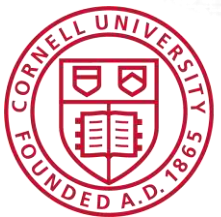


Reducing the economic burden of the replacement heifer enterprise through reproductive management

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Dairy Cattle Biology and Management Laboratory
Department of Animal Science

Vermont Veterinary Medical Association, Vermont
February 4th, 2023



Cornell CALS
College of Agriculture and Life Sciences

Several motivations to reduce days to pregnancy and thus AFC

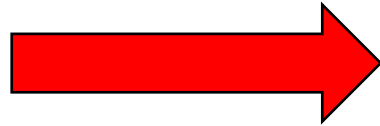
Reducing days to pregnancy...

- 🐄 ...has substantial **positive effects** on heifer enterprise **profitability**
- 🐄 ...does **not compromise productivity** and **reproductive performance** during lactation provided heifers are well fed and managed
- 🐄 ...is **possible** for most herds – usually a **management decision** not limited by heifer biology



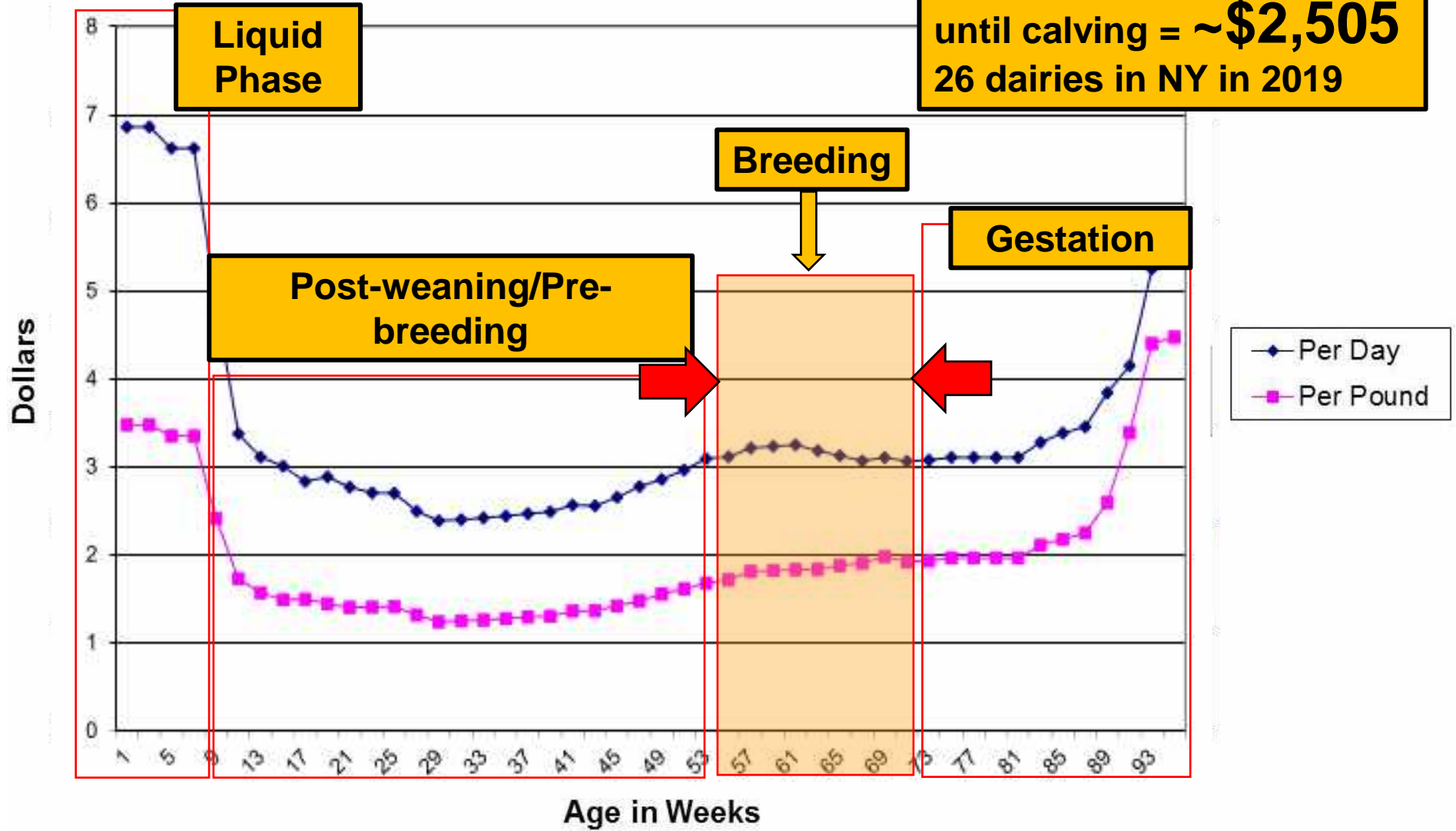
Goal is to get **pregnant** as soon as possible **after heifer is eligible** for pregnancy!!!

Does reducing AFC due to a reduction in time to pregnancy affect the heifer enterprise economics?



Role of reproduction in heifer rearing cost dynamics

Average rearing cost until calving = ~\$2,505
26 dairies in NY in 2019



Does time to pregnancy affect the heifer enterprise economics?

Hypothesis:

Reduced AFC due to improved reproductive performance would improve the economics of Holstein replacements

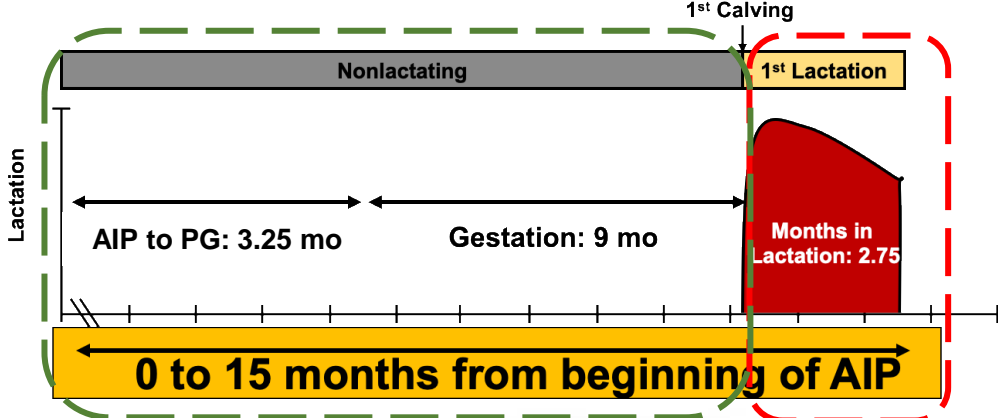
- ❑ Nulliparous Holstein heifers from 3 commercial farms in NY (n = 1,144)
- ❑ Eligible for AI at 368 ± 10 days (12 mo) of age
- ❑ After calving, heifers were **retrospectively** assigned to 1 of 3 groups based on AFC tertiles within farm:
 - Low (20.2 to 21.8 mo; n = 391)**
 - Medium (21.4 to 22.8 mo; n = 376)**
 - High (22.1 to 28.7 mo; n = 377)**



Cash flow estimations conducted per 15 mo per slot



AIP = artificial
insemination period



Cash flow rearing period = Repro cost +
Feed cost + Replacement Cost + Other
operating expenses

Cash flow lactating period = IOFC+ Calf
value + Replacement Cost + Other
operating expenses

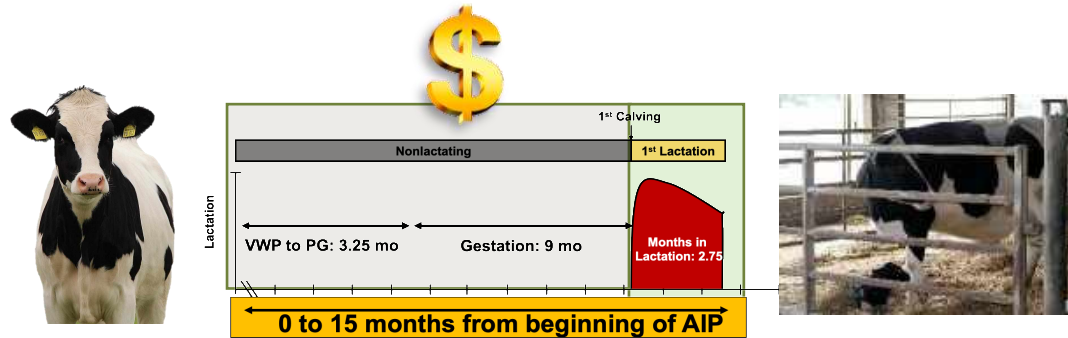
Cash flow (\$/slot/15 mo)



