Review on farrowing housing and management

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1. Executive Summary

The review describes the species-specific biology of pigs during nest building, farrowing and lactation. The text highlights important behavioural and physiological needs of both sow and piglets that need to be considered to facilitate welfare of sow and piglets. Five important key areas challenging welfare of sows and/or piglets are highlighted, and threats for welfare are described based on scientific knowledge with links to literature for further reading. The five key areas are: space and freedom to move, comfortable climate, nest building and exploration, litter size and competition, and mutilations. For each of these key areas, animal- and/or resource-based indicators are described, helping to identify welfare issues. These indicators can be used to facilitate welfare inspections on farms. Later, the legislation within each key area is described, and practises that can improve the welfare on farms within each key area are suggested, also with links to scientific references for further reading.

2. Scientific knowledge on animal welfare at farrowing and lactation

To avoid unintended welfare problems in production, breeding, housing and management during and after farrowing, caretakers need to take the specific biology and behavioural needs of pigs into account.

Pigs are active animals who walk several kilometres daily to forage and explore their environment. Pigs live in social groups, except for a few days around farrowing. A few days prior to farrowing, sows isolate themselves and build a nest where they give birth to their offspring. Piglets are born with low energy reserves and poor ability to thermoregulate, thus survival depends on thermal protection from the nest. Sows show limited maternal care during birth, and piglets are born behaviourally mature in terms of being able to stand and reach the sow's udder within minutes after birth. Piglets are attracted to the udder by the warmth and smell of the udder. At birth, piglet survival strongly depends on fast ingestion of colostrum. Colostrum provides energy for body heat to protect piglets from hypothermia. In addition, colostrum is rich in immunoglobulins, protecting piglets against pathogens during the first weeks of life. The content of immunoglobulin in colostrum rapidly decreases, and already after 4 hours only 50% is left. Colostrum is only available continuously for the first 12-24 hours after which milk is provided approximately once per hour, each milk let-down lasting for 20 seconds. This nursing-suckling pattern of pigs is unique amongst mammals (Drake et al., 2008; Fraser, 1980). It is signalled by the sow through a specific vocalization pattern which attracts the pigs to their preferred teat. This enables piglets to be present and ready to ingest milk without wasting energy on competing over milk with litter mates. Within the first 24 hours of life, piglets gradually develop a stable teat order where each pig defends its ownership of a specific teat or pair of teats. The pattern allows an equal distribution of milk to all piglets within each nursing and reduces intra-litter competition. Sows respond quickly to piglet vocal signals by presenting the udder to allow pre-massage for milk let-down or by postural changes if piglets signal distress. Before lying down, sows perform pre-lying behaviour, intending to move piglets out of danger of being trapped under the sows body. Piglets stay in the nest with the sow for 4-8 days. Sows only leave the nest for eating, drinking, dunging and for wallowing (during hot periods). During the nest bound period, sows are highly attentive to their piglets, and frequent nose-nose contacts occur between sow and piglets.

Piglets learn to forage and eat solid feed facilitated by imitating sow foraging. The sow gradually weans the piglets by hindering udder massage and disrupting nursing bouts, which speeds up the weaning process. The weaning process starts slowly around 3-4 weeks of age, and, if circumstances allow, after 10-12 weeks piglets are weaned from sow milk. Under commercial conditions, the weaning is abrupt and takes place much earlier.

3. Key factors to focus on during welfare inspections in the farrowing unit

Based on the pigs' physiological and behavioural needs, five key areas regarding welfare of sows and piglets can be identified:

1. Space and freedom to move
2. Comfortable climate
3. Nest building and exploration
4. Litter size and competition
5. Mutilations.

For each of these key areas, animal- and/or resource-based indicators can be described, helping to identify welfare issues. These indicators can be used to facilitate welfare inspections on farms (**as indicated below using bold text**).

