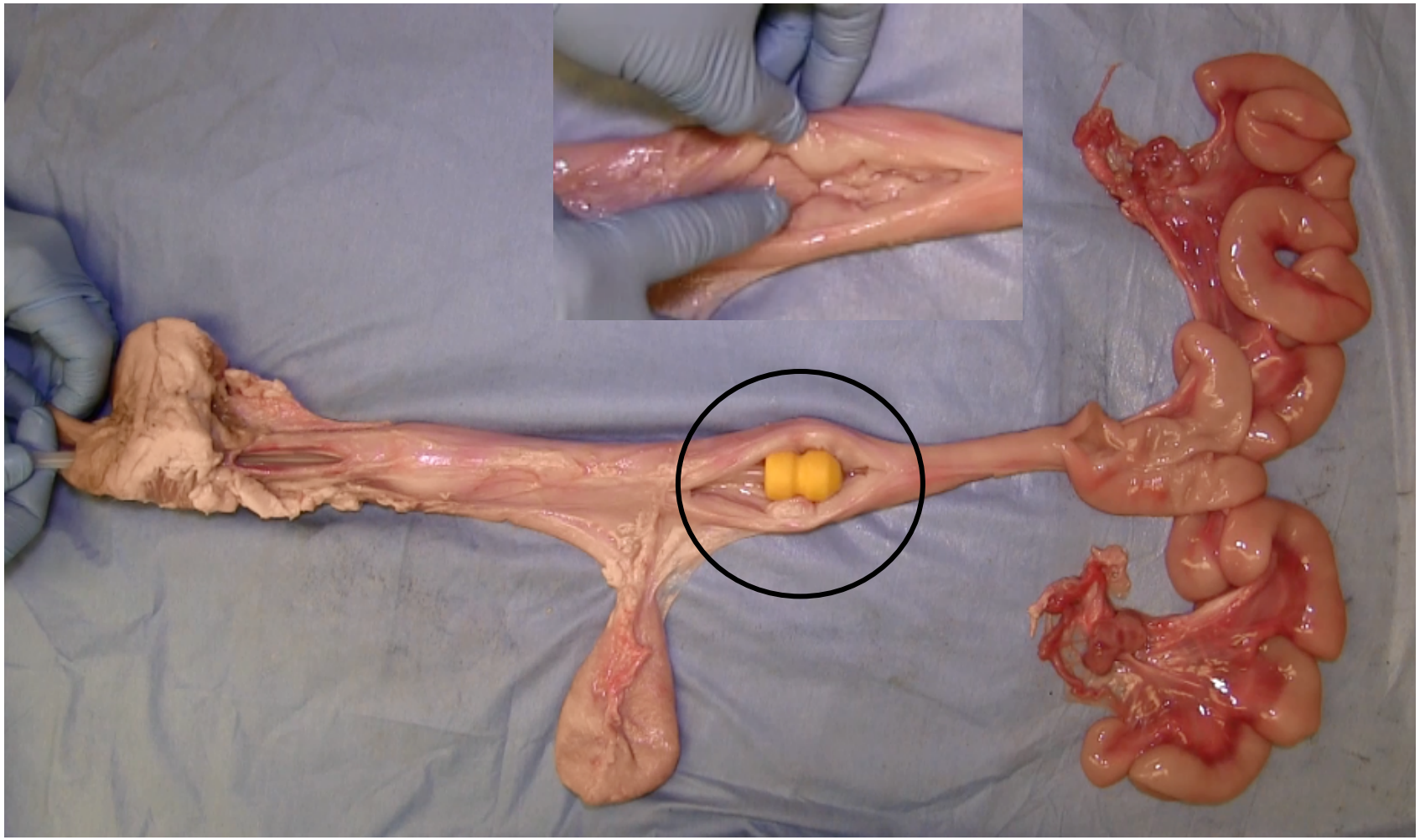