Differences in AFC among groups were explained by differences in age and P/AI at first service

	AFC group			
	Low (n = 391)	Medium (n = 376)	High (n = 377)	P-value
Age 1 st AI (d)	371 ± 0.5 ^a	376 ± 0.5 ^a	378 ± 0.5 ^b	<0.01
P/AI 1 st AI	95.9% ^a	33.2% ^b	0.3% ^c	<0.01

Reduced AFC led to lower reproductive cost



Item (per slot)	AFC Groups			P-value
	Low (n = 391)	Medium (n = 376)	High (n = 377)	
Repro cost, \$	39.9 ± 0.9 ^a	57.0 ± 0.9 ^b	94.6 ± 0.9 ^c	< 0.01
TOTAL RP cost, \$	807 ± 22 ^a	900 ± 22 ^b	1,099 ± 22 ^c	< 0.01
TOTAL FLP profit, \$	454 ± 45 ^a	408 ± 45 ^a	304 ± 45 ^b	< 0.01
Cash Flow 15-mo, \$	-354 ± 63 ^a	-492 ± 63 ^b	-795 ± 63 ^c	< 0.01

Reduced AFC reduced rearing cost after end of the VWP

Item (per slot)	AFC Groups			P-value
	Low (n = 391)	Medium (n = 376)	High (n = 377)	
Repro cost, \$	39.9 ± 0.9 ^a	57.0 ± 0.9 ^b	94.6 ± 0.9 ^c	< 0.01
TOTAL RP cost, \$	807 ± 22^a	900 ± 22^b	1,099 ± 22^c	< 0.01
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Reduced AFC increased first lactation profit per slot per unit of time

Item (per slot)	AFC Groups			P-value
	Low (n = 391)	Medium (n = 376)	High (n = 377)	
Repro cost, \$	39.9 ± 0.9 ^a	57.0 ± 0.9 ^b	94.6 ± 0.9 ^c	< 0.01
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Reduced AFC led to greater cash flow per slot per unit of time

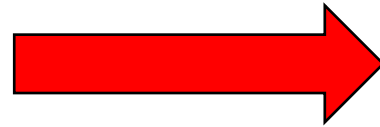
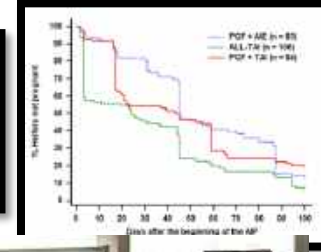
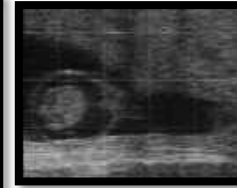
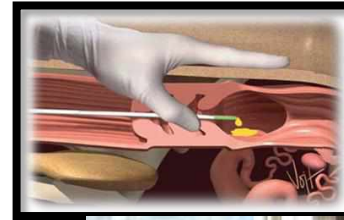
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	Low (n = 391)	Medium (n = 376)	High (n = 377)	
Repro cost, \$	39.9 ± 0.9 ^a	57.0 ± 0.9 ^b	94.6 ± 0.9 ^c	< 0.01
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TOTAL FLP profit, \$	454 ± 45 ^a	408 ± 45 ^a	304 ± 45 ^b	< 0.01
Cash Flow 15-mo, \$	-354 ± 63^a	-492 ± 63^b	-795 ± 63^c	< 0.01

-\$138
-\$441

Does time to pregnancy affect the heifer enterprise economics?

- Differences in time to pregnancy driven by differences in reproductive performance (not on growth) led to **substantial benefits**:
 - **Reduced reproductive cost**
 - **Reduced rearing cost** after the beginning of the insemination period
 - **Earlier first lactation revenue** ---- more profits per unit of time
- A major driver of the reduction in time to pregnancy is **days to and fertility after first service**

Does earlier AFC negatively impact reproductive performance during first lactation?



Evaluated effect of AFC on first lactation reproductive outcomes

Retrospective Cohort Study

- Primiparous Holstein lactating dairy cows from 5 farms in NY (n = 2,235)
- Cows grouped by AFC tertiles within farm (n; mean; range):
 - **Low 21.5 (18.5-22.4)**
 - **Medium 22.1 (21.3-23.3)**
 - **High 23.5 (21.8-29.7)**
- Cows managed with program designed to either inseminate as many cows after detection of estrus or synchronization of ovulation as possible



Summary

We **did not observe** significant **negative consequences** for heifers in the **Low** and **Medium AFC** categories for:

- AI at detected estrus
- Pregnancy per AI to first service for AI at detected estrus or TAI services
- Percent pregnant by 200 DIM
- Percent sold and died by 200 DIM

In fact, we observed some **positive effects** for **Low** and **Medium AFC** for:

- AI at detected estrus
- Pregnant by 200 DIM

Most common issue with heifer repro is poor service rate

Farm	VWP (d)	Heifers			Cows		
		21 d- SR (%)	CR (%)	21 d-PR (%)	21 d-SR (%)	CR (%)	21 d-PR (%)
A	395	57	53	31	68	35	23
B	395	48	66	34	58	40	23
C	385	46	50	25	50	37	18
D	320	26	53	14	50	30	14
E	355	75	49	40	70	39	28
F	400	31	60	19	64	33	20
G	320	13	38	5	59	25	15
H	365	55	42	24	59	38	23
I	385	28	42	15	65	31	20
J	380	53	49	24	66	31	21
K	390	58	48	30	61	32	19
L	325	36	45	18	68	33	23
Avg.	368	44	50	23	62	34	21

18 percentage points

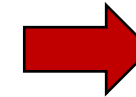
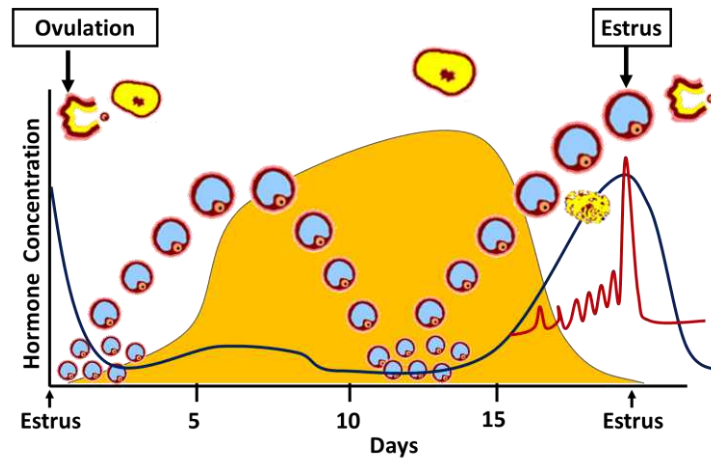
Expression of estrus is not (or should not be) a limitation for dairy heifers