3.1 Space and freedom to move

The majority of sows within the EU and the rest of the world are kept in crates during farrowing and lactation. Sows are typically moved to a farrowing unit few days prior to farrowing and crated in a box close to the time of farrowing. They stay in the farrowing unit until the litter is weaned (typically 3-5 weeks after farrowing, depending on national legislation and/or label production). Most sows remain crated during farrowing and lactation without the possibility of turning around. The crate is positioned in a pen that typically measure 3.5-5 m^2. Space allowed for the sow inside the iron bars is around 2 m in length and 0.6-0.9 m in width. Crate size is regulated in some member states. Sows are crated to save space and provide easy manure handling through slatted floor. Crating protects the farmer from aggressive sows and is considered to reduce early piglet mortality although results from larger farm studies do not always confirm this (Pedersen et al., 2013a).

Crating, however, prevents sows from performing the majority of behavioural elements in their innate repertoire, resulting in frustration and stress. Nest building, turning around, exploration and other behaviours are not possible in a conventional farrowing crate. Stress inhibits hormones involved in the farrowing process and in the initiation of maternal behaviour and lactation. Therefore, crating increases the risk of prolonged farrowing and of piglets suffering from hypoxia at birth; a known risk factor for stillbirth and postnatal mortality of live-born piglets (Baxter et al., 2018; Yun and Valros, 2015).

Measurements of sow dimension (Moustsen et al., 2011) and space between the bars in commercial herds even suggest that the physical dimension of especially older sows can be both longer and wider than the space allowed within the bars (Pedersen et al., 2013a). Such severe space restriction impairs both resting posture as well as lying-down and getting-up movements. In addition, prolonged crating reduces bone and muscular strength as well as cardiovascular fitness, likely due to the prolonged lying and reduced activity. Crating has been associated with hoof and leg lesions and increased incidence of thickening of the skin (callosities) (Bonde et al., 2004). Insufficient space within the crate disturbed postural changes and increased time spent lying (Anil et al., 2002), which indirectly increases the risk of shoulder sores due to a positive correlation between lying time and risk of **shoulder sores** (Rolandsdotter et al., 2009). Insufficient space can easily be identified by space between the bars when sows permanently touch the bars to both sides. Further identification of the problem can be done by measuring sow dimensions and space inside the bars of the crate and comparing these. In addition to the physical dimension of the sow, **the space needs also to accommodate for sow postural changes**, suggested to be around 40-50 cm in both directions (forward/backward direction) and sideward direction (Pedersen et al., 2013a).

Limited space also affects the piglets, as they may not be able to find a thermally comfortable lying area. A typical litter size of 10-14 piglets at weaning takes up 1.1-1.3 m^2 when resting (Pedersen et al., 2013a). Accordingly, this is the floor surface which needs to be warm and solid to provide a thermally comfortable lying area for the entire litter where all piglets can rest together at one place. If not provided, piglets easily suffer from hypothermia. Insufficient space around the sow's udder during suckling also occurs, particularly in asymmetric pens where the distance between the udder and the inner wall of the farrowing pen is less than 50-60 cm (i.e. equal the body length of a 4-week-old piglet). Lack of space around the udder prevents piglets from getting access to their preferred teat, thus induces teat fighting and unstable teat order. Poor access to the udder can be assessed by measuring **the space to suckle**, i.e. the distance from the wall to the inner pipe of the crate. Signs of teat fighting and unstable teat order are increased **facial lesions**, **lesions on the joint** and poor growth of piglets. Severe teat fighting can result in **udder and teat injuries** of the sow. Space is also required for piglets to interact with litter mates and to learn social skills.

3.2 Comfortable climate

Sow and piglets have different thermo-neutral zones, thus the thermal climate inside the farrowing unit is a compromise between their different needs. Sows' thermo-neutral zone is around 16-20°C. The upper limit of the thermo-neutral zone (evaporative critical temperature) is the temperature at which sows increase respiration rate to lose heat through evaporation from lung tissues. At this temperature, the voluntary feed intake may drop (Black et al., 1993). The upper limit depends on management and housing factors which influence the sow's ability to thermoregulate (Prunier et al., 1997). One of these factors is crating which limits sows' ability to thermoregulate through behaviour, thus crated sows are particularly sensitive to **heat stress, shown by panting behaviour**. Also, large litters may lower this limit since sows need to produce large amounts of milk, thus feed intake and associated heat production are increased.

