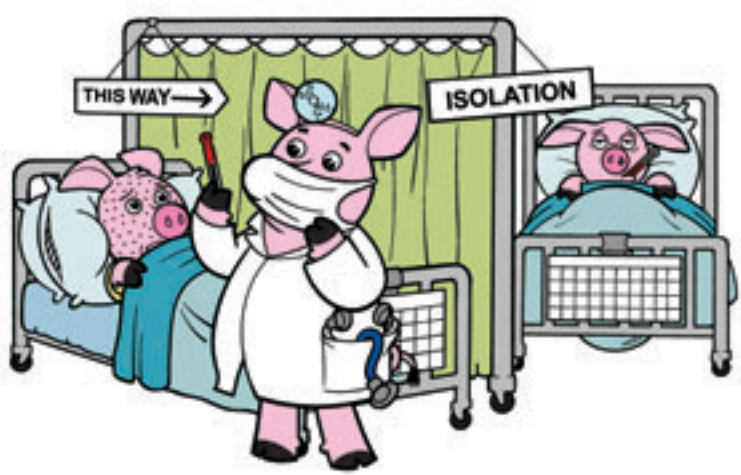
- Aim to move from the youngest animals to the oldest throughout the day. Complete jobs involving contact with the youngest animals, or in buildings that house the youngest animals, at the beginning of the day. Move to the older animals as the day goes on.
- Maintain a hygiene barrier between different buildings or areas within the farm.
- Operate a 'Clean and Dip' policy between buildings and rooms. Including, if possible, foot dips preceded by hosepipes with boot brushes so that boots can be cleaned before dipping them in disinfectant.
- Where possible avoid entering pens. If this is unavoidable take precautions such as dipping boots.
- If possible use separate feed barrows, hand tools and other equipment for different sections of the herd.

- If possible have separate clothing for different areas of the unit.
- Ensure machinery and equipment used for scraping is cleaned and disinfected on a regular basis. This is particularly important with solid-floor scrape through systems.
- Use different equipment for each different job. For example, do not use an empty feed barrow for moving weaners as this risks spreading infection.

All-in, all-out production systems

All-in, all-out production systems provide the opportunity to reduce the risk of cross-contamination between pigs and lower the levels of residual infection on the farm.

- All-in, all-out severs the links between different age groups of pigs on a unit and, if properly managed, can prevent *Salmonella* infection from passing between these groups.
- All-in all-out allows for effective cleaning and disinfection practices to be employed between batches.



Batch farrowing systems make practising all-in all-out production easier. However, implementing this system may still be difficult, requiring an investment of both time and effort, and may not be feasible in all cases. A more practical approach may be to separate different age groups of pigs, possibly allocating different members of staff to different groups. Efforts should be made to avoid mixing poor performing pigs, 'poor doers', in with younger age groups.

Sick pens

Sick or hospital pens, together with 'slow stream' pens, represent potentially the highest risk of infection on the whole farm. Sick and recovering pigs are more likely to carry and excrete *Salmonella* and can infect otherwise healthy pigs, therefore hygienic sick pen management is essential:

- Sick pens should be isolated from the main pens to reduce the risk of cross-infection.
- Ensure sick pens are constructed from and lined with materials that can be effectively cleaned and disinfected.
- Feeders and water medicators/drinkers should be removed, cleaned and disinfected on a daily basis.
- Dedicated sick pen overalls and boots should be provided.
- Clean gloves and needles should be used when dealing with sick pigs.
- Sufficient numbers of disinfectant foot dips for the sick pen area should be provided.
- Adequate lighting should be provided so that sick pens can be thoroughly cleaned out before disinfecting.

- There should be sufficient sick pens on the unit so they can be emptied regularly and thoroughly cleaned and disinfected before re-use.
- Recovered pigs leaving sick pens should not be re-introduced into general housing. Instead they should be penned and preferably housed separately from the main herd.

Key message

All-in, all-out production can control cross-contamination between batches

- Clean and disinfect effectively between batches.
- Have a one way pig flow.
- Aim for small group sizes with minimal mixing.
- Manage sick pens and do not mix sick pigs back into main production.

