Piglet Survival: New thinking for an old problem

Emma Baxter

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Background

How can we reduce piglet mortality?

- Look at the causes
  - Check accuracy in all farrowing systems
- Identify the pre-disposing events to mortality
- Identify the individual risk factors associated with mortality
  - In all farrowing environments
- Target these risk factors
  - Short-term/Immediate interventions
  - Long-term breeding goals

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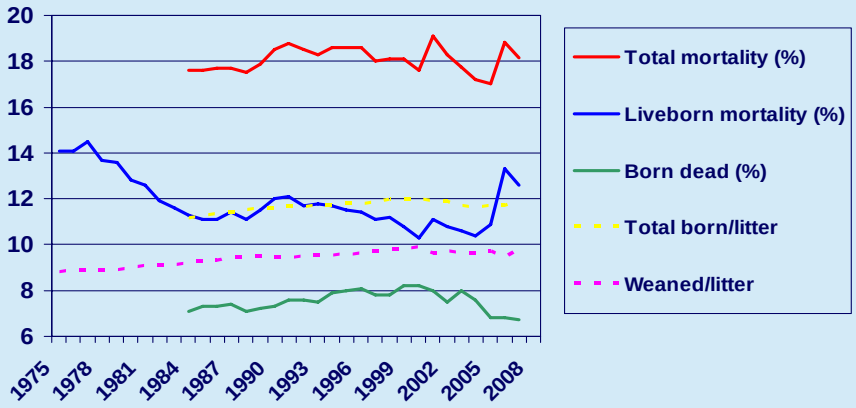
TRENDS IN PIGLET MORTALITY (UK Pigplan herds)

~ 2 million piglets dies each year in the UK



Edwards, 2008

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What are the causes of pre-weaning mortality?

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Causes of mortality

- Crushing thought to be the main cause
- Misdiagnosis is common
  - 42% incorrectly attributed to stillbirths *(Edwards et al. 1994)*
  - 32% incorrectly attributed to crushing *(Vaillicourt et al. 1990)*
- Causes differ between indoor and outdoor systems

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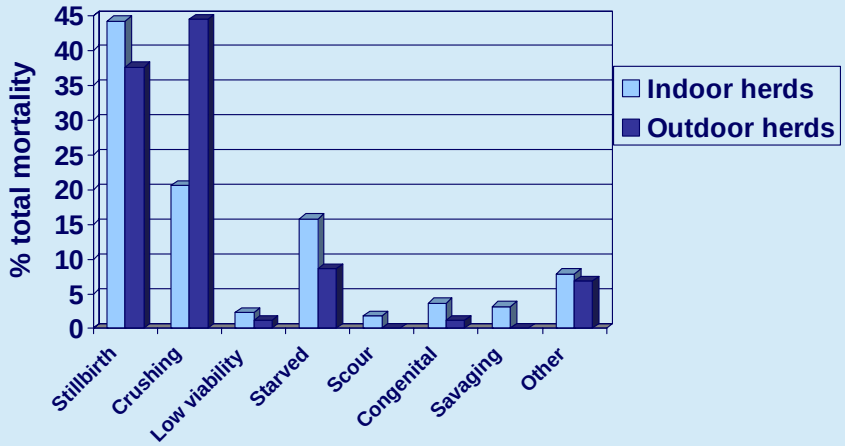
Causes of mortality (Riart et al., 2000)

From post-mortem examination



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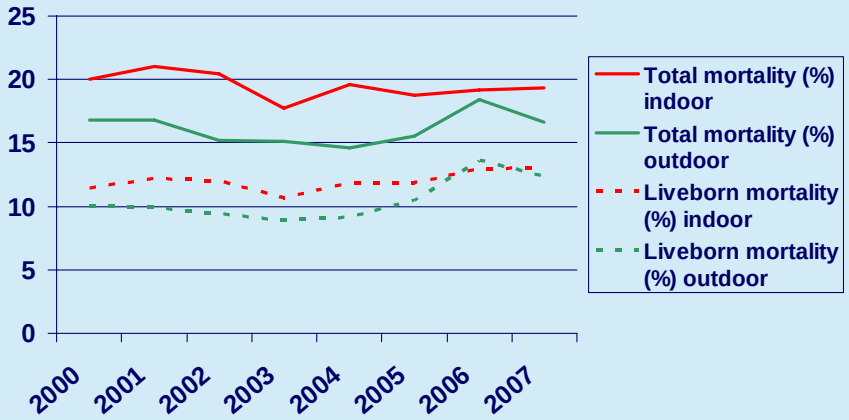
Indoor and Outdoor survival

Total mortality INDOOR = 19.5%, OUTDOOR = 16.2%



Edwards 2008

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Stillbirths

- Two types of stillbirth
  - Type I = Pre-partum/Ante-partum (“Mummies”)
    - Reason – intrauterine infections
  - Type II = Intra-partum
    - Reason – non-infectious aetiologies

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What predisposes a piglet to be stillborn?