In contrast to the sow, the neonatal piglets are vulnerable to low ambient temperature. At the time of birth, piglets' lower critical ambient temperature is above 34°C (Berthon et al., 1993). Newborn piglets are particularly susceptible to hypothermia during the first critical hours of life. During this period, their capacity for heat production is poor due to lack of brown adipose tissue and low glycogen reserves (Herpin et al., 2002). A **room temperature** around 22-24°C, typical for farrowing accommodation, is below the thermo-neutral zone (34°C) of newborn piglets. Hypothermia at birth is common and is often the triggering factor for dying later of starvation, crushing and diseases (Pedersen et al., 2011). After the first critical day of life, piglets have a broader thermo-neutral zone. **Signs of hypothermia are huddling, shivering and pilo-erection** and poor growth, and the consequence is higher mortality (Berthon et al., 1994; Herpin et al., 2002).

3.3 Nest building and exploration

Sows have a strong motivation to build a nest, driven by hormonal changes prior to birth. Due to the internal control of nest building, sows are motivated to nest build even in environments where they cannot perform the behaviour and even with no substrates available. In pig production, the floor typically consists of fully slatted plastic, iron or concrete floor, or part of the floor underneath the sow is solid concrete. Due to the use of vacuum slurry systems, nest materials and bedding are not widely used. In such cases, sows redirect their behaviour towards the floor and pen fittings, including the feed trough and bars of the crate. Scientific literature shows clear evidence of frustration and stress when the performance of nest building is prevented both by crating and/or by lack of suitable nest materials (Algers and Uvnäs-Moberg, 2007; Yun and Valros, 2015).

Stress inhibits hormones responsible for the progress of farrowing and may thus lead to prolonged farrowing, risk of stillbirth, crushing and risk of farrowing-related diseases such as MMA/PDS (Mastitis Metritis and Agalactia syndrome/Postpartum Dysgalactiae Syndrome) (Yun and Valros, 2015). Farrowing-related diseases cause prolonged lying periods, being an important risk factor for the development of shoulder lesions (Rolandsdotter et al., 2009) and thus also for premature culling. Stress also inhibits hormones involved in the initiation of lactation and maternal behaviour (Yun and Valros, 2015).

A complete **nest built of materials like straw** provides thermal comfort and dries up the newborn piglets, preventing hypothermia and promoting piglets' growth (Westin et al., 2014; Bolhuis et al., 2018). In addition, a soft floor surface made of nest materials (such as straw, jute sacks or similar) also prevents fore-knee and sole lesions (Westin et al., 2014) and at the same time provides piglets with exploratory materials. As for nest materials and bedding, **exploratory materials** are scarce or lacking in pig production.

3.4 Litter size and competition

Genetic selection for large litters is an ongoing process aiming to increase the number of weaned piglets to benefit farmer economy and to reduce environmental impact by maximising the output per sow (Rutherford et al., 2013). As a consequence, litter size often outnumbers functional teats. Along with the increase in litter size, the mortality rate has also increased, likely due to a strong relation between litter size and mortality rate. In commercial herds using hyper-prolific genetic lines, mortality rate averages 20-25% of the total born piglets (Pedersen et al., 2013; Baxter and Edwards, 2018). Mortality rate can be kept low by a large management investment. However, cost of doing so is high in terms of labour cost, and welfare and health may be threatened and thus question the sustainability of the continuous increase in litter size.

Due to the unique nursing pattern of pigs (Drake et al., 2008; Fraser, 1980), piglets born in hyper-prolific litters have difficulties in maintaining a stable teat order. An unstable teat order results in teat competition associated with **teat lesions**, starvation and poor growth as well as increased prevalence of **facial lesions**

and risk of lesions on fore-knee/carpal joint (Prunier et al., 2010). Other side effects hyper-prolific litters are reduced piglet birth weight, increased likelihood of pigs suffering from IUGR (intra-uterine growth retardation), prolonged farrowing, reduced colostrum intake per piglet, lack of space and high metabolic load on the sow (Quiniou et al., 2002; Quesnel et al., 2012; Rutherford et al., 2013).