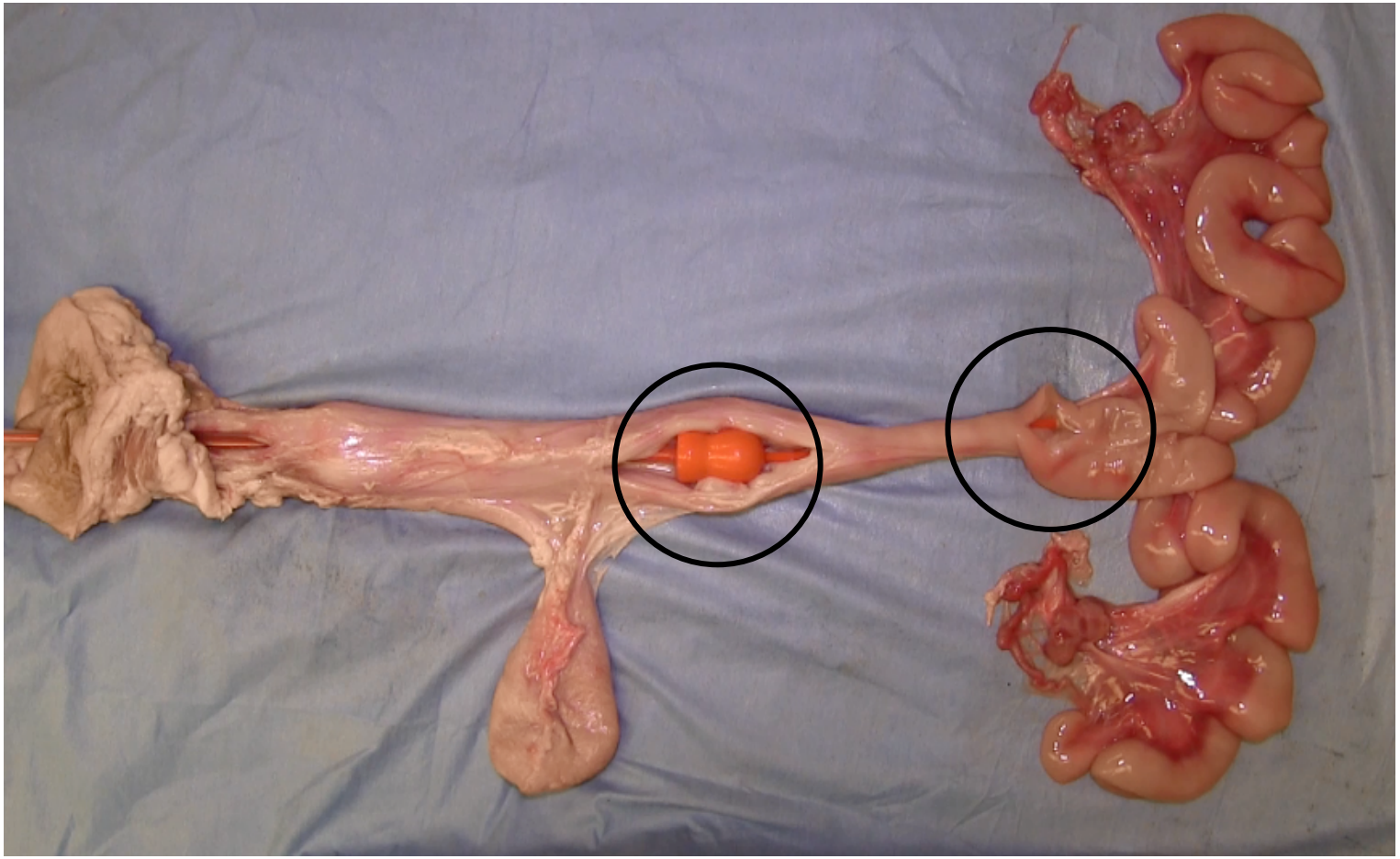
Maximizing advantages from using PCAI

