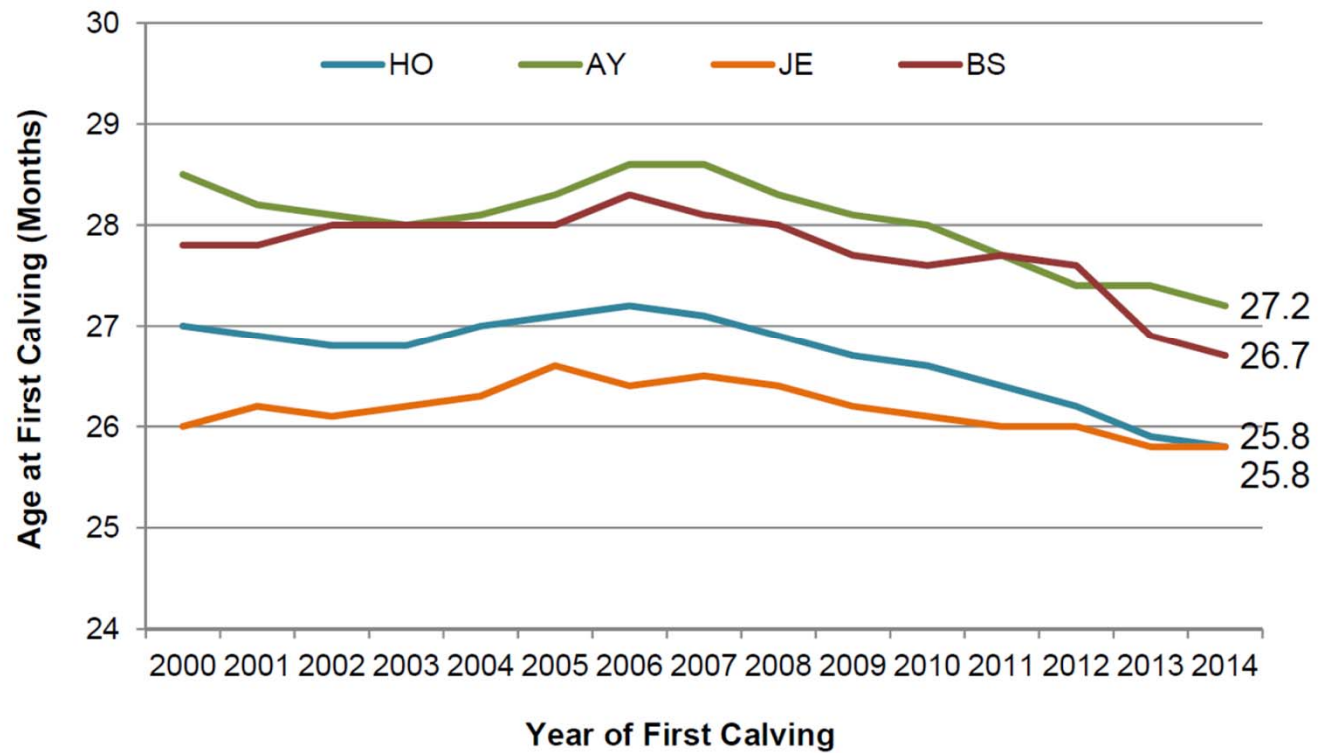


# **Reproductive management of heifers**

Stephen LeBlanc

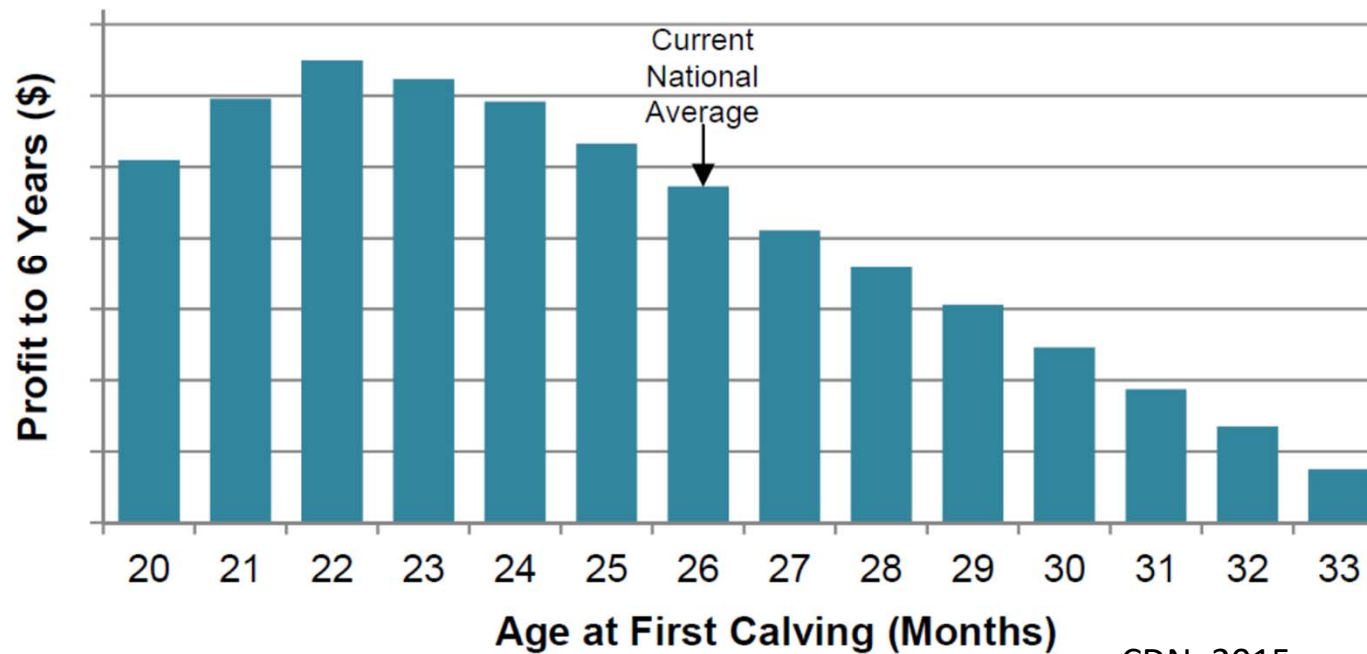
# It's getting better...

Figure 1: Trend in Average Age at First Calving by Breed



# But there is still considerable economic opportunity

Figure 2: Average Profit to 6 Years by Age at First Calving in Holsteins



CDN, 2015

- **Milk/lactation is ~ the same from AFC  $\geq$  22**
- **Lifetime is ~ the same irrespective of AFC**
- **So, older AFC = shorter productive life**

**Table 1: Profit Gained by Decreasing Average Age at First Calving**

	<b>Holstein</b>	<b>Ayrshire</b>	<b>Jersey</b>	<b>Brown Swiss</b>
Current average age at first calving (months)	26	27	26	27
Most profitable age at first calving (months)	22	23	22	23
Profit per cow gained by decreasing the current breed average to the most profitable age at first calving	<b>\$880</b>	<b>\$870</b>	<b>\$920</b>	<b>\$1380</b>

