



Pigs

Introduction

Domesticated pigs are derived from the Wild Boar (*Sus scrofa*) and still retain a number of characteristics of the biology and behaviour of this species. Pigs are also known as **swine** (in the USA) or **hogs**. Entire males are called **boars**. Females are called **gilts** until they have produced a litter, and **sows** after that.

The pig has proved particularly useful in scientific research. Many of its organ systems and physiological responses resemble those of humans, which make it a good model for human physiology and patho-physiology.

There are several different breeds of pig found in the UK, but they all belong to the same species (*Sus scrofa*) and therefore have similar biology (see **Appendix 1**) and will interbreed.

Pig Breeds

Commercial pigs: The vast majority of UK farm pigs are hybrids, produced by one of the several large pig breeding companies. Most hybrids are based on crosses of the Large White and the Landrace. The purebred Large White is distinguished by its large size, erect ears and slightly dished face. The Landrace was originally imported into Britain from Sweden in 1949. Known as the British Landrace, these are also white pigs, but distinguished by their floppy ears, which often cover their eyes.



Landrace



Large White

Commercial pigs in the UK are nearly all hybrids, mostly derived from a background of genetically improved Large White and Landrace crosses, but also including genetics from other breeds such as the Danish Duroc, the Pietrain, the Hampshire or the British Saddleback. These hybrids have superior fecundity, as well as improved conformation, growth rates and meat eating qualities, when compared to the original pure-breeds.

The hybrids are produced by a small number of commercial pig-breeding companies, which dominate the pig industry in the UK. They produce a variety of F1 hybrids, which are supplied to

“multiplier” farms, either owned by the company, or under their control, where the next (F2) generation is produced, for sale to commercial pig farmers. The commercial farmers will cross the F2 hybrid with a terminal sire (also produced by the breeding company) to produce the slaughter generation piglets for sale to the abattoir.

Miniature Pigs

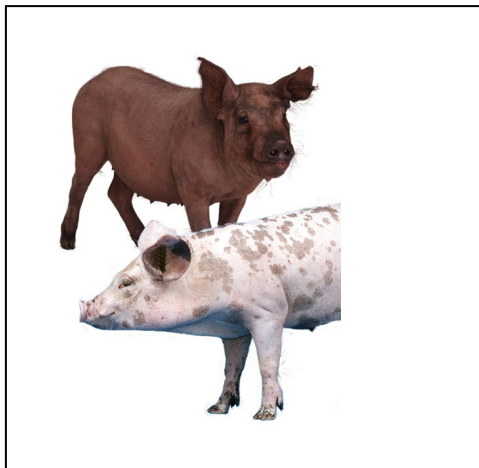
Also known as mini-pigs, these lines were originally developed by selecting and breeding from naturally occurring small pigs. These programmes took place in a number of different establishments in Europe, before they were introduced into the USA in the 1980s. They are particularly suitable for use in research because of their small size, their in-bred genetics, and their high health status. However, because they are inbred, their fertility and fecundity are much less than those of commercial pigs.

There are currently three breeds of mini-pig commonly used in research:

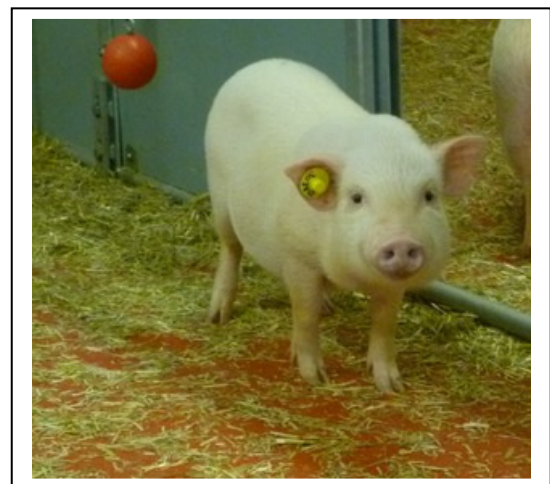
Yucatan Minipigs are a naturally occurring small breed of pig originating from Southern Mexico. They have been in-bred to produce two distinct lines, one with an adult bodyweight of around 40-50kg and the other 70kg. They generally have a dark skin with sparse haircoat.