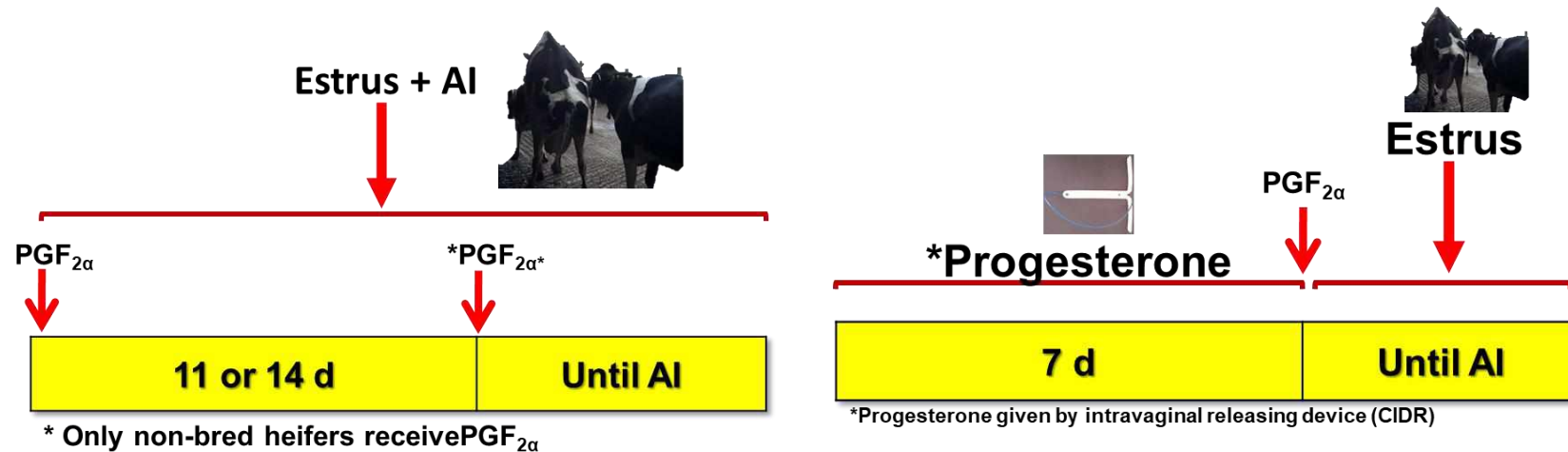
- 🐄 Heifers **DO NOT** present same **limitations to estrus expression** as cows
 - 🐄 No milk production
 - 🐄 Less metabolically challenged
 - 🐄 Fewer health issues
- 🐄 Key factors for success
 - 🐄 Good **nutrition**
 - 🐄 Good **health**
 - 🐄 Reasonable **environmental conditions**

Programs based predominantly on detection of estrus for AI may not be ideal but work

🐄 Efficient estrous detection possible without hormonal intervention



🐄 Promotion of estrus with PGF or P4-based protocols is effective for heifers



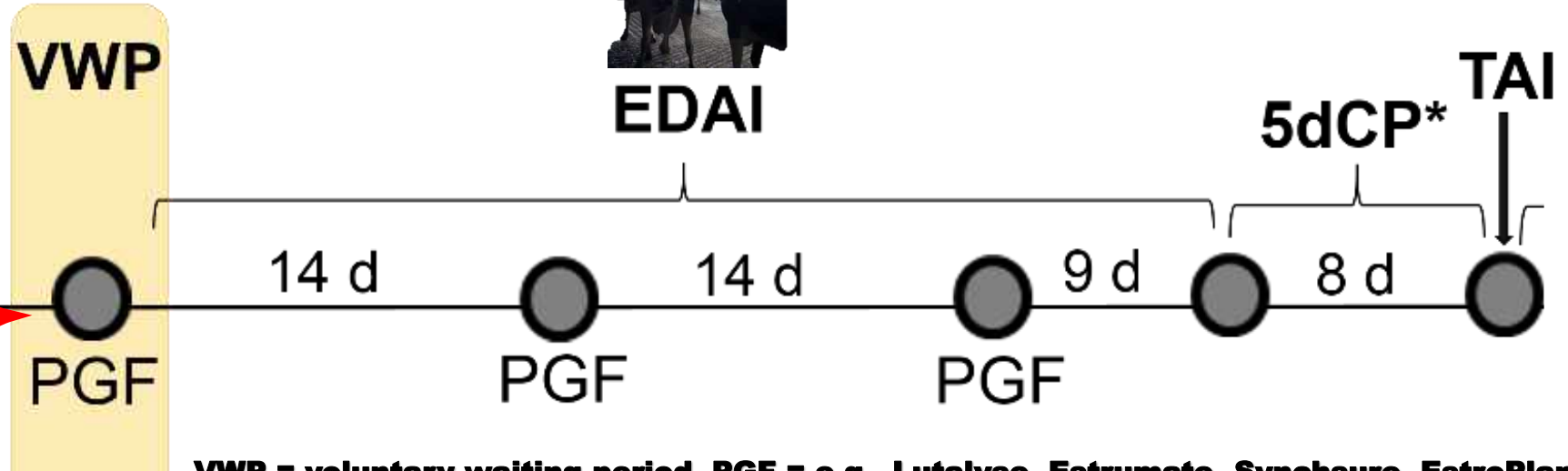
Programs based predominantly on detection of estrus (AIE) after PGF treatments work well



EDAI

5dCP* TAI

**Example (proven) program:
predominant AIE with up to
3 PGF treatments and
synch protocol for TAI as
safety net**



**VWP = voluntary waiting period, PGF = e.g., Lutalyse, Estrumate, Synchsure, EstroPlan,
5dCP = 5 day Cosynch**

- Recent work (Masello et al., 2019 JDS 102(2):1671-1681) showed program can be effective and lead to reasonable preg. rate – good estrus detection is key!!!
- May not maximize profitability as compared to more aggressive use of TAI

Traditional methods or automated technologies for detection of estrus work well for heifers

Traditional methods



Automated detection of estrus



- Heifers **DO NOT** present same **limitations to estrus expression** as cows
- No milk production
- Less metabolically challenged
- Fewer health issues
- Key factors for success
 - Good **nutrition**
 - Good **health**
 - Reasonable **environmental conditions**
- **Unlikely to present biological limitations to express estrus!!!**

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Automated estrus detection (AED) systems are effective for heifers



J. Dairy Sci. 102:6624–6638
<https://doi.org/10.3168/jds.2018-15205>
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Genomic merit for reproductive traits. I: Estrous characteristics and fertility in Holstein heifers

Anderson Veronese,¹ Odinei Marques,¹ Rafael Moreira,¹ Anna L. Belli,¹ Rafael S. Bisinotto,¹ Todd R. Bilby,² Francisco Peñagaricano,³ and Ricardo C. Chebel^{1,3*}
¹Department of Large Animal Clinical Sciences, University of Florida, Gainesville 32610
²Merck Animal Health, Madison, NJ 07940
³Department of Animal Sciences, University of Florida, Gainesville 32610



- There were no significant differences for detection of estrus and P/AI for an **AED system** versus **tail-head mount detectors**

	Group		P-value
	AED (n = 260)	Mount detector (n = 236)	
First service rate	No difference		0.11
P/IA for AI services	50.6%	50.6%	0.30
Pregnancy rate ET	26.7%	31.1%	0.14

No difference for 2+ IA P/AI. Tendency (P = 0.06) to reduce days to second AI for AED system .

Automated estrus detection systems are effective for heifers



Performance and optimization of an ear tag automated activity monitor for estrus prediction in dairy heifers^{2*}



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^a Livestock Center, University of Alberta, Edmonton, AB, T6G 2C8, Canada

^b Department of Large Animal Clinical Sciences, Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, SK, S7N 5B4, Canada

^c Livestock Systems Section, Alberta Agriculture and Forestry, Edmonton, AB, T6H 5T6, Canada

- AED system (eSense, Allflex) detected the **vast majority (>90%) of estrus events** and generated a **reasonable number of false positives (<10%)** when using mount detectors as control

Reference method	Sensitivity	False positives	PPV ¹
Mount patches (Estrotec) (n = 468)	91.0%	8.0%	83.5%

¹PPV = positive predictive value

AED systems are a tool available for dairies that struggle with traditional methods for detection of estrus or benefit by use of this technology

- AED systems **effective** but **not superior** to traditional methods of detection of estrus (at least under research conditions)
- **Useful tool** for implementation of reproductive management programs that depends primarily on AI at detected estrus