# Reproduction

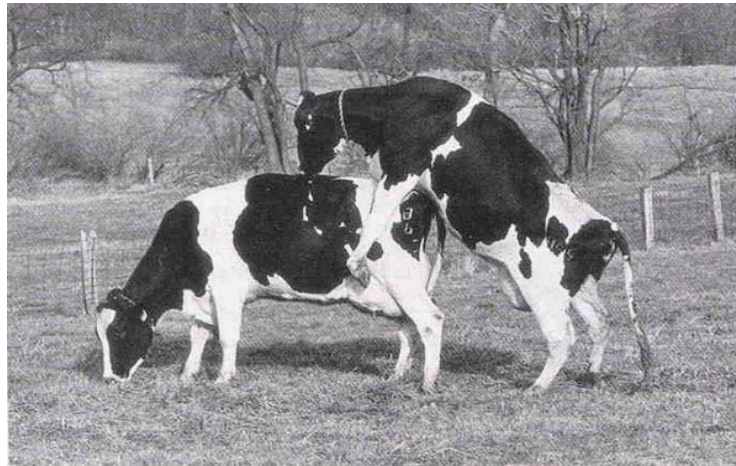
- $\geq 30\%$  of pregnancies in a herd per year come from heifers
  - Close to the proportion from 1<sup>st</sup> service in cows
- If the goal is to have heifers pregnant at 15 months, and CR = 50%, then must start by 13 months to have 87% pregnant on time, even if heat detection rate were 100%

# Reproduction

- Set targets for size and age at first calving
- Calculate target rate
- Periodically measure heifers, starting at weaning
- Monitor % of heifers pregnant by 14-15 months

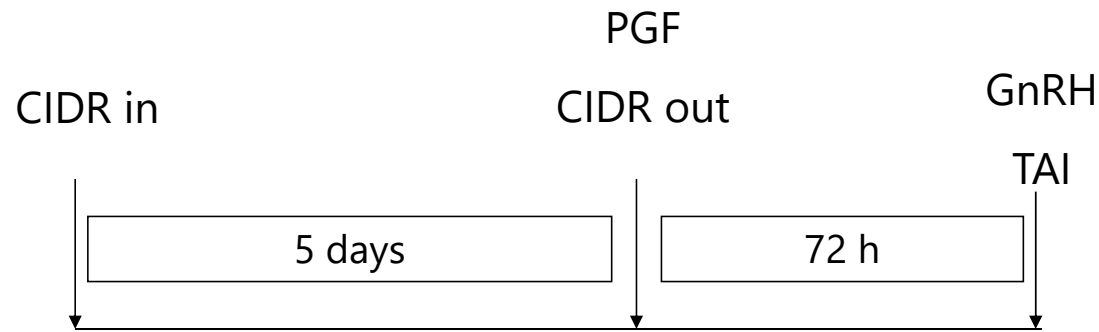
# Heat Facts

	<u>Duration</u>	<u>Mounts</u>
Holstein Heifers	$10.3 \pm 5.9$ h	$16.3 \pm 11.6$
Holstein Cows	$7.1 \pm 5.4$ h	$7.5 \pm 6.6$



Dransfield et al,  
1998

# Heifer "5 day" CIDR Ovsynch Protocol



- GnRH not needed at start (?)
- Single PGF on day 5 is sufficient (?)
- Expected CR 50 to 60%

Thatcher et al DCRC 2009

Colazo & Ambrose 2011

Rasimanickam et al 2014

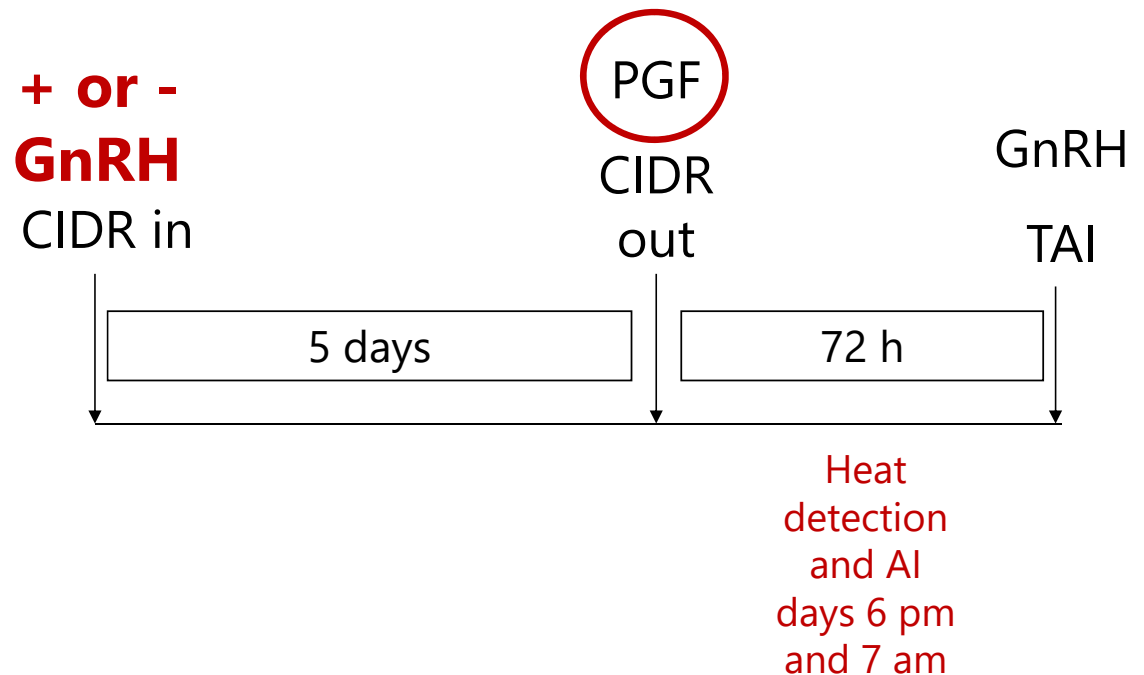
# CIDR 5d Cosynch 72 in heifers

(Thatcher et al DCRC 2009)

	Double PGF		Single PGF	
	n	CR at 45 d	n	CR at 45 d
Exp 1	128	51%		
Exp 2	165	59%		
Exp 3 farm 1 a	88	39%	88	38%
Exp 3 farm 2	101	55%	98	54%
Exp 3 farm 1 b	109	51%	109	46%
Exp 4 As Resynch at 32 d	43	54%	40	55%
Exp 5 - Descriptive			1 <sup>st</sup> AI – 416 2 <sup>nd</sup> AI - 165	58% (60 d) 47%
Exp 6			1 <sup>st</sup> AI – conv 1 <sup>st</sup> AI - sexed	51% 42%
			2 <sup>nd</sup> AI – conv	52%

# Include GnRH at the start?

- 1 herd in Alberta
- 527 AI in 320 heifers  
13-16 months old
- 73% conventional,  
27% sexed semen  
(balanced)
- Heat detected
  - GnRH: 14%
  - No GnRH: 22%



# Include GnRH at the start?

Overall, pregnancy at AI not improved with GnRH at the start.