Göttingen Minipigs were originally bred at the University of Göttingen (Germany) by crossing Minnesota pigs with the Vietnamese pot-bellied pig. These were then back-crossed with the German Landrace and selected for small body weight to produce a white miniature pig of adult bodyweight 35-40kg. Adult pigs weigh around 100kg.

Minnesota Minipigs were originally bred by the University of Minnesota. They are the largest of the mini pig breeds, with adult boars weighing approximately 150 kgs, and are less commonly used.



Yucatan mini-pigs



Göttingen mini-pig

There are also several other breeds of small pig found in the UK, and some of these have become increasingly popular as pets. They include the Vietnamese pot-bellied pig and the KuneKune.

Biology

In many respects, the pig resembles the human, which is what makes it a good model for many human conditions.

Skin and hair: Pigs have a thick layer of subcutaneous fat, which makes the skin relatively fixed to underlying tissues when compared to other species. There is usually only a sparse hair covering, although pigs reared outdoors will grow thicker coats.

Digestive system: Pigs are simple-stomached omnivores, with a digestive system similar to that of humans, although they retain a large caecum.

Reproductive system: Sows come into oestrus every 21 days from about 6 months of age (80kgs). The oestrous cycle continues throughout the year, unlike sheep and goats.

Young female sows (gilts) are first mated at 6-8 months of age (200-220 days of age – 100-125kgs bodyweight). Mating (service) may be naturally, by boar, or by artificial insemination (AI). Pig semen possesses the advantage that in suitable diluents, it will survive in the fresh state for up to 3 days. This has led to the major breeding companies developing AI centres to supply farms with fresh semen from high genetic merit boars on a daily basis. Frozen pig embryos are not viable, and so embryo transfer is not yet possible in this species.

Gestation length is 113-115 days and litters of 8-14 can be expected. Piglets remain on the dam for 28 days before weaning and the sow is re-mated at the first oestrus post-weaning (4-5 days).

Sows continue to breed throughout the year, most farrowing just over twice a year and producing an average of about 23 piglets / year.

The various breeds of 'miniature pigs' used in research have similar oestrus cycles and gestation lengths to other pigs, but generally come into puberty earlier than larger pigs, and produce considerably fewer piglets. The average litter size for Göttingen minipigs is 6 piglets (range 2 – 8 piglets).

Some normal biological values for pigs

	Commercial Hybrid	Yucatan
Adult weight of Large White sow	200-250kg	70-80kg
Adult weight of large White boar	300-350 kg	100 kg
Life span	15 years	8 years
Oestrous cycle	21 days (20-22)	20 days (19-21)
Gestation period	113-115 days	113-115 days
Litter size	8-14	4-6
Weight at birth	1.3kg	0.56kg
Weaning age	28 days	35-42 days
Age at sexual maturity	6-8 months	4 - 5 months
Blood volume	65ml/kg	
Temperature	38.6-39.2 ^o C	
Respiratory rate	12 – 16 / minute	
Heart rate	50 – 100 / minute	
Blood volume	65ml / kg	

Husbandry

Housing: In the UK, the majority of pigs are housed indoors throughout their life, although there are some large outdoor pig herds kept in certain areas of the country. The outdoor system of pig-keeping started in the 1950s in South Oxfordshire, and this remains the largest outdoor pig production area in the UK.

Sows and gilts are kept in groups, either on straw, or slats, or in stalls, or outdoors. In some countries, sows may be tethered, but this is no longer allowed in the UK. The use of sow stalls is also being phased out under welfare legislation. Outdoor sows normally have communal kennels for shelter and shade.

If kept indoors, the sows are confined in a farrowing pen or 'crate' for the perinatal period, to protect the piglets from crushing. Within the farrowing pen there is a 'safe area' for the piglets, with a heat lamp or pad to maintain the optimum temperature. This attracts them away from the sow, where they may be easily injured or killed by crushing when the sow lies down. Outdoor sows are provided with an "ark" in which they farrow and rear their litter until weaning.

Once the piglets are weaned from the sow they are moved to group pens with other litters (usually grouped by size). These pens are initially kept considerably warmer than adult accommodation (27-30°C for newly weaned, 21-24°C for 6 weeks old and older). Indoor pigs will be kept on straw or other bedding, or possibly on slatted floors. Piglets reared outdoors will have a roofed shelter with additional bedding and a heat source, as well as an outdoor run.