Kara Stewart

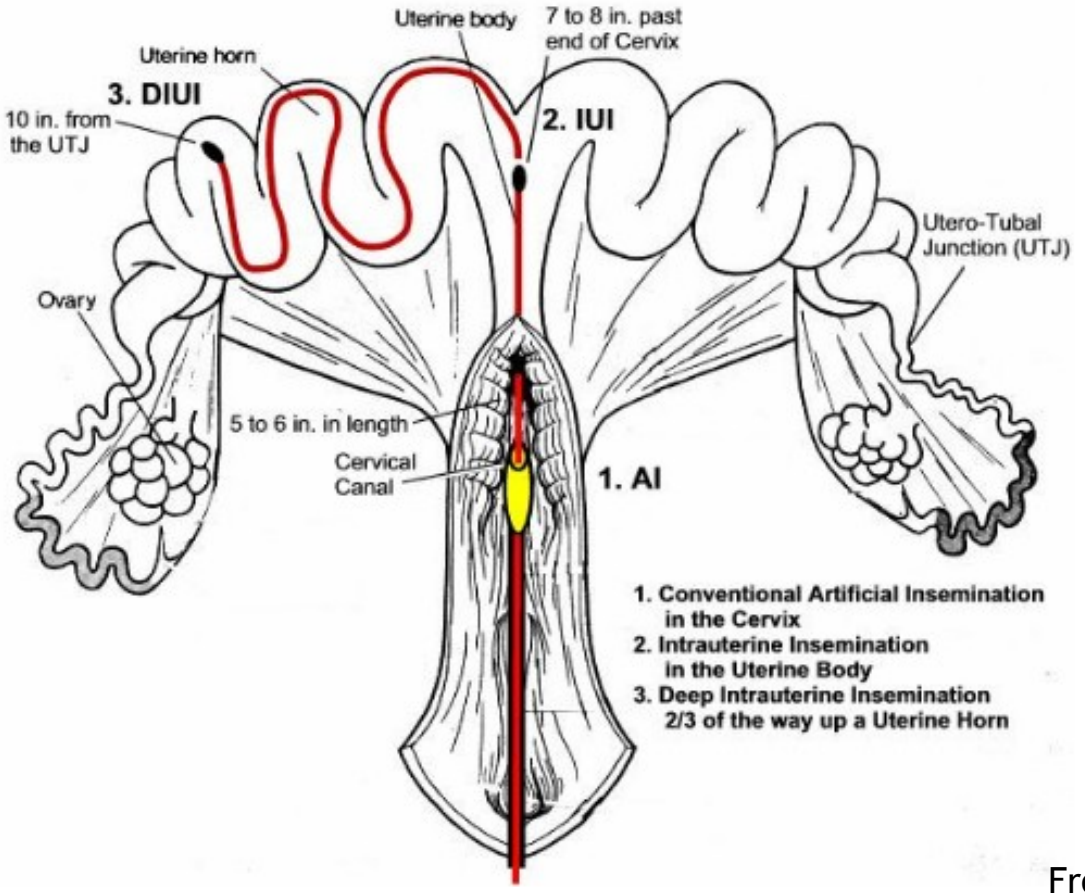
Conventional AI (CAI)



Intrauterine Insemination (IUI or PCAI)



Deep Uterine AI (DIUI)