Item	TAI protocol		P-value
	+GnRH <sup>1</sup>	-GnRH <sup>2</sup>	
1 AI			
N	148	169	—
P/AI (27 d; %)	56.8	66.3	0.08
PL <sup>3</sup> (%)	2.4	3.6	0.7
≥2 AI			
N	85	105	—
P/AI (27 d; %)	55.3	57.1	0.8
PL (%)	4.3	3.3	0.9
ED <sup>4</sup> (%)	13.7	21.5	0.03

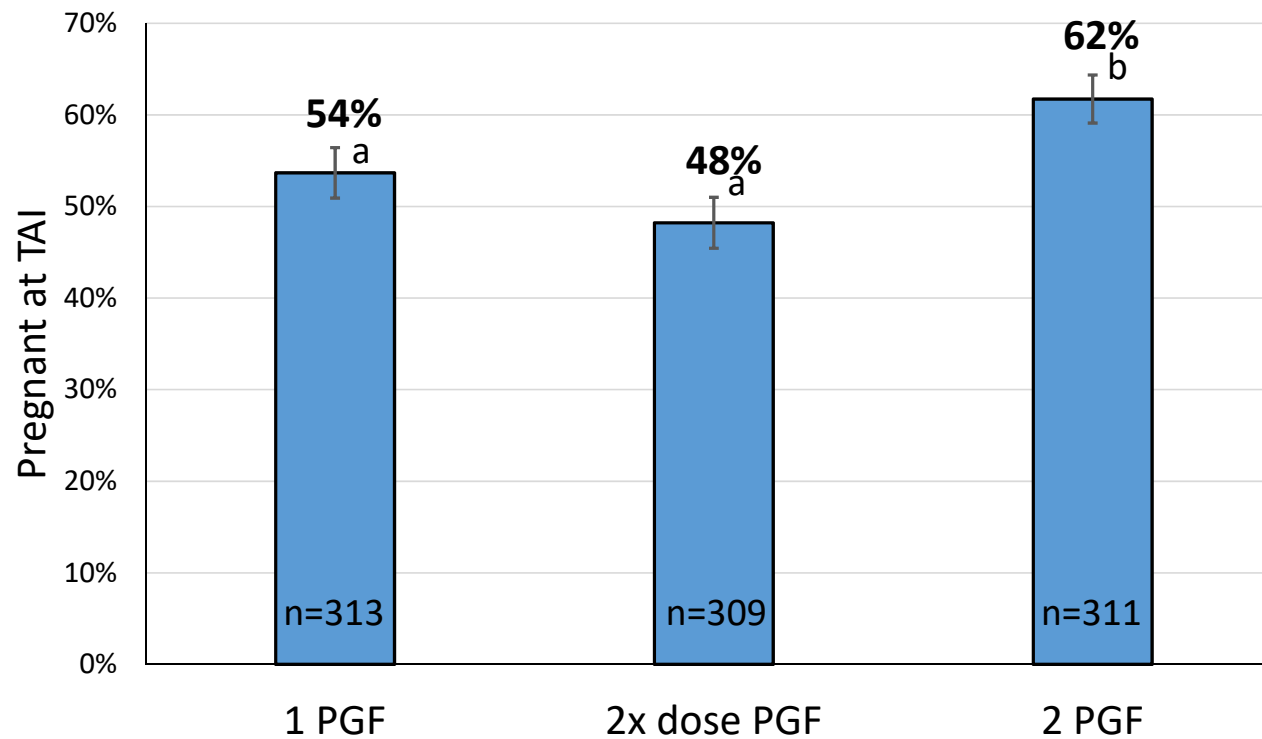
No GnRH\*sexed  
Overall 42 d pregnancy:  
Sexed 54%  
Conventional 60%

CR somewhat higher to detected estrus than TAI... but required 2 sessions of detection

Item [no. (%), unless noted]	Type of AI <sup>1</sup>		P-value
	TAI	ED	
N (%)	416 (78.9)	111 (21.1)	—
P/AI (27 d)	242 (58.2)	75 (67.6)	0.08
P/AI (42 d)	232 (55.8)	75 (67.6)	0.03
PL <sup>2</sup>	10 (4.1)	0 (0.0)	0.03



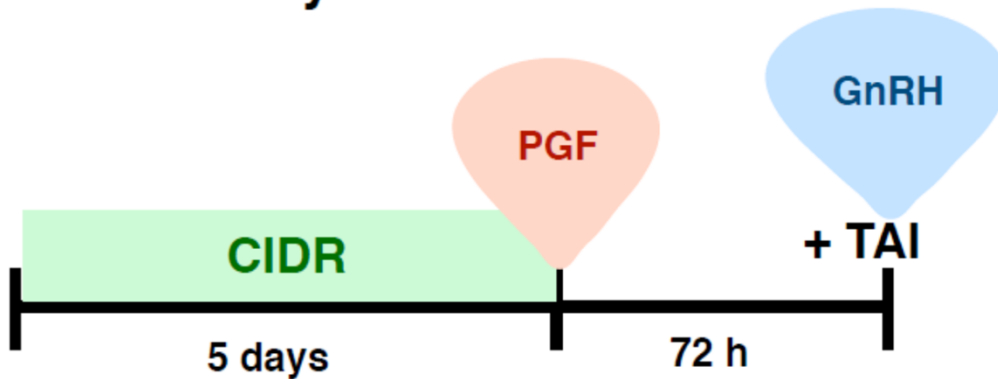
# 1 or 2 PGF in "5-day" CIDR Synch



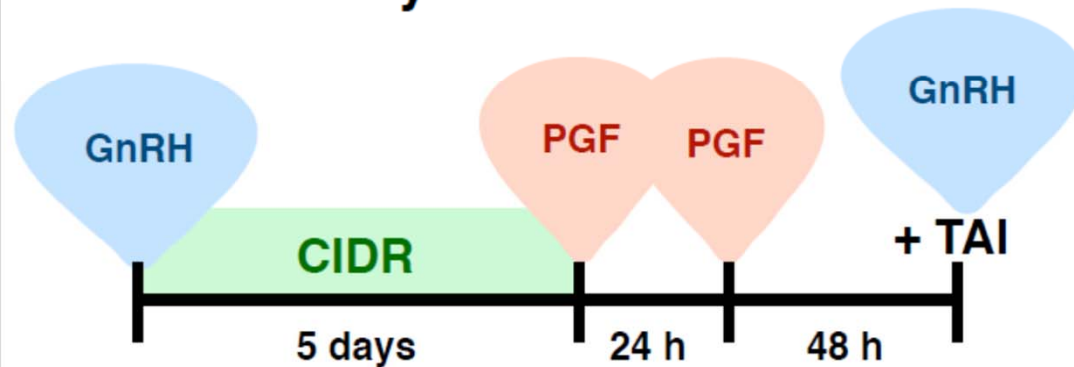
Say et al 2016

# Decisions, decisions...

## B. 5-d CIDR-Synch without GnRH and 1 PGF



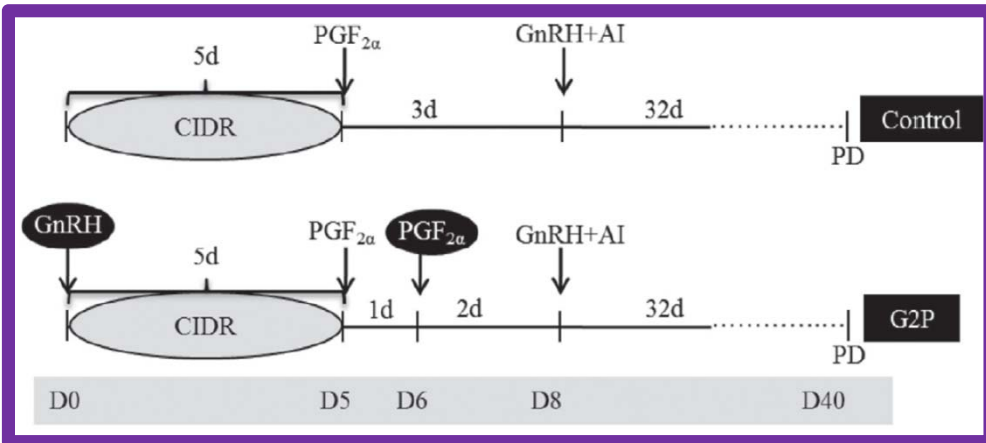
## A. 5-d CIDR-Synch with GnRH and 2 PGF