Temperature and Humidity: Pigs kept outdoors, will obviously be maintained at ambient temperature and humidity. Pigs kept indoors in enclosed conditions should have a room temperature within the HO recommended limits of 15-24°C.

The temperature selected will be determined by the age of the animal. Temperature regulation should ensure that there are no undue fluctuations beyond a bandwidth of 4°C. The room temperatures should be continuously monitored by instruments that are checked at least once daily.

Extremes in relative humidity can have adverse effects on the well being of animals and, by affecting the rate of heat loss, can influence activity and food intake. The RH in pig accommodation should be 55% +/-10%.

Ventilation: The ventilation of a controlled environment room is related to its stocking density and to the heat generated by the animals and equipment in the room. For pigs, 10-12 room changes may be adequate. A good indication of the effectiveness of the system will be absence of significant odour on first entering the room. It is important that the ventilation system ensures good air circulation without creating draughts.

Lighting: Ideally this should be natural, but in some secure accommodation this may not be possible. A 12:12, light:dark cycle is acceptable for farm animals. Interruptions of this cycle will affect the circadian rhythm, which may affect breeding and is generally undesirable.

Noise: If radios are used, they should be at low volume and must be turned off at night. The HO Code of Practice suggests that the general background level of noise in an empty animal room should be below 50 dB and free from distinct tonal content.

Stocking densities: The HO guidelines on pen dimensions for pigs are given below:

Bodyweight	Min floor area m ² Group housed	Min floor area m ² Single housed	Min feed rack/head in metres
<30 kgs	1.0	2.0	0.20
30-50 kgs	1.3	2.0	0.25
50- 100 kgs	2.0	3.0	0.30
100-150 kgs	2.7	4.0	0.35
>150 kgs	3.75	5.0	0.40
Adult boar	----	7.5	0.5

Group housing is to be preferred whenever possible. Pens should be free of projections that may present a hazard to animals and staff.

Feeding: Pigs are omnivorous, with a digestive system similar to humans. In the wild, pigs will eat a wide range of foods including roots, fruit, nuts, fungi, insects, small mammals and carrion. The majority of farmed pigs in the UK are fed on compounded, manufactured food, based on cereals. Pigs kept outdoors will also root for food in the ground. Those kept indoors will root in the bedding and consume some straw.

Specialist diets are available for each stage of pig production (piglet creep, grower ration, pregnant and lactating rations etc.). These will be balanced as complete feeds by the addition of a variety of other components, which may include fish meal, soya bean-meal, vitamins & mineral supplements. Many commercial diets for growing pigs used to contain antibiotics for growth promotion and disease prevention, but these are now banned in the UK, except for the treatment of disease under veterinary prescription.

Not only is it important to feed the correct rations but, unless the pigs are fed *ad libitum*, you must also ensure that there is adequate space for all of the animals in a pen to feed at the same time. This will help to avoid bullying at feeding time.

Water: Fresh water must be provided at all times. This may be from a trough, bowl drinker or nipple drinker.

Bedding: Pigs may be bedded on deep straw, wood chips, shavings or similar. If slatted floors are used, the design and finish must allow the animals to lie comfortably without injury to legs, feet or udder. If pigs are housed on concrete, as in controlled environment rooms, the flooring should be non-slip and mats should be used to protect pressure points.

Environmental enrichment: Pigs are gregarious, curious, social animals which live in groups. Within these groups, they establish a dominance hierarchy from early in life, and any subsequent mixing into different groups can result in fighting and threats until a new hierarchy is established. Generally, they respond very well to environmental enrichment, and playthings, such as balls, toys, tyres, straw bales etc. should always be provided in their pen.

Usually pigs are housed in groups of up to 15 or 20 animals. However, boars can be aggressive to other males and these are generally housed alone if kept indoors.

Personal Safety

1) Handling and restraint

Although trained animal attendants should always be available to give assistance, licence holders must be aware of the potential dangers when handling pigs and be aware of ways to reduce the risk of injury to themselves or the animals. It should be remembered that normally placid animals can sometimes become aggressive when ill, rearing young or subjected to rough handling, loud noises or sudden changes in environment.

Methods of handling and restraint of pigs will be demonstrated in the practical, and tuition given in basic techniques to allow the licence holder to feel confident in approaching and handling pigs.

The handling methods adopted should balance minimum effective restraint and least risk.