AED systems

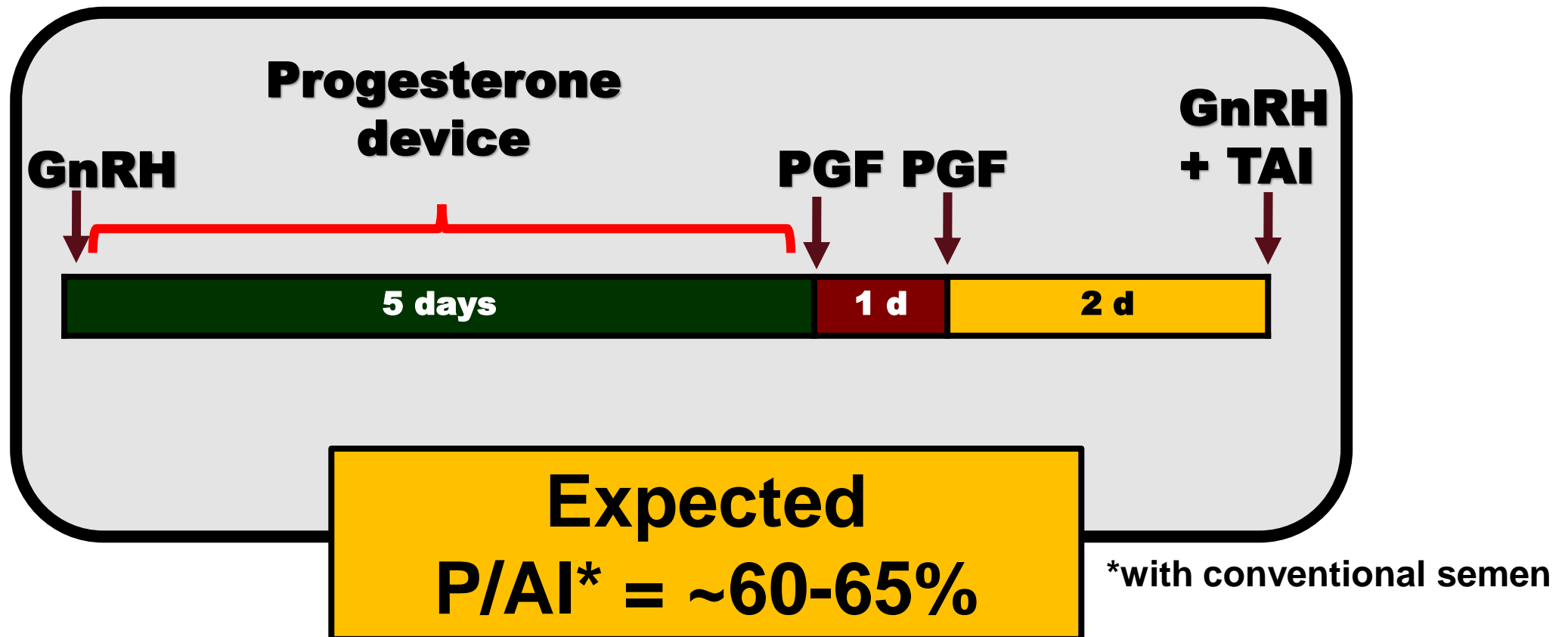


Effective TAI programs are available for heifers

To synch or not to synch (?)

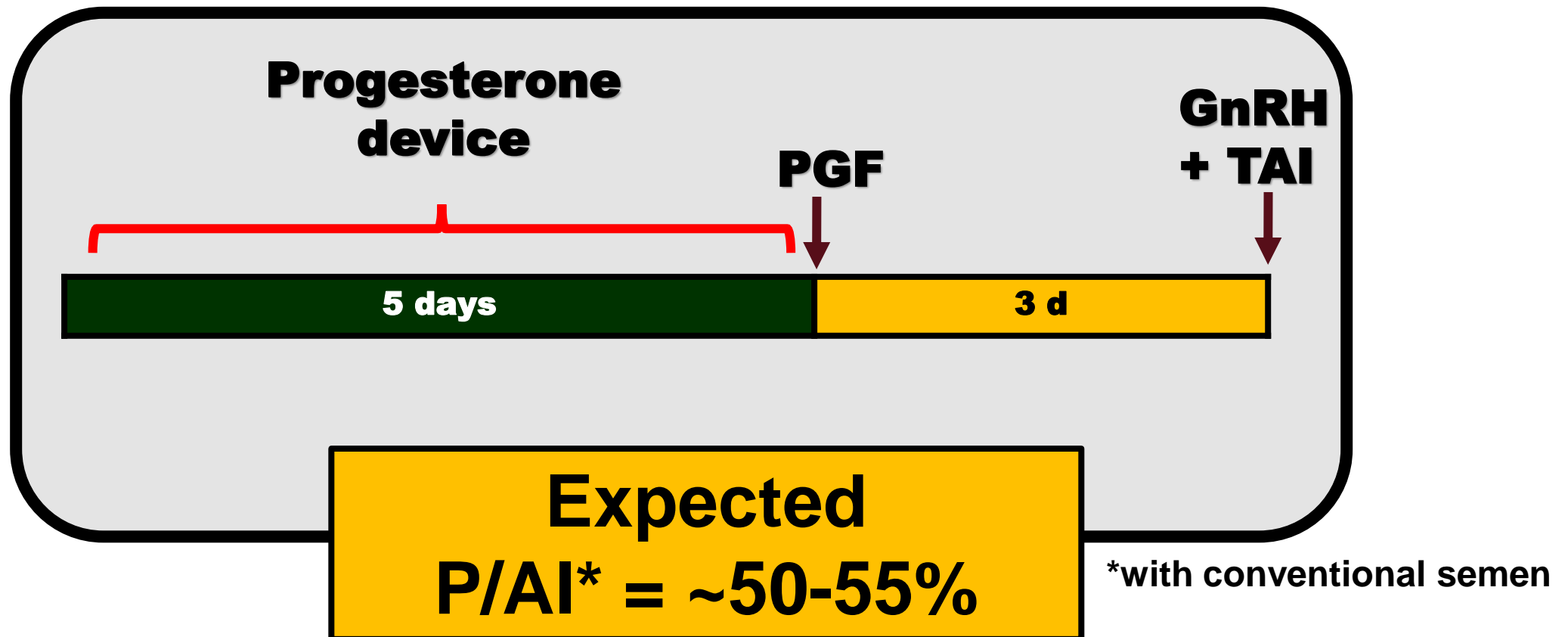
- 🐄 **Entail complex treatment schemes of difficult implementation for some farms**
- 🐄 **May be more expensive to implement than predominant AIE programs**
- 🐄 **May be more profitable through a reduction of time to pregnancy**

5 d-Cosynch + Progesterone optimal for TAI in Heifers



Rabaglino et al., 2010, Lima et al., 2013; Santos et al., 2011

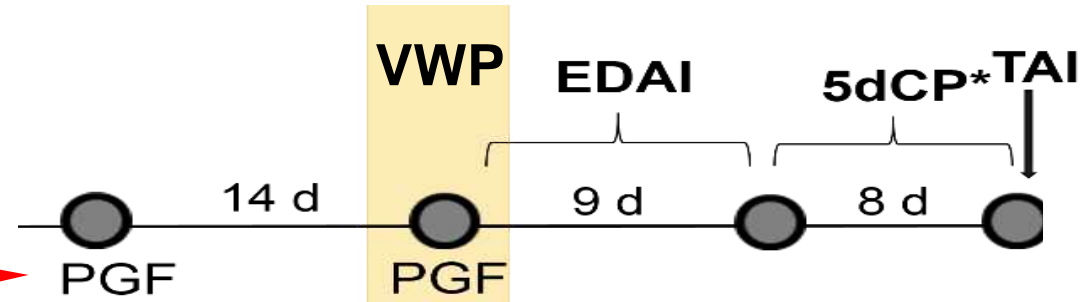
5 d-Cosynch + Progesterone optimal for TAI in Heifers



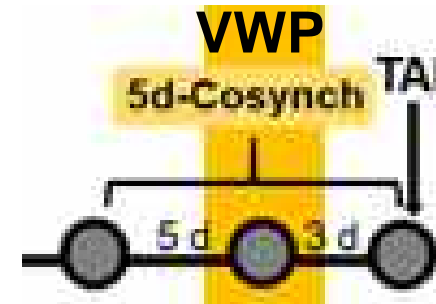
Rabaglino et al., 2010, Lima et al., 2013; Santos et al., 2011

ALL-TAI or TAI after 2 PGF treatments works well and more profitable than predominant estrus breeding