DCRC 2018

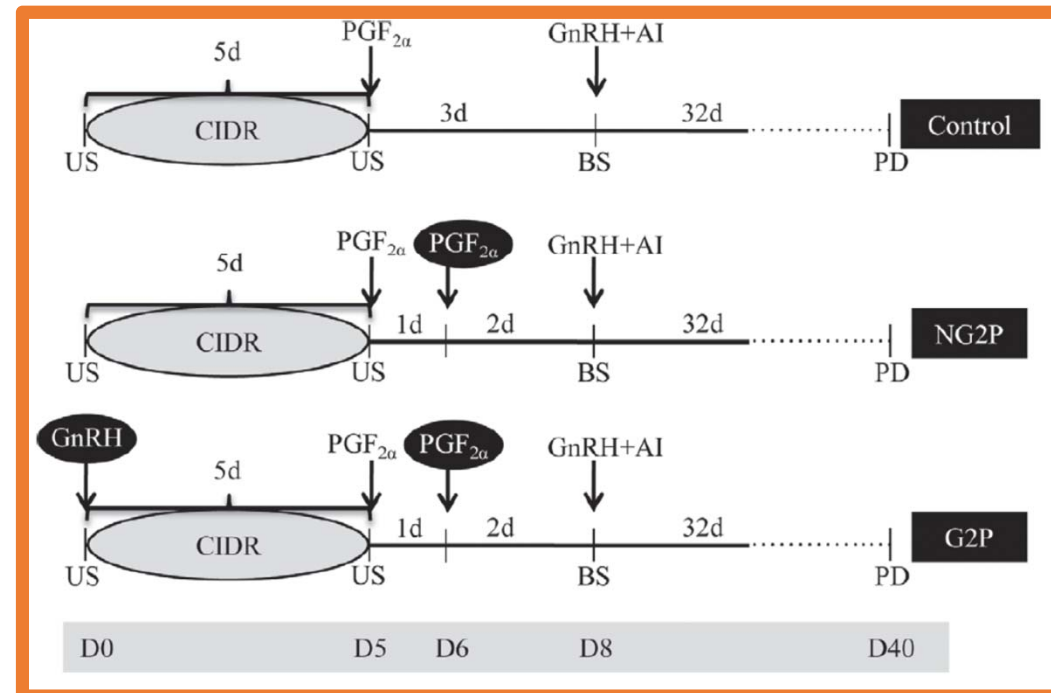
# Combined effects of GnRH-1 and 2X PGF

2 farms in Florida  
 1106 Holstein and Holstein x Jersey heifers  
 14 ± 2 months old



Lima et al JDS 2013

1 farm in Florida  
 2144 Holstein heifers (80% 1<sup>st</sup> AI)  
 13.5 ± 1 month old



# Combined effects of GnRH-1 and 2X PGF

**Table 1.** Effect of the initial GnRH injection and 2 doses of PGF<sub>2α</sub> on fertility responses of dairy heifers subjected to the 5-d timed AI program (study 1)

Item	Treatment, <sup>1</sup> % (no./total no.)		AOR (95% CI) <sup>2</sup>	P-value
	Control	G2P		
Estrus at AI <sup>3</sup>	76.7 (429/559)	76.9 (421/547)	1.03 (0.77–1.38)	0.83
Pregnant				
d 32	53.5 (299/559)	59.4 (325/547)	1.28 (1.01–1.63)	0.04
d 60	51.3 (287/559)	56.6 (309/546)	1.24 (0.98–1.58)	0.07
Pregnancy loss <sup>4</sup>	4.0 (12/299)	4.6 (15/324)	1.15 (0.53–2.52)	0.72

**GnRH AND 2X PGF better than No GnRH with 1 PGF**

# Combined effects of GnRH-1 and 2X PGF

**Table 3.** Effect of the initial GnRH injection and 2 doses of PGF<sub>2α</sub> on fertility responses in dairy heifers subjected to the 5-d timed AI program (study 2)

Item	Treatment, <sup>1</sup> % (no./total no.)			P-value
	Control	NG2P	G2P	
Estrus at AI <sup>2</sup>	72.6 (525/723) <sup>b</sup>	74.4 (523/703) <sup>B</sup>	78.6 (564/718) <sup>a,A</sup>	0.02
Pregnant <sup>3</sup>				
d 32	52.9 (376/711) <sup>b</sup>	55.0 (383/696) <sup>b</sup>	61.7 (439/711) <sup>a</sup>	0.003
d 60	49.0 (348/711) <sup>b</sup>	51.6 (359/696) <sup>b</sup>	59.1 (420/711) <sup>a</sup>	0.001
Pregnancy loss <sup>4</sup>	7.5 (28/376) <sup>B</sup>	6.3 (24/383) <sup>AB</sup>	4.3 (19/439) <sup>A</sup>	0.15

<sup>a,b</sup>Different lowercase superscripts within a row indicate significant differences ( $P < 0.05$ ).

<sup>A,B</sup>Different capital superscripts within a row indicate tendencies to differ ( $P \leq 0.10$ ).

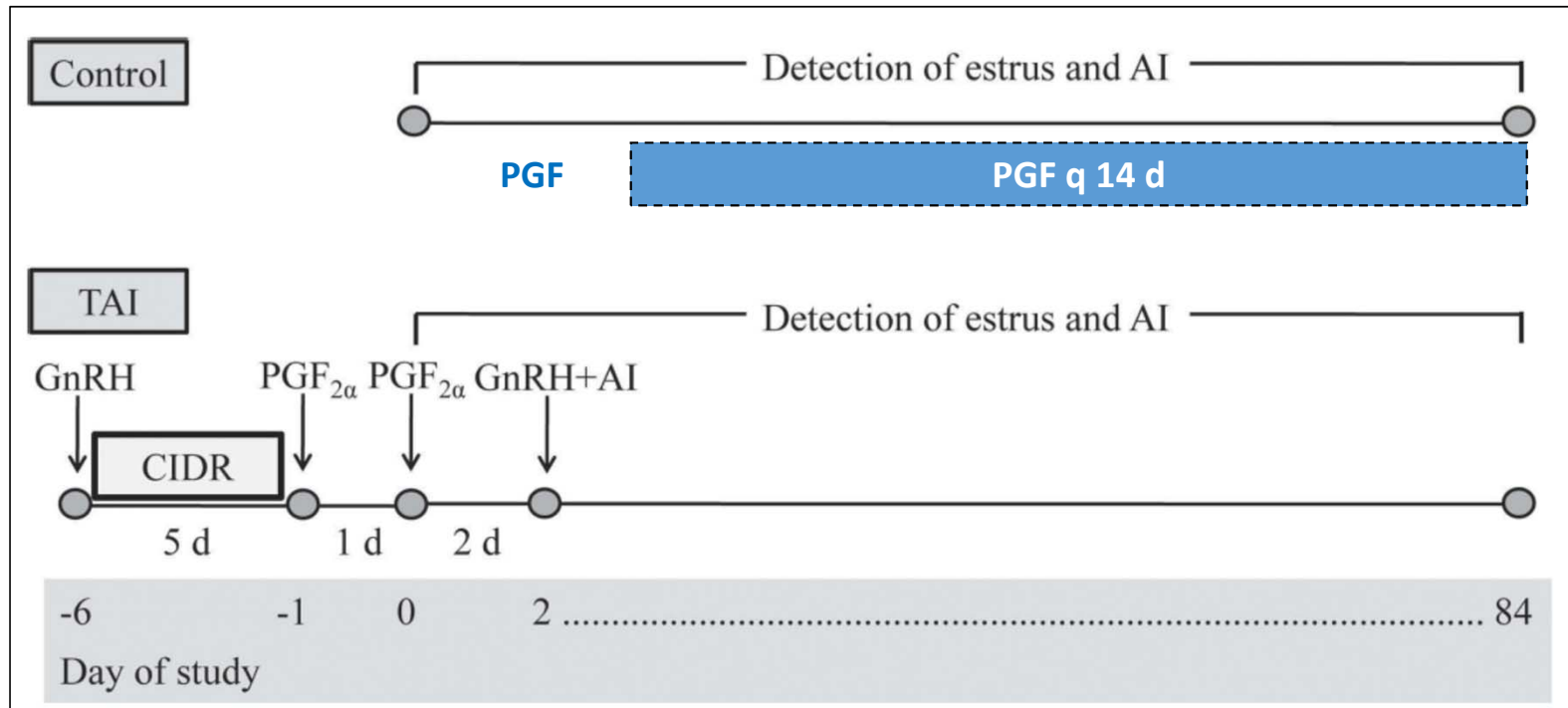
## Conclusions:

- **Benefit to adding GnRH at start**
- **But then need to do 2 PGF**

# TAI vs. Heat detection in heifers

- 611 heifers on 3 farms in California
- Dry lots
- Enrolled April – June 2014
- Tail chalk once daily. Read after am feeding. If rubbed → AI that am

# TAI vs. Heat detection in heifers

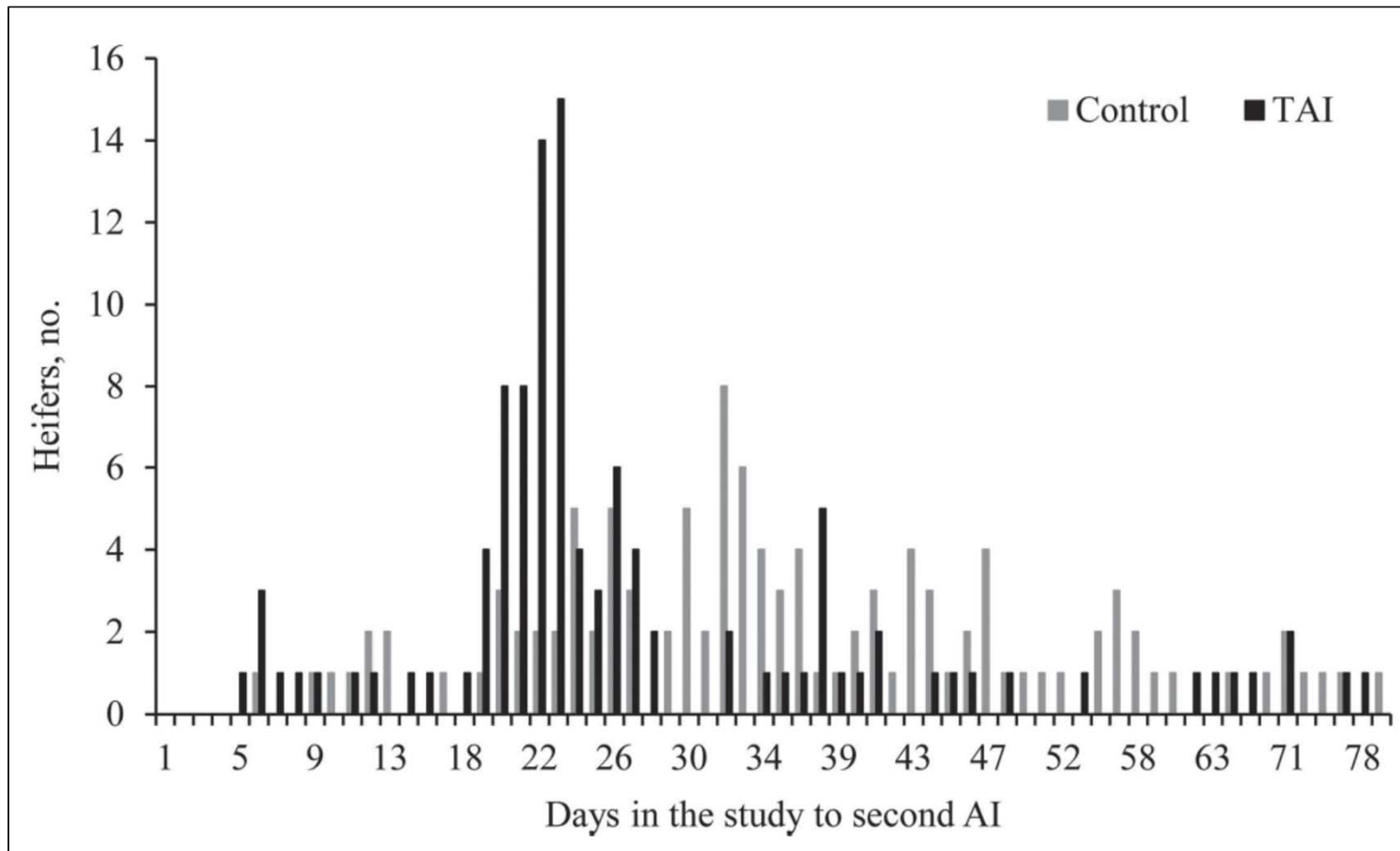


# No overall difference in pregnancy at 1<sup>st</sup> AI (but TAI better with sexed semen)

**Table 1.** Effect of treatment on fertility responses of dairy heifers at first AI

Item	Treatment <sup>1</sup>		AOR <sup>2</sup> (95% CI)	<i>P</i> -value
	CON	TAI		
Days to first AI				
Median (95% CI)	10.0 (9.0–11.0)	2.0 (1.0–2.0)	—	0.001
Mean ± SEM	10.4 ± 0.4	1.7 ± 0.1	—	—
Heifers inseminated, %	97.1 (297/306)	100 (305/305)	—	—
Pregnant first AI <sup>3</sup>				
Day 32, % (no./no.)	62.3 (185/297)	65.5 (199/304)	1.18 (0.82–1.69)	0.36
Day 60, % (no./no.)	58.3 (173/297)	62.8 (191/304)	1.28 (0.90–1.85)	0.17
Pregnancy loss, % (no./no.)	6.5 (12/185)	4.0 (8/199)	0.60 (0.24–1.52)	0.28
Pregnant d 60 according to semen type <sup>4</sup>				
Conventional, % (no./no.)	64.6 (155/240)	65.4 (151/231)	1.04 (0.71–1.51)	0.86
Sex-sorted, % (no./no.)	31.6 (18/57)	54.8 (40/73)	2.63 (1.26–5.46)	0.01