Effective cleaning protocols

All-in all-out production systems provide the opportunity for more frequent cleaning and disinfection between batches. Investing time and resources to implement this type of system could be wasted if effective cleaning and disinfection is not practised.

Whatever type of production system is in operation on the unit ineffective cleaning will lead to high levels of residual infection remaining in pens and on equipment. Therefore, cleaning protocols on the unit should be reviewed to ensure that the risk of infection is kept to a minimum. It may be useful to operate a checklist for effective cleaning and disinfection between batches. This will involve a systematic process of signing off each stage to ensure no key procedures are missed.

Cleaning techniques

Cleaning, prior to the disinfection stage, has to be thorough if *Salmonella* control is to be effective. The following guidelines should be adhered to during cleaning:

- The floor must be scraped or cleaned to remove loose dirt before hosing it down.
- Ensure corners are not missed. Slats must be carefully cleaned so that material from the floor is not redistributed over clean areas.
- Ensure pen fittings and partitions are cleaned effectively.
- All portable equipment, feeders and other items should be removed and cleaned outside the room when possible to avoid recontamination onto clean areas.
- Empty, clean, and dry troughs and similar items.
- Clean around and underneath feeders.
- Use a detergent when hosing down. Using water alone requires more water, takes more time and is far less effective at removing micro-organisms. Using a detergent is more cost-effective, saving 20% or more of the overall cost of using water alone.
- After cleaning allow rooms to dry fully before disinfection.
- Equipment and floor surfaces should be maintained and repaired when pens/rooms are emptied as this will contribute to effective cleaning and disinfection.

Pre-soaking

Pre-soaking and applying a detergent to an area saves time when cleaning. For example, a pre-soak spray system can be activated to work intermittently and left unsupervised. The process also produces less slurry, saves labour and uses less water than conventional cleaning methods.

Detergents/Degreasers/Foam cleaners

Dirty pens will contain residues of faeces, feed, animal dust and hair. Consider the following:

- Heavily soiled areas may be more effectively cleaned using a farm degreaser in combination with a detergent.
- A detergent should contain a surfactant to help break down residual organic materials and help remove the biofilm, where bacteria can reside, before disinfection. Alkaline-based detergents are usually the most effective at removing this type of organic matter.
- Long-cling foams offer benefits where a longer time is needed to clean heavily soiled surfaces.

Research is underway to identify products that are more effective when used at lower water pressures. This will have health and safety benefits and reduce the risk of generating air-borne particles that risk re-contaminating cleaned surfaces for up to three hours.

Hot versus cold pressure-washing

There is evidence to suggest that using hot water during pre-soaking saves time compared to cold water use. However when detergents are used in combination with pre-soaking, little difference between hot and cold is observed. Therefore, if using a detergent, it is more cost effective to use cold rather than hot water. Hot water pressure-washing also has the disadvantage of producing steam, which will reduce visibility for the operator.

Disinfectant use

It is important to use disinfectants correctly to reduce the risk of infection.

- Ensure that surfaces are clean and dry before application.

- Use disinfectants from the Defra approved list, chosen to be effective against *Salmonella*[5].
- Ensure that the disinfectant used is not inactivated by the presence of organic material.
- Ensure the correct level of dilution to cover a range of diseases, including *Salmonella*. Disinfectant dilutions should be calculated based on the levels present on the particular unit in accordance with the manufacturers' instructions.
- Simple written information on using disinfectants, including the correct dilutions, should be made available to all staff and translated into appropriate languages where necessary.
- Foot dips must be maintained regularly.

Feed and water systems

Salmonella can be spread in feed and water systems, therefore it is important to include these in the cleaning programme. Residual contamination of feeders is an important source of infection for incoming pigs and they must be emptied, washed, drained and dried. Drinking systems also carry a risk of infection and need to be regularly flushed out and disinfected. When cleaning feed and water systems aim to:

- Empty feed troughs weekly, discarding any wet or stale feed.
- Empty bulk bins regularly.
- Clean all water troughs daily.
- Flush drinking systems with peroxide-based cleaning fluids when the building is empty.
- Use highly diluted peroxide in the water following reintroduction of stock.

[5] This list can be viewed online at, www.defra.gov.uk/animalh/diseases/control/testing_disinfectants.htm

- Ensure debris is removed from header tanks before the inside is cleaned out and disinfected.
- Ensure tight fitting covers are in place on header tanks.

