Management strategies to reduce piglet pre-weaning mortality

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**Introduction**

Nowadays, swine production in Thailand has become more industrialized and the number of total born piglets per litter increase rapidly during the past decade. One of the most important factors to achieve a successful swine farming industry is to optimize farrowing management. The key success for intensive farrowing management include, among other factors, a proper farrowing supervision, farrowing intervention of sows with dystocia, care of newborn piglets and optimization of cross-fostering management. The swine genetics in Thailand is mostly imported from Europe, mainly from Denmark. Due to the improvement of genetic selection of high prolific sows in Europe (1), litter size in sows in commercial swine herds in Thailand has been dramatically improved during recent years (Figure 1). Therefore, farrowing management practices and care of newborn piglets are becoming a new focus of interest in the swine research area (2).

“Piglet pre-weaning mortality” is therefore becoming one of the most interesting reproductive components affecting productivity in swine industry. Fundamental knowledge concerning factors that influence piglet pre-weaning mortality are important to reduce production loss, to raise profits in commercial swine herds and, importantly, to improve animal welfare (3). The aims of this review was to summarize some of the important factors causing piglet pre-weaning mortality and to illustrate some management strategies to reduce piglet pre-weaning mortality under field conditions.

The mean piglet pre-weaning mortality rate in commercial swine herds worldwide varied from 10 to 20% (4-7). Base on some recent literatures (2-7), the mean piglet pre-weaning mortality rate is 12.9% in Europe, 9.4% in the Philippines, and 12.2% in Thailand. On the other hand, the mortality rate in the nursery and finishing phases usually reaches 2.6% and 2.5%, respectively. Considering these mortality values, reducing the piglet pre-weaning mortality from 11.5 to 9.0% in a farm with a mean of 13 live-born piglets per sow, would result in an increase of 65 kg of live body weight at slaughter per sow per year (2.30 litters/sow/year) (3).

On average, 50–80% of piglet deaths occur during the first week after birth, with the most critical period being the first 72 h of life (6). Many factors determine the incidence of piglet pre-weaning mortality under field conditions, including piglet birth weight, litter size, birth order, gender, parity, farrowing duration, maternal behavior, sow nutrition, and temperature (8-11). Thus, it is important for veterinarians to understand the causes underlying piglet pre-weaning mortality and to perform a multifactorial approach of piglet pre-weaning mortality in farm situations, to increase the number of healthy piglets at weaning.

Some current knowledge concerning important non-infectious causes of piglet pre-weaning mortality focusing on the main factors found under commercial conditions has been recently reviewed (3). Table 1 demonstrated some basic information on postpartum sows and their piglets parameters recently collected from a commercial swine herd in Thailand.

**Figure 1** Litter size at birth in a swine commercial herd in Thailand

**Piglet pre-weaning mortality**
Table 1 Descriptive statistics on some reproductive parameters in postpartum sows and piglets

<table>
<thead>
<tr>
<th>Variables</th>
<th>Means±SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sows (n=183)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gestation length (d)</td>
<td>114.9 ± 0.9</td>
<td>112–118</td>
</tr>
<tr>
<td>Parity number</td>
<td>2.5 ± 1.4</td>
<td>1–5</td>
</tr>
<tr>
<td>Backfat (mm)</td>
<td>15.2 ± 3.0</td>
<td>6–25</td>
</tr>
<tr>
<td>Farrowing duration (h)</td>
<td>4.6 ± 3.5</td>
<td>0.5–29</td>
</tr>
<tr>
<td>Total born</td>
<td>13.4 ± 3.3</td>
<td>4–20</td>
</tr>
<tr>
<td>Born alive</td>
<td>12.3 ± 3.0</td>
<td>3–18</td>
</tr>
<tr>
<td>Stillborn (%)</td>
<td>5.5 ± 7.7</td>
<td>0–50</td>
</tr>
<tr>
<td>Colostrum yield (kg)</td>
<td>3.03 ± 1.2</td>
<td>0.6–6.8</td>
</tr>
<tr>
<td>Piglets (n=2,395)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth interval (min)</td>
<td>20.7 ± 55.8</td>
<td>0–1,656</td>
</tr>
<tr>
<td>Body temp. 24 h (°C)</td>
<td>38.2 ± 1.0</td>
<td>30–41</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>1.43 ± 0.34</td>
<td>0.4–3.5</td>
</tr>
<tr>
<td>BW at 24 h (kg)</td>
<td>1.51 ± 0.36</td>
<td>0.4–2.8</td>
</tr>
<tr>
<td>Colostrum intake (g)</td>
<td>249 ± 153</td>
<td>0–984</td>
</tr>
</tbody>
</table>

Predisposing factors

Piglet pre-weaning mortality is a multifactorial process, the small size of piglets at birth, together with their low body energy storage and their immature immune system, make them prone to chilling, starving, or being crushed by the sow (3). In general, factors causing piglet pre-weaning mortality are usually classified into three major groups: piglet, sow and environmental factors (3).