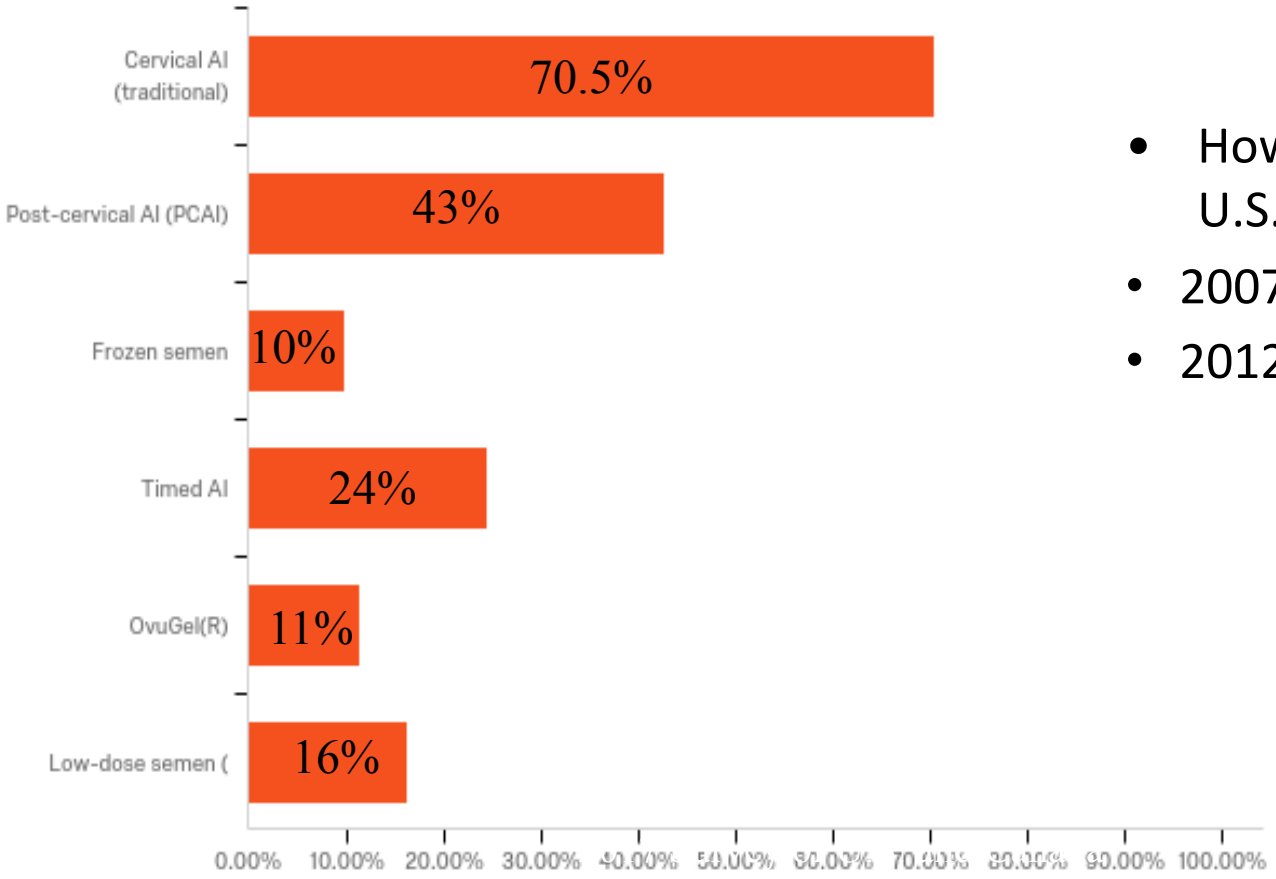


From Belstra, 2002

How is PCAI performed?

- Perform heat detection and identify sows in heat
- Wait >10min (not more than 45min ??) to return to inseminate
- Place outer catheter into cervix, then thread inner catheter into uterine body
  - If inner won't pass, you can remove it and breed conventionally
- Attach semen dose and gently squeeze semen into uterus

Who is Using PCAI?



- How many farms in the U.S. are using PCAI?
- 2007 – 6% (Knox et al., 2008)
- 2012 – 24% (Safranski, 2012)