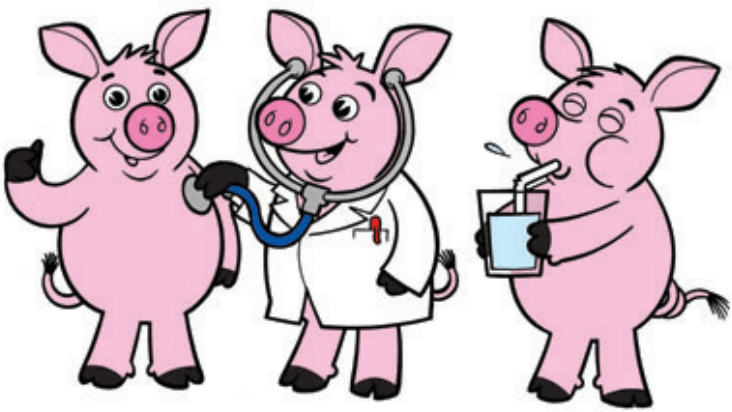
Outside building hygiene

To control *Salmonella* it is important to consider hygiene practices in outdoor areas of the farm as well as inside the buildings that house pigs.

- Manage manure handling systems to remove, or at least lower, the risk of liquid spillage onto walkways/yard areas where pigs will be moved. This should include managing manure collection, storage and removal for spreading.
- Preferably use a loading ramp with a washable concrete driveway and separate drainage system.
- If possible ensure that the loading ramp is built on the perimeter of the unit to avoid the need for outside livestock vehicles to enter the unit.
- Ensure prompt disposal of carcasses to prevent infection build-up.
- Pay particular attention to cleaning and disinfecting carcass storage areas or carcass containers each time they are emptied.
- Ensure carcass containers have tight-fitting lids.
- Prevent access by wild animals by locating the carcass storage area on the perimeter of the unit. This is especially important when using a fallen stock contractor.

Control through feed and water

Once basic hygiene and management procedures are in place on the unit additional control measures may be considered to control *Salmonella* infection. These measures are not substitutes for improving basic hygiene and management practices, but instead offer extra control where problems persist. One option for reducing *Salmonella* involves control through feed and water management.



Physical form of feed

The physical form of feed given to pigs can have an effect on the levels of *Salmonella* organisms.

- Using coarsely ground meal rations, particularly barley-based rations, can result in lower *Salmonella* levels compared to feeding pellets. Coarse meal is retained in the pigs' stomach for longer periods where the acidic conditions help destroy any *Salmonella* organisms ingested from the environment.
- Danish research has lead to the production of specialised diet formulations (meal and pellet form), that can help control *Salmonella*.

- Looseness and associated enteric disease can predispose pigs to *Salmonella* infection. Consider the suitability and specification of diets for specific ages of pigs, together with the ingredients that are optimally digestible to minimise this risk.
- Liquid feeding greatly reduces the risk of *Salmonella* over dry feeding, possibly due to the acidity of the feed. Although there may be cost savings in the long term, changing to a wet feeding system requires considerable initial investment. The benefits of potential feed cost savings as well as benefits from *Salmonella* reduction need to be assessed.

Acidification of feed/water

The use of organic acids, such as formic, acetic, propionic and butyric acid, can inhibit *Salmonella*. They act by reducing the pH of the gut, creating an unfavourable environment for the organism. Although these acids have not been widely used in the UK they have contributed to the reduction in *Salmonella* seen in Denmark.

A number of products, claiming to effect different parts of the digestive system, are available. The use of organic acids in feed and water may benefit overall pig performance through improved gut health; however reductions in *Salmonella* infection have not been consistent. Before introducing organic acids to feed/water consider that:

- The cost of organic acids can be high so it may be more practical to attempt to reduce the risk of infection by other means initially.
- For farms with moderate levels of *Salmonella* infection, trials have suggested that providing acidified water and/or feed to pigs between 8 – 40 kg can help reduce infection in finishers.
- Acidification of water and/or feed has implications for the equipment on the unit. Metal pipework and fittings as well as concrete under drinkers may be corroded by the acid and will need replacing.