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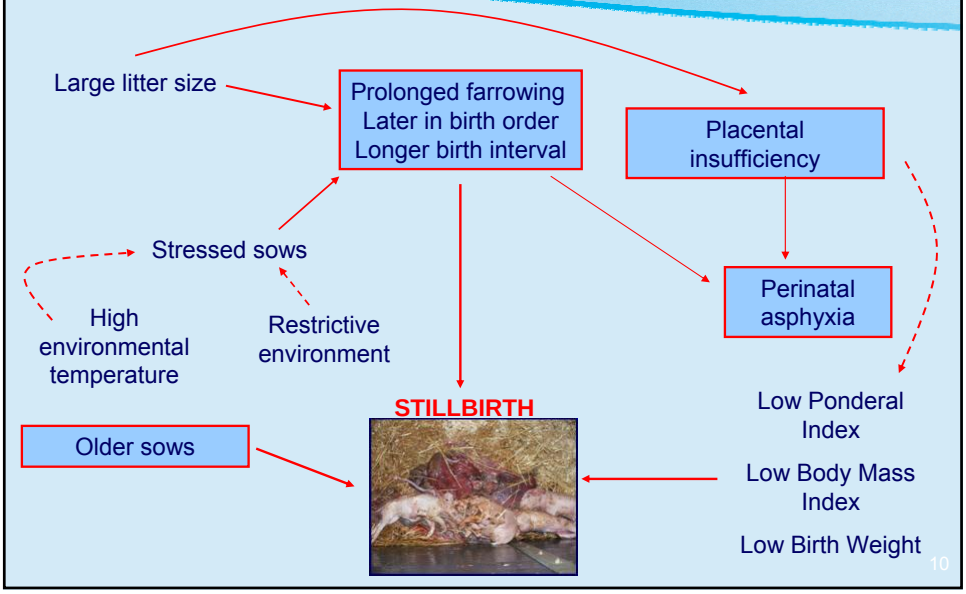
What are the predisposing events of type II stillbirth?



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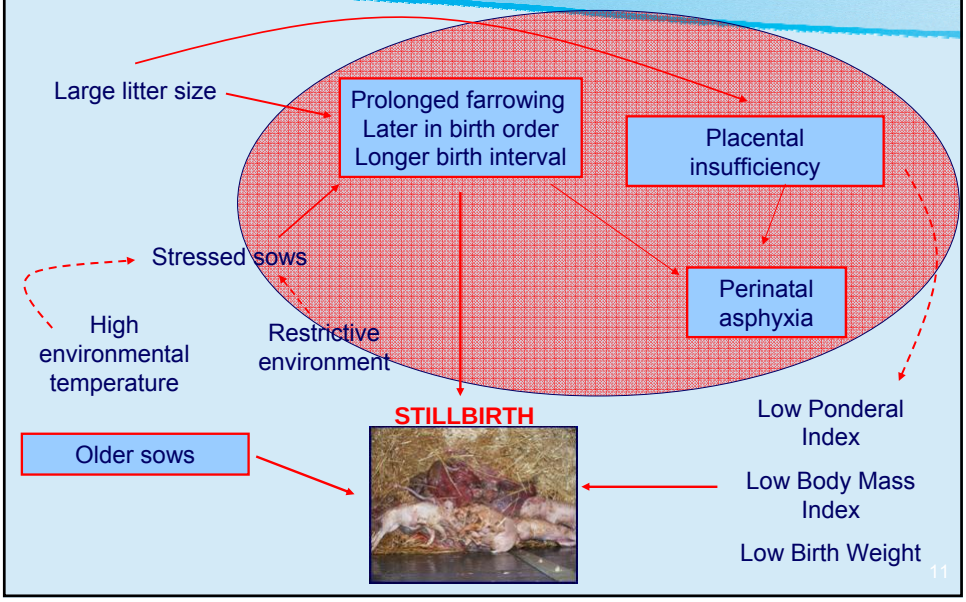
What are the predisposing events of type II stillbirth?



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Results

(Baxter et al.)

Survives

Body conformation
- Higher Birth Weight (1520g)
- Shorter Crown-rump length (27cm)
- Higher Ponderal Index (76)
- Higher Body Mass Index (20)
- Larger Abdominal circumference (27cm)

Prenatal environment
- Higher Placental Efficiency (6.48)

Farrowing kinetics
- Earlier in Birth Order (7)

Stillborn

Body conformation
- Lower Birth Weight (1330g) *
- Longer Crown-rump length (28cm) *
- Lower Ponderal Index (58) ***
- Lower Body Mass Index (16) ***
- Smaller Abdominal circumference (24cm) ***

Prenatal environment
- Lower Placental Efficiency (6.00) *

Farrowing kinetics
- Later in Birth Order (9) ***

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What are the most important prenatal survival ind

- Ponderal index (PI)- birth weight/crown-rump^3
  In human literature considered a better predictor of morbidity and mortality than birth weight (Fay et al., 1991). Measure of soft tissue growth - Does shape matter?
- Body Mass Index (BMI) - birth weight/crown-rump^2
  A measure of fat covering

Stillborn piglets were disproportionately long and thin (low PI and BMI) – can be a sign of intra-uterine growth retardation (IUGR)

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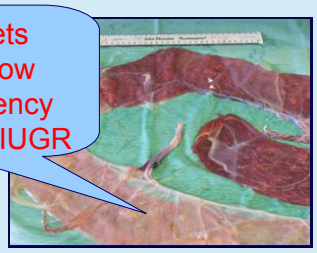
Stillborn piglets were disproportionately long and thin (low PI and BMI) – can be a sign of intra-uterine growth retardation (IUGR)

Stillborn piglets experienced low placental efficiency → could lead to IUGR



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What are the most important prenatal survival indicators?