**Example (proven) program:
Predominant AIE with up to 2 PGF
(Presynch) and synch protocol for TAI
as safety net**



**Example (proven) program:
ALL-TAI for first service**



- Recent work (Masello et al., 2019 JDS 102(2):1671-1681) showed programs can be more effective for improving preg. rate compared with almost ALL-estrus AI
- Expected to maximize profitability as compared to ALL-AIE



J. Dairy Sci. 102:1671–1681
<https://doi.org/10.3168/jds.2018-15200>
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Reproductive performance of replacement dairy heifers submitted to first service with programs that favor insemination at detected estrus, timed artificial insemination, or a combination of both

M. Masello,¹ M. M. Perez,¹ G. E. Granados,¹ M. L. Stangaferro,¹ B. Ceglowski,² M. J. Thomas,² and J. O. Giordano^{1*}

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J. Dairy Sci. 104
<https://doi.org/10.3168/jds.2020-18588>

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Effect of reproductive management programs for first service on replacement dairy heifer economics

M. Masello,¹ M. M. Perez,¹ G. E. Granados,¹ M. L. Stangaferro,¹ B. Ceglowski,² M. J. Thomas,² and J. O. Giordano^{1*}

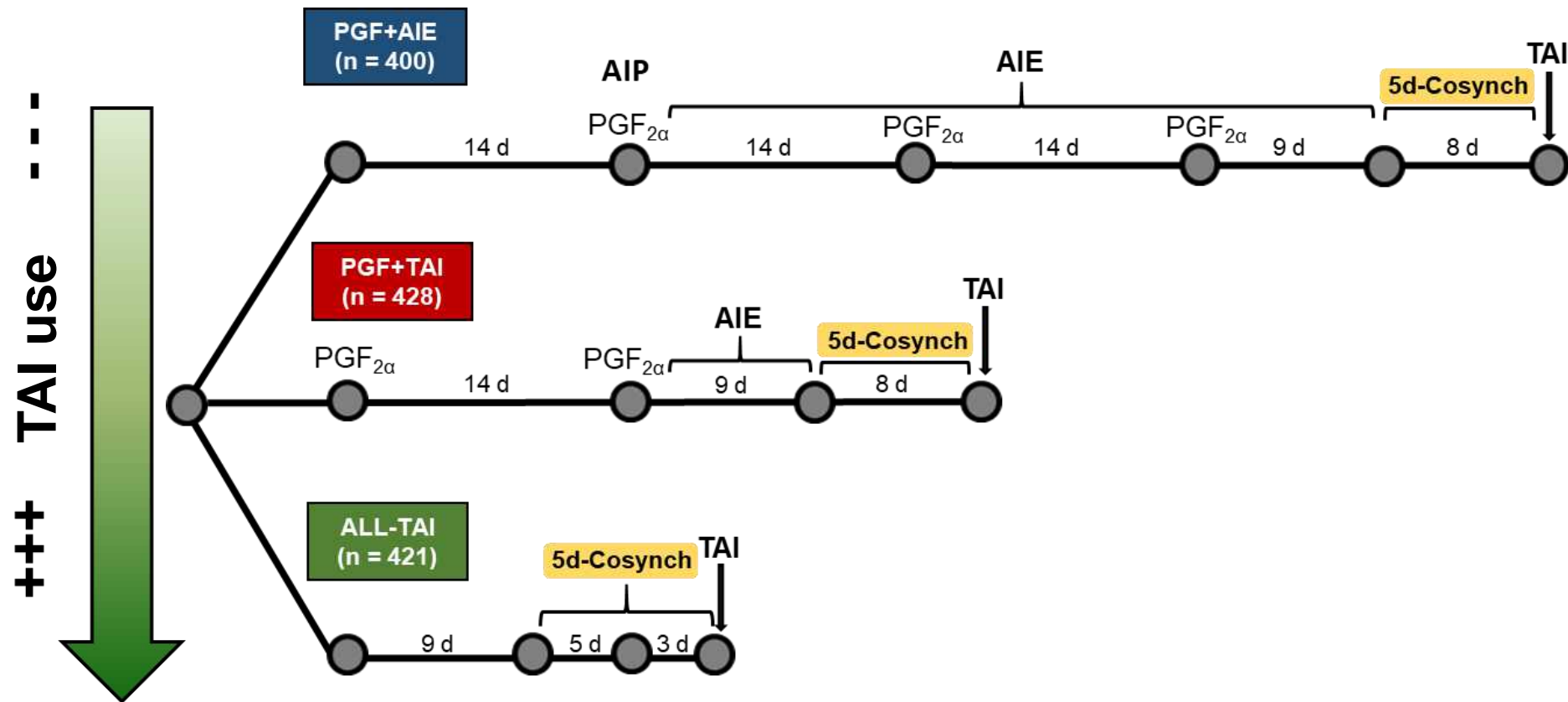
¹Department of Animal Science, Cornell University, Ithaca, NY 14853

²Dairy Health and Management Services, Lowville, NY 13367

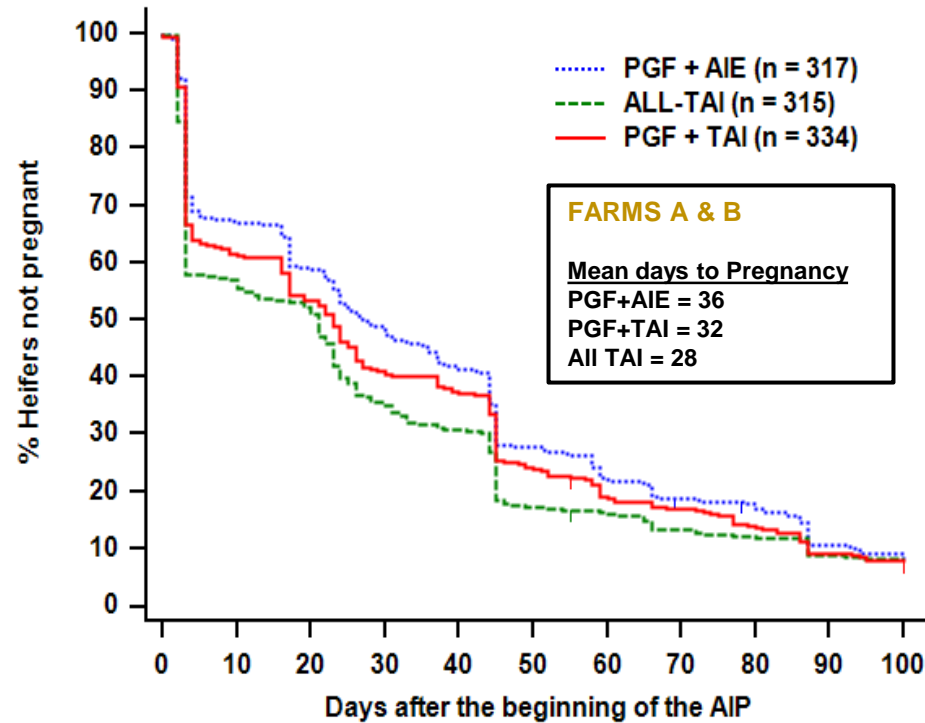
- **Holstein heifers 3 commercial farms in NY**
 - **Farms A & B** → relatively equal repro management (**MORE** effort on estrus detection)
 - **Farm C** → different approach to repro management (**LESS** effort on estrus detection)
- **Enrolled at 368 ± 10 days (12 mo) of age**
- **Semen use**
 - **1st service - 100% sexed semen**
 - **2+ AI service – 100% conventional semen**