Low birth weight and growth-retarded piglets (runts) are vulnerable to most risk factors for **death**, such as stillbirth, hypothermia, starvation, crushing and disease (Pedersen et al., 2011). Therefore, large litter size is associated to high mortality rate as well as low weaning weight (Quiniou et al., 2002; Andersen et al., 2011; Pedersen et al., 2015).

Large litters are also associated with high risk of long farrowing, stillbirth and pain. Parturition is energy demanding, thus sows may suffer from uterine and maternal fatigue which may lead to dystocia. Dystocia is a risk factor for MMA/PDS and thus for piglet starvation and death (Mainau et al., 2010; Mainau and Manteca, 2011). Birth-induced hypoxia is induced by long birth duration and increases with decreasing birth weight (Malmkvist et al., 2006). Hypoxia increases the risk of death (Pedersen et al., 2011) and may also be related to brain damage, impaired behaviour and learning capacity in those surviving as shown in many species (Rutherford et al., 2013).

Colostrum is an important source of energy for new-born piglets and their only source of immunoglobulins during the first 3-4 weeks of life. The availability of colostrum is not affected by litter size. Therefore, piglets in large litters ingest less colostrum than piglets in smaller litters. Insufficient ingestion of immunoglobulin through colostrum results in low immune resistance and thus increased prevalence of disease and death (Quesnel et al., 2012).

In large litters, space is often not sufficient around the sow’s udder to allow piglets to suckle without difficulties and to rest together on a comfortable and warm surface away from the sow (Pedersen et al., 2013a). These problems are associated with poor growth and facial/fore-knee lesions as well as signs of cold stress (pilo-erection, shivering and lying pattern), respectively.

In addition, the requirements of lactating sows for nutrients and particularly for minerals are high with a large litter size due to increased milk production. Highly productive sows, particularly young animals, may have difficulties ingesting sufficient feed to match their milk production, which can lead to intense catabolism and mobilization of minerals from their bone stores. Such problems are associated with **poor body conditions (underconditioning)** and increased risk of fractures and hence of lameness, pain and culling. Particularly gilts and first-parity sows may be at risk since they still need minerals and nutrients for own growth (Prunier et al., 2010). These problems can be observed as sows with poor body condition, lameness and high culling rate.

3.5 Mutilations

Different mutilations of neonate piglets take place in the farrowing unit including **castration, teeth grinding and tail docking**. Teeth-grinding is practiced to reduce the negative consequences (facial lesions of piglets and teat/udder lesions of sows) of high intra-litter competition. Similarly, tail docking is performed to reduce the risk of tail biting caused by the build-up of multiple stressors in the pigs' environment, primarily post weaning.

These procedures are known to be associated with immediate pain and some prolonged pain. In addition, castration has been shown to enhance stress hormones and lactate (Prunier et al., 2005). Such practices are therefore detrimental to the welfare of pigs. In addition, pig welfare may also be at risk due to a change in behaviour as a response to pain (Herskin and Giminiani, 2018). Piglets suffering from pain will be more likely to be inactive and to hide and thus to miss milk let-down (Rault et al., 2011). Both problems increase the risk of starvation and crushing. Tissue damage, and herein risk of infection associated with mutilations, increases the risk of morbidity and mortality due to bleeding, septicaemia and trauma (Valros et al., 2004).

According to the Council Directive 2008/120/EC on the protection of pigs, neither teeth grinding nor tail docking may not be carried out routinely and thus other preventive measures need to be taken (see chapter 3).

4. Legal requirements related to pig welfare in the farrowing and lactation period

The specific requirements related to pig welfare in the farrowing and lactation period are laid down in Council Directives 98/58/EC and 2008/120/EC.

Council Directive 98/58/EC sets down general standards for animals kept for farming purposes. Article 4 states that *"Member States shall ensure that the conditions under which animals (other than fish, reptiles or amphibians) are bred or kept, having regard to their species and to their degree of development, adaptation and domestication, and to their physiological and ethological needs in accordance with established experience and scientific knowledge, comply with the provisions set out in the Annex."*

4.2 Space and freedom to move

There is no specific space allowance for farrowing pens except the general term in the Council Directive 2008/120/EC stating that "*The accommodation for pigs must be constructed in such a way as to allow the animals to: have access to a lying area physically and thermally comfortable as well as adequately drained and clean which; allows all the animals to lie at the same time; rest and get up normally. However, in the week before the expected farrowing time and during farrowing, sows and gilts can be kept out of the sight of conspecifics." {Annex I, Chapter I, point 3}."*. In addition, there are provisions for sows and gilts stating that "*An unobstructed area behind the sow or gilt must be available for the ease of natural or assisted farrowing.*" {Annex I, Chapter II, point B4}. Besides these regulations, it is stated for piglets that in "*Where a farrowing crate is used, the piglets must have sufficient space to be able to be suckled without difficulty."* {Annex I, Chapter II, point C2}.