Advantages of PCAI

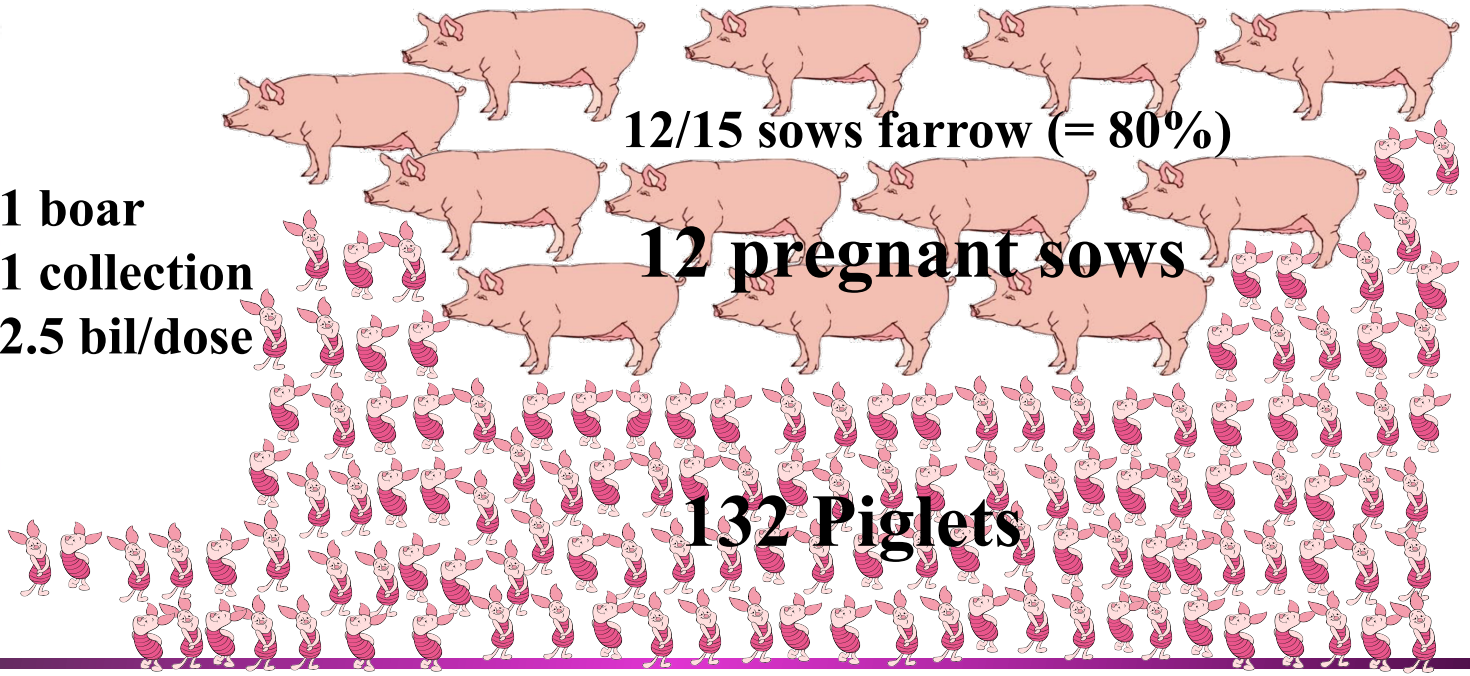
1. Fewer sperm cells per insemination

→ Fewer boars required

→ Paternal genetic cost reduced

1 boar
1 collection
2.5 bil/dose

Assume 2 inseminations/sow



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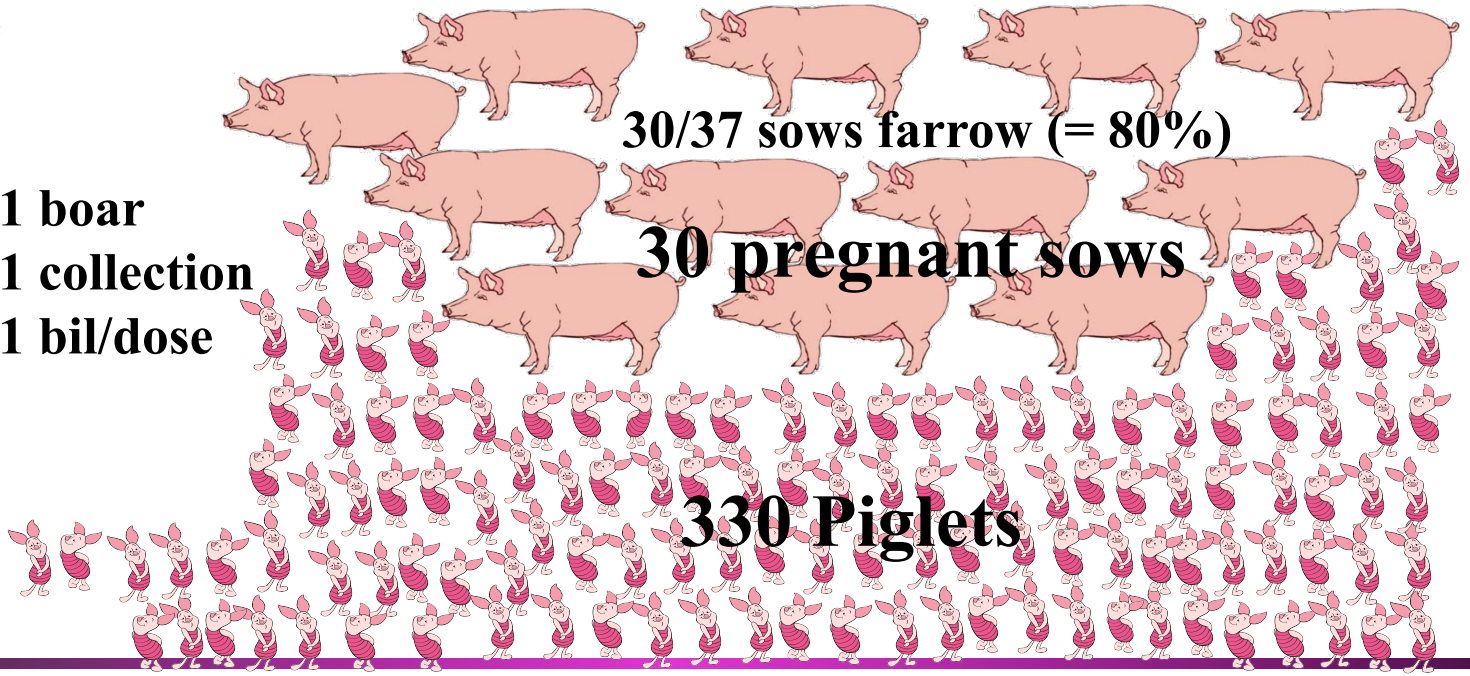