Compared predominant AIE, TAI, or combined programs

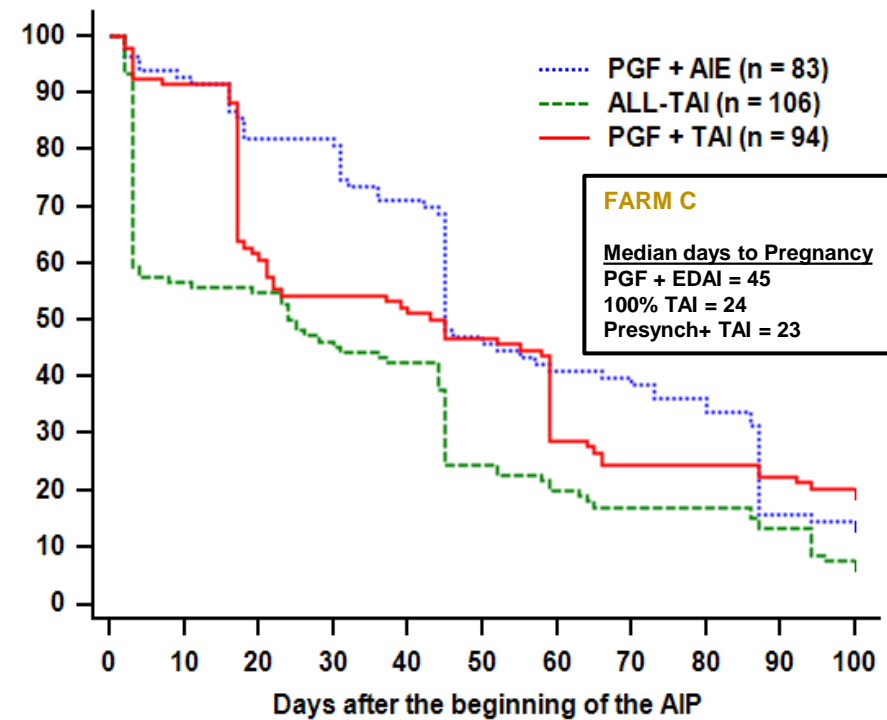
1st AI Service – Sexed sorted semen



Time to Pregnancy for up to 100 d affected by Treatment and Farm



Hazard Ratios (95% CI)		
PGF + EDAI	100% TAI	Presynch + TAI
REF	1.20 (1.02 - 1.42)	1.13 (0.96 - 1.32)




Hazard Ratios (95% CI)		
PGF + EDAI	100% TAI	Presynch + TAI
REF	1.69 (1.24 - 2.30)	1.58 (0.77 - 1.49)

Economics – “Up to 15 mo of VWP”

FARMS A & B

Variable	Treatment Groups			P-value
	PGF+AIE (n = 313)	PGF + TAI (n = 330)	100% TAI (n = 306)	
Repro cost (\$/heifer slot)	69.9 ± 2.0a	72.3 ± 2.0a	85.1 ± 2.3b	<0.001
Rearing cost (\$/heifer slot)	931 ± 9	911 ± 10	900 ± 10	0.08
First lact profit (\$/heifer slot)	393 ± 20	424 ± 18	405 ± 19	0.48
Total cash flow (\$/ heifer slot)	(-538) ± 24	(-486) ± 21	(-495) ± 21	0.22
		+\$52 X Presynch+TAI	+\$43 X 100%TAI	


Presynch + TAI strategy most (numerically) profitable when accounting for rearing cost and opportunity cost of lactation in herds with **GOOD** detection of estrus!!!

Economics – “Up to 15 mo of VWP”

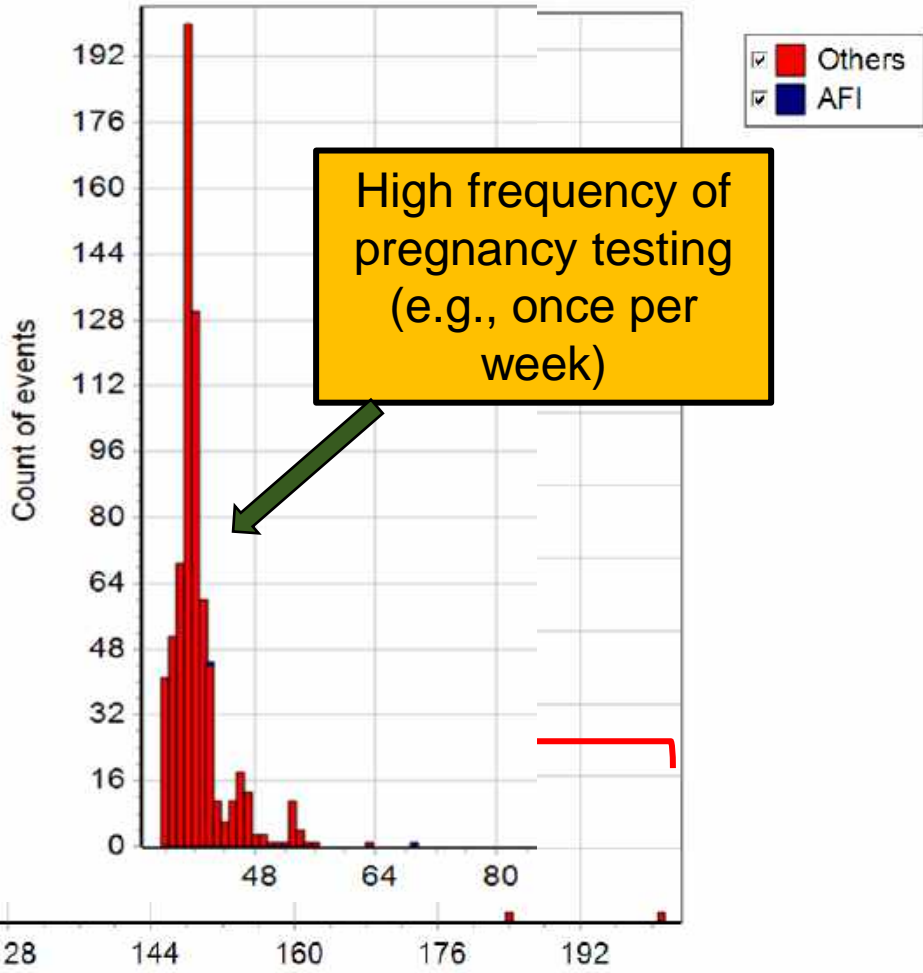
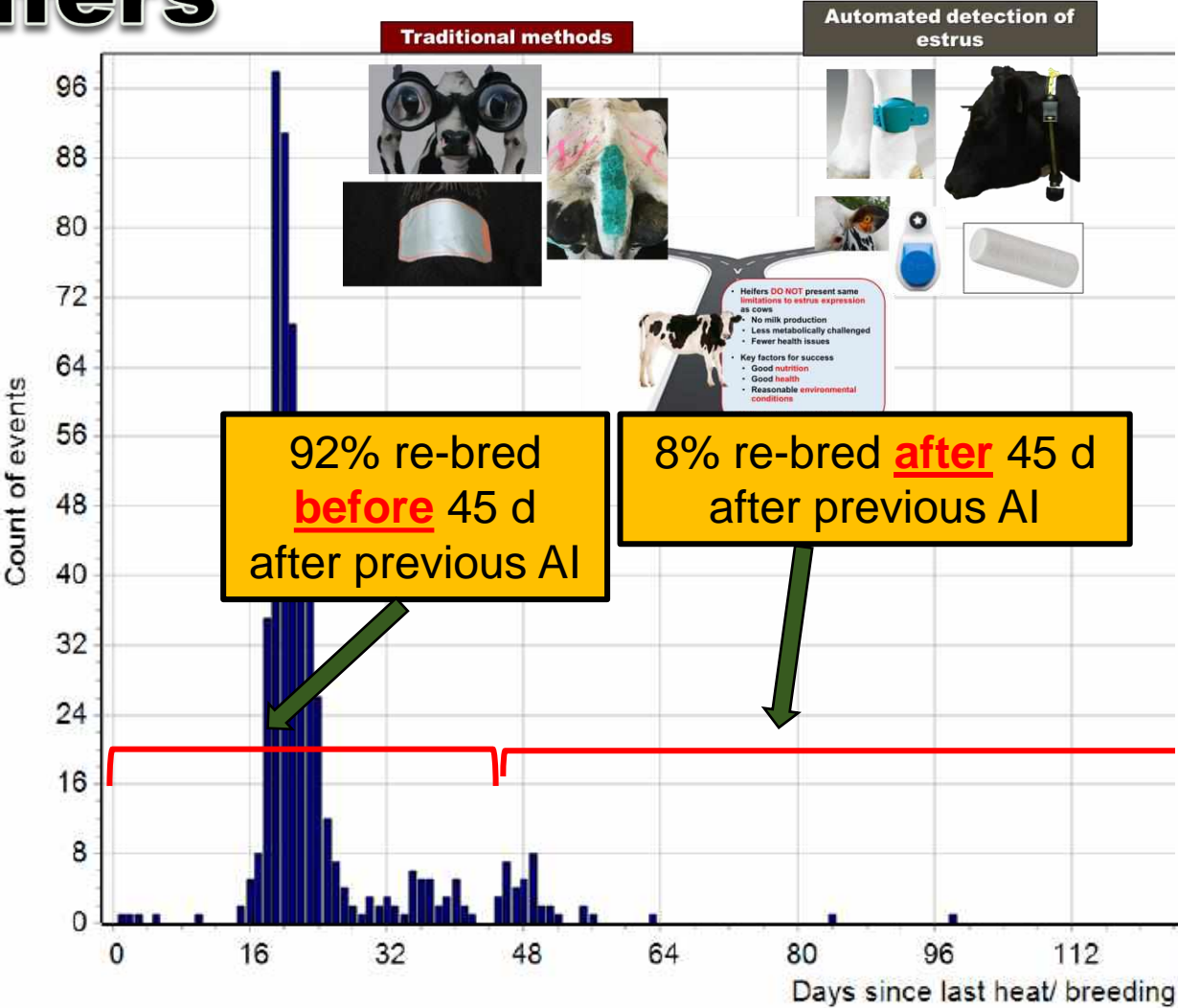
FARM C