Key message

Pig health, feed and water can help control *Salmonella* infection

- Management for a healthy herd will reduce stress and help control *Salmonella*
- Meal or liquid feeding may help control *Salmonella*
- Acidification of feed or water can promote gut health and minimise *Salmonella* and other infections

The future of *Salmonella* control

Although research is limited at present there is some evidence to suggest that other techniques may be employed to control *Salmonella* in future. Probiotics, usually in the form of lactic acid bacteria, and prebiotics have been shown to prevent growth and colonisation of *Salmonella* in the intestine of pigs and could potentially form part of an overall control strategy. Bacterial binders and phages may also prove useful by inactivating *Salmonella* organisms.

Pig welfare

Owners and those looking after pigs have a legal responsibility to protect the welfare of their animals at all times. Appendix 5 describes the legislation that is relevant to the welfare of pigs.

Conclusion

Following the advice in this booklet will help ensure levels of *Salmonella* on pig farms are reduced. Reduction in *Salmonella* prevalence will have significant benefits for the producer, abattoir operator, retailer, consumer and all those involved in the production chain and assist in strengthening confidence in UK pork.

Producers must consider the most practical ways of minimising *Salmonella* by taking whatever steps are suitable for their particular unit. Many of the measures that will help control *Salmonella* have the additional benefit of improving herd health generally; therefore taking steps to reduce *Salmonella* should also improve general performance and productivity on the unit.

Any control programme will be difficult to implement and will require a long-term action plan. It need not be expensive to achieve good levels of control over *Salmonella* but the amount of effort and diligence required to maintain this control is likely to be high and ongoing.

Appendices 1 – 4 provide checklists for particular management practices that may be employed as part of a *Salmonella* control strategy.

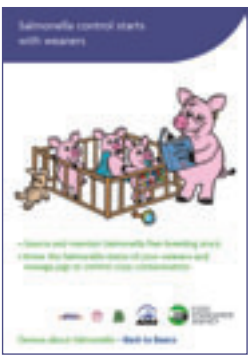
There is a DVD that accompanies this booklet and also a range of posters emphasising the five key messages for controlling *Salmonella* in pigs. These are available free of charge. For further details on how to order these please see page 44.


Rodents, wild birds and cats carry Salmonella


Farm hygiene and biosecurity can prevent Salmonella infection


Serious about Salmonella


All-in, all-out production can control cross-contamination between batches


Salmonella control starts with weaners


Pig health, feed and water can help control Salmonella infection


Serious about Salmonella
Salmonella control starts with weaners
Rodents, wild birds and cats carry Salmonella
Farm hygiene and biosecurity can prevent Salmonella infection
All-in, all-out production can control cross-contamination between batches
Pig health, feed and water can help control Salmonella infection

Appendix 1 – Checklist for breeding

- Source breeding stock from *Salmonella*-free herds ☐
- Batch farrow whenever possible ☐
- Clean sows on entrance to buildings ☐
- Crate sows in due date order ☐
- Keep sows off wet or dirty crates ☐
- Thoroughly clean under slats where possible ☐
- Use powder disinfectants in crates ☐
- Pay particular attention to fly control ☐
- Wash milk water dishes daily ☐
- Keep fostering to a minimum and avoid mixing healthy and sick piglets ☐
- Never hold back poor/sick piglets or move them into a clean, healthy farrowing house ☐
- Check heat mats and lamps are working correctly ☐

Specific biosecurity measures to consider:

- Always work with the youngest piglets first, then in age order ☐
- Leave scouring or ill piglets until last ☐
- Use clean latex gloves and needles when dealing with a scouring litter ☐
- Disinfect tagging equipment, tail docking equipment and teeth clippers in-between each litter ☐
- Limit the use of mucking-out tools between houses ☐
- Always provide a foot dip containing a disinfectant at the correct strength at entrances to the farrowing house ☐
- Remove visible muck with a boot brush before dipping boots in the disinfectant foot dip ☐
- Use clean overalls daily ☐
- Wash hands regularly with soap and water ☐
- Never move piglets from house to house ☐
- Never bring weaned piglets back into the farrowing house ☐
- Do not use a feed barrow as a piglet barrow – ensure both are cleaned and disinfected regularly ☐