The following points must be considered:

1. Whenever possible ensure you have arranged for a competent animal attendant to be available to give assistance and advice on handling of any large animal.
2. Safety boots and protective clothing should be worn at all times.
3. Before entering any pen or room ensure that you have fully explained your intentions to the attendants and any particular way in which you may require the animals to be restrained and for how long.
4. Consider whether the use of a sedative would be beneficial to the animal, and/or the handler. Advice on their use should be obtained from the Named Veterinary Surgeon.
5. Always approach pigs slowly and with caution, noting any abnormal behaviour. Do not chase them, a practice that can soon lead to injury of staff or the animals, but restrict them into as small a space as possible before catching.

The greatest care should always be exercised when approaching and handling pigs. Larger boars can weigh 300kgs, and can be very dangerous. The teeth of adult sows and boars can inflict very serious wounds, usually to the legs of the handler, so the use of a "pig board" to protect against this risk is advisable.

Like humans, animals differ from one another in temperament and in response to activity in their immediate environment. Otherwise quiet animals may react violently or unpredictably when:

1. placed in strange surroundings;
2. separated from others;
3. frightened by sudden movement or strange objects;
4. they have been injured;
5. they are getting to their feet on slippery floors;
6. the nursing mother feels that the young are threatened. In particular, a squealing piglet may cause the sow to attack and bite the intruder. Note that a squealing piglet in another pen may upset an unrelated sow, provoking her to attack:
7. they have previously been roughly handled.

The presence of the attendant or other competent person is essential before an animal is approached. Make a careful note of the general terrain, *e.g.* whether there are bales or deep straw on the floor that could impair movement and cause tripping. Also, whether there are projections, such as water bowls, which could impede escape or cause injury if you were thrown against them. A slippery floor is an additional hazard often encountered.

Also let the animal become aware of your presence by talking to it. Approach cautiously and avoid causing undue excitement. Any animal may move around at first but be patient and deliberate in your movements, and be ready for retreat. Do not attempt to handle an animal without additional help.

Never step over any recumbent animal but always walk carefully round it. No matter how well you think you know an animal, always be alert to possible changes in behaviour.

Do not let frustration cause you to become impatient and abandon caution if an animal is persistently awkward. Any type of inconsiderate behaviour and possible loss of temper is an admission of failure which will only excite the animal and may make it more difficult for you to approach next time. Consider other methods of restraint or get more help.

2) Zoonotic diseases

A number of pig diseases are transmissible to humans, as follows:

- Salmonellosis, especially *Salmonella typhimurium*.
- E Coli including O157 strains
- Streptococcal meningitis
- Anthrax
- Erysipelas
- Ringworm (a fungal skin infection) (*Trichophyton and Microsporum* species)

Minor Procedures

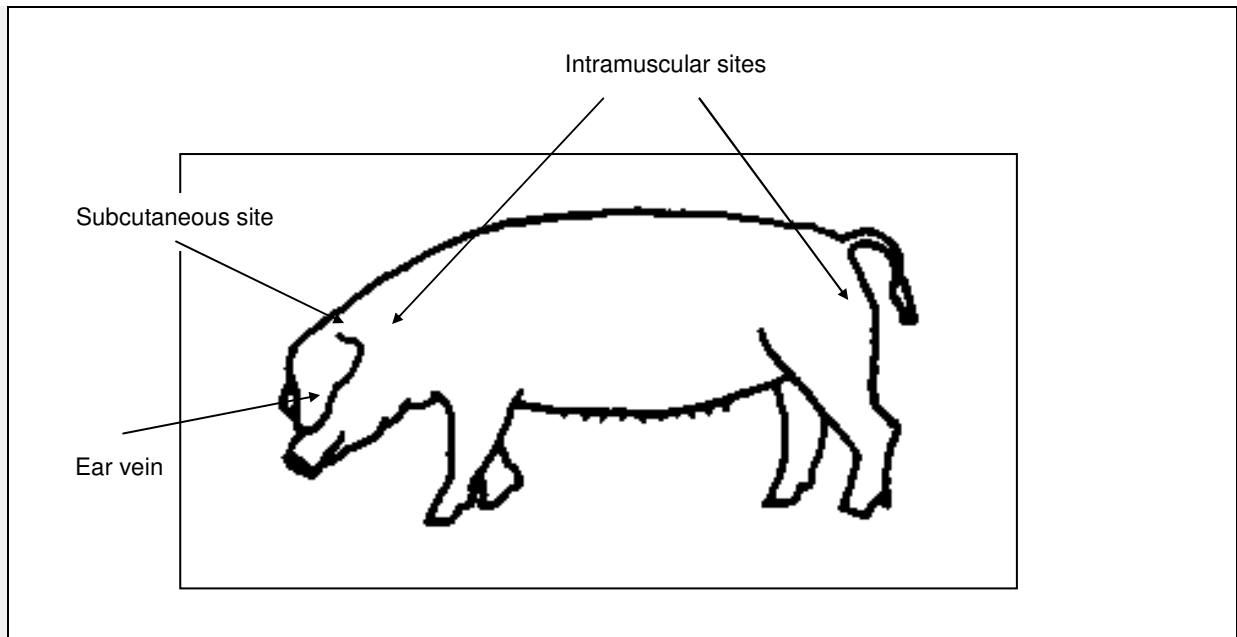
1) Restraint: Before attempting to carry out any procedure on a pig, ensure that it is suitably restrained using the assistance of one or more competent animal handlers. It is useful to remember that animals may frequently be more disturbed by inadequate or incorrect restraint than by the experimental procedure itself.