# TAI synchronized return to estrus

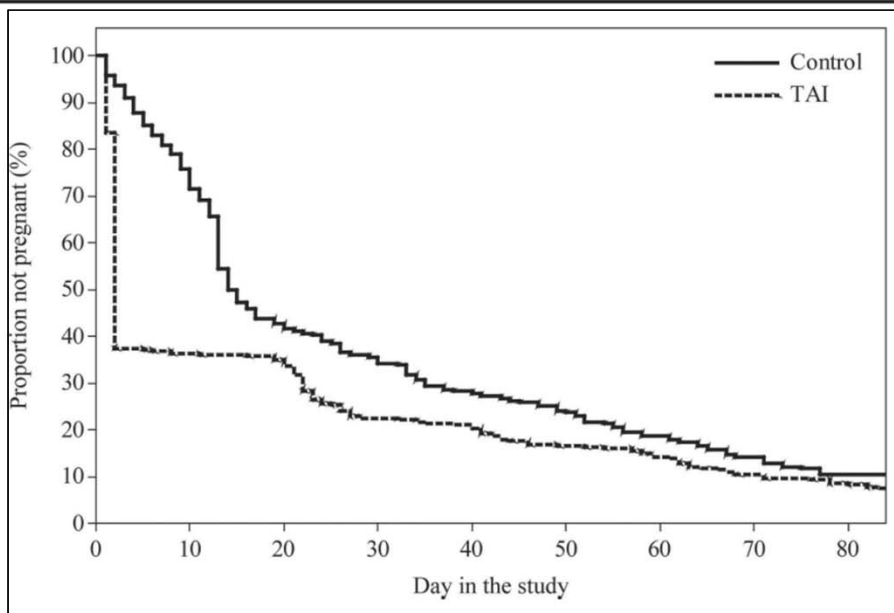


Silva et al 2015

**Table 2.** Effect of treatment on fertility responses of dairy heifers for the 84-d study

Item	Treatment <sup>1</sup>		AOR <sup>2</sup> (95% CI)	P-value
	CON	TAI		
21-d cycle insemination rate, % (no./no.)				
All 21-d cycles	82.4 (449/545)	91.4 (446/488)	3.51 (1.93–6.41)	0.001
After first 21-d cycle	68.2 (163/239)	77.1 (141/183)	2.67 (1.35–5.26)	0.005
Pregnancy per AI on d 60, % (no./no.)				
All AI	56.0 (261/466)	57.4 (279/486)	1.14 (0.86–1.50)	0.37
Repeat AI	52.1 (88/169)	48.4 (88/182)	0.90 (0.58–1.39)	0.63
21-d cycle pregnancy rate, <sup>3</sup> % (no./no.)				
All 21-d cycles	47.9 (261/545)	57.2 (279/488)	1.47 (1.11–1.94)	0.008
After first 21-d cycle	34.7 (83/239)	38.8 (71/183)	1.37 (0.88–2.13)	0.17

**Greater  
insemination  
rate drove  
greater  
pregnancy  
rate in TAI**



Median time to pregnancy

CON 14 d

TAI 2 d

AHR = 1.6 {1.4 – 1.9}

Silva et al 2015

# Economic analysis

Inputs and assumptions:

- \$2 per PGF or GnRH; \$12/CIDR (2 uses)
- \$10/h labour
- \$6/straw semen; \$18 sexed semen
- \$2/preg check; all pregnancies confirmed
- \$0.20/kg DM at 9 kg DMI/d during breeding; \$0.17/kg at 13 kg DMI once pregnant
- Breed 30 heifers/h
- Insert 40 or remove 80 CIDR/h
- Tail chalk 120 heifers/h

# Cost per pregnancy was lower for TAI

Table 4. Effects of treatment (CON vs. TAI) on costs per heifer or per pregnancy

Item <sup>1</sup>	Treatment <sup>2</sup>		SEM	Difference <sup>3</sup>
	CON	TAI		
Costs per heifer, US\$				
Hormonal treatment	1.31	12.87	0.06	-11.56
Detection of estrus	4.57	3.92	0.10	0.65
Semen and AI	13.28	14.50	0.40	-1.22
Pregnancy diagnosis	3.68	3.86	0.05	-0.18
Extra feed	62.11	40.43	3.46	21.68
Total cost	85.00	75.57	3.88	9.43
Cost per pregnancy, US\$				
Hormonal treatment	1.54	14.07	0.08	-12.53
Detection of estrus	5.37	4.28	0.11	1.09
Semen and AI	15.56	15.83	0.45	-0.27
Pregnancy diagnosis	4.31	4.22	0.05	0.09
Extra feed	72.82	44.17	3.91	28.65
Total cost	99.59	82.59	4.36	17.00

Silva et al 2015

# Cost per pregnancy was always lower for TAI

**Table 5.** Economic differences per pregnancy (cost per pregnancy of CON minus TAI, US\$) between CON and TAI according to observed and simulated inputs<sup>1</sup>

Scenario <sup>2</sup>	Study IR <sup>3</sup>	Simulated IR <sup>4</sup>			
		50%	60%	70%	80%
Feed, \$/kg of DM					
0.15	11.35	10.51	8.06	6.04	4.33
0.18	18.21	17.30	14.40	11.92	9.78
0.21	25.07	24.15	20.68	17.73	15.22
Labor wage, \$/h					
8.00	11.71	10.71	8.00	5.71	3.77
11.00	11.09	10.21	7.44	5.11	3.12
14.00	10.48	9.71	6.88	4.50	2.48
Synchronization cost, \$					
10.00 (1.67)	17.99	17.30	14.46	12.06	10.01
13.00 (2.17)	14.89	13.87	11.17	8.88	6.94
16.00 (2.67)	11.79	10.45	7.87	5.70	3.87
Semen cost, \$/straw					
4.00	10.04	9.38	6.53	4.10	2.04
7.00	11.93	10.87	8.18	5.91	3.99
10.00	11.79	10.92	8.17	5.84	3.86
P/AI, % of observed in study					
90	11.59	10.59	7.45	4.80	2.56
80	11.95	10.86	7.25	4.21	1.63
70	12.41	11.20	6.99	3.42	0.41