Causes of piglet pre-weaning mortality

There is a general agreement that crushing is the principal cause of piglet pre-weaning death, with chilling and starvation as underlying causes (3, 11). In USA, Vaillancourt et al. (12) reported that the causes of the suckling piglets mortality included crushing (33.8%), low viability (29.7%), scours (12.2%), infection (8.1%), deformity (5.5%), and others (10.7%). Similarly, Koketsu et al. (6) found that crushing and a low viability of piglets at birth were the main causes of piglet pre-weaning mortality in Japan. In England, the cause of mortality of live-born piglets in 458 commercial herds was recorded and the results suggested that crushing is by far the major cause of death (3). Other minor non-infectious causes of death, such as congenital problems or savaging by the sow also exist.

Physiological background

At birth, piglets have to recover from the stress of birth, to cope with a decrease in ambient temperature, and to compete with their siblings. However, piglets are born physiologically and immunologically immature. Due to the epitheliochorial nature of the swine placenta, piglets need to receive a passive immunity supply, mainly from immunoglobulin G (IgG) in the colostrum (3). Piglets are also born with no brown adipose tissue, which is used for thermoregulation and are born wet with placental fluids and with a high surface/volume ratio, due to their small size. As a consequence, newborn piglets are prone to chilling and starvation. Hypothermia and deficits in energy intake are factors that further weaken the piglet and thus increase the risk of crushing by sows. As a result, piglet pre-weaning mortality, especially at early stages, is considered to be the outcome of complex interactions between the piglet, the sow and its environment, with crushing being the final act in a complex chain of events. The above-mentioned interactions make it difficult to establish single causes for piglet mortality, but inadequate colostrum intake might be the main factor that triggers early death in piglets due to undersupply of piglets with nutrients and immunoglobulins (3). In farm conditions, the assessment of pre-weaning deaths strongly depends on the farmer’s skills and observations. However, the practicalities of production and the multifactorial nature of piglet pre-weaning mortality limit the accuracy of identifying the underlying cause of death (3).

Factors causing piglet pre-weaning mortality

In general, factors that cause piglet pre-weaning mortality can be classified into 3 main groups: piglet, sow, and environmental factors (3).

Piglet factors. Piglet birth weight is the most important factor for survival and performance (7,12). Small piglets also have a reduced ability to maintain body temperature. Piglets with an individual birth weight of >1.8 kg had a survival rate of over 90%, whereas piglets with a BW of 700 g had a survival rate of only 33% (3). A reduced energy reserve in low birth weight piglets is one factor that explains the higher risk of death. Piglets with a low birth weight have a low body-mass index. Body-mass index is positively correlated with body muscle, glycogen storage and survival rate. Body weight strongly influences an important piglet survival indicator—thermoregulation ability. Within the first hours of life, thermoregulation is compromised in piglets because of evaporation of the placental fluids and consequent cooling. Susceptible piglets fail to recover from this initial temperature drop, and hypothermia affects the latency to suckle, leading to starvation, lethargy and to crushing by the sow (3).
Figure 2 Frequency distribution of farrowing duration in LY sows in a commercial swine herd in Thailand (n = 200)

Figure 3 Stillborn piglets (%) by birth order

Piglet vitality determines the capacity of a piglet to compete for a teat and to suckle (3,9). A high vitality piglet has been associated with an improved survival rate at 7 days and at 10 days of life, and has also been positively correlated with piglet growth and survival at weaning (9).