Pigs up to 25kg can be confined in a small space and picked up by holding a hind leg and supporting the weight under the belly. The pig can then be transferred to a trestle holding a trough, or if small enough, held in their arms by an attendant.

Sows or large pigs can be restrained in a crate, or held with a noose (known as a snatch) around the nose.

2) Identification: Pigs are normally identified by the use of a plastic ear tag, although microchips and tattooing can also be used.

3) Administration of substances: The inoculation sites and sampling techniques for pigs will be demonstrated during the practical session. The best site for subcutaneous injection is in the loose skin immediately behind the ear. Intramuscular injections can be given either in the neck muscles, or in the gluteal muscles of the hind leg. There are very few superficial veins suitable for intravenous injection. Virtually the only one available is the marginal ear vein, as the jugular lies buried beneath too much fat for accurate placement.



4) Blood sampling: The collection of a blood sample from a pig is not an easy task, due to the scarcity of easily accessible veins.

- a) **Marginal ear vein.** This vein is usually visible, especially in white pigs, but although it is possible to inject substances into it, it is less useful for the collection of a blood sample, as the vein tends to collapse onto the needle. Use EMLA cream as a local anaesthetic and a tourniquet at the base of the ear to raise the vein. May be used for samples up to 2-3 ml.
- b) **Jugular vein.** This vein cannot be raised in the pig (cf sheep and cattle), because it is buried under a thick layer of fat. To take a blood sample from the jugular, the pig is restrained by a snatch in the standing position, with the head raised, exposing the neck and the jugular furrow. The jugular vein lies deep in the jugular furrow, but it cannot be palpated or visualised. Sampling is therefore “blind” and training by experienced technicians will be necessary before this is attempted. The use of a syringe and needle is easier than a vacutainer.
- c) **Anterior vena cava.** In smaller pigs, (<15kgs) the pig may be restrained in dorsal recumbence in a trough and blood collected from the anterior vena cava. This technique is easier to carry out than sampling from the jugular, but requires a longer needle and can be hazardous to the pig. The needle puncture must be made “blind” into the area of the thoracic inlet, where a number of vital nerves and arteries lie.

Health and disease

Biosecurity: Pigs are not among the species listed in Schedule 2 of ASPA, which means that you do not have purchase them from HO designated sources, unless they are genetically altered. You may therefore purchase pigs from any source; direct from a commercial farm; from a dealer; or even from a market. Such animals will often be of unknown health status, so it is a case of “*caveat emptor*” – let the buyer beware.

Pig farms that are owned by breeding companies are usually bio-secure and well aware of the health status of their farms. Information about this can normally be obtained directly from the company. However, even with “high health” status herds, the disease picture is never static and disease breakdowns occur occasionally.

Unfortunately sub-clinical infections can often become clinical if the animal is stressed, for instance by transport, or changes in the management or environment. These are exactly the stresses imposed on conventionally reared farm animals that are purchased for use in research. An additional stress will also occur if animals from different sources are mixed together. Then, the different pathogens that each is carrying will inter-act. The effects of this are normally additive, resulting in an outbreak of clinical disease in the group a few days after mixing.