Advantages of PCAI

1. Fewer sperm cells per insemination

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→ Paternal genetic cost reduced

CAI → **6,864 piglets/boar/yr**

PCAI → **17,160 piglets/boar/yr**

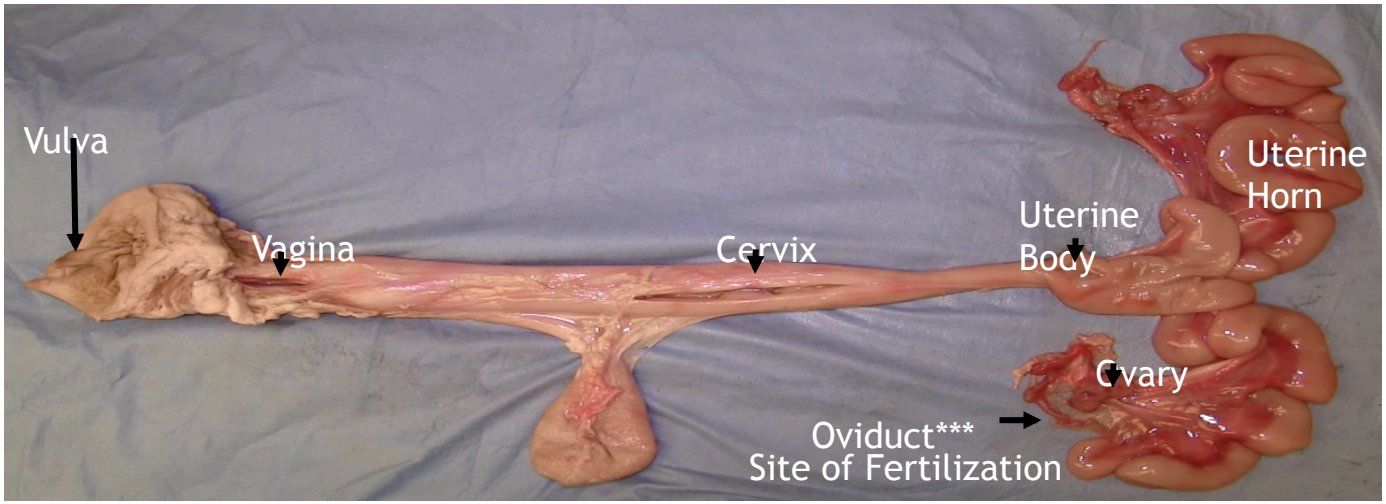
Assuming 75 bil/ejac., 1 ejac per week,
2 inseminations/sow