- Ponderal index (PI)- birth weight/crown-rump^3
  In human literature considered a better predictor of morbidity and mortality than birth weight (Fay et al., 1991).
  Measure of soft tissue growth - Does shape matter?
- Body Mass Index (BMI) - birth weight/crown-rump^2
  A measure of fat covering
- Good uterine environment (placenta) is crucial
- Farrowing progression is important
  - Stillborn piglets were born later in the birth order

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Results
(Baxter et al.)

Survives

Stillborn

Body conformation
- Higher Birth Weight (1520g)
- Shorter Crown-rump length (27cm)
- Higher Ponderal Index
- Higher Body Mass Index
- Larger Abdominal circumference (27cm)

Prenatal
- Higher

Farrowing kinetics
- Earlier in Birth Order

Body conformation
- Lower Birth Weight (1330g) *
- Longer Crown-rump length (28cm) *
- Lower Ponderal Index
- Lower Body Mass Index
- Smaller Abdominal circumference (24cm) ***

Farrowing kinetics
- Later in Birth Order

Prenatal survival indicators are the same in farrowing crate and outdoor environments

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So what? How can we reduce stillbirths?

Immediate

- Improve gestational environment for piglets
  - Optimum nutrition
- Improve farrowing progression
  - Decrease stress in sow
    - Ambient temp no higher than 20°C
    - Give substrate for nesting ⇨improve nesting behaviour, quicker farrowing

Long-term

- Genetic selection strategy
  - Increase placental efficiency
    - ⇨ Decrease IUGR
    - ⇨ Increase PI and BMI
  - Increase physiological maturity at birth
    - Cf. Meishans
  - Select for optimum weight + decrease within-litter variability

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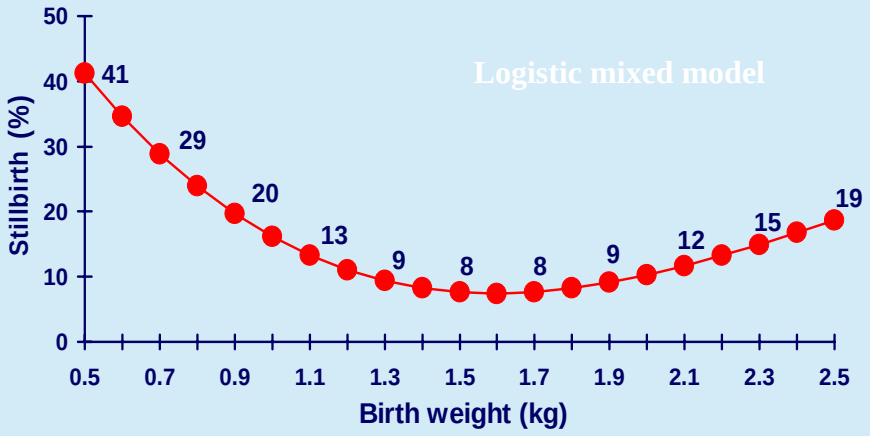
Risk of stillbirth associated with birth weight



Roehe, 2003

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What predisposes live-born mortality?

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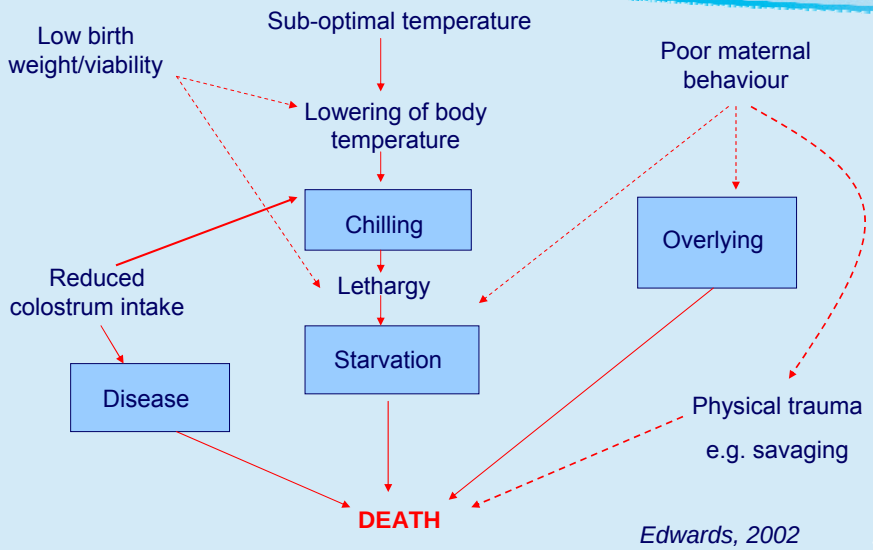
Events pre-disposing postnatal mortality



Edwards, 2002

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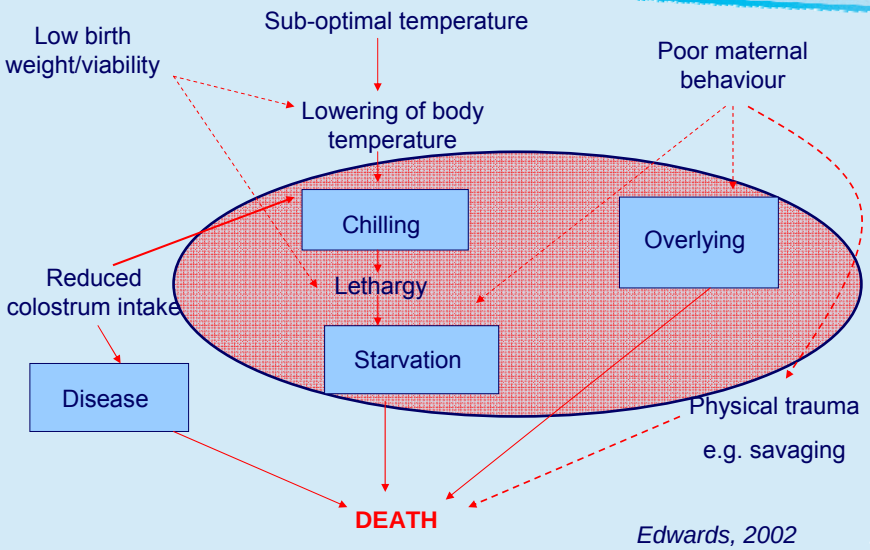
Events pre-disposing postnatal mortality



Edwards, 2002

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Results – Piglet factors

(Baxter et al.)