For these reasons, it is essential that every effort is made to purchase pigs from farms of known health status and to carry out confirmatory health checks prior to their use in a scientific procedure.

Disease history: Where possible obtain a full history of both the farm and the animal. Are any routine health screenings carried out? Does the farm belong to any voluntary animal health or farm assurance schemes? Are any routine vaccinations given? Has the animal had any illness or treatment?

Behaviour: A healthy pig should be alert, inquisitive and interact with others in the group (normal social behaviour). Inactivity and separation from others in the group is often the first sign that an animal is unwell. However, note that a normal pig will be awake and alert for many short periods for a total of about 12 hours out of 24, therefore it is quite normal to look into a room of pigs and see the entire group quietly lying around. It is important to watch their behaviour without disturbing them for a reasonable period and then assess the response when the pigs are disturbed. A sick pig may hide at the back of a group, lag behind when they are moved and when it stands may have an arched back and head and ears more drooped than normal.

Body condition: Assess the condition of the animal. Is it well-grown for its age? Does it have a healthy covering of fat over the dorsal spines of the backbone? There are systems for body condition “scoring”, grading between 1 (emaciated) to 5 (obese). A condition score of between 2.5 and 3.5 is normally considered desirable. The body condition of pigs can be usually be assessed relatively easily from a distance, but this can be more difficult in outdoor units.

Appearance of the coat / skin: The appearance of the skin can usually be easily assessed and any lesions seen in pigs, although this may be more difficult in darkly pigmented breeds.

Lesions to look for include wounds, erysipelas (often diamond shape lesions), ringworm (circular, crusting scabs), and evidence of tail-biting or hernias (umbilical or inguinal).

Gait and nervous symptoms: Animals should have a relaxed posture and normal gait, without lameness or ataxia. They should be able to rise from the lying position without difficulty. Note that pigs normally rise on their front legs first (the reverse of cattle and sheep). Pigs, especially large pigs or those kept on slats can be particularly prone to lameness. There should be no other nervous signs

– body tremors, circling, blindness or head tilt etc. Pigs can suffer from meningitis due to *Streptococcal* infections and are also prone to inner ear infections, leading to head tilt.

Respiratory system: When a pig is at rest, the respiratory movements should be hardly visible. If they are shallow and rapid or deep and laboured, then there is some degree of respiratory distress. This could be due to pain or disease, or to a combination of both. There should be no coughing or sneezing and the eyes should appear bright and clear, without discharges or swollen / closed eyelids.

Gastro-intestinal system: There should be no evidence of diarrhoea, which usually shows as staining of the tail and perineum. Blood in the faeces may be due to excessive straining, or to some of the more virulent infections, such as salmonella or swine dysentery (*Brachyspira*).

Temperature, respiration rate and heart rate: The normal values are given below:

Temperature	38.6 -39.2 ⁰ C
Respiratory rate	12-20/minute
Heart rate	50-100/minute

Colour of mucous membranes: The inner surface of the conjunctiva is a good place to look for this, although the inside of the mouth or the vulva can also be used.

The mucous membranes should normally be pink. Paleness may indicate anaemia; yellow discolouration (jaundice) is due to liver disease, redness may be local inflammation or a sign of systemic disease, whilst blue discolouration (cyanosis) usually indicates circulatory collapse.

Dehydration: If fluid loss, (due to diarrhoea, vomiting, urine, sweat and respiration), exceeds fluid intake, then the animal will become dehydrated. Evidence of this can be detected in the elasticity of the skin. If a fold of skin is pinched between the thumb and forefinger, it should return immediately to its former position when released. If it “tents”, then the animal is approximately 5% dehydrated. If dehydration approaches 10%, fluid is lost from the fat pad at the back of the eye and the eye appears to retract into the socket (sunken eye). This is a serious level of dehydration which is life threatening if it remains uncorrected.

Laboratory tests: Examples of such tests would be the examination of a rectal swab for salmonella; blood tests for specific disease antibodies; skin scrapes for ringworm or parasites such as the mange mite.

Some laboratory tests will be undertaken to establish freedom from disease in order to protect the health of the other animals in the unit, or the humans who come into contact with them. Other tests may be specifically to establish the health status of an animal prior to use on a procedure.