4.3 Comfortable climate

According to Council Directive 2008/120/EC it is stated for piglets in the farrowing accommodation that *“A part of the total floor, sufficient to allow the animal to rest together at the same time, must be solid or covered with a mat, or be littered with straw or any other suitable material.”* {Annex I, Chapter II, point C1}.

4.4 Nestbuilding and exploration

The Council Directive 2008/120/EC states that “*In the week before the expected farrowing time sows and gilts must be given suitable nesting material in sufficient quantity unless it is not technically feasible for the slurry system used in the establishment.*” {Annex I , Chapter II, point B3}

For exploration “(...) *pigs must have permanent access to a sufficient quantity of material to enable proper investigation and manipulation activities, such as straw, hay, wood, sawdust, mushroom compost, peat or a mixture of such, which does not compromise the health of the animals.*” {Annex 1, Chapter I, point 4}

4.5 Litter size and competition

Breeding for large litters is not specifically mentioned in the Directive. However, breeding procedures for animals kept for farming purposes are regulated by Council Directive 98/58/EC. In the Annex, it is specified under paragraph 20 that “*Natural or artificial breeding or breeding procedures which cause or are likely to cause suffering or injury to any of the animals concerned must not be practised. This provision shall not preclude the use of certain procedures likely to cause minimal or momentary suffering or injury, or which might necessitate interventions which would not cause lasting injury, where these are allowed by national provisions.”* {Annex , point 20}

Furthermore, it is specified in paragraph 21 that *“No animal shall be kept for farming purposes unless it can reasonably be expected, on the basis of its genotype or phenotype, that it can be kept without detrimental effect on its health or welfare.”* {Annex , point 21}

For some of the practices applied to ensure survival in large litters, the EU Council Directive 2008/120/EC on weaning age may also be relevant stating that *“No piglets shall be weaned from the sow at less than 28 days of age unless the welfare or health of the dam or the piglet would otherwise be adversely affected. However, piglets may be weaned up to seven days earlier if they are moved into specialised housings which are emptied and thoroughly cleaned and disinfected before the introduction of a new group and which are separated from housings where sows are kept, in order to minimise the transmission of diseases to the piglets.”* {Annex I , Chapter II, point C3}

4.6 Mutilations (tail docking, reduction of corner teeth and castration)

According to Council Directive 2008/120/EC *"Neither tail docking nor reduction of corner teeth must be carried out routinely but only where there is evidence that injuries to sows' teats or to other pigs' ears or tails have occurred. Before carrying out these procedures, other measures shall be taken to prevent tail biting and other vices taking into account environment and stocking densities. For this reason inadequate environmental conditions or management systems must be changed."* {Annex I, Chapter 1, point 8}

Additionally: *"Any of the procedures described above shall only be carried out by a veterinarian or a person trained as provided in Article 6 and experienced in performing the applied techniques with appropriate means and under hygienic conditions. If castration or docking of tails is practised after the seventh day of life, it shall only be performed under anaesthetic and additional prolonged analgesia by a veterinarian." {Annex 1, Chapter I, point 8}*

5. Minimising welfare problems: improved practices

Risks can be considerably reduced if correct measures and practices are introduced. Improved practices are again structured around the five key areas described below.

5.1 Adequate space and freedom to move

Older and large sows are often both longer and wider than the dimensions of the crates. On farms where it is not possible to install pens for loose sows, it is necessary to have a certain amount of longer and wider crates installed to accommodate larger animals. If the standard crate used is only 200 cm long, it is likely that part of the sows are longer and thus there is a need to rebuild some crates, making them both longer (at least 220 cm long) and with side-adjustable bars behind the sow. Such crate design provides sows with slightly more space for resting and postural changes but does not allow full freedom to move.