Survives	Vs.	**Dies pre-weaning**	
Physiology		**Physiology**	
Higher Birth Weight (1520g)		Lower Birth Weight (1289g)	***
Higher 24h Weight (1628g)		Lower 24h Weight (1326g)	***
Higher Birth Temp (37.74ºC)		Lower Birth Temp (37.13 ºC)	***
Higher 2h Temp (38.00ºC)		Lower 2h Temp (37.57 ºC)	**
Higher 24h Temp (38.55ºC)		Lower 24h Temp (37.56 ºC)	***
Behaviour		**Behaviour**	
Quicker to udder (17mins)		Slower to udder (25mins)	*
Quicker to teat (24mins)		Slower to teat (38mins)	***
Quicker to suckle (33mins)		Slower to suckle (51mins)	***
Vigour		*Vigour*	
Higher vitality score (2.28)		*Lower vitality score (1.77)*	*
Higher rooting response (1.42m)		*Lower rooting response (0.47m)*	***

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Piglet physiology

Birth weight

- Weight is considered to be an important factor for piglet survival (Kerr and Cameron, 1995, Roehe and Kalm, 2000, Knol et al., 2002)

- Narrow breeding goals have had negative effects on individual birth weight
  - E.g. Increasing litter size:
    - ➢ Increased mortality
    - ➢ Increased heterogeneity of litter

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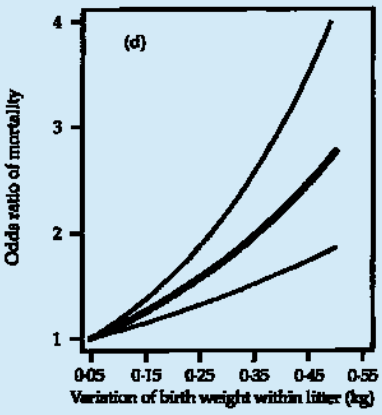
Piglet physiology

- Increased risk of mortality with increased within litter birth weight variation (Roehe & Kalm 2000)



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So what?
How can we improve piglet birth weight?

Immediate

- Improve piglet birth weight
  - Optimum nutrition during gestation and lactation
    - Maintaining high feed intake during lactation influences immediate litter growth rate and survival and influences subsequent litter

Long-term

- Genetic selection strategies
  - Select for optimum weight
  - Select for reduced within-litter weight variability

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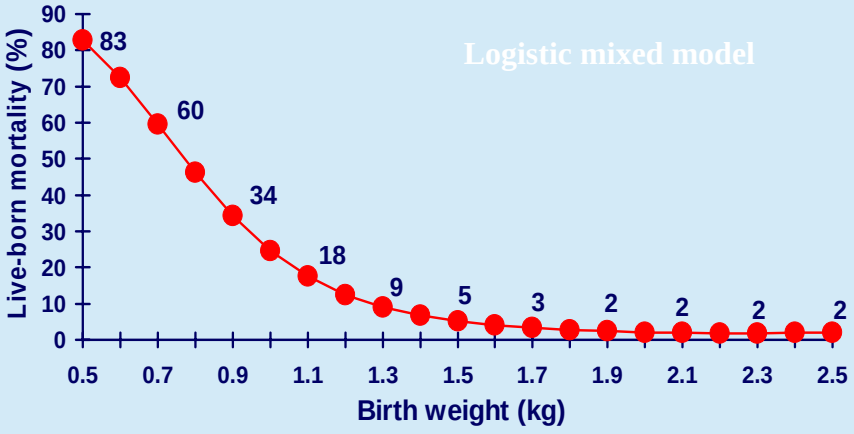
Risk of live-born mortality of piglets associated with birth weight



Source: ROEHE and KALM (2000)

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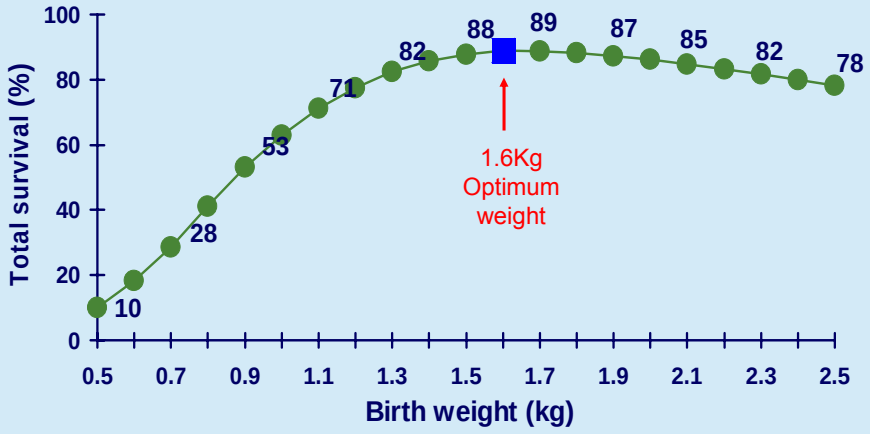
Total survival curve depending on individual birth weight