Common diseases of pigs

1) Notifiable diseases

Under the Animal Health Act 1981, a number of important diseases are designated as notifiable. The law requires that the existence, or the **suspicion** of existence, of a notifiable disease must immediately be reported to the police or to DEFRA. Various orders under the Act give extensive powers to the authorities to prevent certain diseases entering the UK (ie Swine Fever, Foot and Mouth); to eradicate diseases already present (ie Anthrax); or to control the spread of others (ie *Salmonellosis*).

Most of the notifiable diseases are potentially or actually of considerable economic significance to the UK livestock industry. The notifiable diseases are listed below, with those that are zoonoses marked in **bold**.

Anthrax	very rare in UK
Aujesky's disease	not in UK
Rabies	not in UK
Classical and African swine fever (CSF, ASFV).	not in UK
Swine vesicular disease (SVD)	not in UK
Foot and mouth disease (FMDV)	not in UK
Teschen disease (enterovirus)	not in UK

2) Other pig diseases

Piglets

Diarrhoea due to *E. coli*, *Clostridium perfringens*, Rotavirus.

Weaner pigs and older

Diarrhoea and Oedema Disease - *E.coli*

Meningitis - ***Streptococcus suis* type II**

Pneumonia - *Mycoplasma hyopneumonia*, *Actinobacillus*

Erysipelas – ***Erysipelothrix rhusiopathie***

Glasser's Disease - *Haemophilus parasuis*.

Ringworm – ***Trichophyton fungus***

PMWS (Post Weaning Multisystemic Wasting Syndrome) - Circovirus 2.

Swine Dysentery - *Brachyspira hyodysenteria*.

IA (Porcine Intestinal Adenomatosis) - *Lawsonia intracellularis*

Reproductive Failure

Parvovirus – infertility, stillbirths and mummification.

PRRS (Porcine Reproductive and Respiratory Syndrome)

All Ages

Lameness

Tail-biting

Anaesthesia and analgesia

1) Local anaesthesia

Although used widely in cattle and sheep, these are less widely used in the pig due to the restraint problems in this species. Nonetheless, there are preparations which may be useful. One of these is a topical cream (EMLA cream), which can be used over the ear vein before blood sampling. Other preparations include topical drops (onto the cornea) and spray formulations (onto mucous membranes). They may also be injected into tissues to provide local infiltration of an area, (around a wound). The most widely used preparations contain lignocaine.

Post-operative care can have a dramatic effect on the speed of recovery of a pig following surgery. The provision of pre-operative analgesia should be considered essential for this species.

1) General Anaesthesia

Pre-operative preparation

Before general anaesthesia is undertaken in any animal, there are some simple pre-operative procedures that should be carried out:

a) Acclimatisation: If the pig has been recently introduced to the unit, allow an acclimatisation period of at least 1 week, and preferably 2 weeks, before surgery. During this period the metabolic and hormonal changes caused by the stress of moving will return to normal.

b) Health check: Make sure that the pig is in good health. Carry out a clinical examination immediately before anaesthesia, checking cardiovascular and respiratory function.

c) Fasting: This is advisable with to prevent regurgitation of food during induction, in pigs usually 12 hours is sufficient.

d) Pre-medication: The use of certain drugs prior to anaesthesia may be useful.

Sedatives: Will help to reduce anxiety and aggressiveness in pigs prior to the induction of anaesthesia. Sedatives will also reduce the total dose of anaesthetic required and provide a smoother induction of anaesthesia. This is particularly important in pigs which can be very prone to stress and difficult to handle for induction.

Azaperone – (Stresnil, Janssen) is a butyrophenone neuroleptic sedative used in pigs for prevention and treatment of aggression, to reduce stress (ie when associated with transport and as pre-medication for both local and general anaesthesia).

Anticholinergic drugs: (Atropine) This may be used to reduce the volume of salivary and bronchial secretions, which might block airways, and also block the vaso-vagal reflex that causes slowing of the heart during surgical procedures).

Analgesics: Pigs are fairly vocal animals, and will usually let you know if they are in pain, although it can sometimes be difficult to tell if the noise is a normal response to restraint, rather than pain.