Appendix 2 – Checklist for rearing

- If possible aim for all-in all-out production systems ☐
- Consider acidification of feed/water post-weaning if all-in all-out is not achievable ☐
- Never move piglets from one house to another ☐
- Remove sick pigs promptly and place them in isolation sick pens ☐
- Group sick pigs and treat them in one pen ☐
- Avoid climbing into pens or stepping from one pen to another ☐
- Minimise environmental stressors. Check the temperature curve and minimise ventilation settings for newly weaned pigs ☐
- Pay particular attention to fly control ☐

Specific biosecurity measures to consider:

- Always use foot dips on entry to a room ☐
- Use foot dips if stepping into pens ☐
- Never bring older or sick pigs back into a clean flat-deck ☐
- Use designated clean equipment only ☐
- Flush through and sanitise water lines between batches ☐
- Avoid moving from finisher pens to weaner pens ☐

Appendix 3 – Checklist for grower/finisher

- Aim for all-in all-out production with effective cleaning and disinfection between batches ☐
- Do not mix batches ☐
- Avoid mixing pigs from different sources ☐
- Try to limit the number of different sources and keep groups in separate buildings wherever possible ☐
- Clean and disinfect header tanks – flush through and sanitise water lines between batches ☐
- Check dung consistency daily and alter feed specification to prevent looseness if necessary ☐

Straw based housing

- Keep pigs warm by making straw kennels or use a generous amount of straw bedding ☐
- Try to keep pigs from different sources separate, or at least on separate sides of kennel buildings with scraped passages ☐
- Ensure lying areas are kept clean and dry ☐
- Use plenty of bedding if wet areas appear ☐
- Work from the youngest group first, especially when scraping dung passages ☐
- Deter pigs from lying in water troughs ☐
- Do not allow bedding to become higher than drinkers ☐
- Do not allow feed/water hoppers to overrun ☐
- Depopulate buildings regularly and clean and disinfect thoroughly ☐

Specific biosecurity measures to consider:

Cover feed hoppers where possible to discourage birds and vermin ☐

Where possible use netting outside buildings, windows and ventilation openings to deter birds ☐

Remove bird nests and young ☐

Slatted floor housing

Keep the environment optimum for the time of year ☐

Prevent animals overheating and wallowing in their own dung ☐

Do not allow slurry to build up ☐

Avoid draughts that may cause scour ☐

Specific biosecurity measures to consider:

Keep walkways and the weighing area clean ☐

Clean and disinfect walkways on a weekly basis ☐

Appendix 4 – Checklist for outdoor production

- Source *Salmonella*-free breeding stock ☐
- Use feed from *Salmonella*-free suppliers ☐
- Do not distribute feed too widely. Feeding close to an electric fence could help discourage birds ☐
- Avoid the build up of scrap and old equipment that may harbour vermin ☐
- Rotate weaner huts and runs to fresh ground for every group, dry cleaning and disinfecting kennel surfaces ☐
- Leave kennels to dry for as long as possible before reoccupation ☐
- Clean and disinfect second hand equipment off site and allow several weeks before bringing it onto the unit ☐
- Clean contractor equipment, particularly if it has been used on other pig units ☐
- Have a washable loading bay sited away from pigs ☐
- Fit ad-lib feeders with flaps ☐
- Move arcs after each weaning onto clean ground and disinfect whenever possible ☐
- Site weaner arcs on new ground and try to avoid pig contact with any run-off from the previous location or near dungheaps ☐
- Remove and incinerate used bedding ☐
- Rotate sow paddocks regularly ☐
- Remove any carcasses promptly ☐

Specific biosecurity measures to consider:

- Clean wallow water troughs regularly ☐
- Clean and disinfect header tanks regularly ☐
- Deter birds from perching above drinking troughs ☐
- Bird proof weaner arcs wherever possible, especially at rear access hatches ☐
- Maintain rodent control through systematic and thorough baiting ☐
- Put in place fencing to keep badgers and foxes out of the unit ☐
- Keep straw away from livestock and use bait/traps to control vermin ☐