A better option to provide more space is to use modified farrowing crates (Baxter et al., 2012) designed with the opportunity to open up the bars of the crate to allow sows to turn around after a period of crating typically for a few days around farrowing. Crating sows around farrowing is used both to protect the caretaker against aggressive sows and to protect new-born piglets from being crushed by less attentive sows. However, crating the sows before farrowing prevents them from performing nest building behaviour and from thermoregulate by behaviours. Thus, the full welfare potential of keeping sows loose will not be achieved.

Pens for loose-housed sows provide them with more space, freedom to move and with the opportunity to nest build and to perform behavioural thermoregulation. Well-designed pens are at least 6-7 m^2 with division of space into functional zones, opportunities to provide functional nest materials and design features to increase piglet viability and thus protect them from being crushed (Weber et al., 2009; Baxter et al., 2011, 2012; Pedersen et al., 2013; Bolhuis et al., 2018). Pens for loose housing in adequate size also provide more space for piglets to suckle undisturbed, which improves growth (Pedersen et al., 2011). Some studies have shown increased risk of crushing in litters of loose compared to crated sows, particularly in litters of hyper-prolific sows (Hales et al.,2014; Kobek-Kjeldager et al., 2019), while others have not (Weber et al., 2007).

5.2 Improving thermal comfort of sows and piglets

In order to reduce hypothermia of new-born piglets, special care needs to be given, particularly to smaller piglets immediately after birth. Supervision of farrowing combined with drying and warning piglets at birth reduces the risk of death (Andersen et al., 2009; Vasdal et al., 2011; Christison et al., 1997; Rosvold et al., 2017; Haukvik and Bøe, 2009). Placing heat lamps or radiant heaters behind the sow at the birth site in crates during farrowing also reduces risk of hypothermia and can thus aid to ensure survival of new-born piglets (Andersen and Pedersen, 2016). Similar positive effects on thermal comfort of the piglets can be achieved by providing jute sacks behind and beside the sow (Hoofs, 2017). During the first 24-48 hours after birth, piglets do not use a heated creep area, while after this period piglets may benefit from access to a heated creep area that provide a thermal comfortable resting area where piglets are protected from being crushed by the sow. Early attraction to the creep area are enhanced by eg. radiant heat lamps (Larsen et al., 2016), soft rubber mats, or provision of jute sacks on the floor (Bolhuis et al., 2018) A large difference in temperature between the creep area and the rest of the stable also increases the motivation of piglets to use the creep area for resting and, thus, reducing the risk of being crushed by the sow (Pedersen et al., 2013b).

In pens for loose-housed sows, risk of hypothermia can be reduced by heating the floor in the nest area during farrowing (Malmkvist et al., 2006). It is sufficient that the floor is heated during farrowing (Pedersen et al., 2013b), and turning off floor heating early after the end of farrowing reduces the risk of heat stress of the sow (Malmkvist et al., 2009, 2012). Provision of abundant straw is a highly efficient method to reduce hypothermia at birth and can be used in pens for loose sows with partly solid floor and a suitable slurry system (Westin et al., 2013). Straw – when clean and dry – is one of the best methods to dry and warm the piglet at birth (Pedersen et al., 2016), it prevents lesions on fore-knee and provides the sow with an optimal material for nest building (Westin et al., 2014, 2015b).

When sows are kept loose-housed, they are less susceptible to heat stress, since they can thermoregulate by seeking up a cooler floor surface, for example a slatted floor, and by wallowing in water taken from the drinker (Malmkvist et al., 2012). At high ambient temperature, snout coolers, chilled drinking water, cooled air, floor cooling and drip cooling have been shown to reduce heat stress in crated sows (Perin et al., 2016; Van Wagenberg et al., 2006; Biensen et al., 1996; Jeon et al. 2006; Cabezón et al., 2017). These methodologies have been shown to reduce signs of heat stress and to improve sow appetite, milk production and piglet growth.