Advantages of PCAI

1. Fewer sperm cells per insemination

→ Reduced volume at insemination

→ Reduced backflow and inflammation



Sperm cell loss

- What happens to the sperm cells in the female's tract?
  - Mainly move through tract via muscle contractions to oviduct where sperm cells bind to the oviductal cells
  - The fluid is lost via retrograde loss (back flow)
  - The cells are lost via backflow or destroyed by sow's immune system

Sperm cell loss

- What happens to the sperm cells in the female's tract?
  - Is there a minimum volume required?
    - 100mL of semen resulted in improved fertility compared to 20mL or 200mL
    - $5x10^9$ and $10x10^9$ had higher fertilization rates and more sperm in the oviducts compared to $1x10^9$
    - Volume of semen affects sperm reaching the site of fertilization

Baker et al., 1968 - CAI

Sperm cell loss

- What happens to the sperm cells in the female's tract?
  - Is there a minimum volume required?

Dose of Semen (x10^9/ volume)	Farrowing Rate (%)	Number Born Alive	Reference
1 / 26mL	84.1^{ab}	12.2^{a}	Hernandez-Caravaca et al., 2012 - PCAI
1.5/ 40mL	86.8^{b}	12.6^{b}	
Conventional (3/80ml)	82.3^{a}	12.2^{a}	

Minimum volume largely unknown for PCAI – studies largely confounded with concentraiton

Sperm Cell Loss

- What happens to the sperm cells in the female's tract?
  - Retrograde loss
    - Withhin 2.5 hours after insemination – 88% of volume and up to 25% of sperm cells come back out (Steverink et al., 1998, Willenburg et al., 2003)
    - If back flow of 5% or more during insemination process occurs with low doses (1 billion cells), conception rates will be reduced (Steverink et al., 1998)
    - ***Backflow is reduced in PCAI compared to CAI (Hernandez-Caravaca et al., 2012)***

Sperm Cell Loss

- What happens to the sperm cells in the female's tract?
  - Immune system of female
    - Phagocytosis of sperm cells by female's immune system – inflammatory response
    - Inflammatory response due to sperm cells, semen extenders, seminal plasma
    - ***Assumed that lower volumes would reduce inflammation***