Roehe 2003

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Implications

- Optimum size and shape
  - Reduce stillbirths and live-born mortality
- Homogeneous litters
  - Reduce “giants” and “runts”
  - Reduce unfair competition at udder

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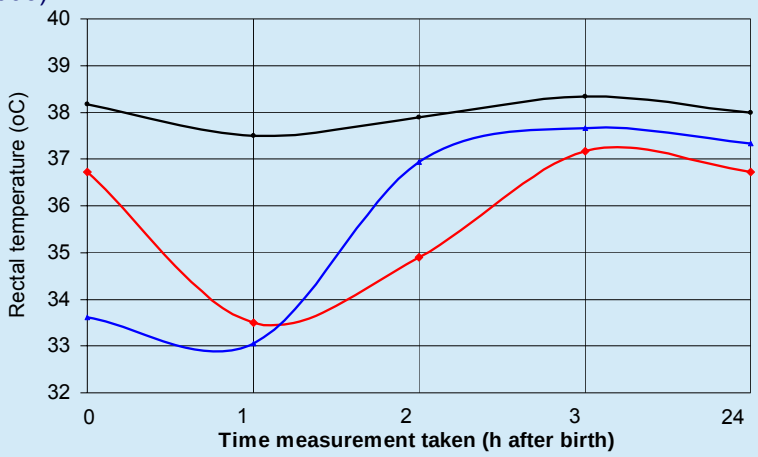
Piglet physiology - Thermoregulation

Rectal temperature

Piglet is the most cold sensitive livestock neonate (Herpin & Le Dividich, 1995) born with very little adipose tissue and no brown fat (Herpin et al. 1993)



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Thermoregulation -

Newborn piglet born into a farrowing environment with no substrate on a concrete floor

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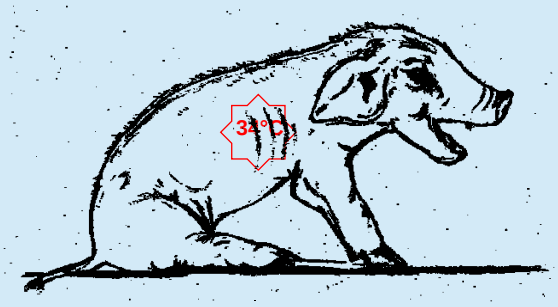
Thermoregulation



Thermal neutral temperature = 34°C (Mount, 1968)

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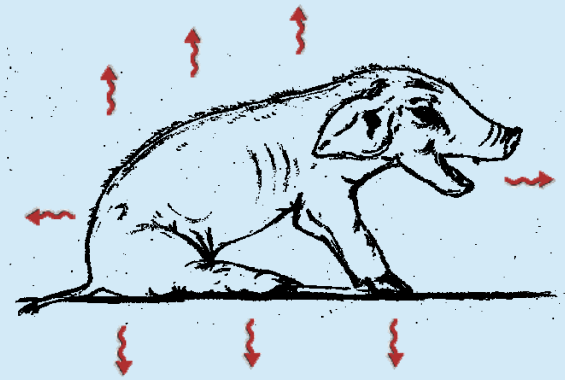
Thermoregulation

20°C



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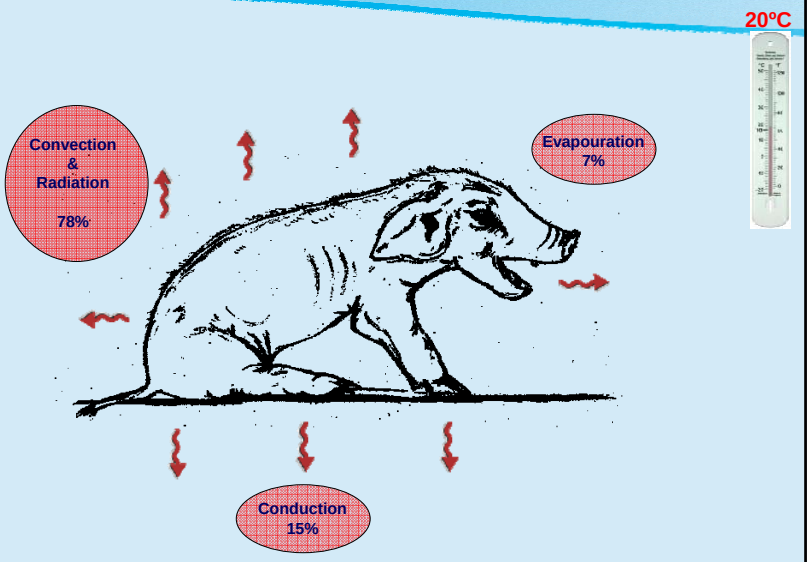
Thermoregulation



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So what? How can we improve piglet thermoregulation?