There are a number of analgesics that can be used to mitigate pain in pigs:

(i) Non-steroidal anti-inflammatory drugs (NSAID's): Some of the newer compounds are effective analgesics for mild to moderate pain in pigs. One NSAID licensed for use in pigs is **Ketoprofen** (Ketofen -Merial). Others that are not licensed but that have been used successfully are **Flunixin** (Finadyne – Schering-Plough) and **Carprofen** (Rimadyl – Pfizer).

(ii) Opioids: These are generally speaking more powerful analgesics than the NSAID's. However, their duration of action can be very short and their effects can vary considerably between the species. They must be used with care as they may also have respiratory depressant effects.

Buprenorphine, (Vetergesic or Temgesic) can be used in all species, but has a shorter persistence of action in pigs (< 4 hours) than in laboratory rodents, although this is still of longer duration than morphine or pethidine.

2) Anaesthetic agents

a) Injectable agents

These are best given intra-venously, but unfortunately there are relatively few superficial veins available for injection in the pig, the only practical one being the marginal ear vein. The following are the agents of choice:

1) Alphaxalone

Alphaxalone (Alfaxan) is not licensed for use in pigs, but is a safe anaesthetic in this species. It is rapidly metabolised and excreted via the liver, to give a quick recovery with few side effects. It should be given intravenously and will give approximately 20 minutes of surgical anaesthesia. This can be extended by incremental dosing without significantly increasing the recovery time. However, Alfaxan can prove expensive for heavier animals, although the use of a pre-medicant sedative will reduce the total dose required.

2) Ketamine and Medetomidine (or xylazine)

This combination does not provide full surgical anaesthesia, but may be used for restraint not involving painful procedures, or for endotracheal intubation. The major advantage is that the agents can be mixed in the same syringe and given by sub-cutaneous injection.

3) Propofol

Propofol (various trade names) is a short-acting anaesthetic giving 5-10 minutes anaesthesia, with very rapid recovery. Like alphaxalone, it must be given intravenously. It is most useful as an induction agent, where it may give long enough anaesthesia to allow endotracheal intubation. However, intubation in the pig is difficult and a longer-acting agent, such as alphaxalone, is usually more suitable.

b) Inhalation agents

The commonest volatile anaesthetic used is **isoflurane** (various trade names). Other more recent volatile anaesthetic agents (Sevoflurane, Desflurane), may have indications in specific procedures.

The induction of anaesthesia: It is not practical, or necessary to induce anaesthesia in pigs by inhalation of isoflurane via a mask. Normally, a short-acting injectable anaesthetic, such as Propofol or Alfaxan, is given intravenously to produce initial unconsciousness. An endotracheal tube is then

passed into the trachea and a low concentration of Isoflurane agent in oxygen is administered to maintain unconsciousness. To avoid the accidental inhalation of the exhaled gases by personnel, it is essential that these gases are scavenged from the room.

NOTE: The 'Halothane Gene' in Pigs - (Porcine Stress Syndrome)

This refers to a recessive gene carried by certain pig strains (particularly the Pietrain breed) which makes them susceptible to acute stress leading to sudden death with extensive muscle damage. It is called the halothane gene because it was originally identified that pigs carrying two copies of this gene developed this syndrome in response to halothane anaesthesia. Most commercial lines of pigs have been bred to eliminate this gene but it is still present in some other breeds.

Humane methods of killing

The methods listed under Schedule 1 to the Animals (Scientific Procedures) Act 1986 for the euthanasia of pigs are as follows:

Suitable for adult pigs

- Overdose of anaesthetic, using a route and an anaesthetic agent appropriate for the size and species.
- Destruction of the brain by a free bullet carried out by a veterinary surgeon
- Captive bolt, percussion or electrical stunning, followed by destruction of the brain or exsanguinations before return of consciousness. This technique must be carried out by a veterinary surgeon or by the holder of a current licence granted under the Welfare of animals (Slaughter or Killing) Regulations 1995.

Suitable for embryos

- Overdose of anaesthetic, using a route and an anaesthetic agent appropriate for the size and species.

Useful web sites

- <http://www.thepigsite.com> – Pig health, welfare, husbandry and disease information
- http://www.ahsc.arizona.edu/uac/notes/classes/farmmodels/farmanim_as_biomodels02.html#SWINE – Use of pigs in Biomedical Research – University of Arizona site.
- <http://www.defra.gov.uk/> - For information on importing and moving pigs, and also Notifiable disease information.