Silva et al 2015

# Model of costs of simulated breeding programs for heifers

Inputs and assumptions

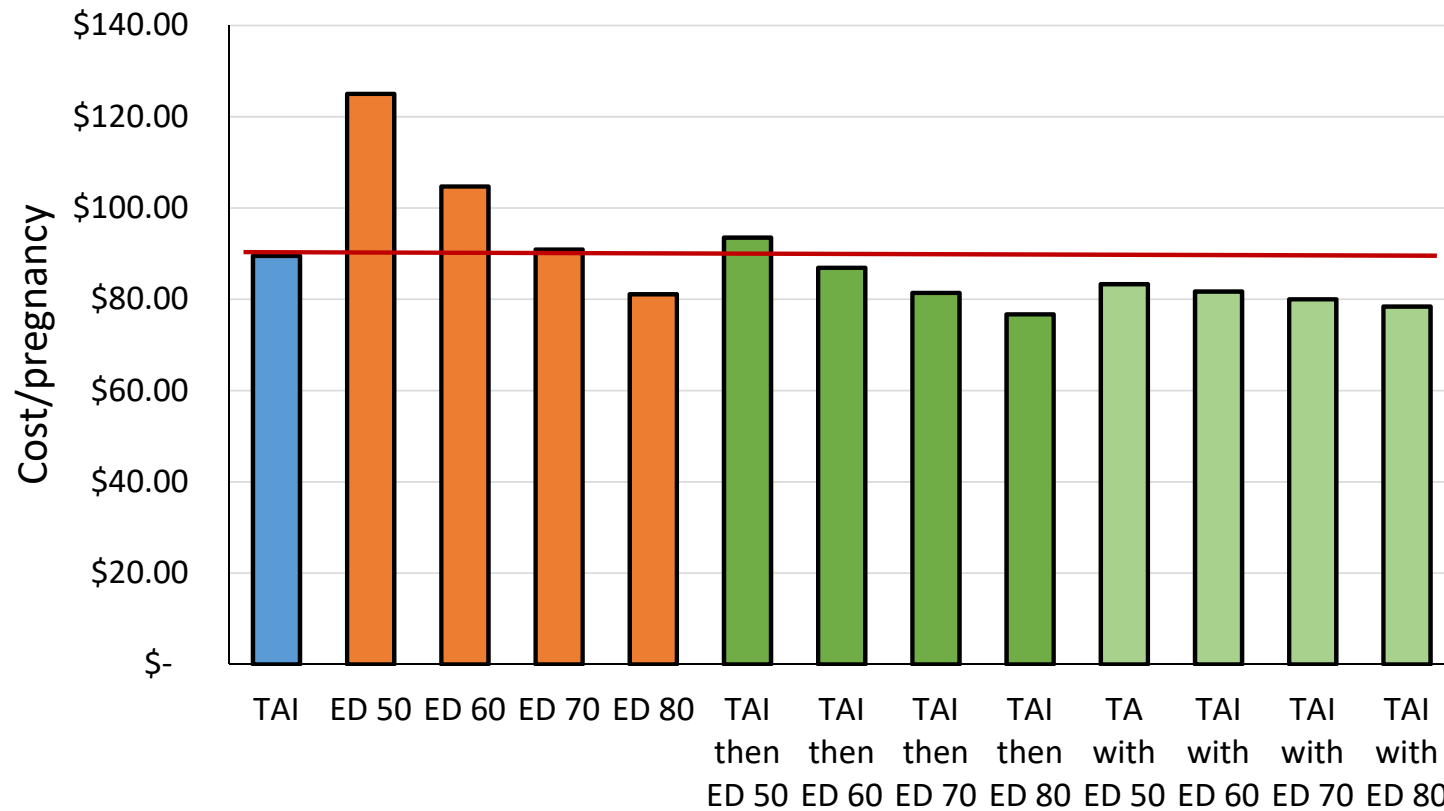
- 84 d programs, starting at 13 months old; heat detection 50 to 80%
- 1) **timed AI for first and subsequent inseminations**
- 2) **detection of estrus only**
- 3) **timed AI for first breeding and detection of estrus for the remaining period**
- 4) **timed AI for first breeding followed by insemination upon detected estrus or resynchronized insemination after nonpregnancy diagnosis**
- Feed cost \$2/d
- Estrus detection includes PGF at start and q 14 d with CR 60% at 1<sup>st</sup> AI and 54% after
- TAI assumes 3 AI q 40 d with CR 59, 55, 51 %
- Drug, semen, labour costs = ???

# Model of costs of simulated breeding programs for heifers

	Breeding program <sup>1</sup>												
	TAI only	Detection of estrus only				TAI + DE on remaining AI				TAI + DE between TAI			
	----	50	60	70	80	50	60	70	80	50	60	70	80
Estrous detection rate (%)	----	50	60	70	80	50	60	70	80	50	60	70	80
Pregnant (%)													
Day 20	59.0	45.0	50.4	54.6	57.6	59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
Day 40	81.6	59.9	66.5	71.8	75.9	70.1	72.3	74.5	76.7	81.4	81.4	81.3	81.3
Day 84	91.0	78.6	84.7	89.1	92.2	84.1	87.3	90.1	92.5	91.1	91.2	91.2	91.3
Age at pregnancy (days)	418.2	426.6	425.0	423.6	422.4	414.4	415.3	415.9	416.3	416.8	416.5	416.2	415.9
Labor days	12	84	84	84	84	68	68	68	68	68	68	68	68
Labor (h/AI)	0.18	0.57	0.49	0.43	0.39	0.37	0.34	0.32	0.30	0.23	0.22	0.21	0.20
Cost/AI (US\$)	20.8	14.9	13.9	13.3	12.8	18.9	18.3	17.8	17.4	19.1	18.5	17.9	17.4
Number of AI/pregnancy	1.75	1.75	1.74	1.74	1.74	1.74	1.75	1.75	1.75	1.75	1.75	1.75	1.75
Feed cost/pregnancy (US\$)	53.1	98.9	80.5	67.8	58.9	60.6	55.0	50.2	46.2	49.9	45.3	48.6	48.0
Total cost/pregnancy (US\$)	89.5	125.0	104.7	90.9	81.1	93.5	86.9	81.4	76.7	83.3	81.7	80.0	78.4

Riberio et al  
2014

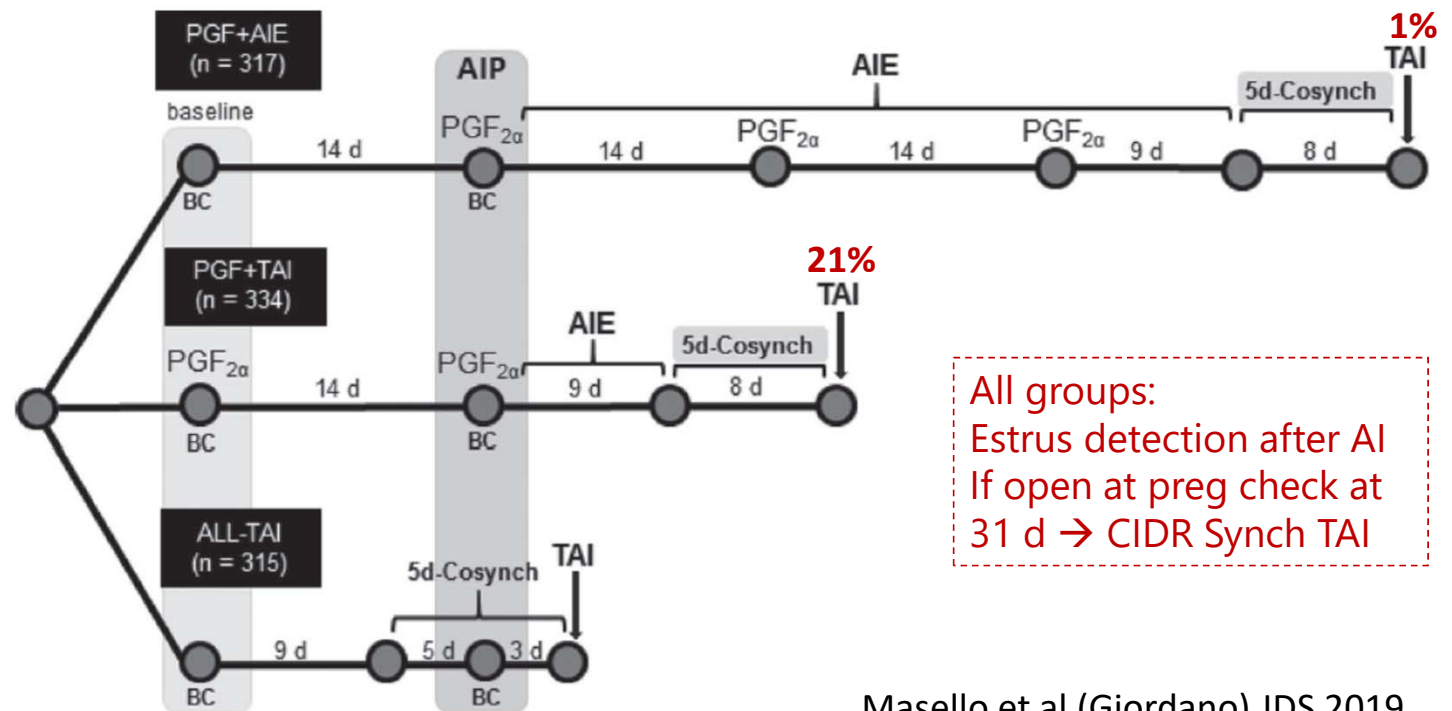
# Model of costs of simulated breeding programs for heifers