Immediate

- Improve piglet micro-climate (cf. outdoor study)
  - Limit routes of heat loss
- Improve piglet birth weight
  - Optimum nutrition during gestation and lactation
    - Birth rectal temperature correlates with birth weight

Long-term

- Genetic selection strategies
  - Select for physiological maturity at birth
  - ⇨Increased vitality
  - ⇨Improve first time behaviours
    - Correlates with thermoregulation

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Piglet behaviour

Behavioural Landmarks

- Piglet is neither altricial nor precocial (Nowak 2000)
  - Physiologically immature
  - Behaviourally mature
- Piglets that are quicker to reach the udder, find a teat and suckle are more likely to survive (Tuchscherer et al. 2000; Herpin et al. 2001; Baxter et al. 2008)

Neonatal viability

- Damage to the foetal central nervous system (CNS) can impair sucking and locomotor activities in pigs and impairs thermoregulation in the neonate (Herpin et al., 1996; Stanton et al., 1973).

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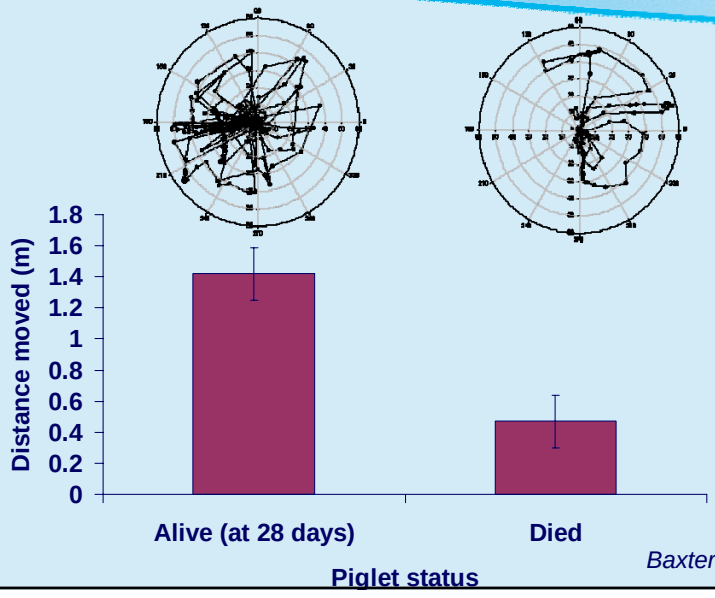
Neonatal viability
Results - Rooting response***



Baxter et al. 2008

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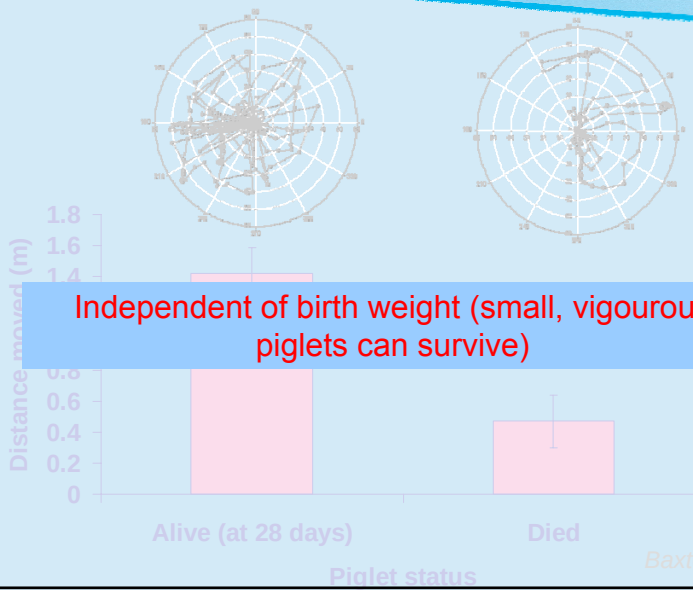
Neonatal viability
Results - Rooting response***



Independent of birth weight (small, vigourous piglets can survive)

Baxter et al. 2008

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So what?
How can we improve piglet behaviour?

Immediate

- Indirectly via improved maternal behaviour
  - Prolonged lateral lying ⇨ safe udder access
  - Decrease farrowing time ⇨ less chance of perinatal asphyxia
- Improve micro-climate for piglets (cf. outdoor environment)
  - Behaviour correlates with birth rectal temperature

Long-term

- Genetic selection strategies
  - Selection for placental efficiency

    ⇨less chance of perinatal asphyxia
  - Select for physiological maturity at birth

    ⇨Increased vitality

    ⇨Improve first time behaviours

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Results – Piglet factors
(Baxter et al.)

Survives

Vs.

Dies pre-weaning

Physiology

Higher Birth Weight

Higher 24h Weight (1628g)

Higher Birth Temp (37.74ºC)

Higher 2h Temp (38.00ºC)

Physiology

Lower Birth Weight

Lower 24h Weight (1326g) ***

Lower Birth Temp (37.13 ºC) ***

Lower 2h Temp (37.57 ºC) **

The most important survival indicators in farrowing crate systems

Behaviour

Quicker to udder (17mins)

Quic

Behaviour

Slower to udder (25mins) *

Piglet survival indicators are different in outdoor farrowing systems

Vigour

Higher vitality score (2.28)

Higher rooting response

Vigour

Lower vitality score (1.77) *

Lower rooting response

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Case studies

- Piglet survival studied in two environments
  - Indoor conventional crate
  - Outdoor commercial hut