Variable	Treatment Groups			P-value
	PGF+AIE (n = 83)	PGF + TAI (n = 94)	100% TAI (n = 106)	
Repro cost (\$/heifer slot)	87.8 ± 5.1	100 ± 5.7	89.7 ± 4.4	0.19
Rearing cost (\$/heifer slot)	1046 ± 33 a	968 ± 21	1082 ± 14 b	<0.01
First lact profit (\$/heifer slot)	291 ± 29	199 ± 4	291 ± 29	0.09
Total cash flow (\$/ heifer slot)	(-755) ± 48 ab	(-769) ± 50 a	(-637) ± 33 b	0.05

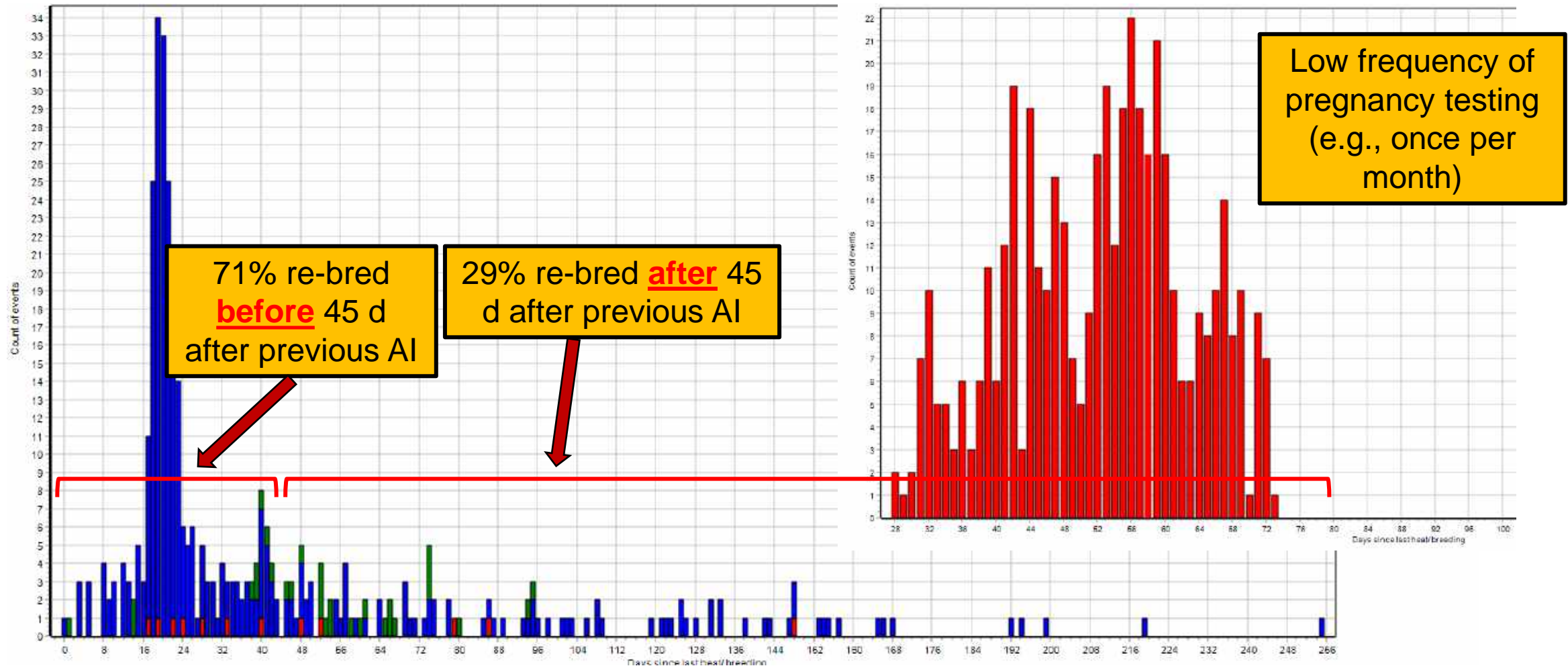
-\$14 X Presynch+TAI	+\$118 100%TAI
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✔ **100% TAI strategy** most profitable when accounting for rearing cost and opportunity cost of lactation in herd with **LOW detection of estrus!!!**

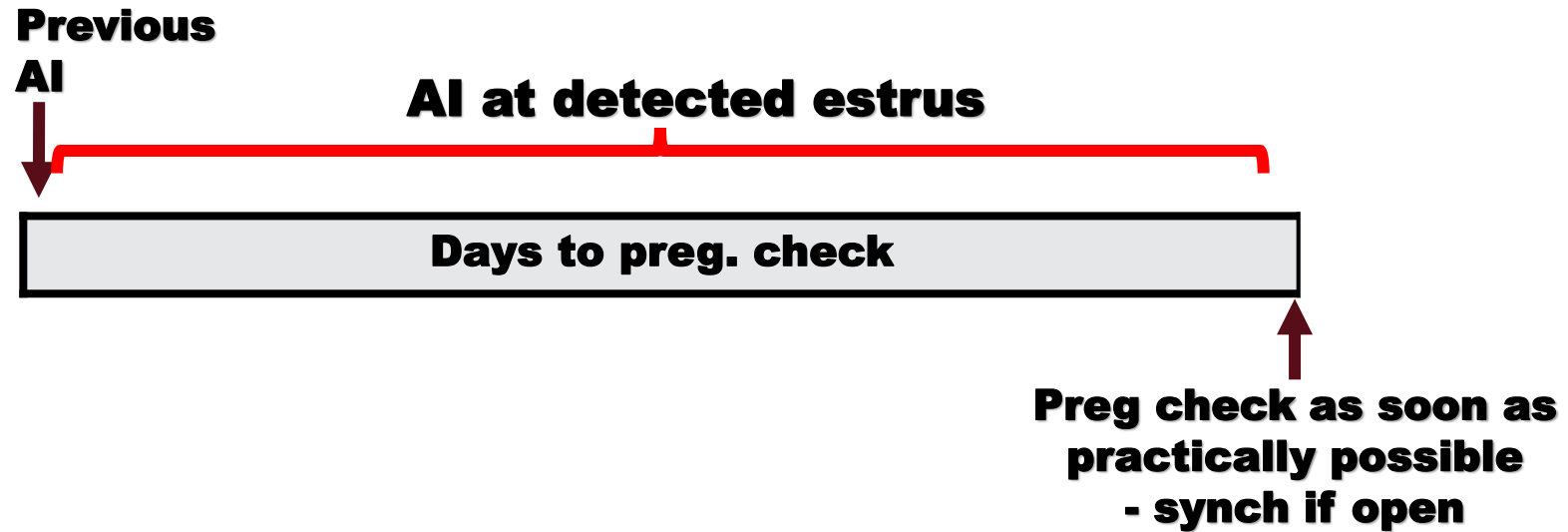
Implement re-breeding program that takes advantage of good estrous expression by heifers