Appendix 5 – Legislative requirements for the welfare of pigs

The Protection of Animals Act 1911[6] , the Agriculture (Miscellaneous Provisions) Act 1968 and the Welfare of Farmed Animals (England) Regulations 2000 (S.I. 2000 No. 1870)[7], make it an offence to cause or allow unnecessary pain or distress to farm animals. The Code of Recommendations for the Welfare of Livestock: Pigs (2003) (Welfare of Farmed Animals (England) Regulations 2000 (S.I. 2000 No. 1870)) states that:

- Animals shall be fed a wholesome diet, appropriate to their species, and which is fed to them in sufficient quantity to maintain them in good health and to satisfy their nutritional needs and to promote a positive state of well-being.
- All pigs over two weeks of age must have permanent access to a sufficient quantity of fresh drinking water.
- Where necessary, sick or injured pigs shall be temporarily isolated in suitable accommodation with dry comfortable bedding.
- Pigs must be free to turn around without difficulty at all times. Their accommodation must be constructed as to allow each pig to stand up, lie down and rest without difficulty; accommodation must be clean, comfortable and adequately drained.
- Where bedding is provided, this must be clean, dry and not harmful to the pigs.
- Air circulation, dust levels, temperature, relative humidity and gas concentration in accommodation must be kept within limits which are not harmful to the animals.
- Animals not kept in buildings shall, where necessary and possible, be given protection from adverse weather conditions, predators and risks to their health and shall, at all times, have access to a well-drained lying area.

[6] In Northern Ireland, Welfare of Animals Act 1972.
[7] Welfare of Farmed Animals Regulations (Northern Ireland) 2000; Welfare of Farmed Animals (Wales) Regulations 2001; Welfare of Farmed Animals (Scotland) Regulations 2000 No. 442.

Further information

To order further copies of this or any other publications produced by the Food Standards Agency, contact FSA publications:

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Fax: 020 8867 3225

Email: foodstandards@ecgroup.uk.com

Posters

1. Rodents, wild birds and cats carry *Salmonella*
   A3 FSA/1158/0507
   A4 FSA/1159/0507
2. Farm hygiene and biosecurity can prevent *Salmonella* infection
   A3 FSA/1160/0507
   A4 FSA/1161/0507
3. All-in, all-out production can control cross-contamination between batches
   A3 FSA/1162/0507
   A4 FSA/1163/0507
4. *Salmonella* control starts with weaners
   A3 FSA/1164/0507
   A4 FSA/1165/0507
5. Pig health, feed and water can help control *Salmonella* infection
   A3 FSA/1166/0507
   A4 FSA/1167/0507
6. Serious about *Salmonella*
   A3 FSA/1168/0507
   A4 FSA/1169/0507

DVD

1. Serious about *Salmonella* – Back-to-Basics
   contact: vetpublichealth@foodstandards.gsi.gov.uk
2. Reducing Stress in Pigs
   contact: lynne.holmes@adas.co.uk

Useful publications

1. Code of Practice for the Prevention and Control of *Salmonella* on Pig Farms

Available online: www.defra.gov.uk/animalh/diseases/zoonoses/zoonoses_reports/pig.pdf

2. ZAP Annual Reports
3. ZAP Steering Group Meeting Summaries
4. ZAP Updates
5. *Salmonella* Action Plan Template
6. *Salmonella* Control Update and Action Plan

ZAP publications are available online:
www.bpex-zap.org.uk/zap/about/library.aspx

Useful web sites

Food Standards Agency –	www.food.gov.uk
	www.ukmeat.org
Department for Environment, Food and Rural Affairs –	www.defra.gov.uk
Scottish Executive –	www.scotland.gov.uk
National Assembly for Wales –	www.wales.gov.uk
National Assembly for Northern Ireland –	www.ni-executive.gov.uk
Agri-Food and Biosciences Institute –	www.afbini.org.uk
Department for Agriculture and Rural Development –	www.dardni.org.uk
British Pig Executive –	www.bpex.org
Quality Meat Scotland –	www.qmscotland.co.uk
National Pig Association –	www.npa-uk.org.uk
Pig Veterinary Society –	www.pigvetsoc.org.uk
Veterinary Laboratories Agency –	www.defra.gov.uk/coporate.vla
ADAS –	www.adas.co.uk
Health Protection Agency –	www.hpa.org.uk

Supporting organisations

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