Intra-partum hypoxia is the main factor that influences piglet vitality by damaging the foetal central nervous system and lowering the capacity to compete for a teat and increasing the time interval between birth and first suckling, which can lead to hypothermia and starvation (3). Low piglet vitality score at birth has been associated to increased blood lactate level, blood partial pressure of CO₂, and reduced blood pH. Birth order (Figure 3) and posterior body presentation at birth are both factors that have been positively associated with intra-partum hypoxia and shown to be influencing piglets’ vitality. Uterine contractions in sows with a long farrowing duration also reduce the oxygenation of prenatal piglets, compromising their vitality, with a higher risk for piglets born later during farrowing. Recently, we determined the farrowing duration of sows in a commercial herd in Thailand. It was found that up to 31% of sows tended to have a relatively long duration of farrowing (Figure 2). This indicate the risk of uterine inertia and low vital piglets at birth. Thus, research on postpartum management should be focused. In our recent work, the risk of being stillborn piglets increased as birth order increased especially the piglets born after birth order above 9 piglets (Figure 3). Thus, care of newborn piglets should be raised in the piglets born during the last period of farrowing.

Sow factors. Important sow factors influencing piglet pre-weaning mortality included colostrum production, stress, sow nutrition and the control of parturition process. “Colostrum” is defined as the first milk secreted by the mammary gland, which sows continuously secrete from around farrowing up to 12–24 h (3). Colostrum is a rich source of digestible nutrients and various bioactive compounds e.g., immunoglobulins, hydrolytic enzymes, hormones, and growth factors, thus, it plays a key role in piglet thermoregulation, the acquisition of passive immunity and intestinal development. Accordingly, rectal piglet temperature at 24 h of age is positively correlated with colostrum intake and is negatively correlated with the time interval between birth and first suckling (3). The primary protein component of colostrum consists of IgG, IgM, and IgA. IgG is the most common bioactive compound in colostrum and is at its highest concentration in the first few hours postpartum and decreases rapidly within 24 h. As has been previously mentioned, piglets need to receive passive immunity from IgG in colostrum to reduce susceptibility to infection in the immediate postnatal period and also after weaning (3).

The peri-partum period (from 4 days before and up to 3 days after farrowing) is a sensitive period in piglet production. The parturition process starts a few days before farrowing. During this period, sows might be stressed due to the new environment in the farrowing pen and due to the parturition process. Stress during the farrowing period increases the duration of farrowing and decreases colostrum production, thus reducing the energy and IgG supply to piglets. The stress of farrowing can also affect the behaviour of the sow and lead to restlessness and even to aggressiveness, which increases the risk of crushing piglets and prevents suckling

Figure 4 Percentage of sows farrowed during working hours (7 AM – 5 PM) in sows naturally farrowing and those induced farrowing using PGF2α or PGF2α in combination with carbetocin

Sow nutrient provision play an important role in piglet pre-weaning mortality due to its influence in foetuses development during pregnancy, with direct impact on piglets’ birth weight and vitality. Therefore, dietary supplementation in pregnant and lactating sows to reduce piglet pre-weaning mortality and enhance piglet growth have been intensively investigated during recent years (3).
Gestation length and time of farrowing are highly variable among sows, and majority of sows farrow at night, farrowing supervision is therefore difficult in commercial conditions. Hence, both natural and synthetic PGF2α are commonly used in breeding herds worldwide for both to induce and to control the onset of the parturition in sows. Once the farrowing time can be synchronized and predicted, the peri- and post-partum management of sows becomes easier. Furthermore, care of the newborn piglets and cross-fostering can be performed properly and more efficiently, reducing the risk of neonatal mortality. In our recent study, induction of parturition by using PGF2α in combination with carbetocin at 24 h later increased the proportion of sows that farrowed during the working hours (Figure 3). However, piglets born after induction of parturition using PGF2α in combination with carbetocin tended to have a lower colostrum intake compared to piglets born from sows that farrowed naturally or sows induced farrowing using PGF2α alone. Thus, despite farrowing induction combining PGF2α and carbetocin successfully concentrates farrowings during working hours, it should be only performed if a proper neonatal care to ensure a proper colostrum intake can be guaranteed.

Conclusions
Piglet pre-weaning mortality is a serious and important welfare and economic problem of great concern in swine production. Although it is well established that piglet birth weight is the main factor that influences piglet survival and growth, piglet pre-weaning mortality has a multifactorial aetiology and is influenced by different factors. Through understanding and knowledge of the different causes and factors that influence piglet pre-weaning mortality, we can therefore reduce piglet pre-weaning mortality by nutritional intervention or management strategies of farm conditions. As observed, it is important for veterinarians and producers to understand and properly diagnose the factors that influence piglet pre-weaning mortality on their farms, in order to develop an efficient intervention protocol. Furthermore, for the implementation of successful farrowing management, a well-educated labor for taking care of both the post-partum sows and the newborn piglets are required.

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