5.3 Possibility for nest building and for piglets to explore

In crate systems, it is difficult to provide nesting materials, since loose materials easily get out of reach of the sow. Attaching a jute sack (Bolhuis et al., 2018), a straw rack, sisal rope and/or branches to the crate/pen fittings provides sows with some outlet for the motivation to nest build. Also, providing wood shavings, straw, shredded paper and newspaper in front of the sow stimulates nesting behaviour (Swan et al., 2018). Such materials can also serve as exploration material for piglets. However, the benefits for the sow in terms of reducing stress and providing stimulation of farrowing and the initiation of maternal behaviour have been shown not to be complete as long as the sow is in a crate (for example Yun et al., 2014; Bolhuis et al., 2018).

A best practise for allowing sows to nest build is to keep them loose in pens (Yun et al., 2014; Bolhuis et al., 2018) with a partly slatted floor and to provide them with either peat, chopped straw (Rosvold et al., 2019) and/or a jute sack (Bolhuis et al., 2018). Even more effect is achieved by providing abundant straw (Westin et al., 2013; 2015 a,b) up to the moment of farrowing. By matching chop length of the straw and sloth design, sows and piglets will press the straw through the slats during the next few days (Westin et al., 2013). After farrowing, a small amount of straw for piglets to explore can be offered. Use of a jute sack can also help guide piglets into the nest and thus reduce the risk of crushing (Bolhuis et al., 2018). This way, piglets will also be provided with optimal foraging material from birth onwards.

5.4 Managing litter size and reducing intra-litter competition

The most efficient way to reduce welfare problems related to large litter size is to use less prolific genotypes who can care for their own litters without intensive management input. Reducing litter size would also increase birth weight and thus result in better growth and increased survival (Baxter and Edwards, 2018; Prunier et al., 2010; Quiniou et al., 2002).

In large litters, it is essential to have high-skilled management input around farrowing and lactation to reduce the risk of mortality and welfare related to for example crushing and starvation. A sufficient energy supply during the final part of the pregnancy period and right until the farrowing is important in order to avoid fatigue of the sow (Feyera et al., 2018). Birth surveillance and assistance can reduce risk of dystocia, stillbirth and early death (Christison et al., 1997; Rosvold et al., 2017).

In order to provide colostrum to all piglets, split-suckling can be applied where the first half of a litter can be locked up after they have had colostrum for at least 2 hours while the second half then suckle colostrum for a similar period (Huser et al., 2015). Smaller pigs and IUGR piglets can also be fed colostrum or glucose injection (Engelsmann et al., 2019) at birth to ensure sufficient energy supply to initiate suckling.

Strategies to provide milk to surplus piglets of high prolific genotypes are necessary in order to reduce mortality. Strategies include the use of nurse sows (Baxter et al., 2013), rescue decks (Schmitt et al., 2019) and provision of milk supplements in drinking cups outside or inside the farrowing pen (Kobek-Kjeldager et al., 2019,). Rescue decks, however, are related to welfare problems (Schmitt et al., 2019), and it is questionable whether the practice complies with the EU Council Directive 2008/120/EC on weaning age, due to sow and piglets being separated earlier than stated as minimum weaning age.

5.5 Alternatives to mutilation (tail, teeth, testicles)

Best practices to reduce the need for tail docking, are through reducing the presence of known risk factors as described in the EU Commission staff working document (SWD, 2016)
Teeth-grinding may be necessary when sows are nursing a large litter in a small crate where high levels of competition are likely to occur. In order to reduce the need for teeth-grinding, litter size must be reduced and sufficient space for suckling provided to reduce competition for access to teats since this causes the problem (Kobek-Kjeldager et al. submitted). If teeth-grinding has to be performed, it is essential that the personnel are sufficiently instructed and do not grind too much of the teeth.

Methods for reducing pain and stress (fear) during surgical castration include providing anaesthesia prior to castration and additional prolonged analgesia. However, the effect of the analgesic compounds currently available is questionable. Also, applying anaesthesia (both general and local) in a farm setting is not unproblematic and can cause pain, stress and discomfort in itself. Immuno-castration is an alternative method for surgical castration only causing pain during injection of the vaccine when pigs are kept in the fattening unit (Nordquist et al., 2017; Rault et al., 2011).

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