Riberio et al  
2014

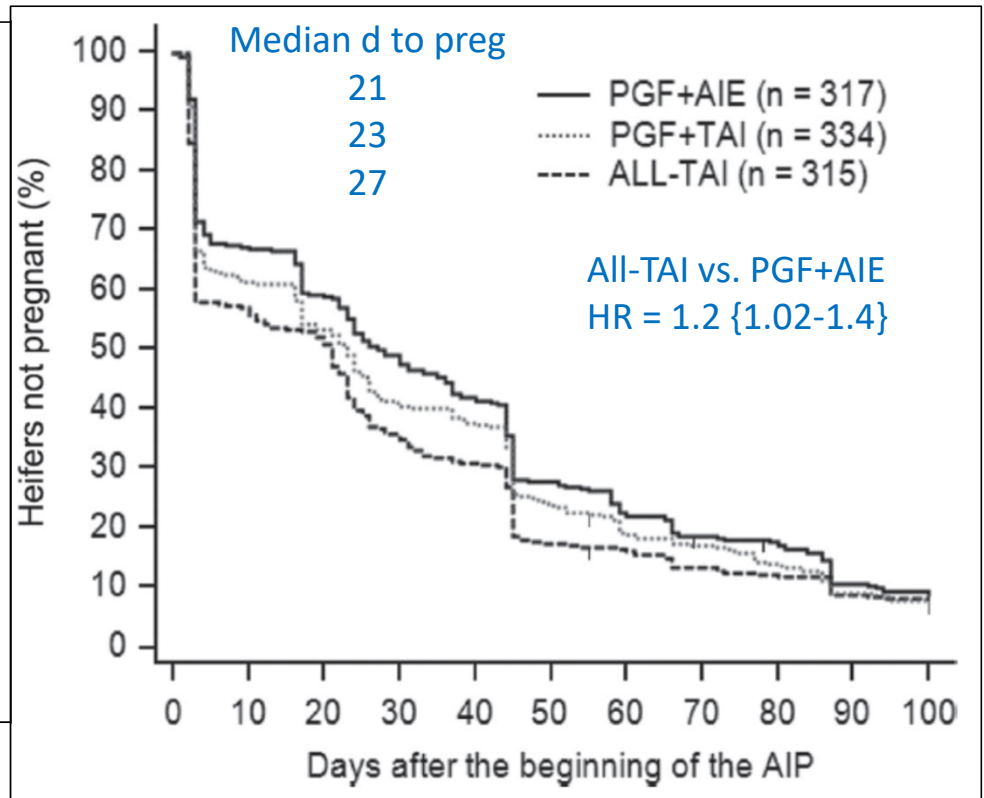
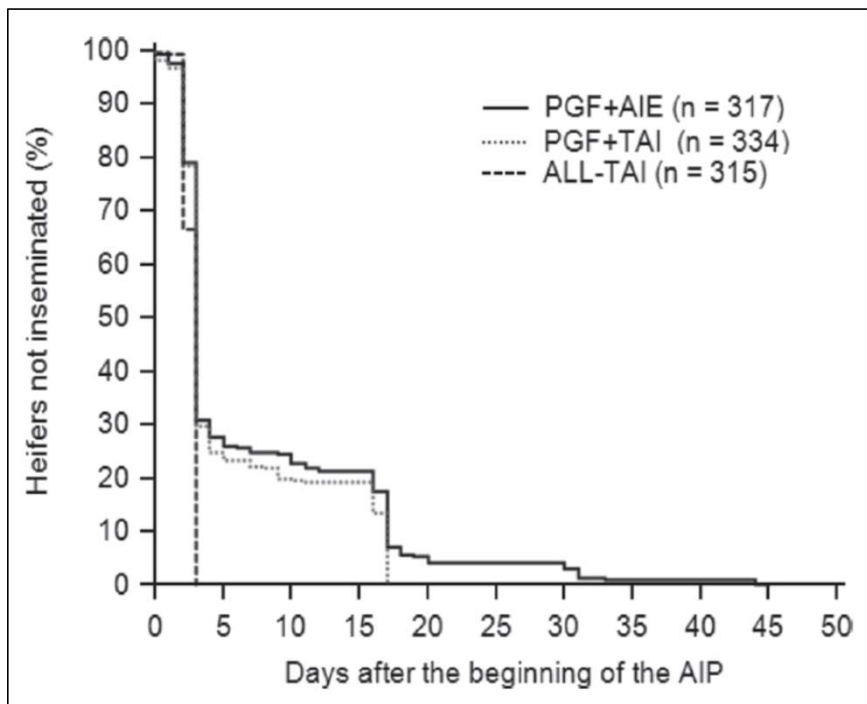
# TAI, heat detection, or hybrid program

- 2 herds in NY
- Heifers enrolled at 12 mo old
- Sexed for 1<sup>st</sup> AI, conventional after
- TAI: GnRH at start; single PGF
- 93-100% cyclic at start



Masello et al (Giordano) JDS 2019

# TAI, heat detection, or hybrid program



# TAI, heat detection, or hybrid program

**Table 2.** Pregnancy per AI (P/AI)  $31 \pm 3$  d after first AI service and after second or greater AI services combined

Item	Treatment, % (n) <sup>1</sup>			P-value
	PGF+AIE	PGF+TAI	ALL-TAI	
Overall P/AI for first AI service <sup>2</sup> <b>All sexed</b>	42.0 (317)	47.3 (334)	43.8 (315)	0.38
P/AI for AIE after PGF <sub>2α</sub> <sup>3</sup>	44.0 (313)	52.9 (269)	—	0.03
P/AI for AIE during 5-d Cosynch <sup>4</sup>	—	45.0 (20)	47.1 (104)	0.86
P/AI for TAI <sup>5</sup>	—	29.0 (45)	41.4 (211)	0.13
Overall P/AI for second and greater AI services <sup>6</sup> <b>All conventional</b>	58.8 (311)	55.7 (318)	57.6 (311)	0.72
P/AI for AIE after AI <sup>7</sup>	59.1 (154)	58.5 (188)	60.3 (189)	0.94
P/AI for AIE during 5-d Cosynch	62.0 (45)	60.0 (30)	66.9 (21)	0.83
P/AI for TAI	53.6 (112)	47.1 (100)	47.7 (101)	0.58

Overall 1<sup>st</sup> CR  
ED: 46%  
TAI: 40%  
P=.10

# Sexed semen

- Typically ~ 20% relative reduction in pregnancy/AI
- AI at detected estrus in heifers favoured
- Generally, no sexed\*protocol interactions
  - No particular TAI protocol is better for sexed semen
- Aim to breed closer to time of ovulation with sexed semen
  - AI 12-24 h (ideally 24 h) after detection of standing heat
  - 24-40 h after onset based on activity (data from cows, not heifers; Bombardelli & Chebel 2016)

# Conclusions

- No consistent advantage to GnRH at start of 5 d CIDR Synch
- 2X PGF in 5 d CIDR Synch may (?) worthwhile
- But if adding GnRH, then do 2X PGF
- Heat detection needs to >70% (80%) to beat primary use of TAI
- Hybrid program works well with heat detection > 70%
  
- Taking charge/setting limits on insemination is a powerful first step