Advantages of PCAI

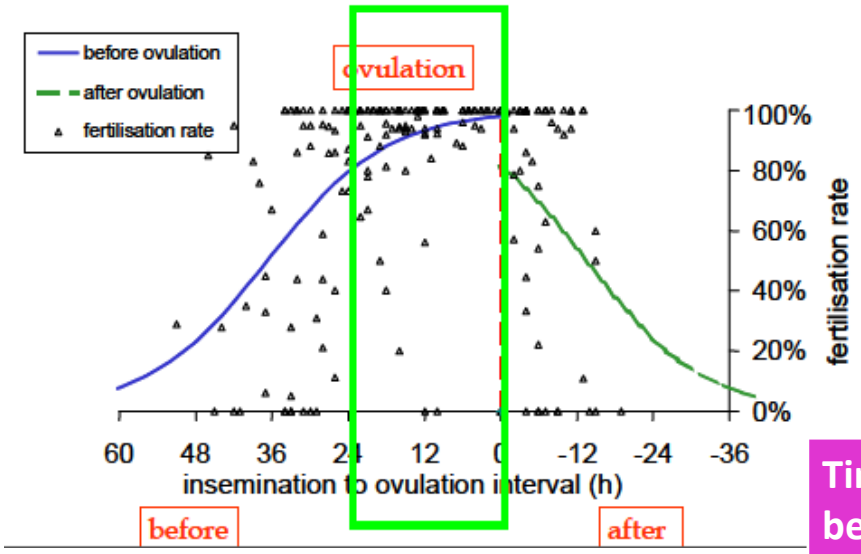
1. Fewer sperm cells per insemination
   - → Fewer boars required
   - → Reduced volume
2. Maximize use of high indexing boars
   - → Improved rate of genetic progress
3. Reduced time to inseminate individual sow
   - → Reduced labor costs – or improved labor utilization

Advantages of PCAI

4. Facilitate other technologies

- Single fixed timed AI
- Low-dose semen
- Bulk semen delivery
- Frozen semen

Facilitate other technologies……



Courtesy of Hanneke Feitsma

- Sperm need to be in female's tract BEFORE ovulation to maximize fertility
- Insemination within ~24 hour of ovulation maximizes fertility

Time before Ovulation (h)	Method	Citation
6-18	Natural Mating	Dziuk,P. 1970
0-12	CAI, fresh semen	Waberski et al., 1994
0-24	CAI, fresh semen	Soede et al., 1995

Table 3
Least squares means for fertility responses in relation to hours from insemination to ovulation.

Interval from insemination to ovulation (h)	n	Pregnancy rate (%)	Farrowing rate (%)	Total born	Pigs born alive
−30−−34	3	100.0[a]	100.0[a]	16.0	14.5
−26	63	92.1[a]	87.3[ab]	13.6	12.0
−22	50	86.0[a]	82.0[ab]	13.9	12.1
−18	84	83.3[ab]	79.5[ab]	13.5	12.2
−14	43	79.1 [ab]	71.4[ab]	14.0	12.7
−10	62	74.2[ab]	72.6[ab]	13.1	11.9
−6	23	87.0[ab]	82.6[ab]	12.8	12.0
−2	17	58.8[b]	52.9[b]	10.9	9.9
+2−+6	7	57.1[b]	57.1[b]	12.5	11.7
SE		0.2	0.2	0.2	0.2
P-value		0.02	0.06	ns	ns

Means without common superscripts differ (P < 0.05).

Knox et al., 2017 – PCAI single insemination following triptorelin acetate (1.5 and 2.5 bill sperm per dose)

Timing of insemination relative to ovulation

Single AI to Ovulation (hours)	Pregnancy Rate(%)
8	56.4
16	74.5
24	86.2
30	73.6

Insemination AT ovulation ***MAY*** not be better in SFTAI

Belstra et al., unpublished – PCAI and DIUI single insemination following triptorelin acetate (all below 1.2 bil sperm per dose)

Considerations with PCAI

- Employee training
  - Passing inner catheter, understanding cervical anatomy
  - Managing troublesome inseminations
- Catheter costs more
- Gilts
  - Can be challenging to pass inner catheter compared to older parity sows

Tips to Maximize PCAI Benefits

- Minimize backflow during insemination
  - Proper catheter placement
  - Careful observation during insemination
- Identify high indexing/high fertility boars
  - NOT one in the same
  - Still need a means to identify high fertility boars

Tips to Maximize PCAI Benefits

- Reduce the concentration of sperm SLOWLY
  - Highly impacted by management of the sow farm
  - Do we need to adjust any trash rate criteria for low dose?
- Focus on semen quality if reducing the dose AT THE BOAR STUD
- Focus on semen dose management AT THE SOW FARM

Thanks!

Kara Stewart