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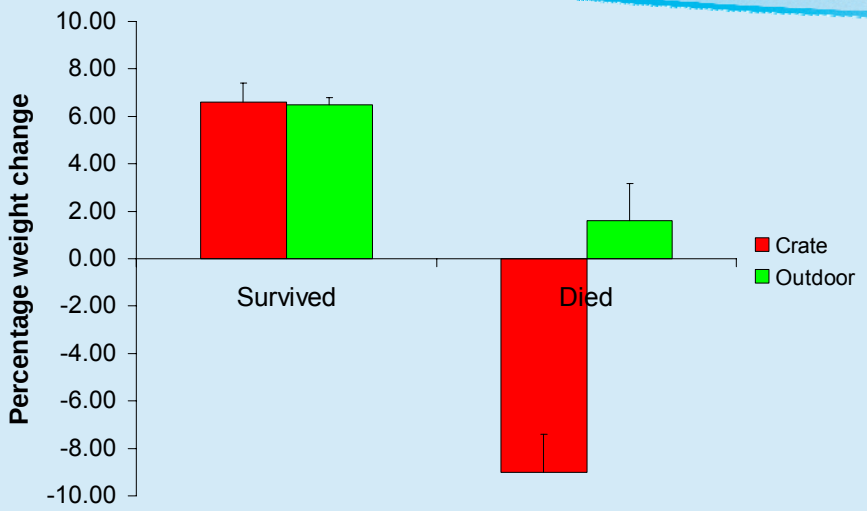
Percentage weight change over 24h



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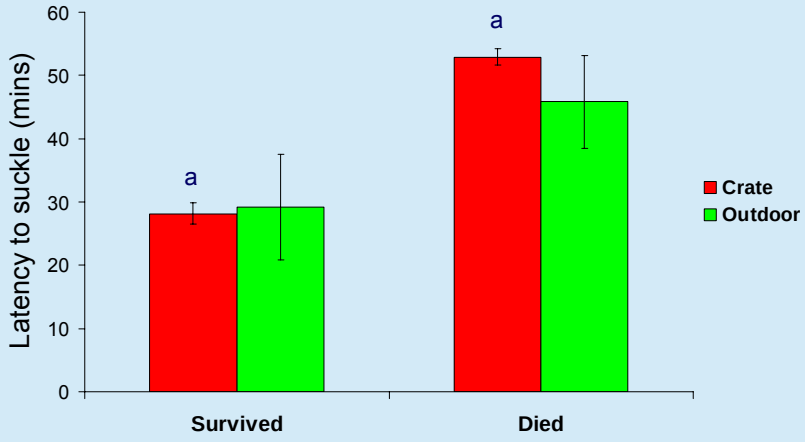
Landmark behaviour – latency to suckle



a = P<0.001

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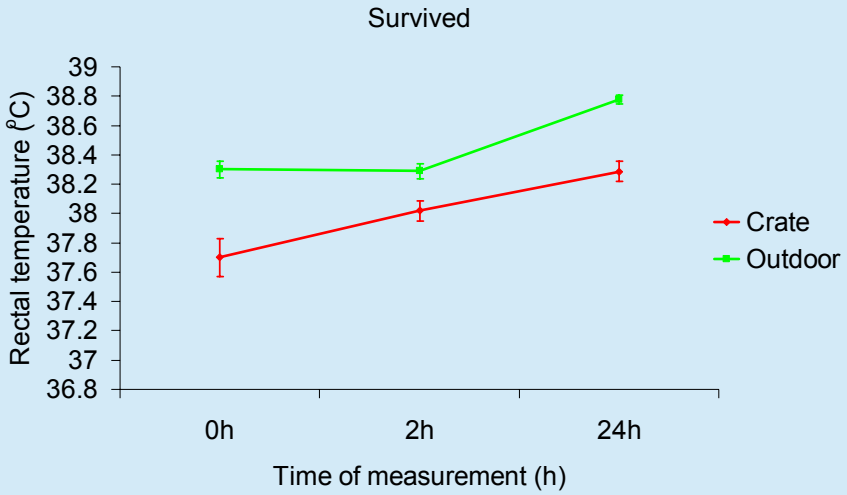
Thermoregulation



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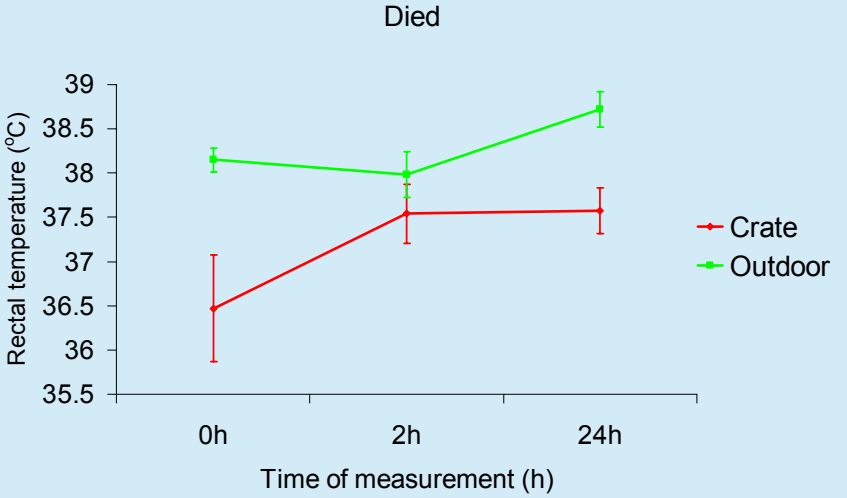
Thermoregulation



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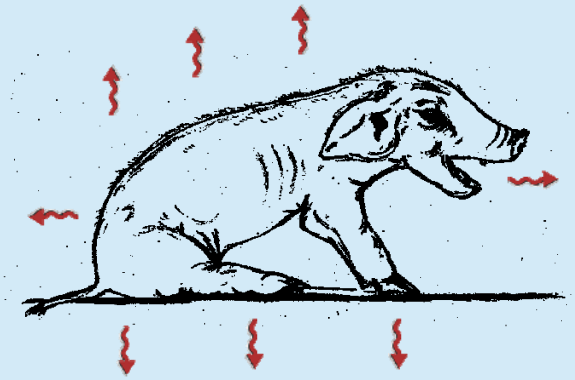
Piglet survival - Thermoregulation



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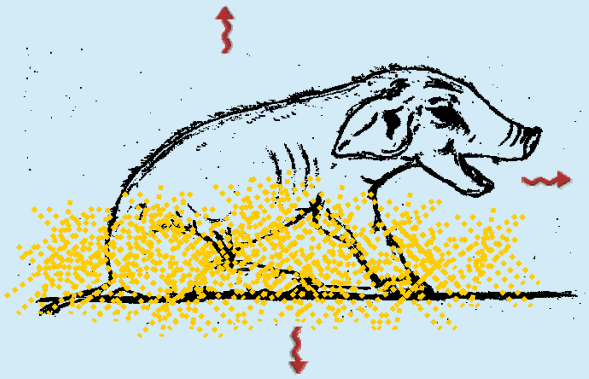
Piglet survival - Thermoregulation

2.5cm of straw decreases heat loss by 40% (Mount, 1968)



Demonstrates the importance of a micro-climate

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Maternal behaviour

Behaviour during nesting

- Active nesting phase
  ⇨Prepare for farrowing

Behaviour during farrowing

- Prolonged lateral lying
- Careful, supported posture changes*
- Less crushing behaviour**

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Maternal behaviour

Behaviour during nesting

- Active nesting phase
  ⇨Prepare for farrowing

Behaviour during farrowing

- Prolonged lateral lying
- Careful, supported posture changes*
- Less crushing behaviour**

Most important maternal behaviours in outdoor systems

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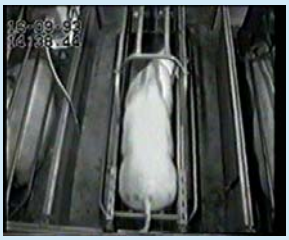
Maternal behaviour

- Maternal behaviour is restricted in farrowing crates
- Sows still want to nest-build
  - Domestication has not changed this innate behaviour (Jensen 2002) = functional behaviour



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Maternal behaviour

- Positive maternal behaviour may have become masked by selection in crate systems (Jarvis et al. 2005; Andersen et al. 2005)
- Restriction can increase negative maternal behaviour (Lawrence et al. 1994; Jarvis et al. 1997)
  - E.g. Savaging
- Savaging influenced by neophobia (i.e. gilts), pain and maternal stress
  - Evidence that prenatal stress increases the risk that female offspring will savage as mothers (Jarvis et al. 2006)

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So what?
How can we improve maternal behaviour?

Immediate

- Minimise gestational stress
  - No mixing during pregnancy (middle third = high risk of prenatal stress)
- Decrease sow stress particularly during nesting and farrowing
  - Give substrate to allow nesting behaviour ⇨Improved farrowing behaviour
  - Minimise heat stress

Long-term

- Genetic selection strategies

  E.g. Breeding for improved maternal behaviour:
  - Very important in loose-housed systems
  - Outdoor selection study influenced survival and crushing behaviour in selected lines (Baxter et al., Roehe et al.)

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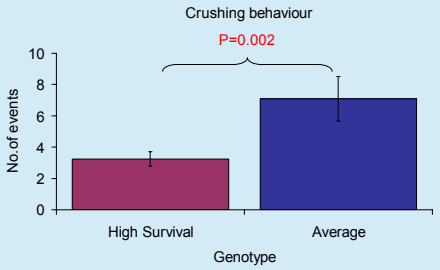
Case study: Breeding for improved survival

- Deta
  stud
  - Ye
    improved in outdoor pigs
  - Which survival indicators were influenced by genotype?
    - High Survival gilts were more careful with **less crushing behaviour** during farrowing

Total mortality:
High Survival: 12%
Controls: 18%



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Improving piglet survival

- Larger genetic study – "GENOMUM"
  - unique (<22k records) **cross-over selection experiment** for piglet survival (High vs. Control) on a Scottish outdoor unit
  - results indicate that **genetic selection** could be an effective route to improving piglet survival in outdoor conditions
    - possibly also other non-crate farrowing systems

↗ genetic improvement in survival: 3% better in HS lines (over 2 generations)

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Conclusions and take-home messages

- Cause of death in different farrowing systems must be accurately diagnosed
- In order to tackle piglet mortality we must understand the pre-disposing factors and target those risk factors
  - Different for different types of mortality
- Risk factors for prenatal survival are generic for different farrowing environments
  - Body conformation indices
  - Farrowing birth order/farrowing duration

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Conclusions and take-home messages

- Risk factors for live-born mortality are different in different farrowing systems
  - Crated systems – focus on piglet (weight, behaviour and vigour)
  - Outdoor systems – piglet and sow characteristics are important, particularly maternal behaviour
- The sow, piglets and their environment all interact to influence piglet survival
  - Solutions must focus on immediate (environmental improvements), as well as the long-term (biological "improvements" via genetic selection programmes) strategies

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Success through Knowledge

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