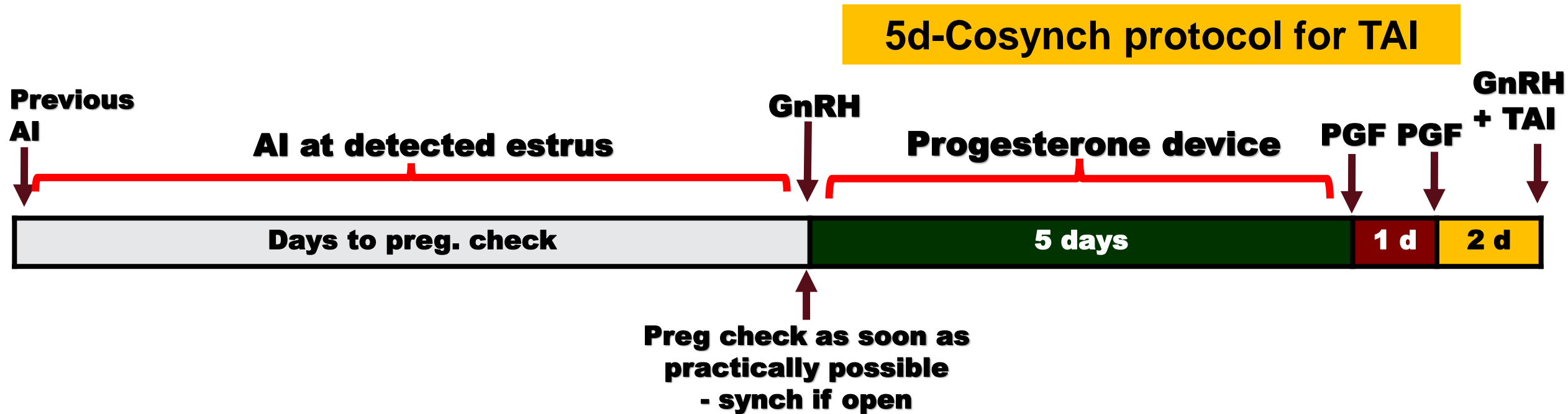
TAI may help with re-breeding if detection of estrus is not optimal



Combine estrous detection + TAI for re-breeding heifers

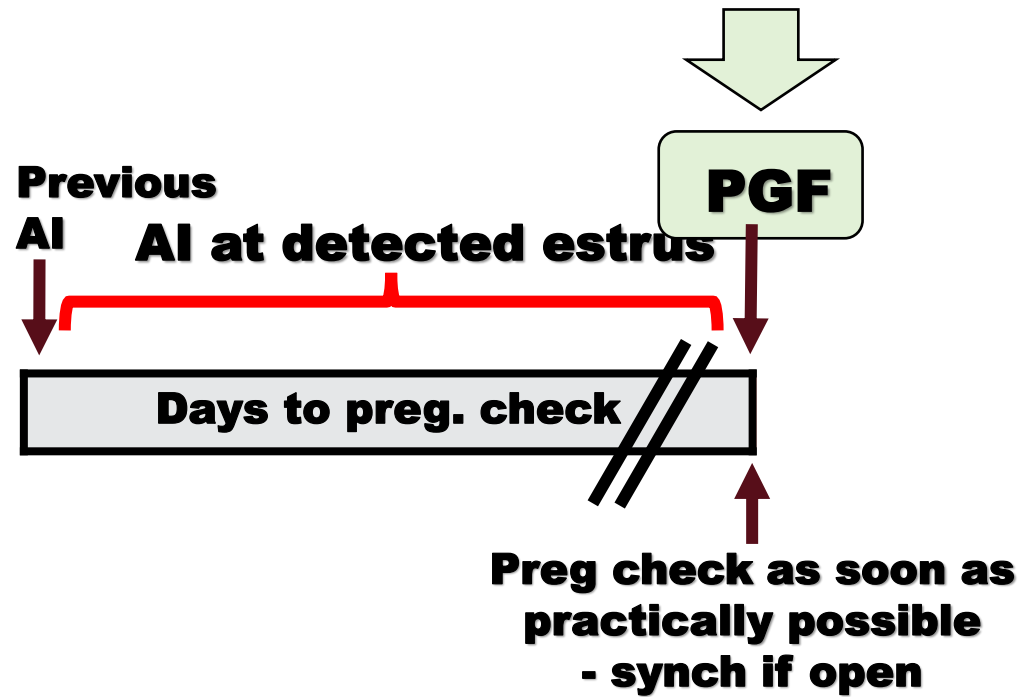


Combine estrous detection + TAI for re-breeding heifers



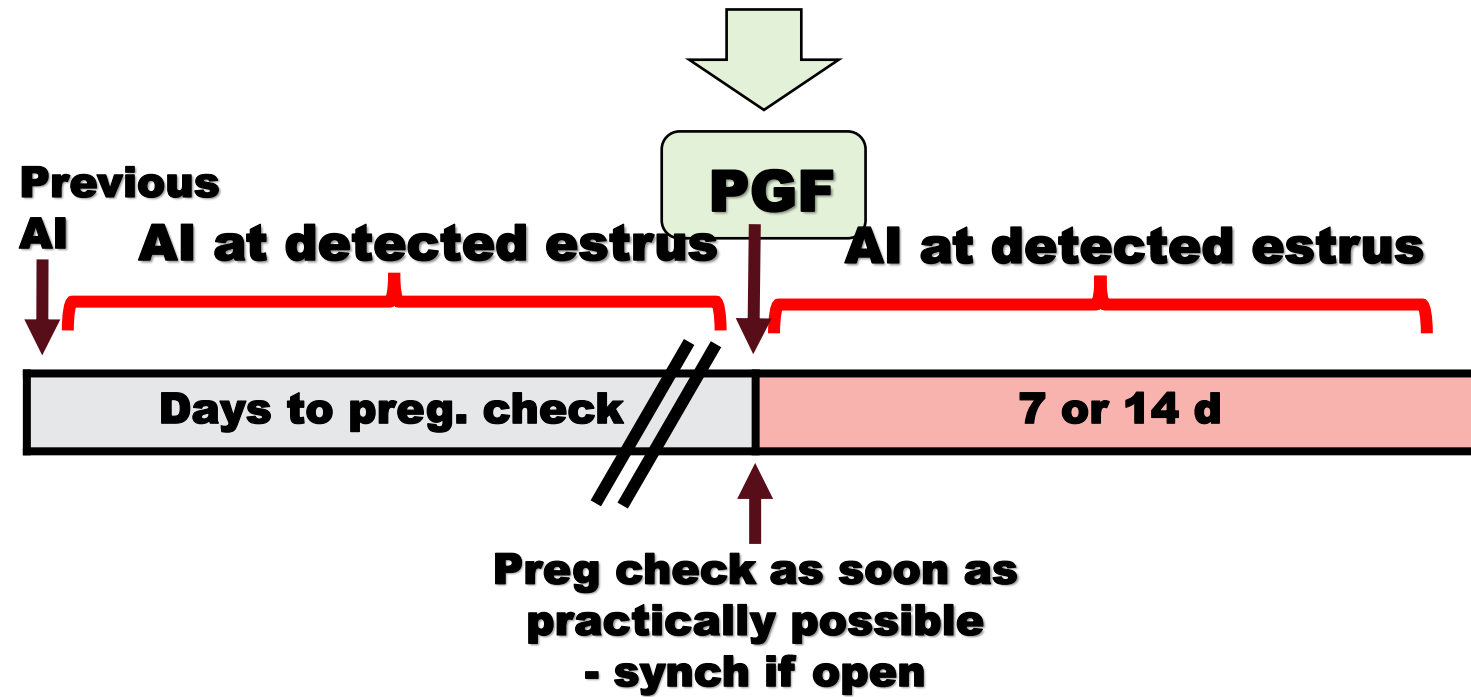
- 🐄 Use any synchronization protocol that allows TAI and leads to good fertility
- 🐄 Will help reduce days to pregnancy by earlier re-breeding
- 🐄 The worse the estrous detection the greater the benefit of this type of strategy

Combine estrous detection + TAI for re-breeding heifers



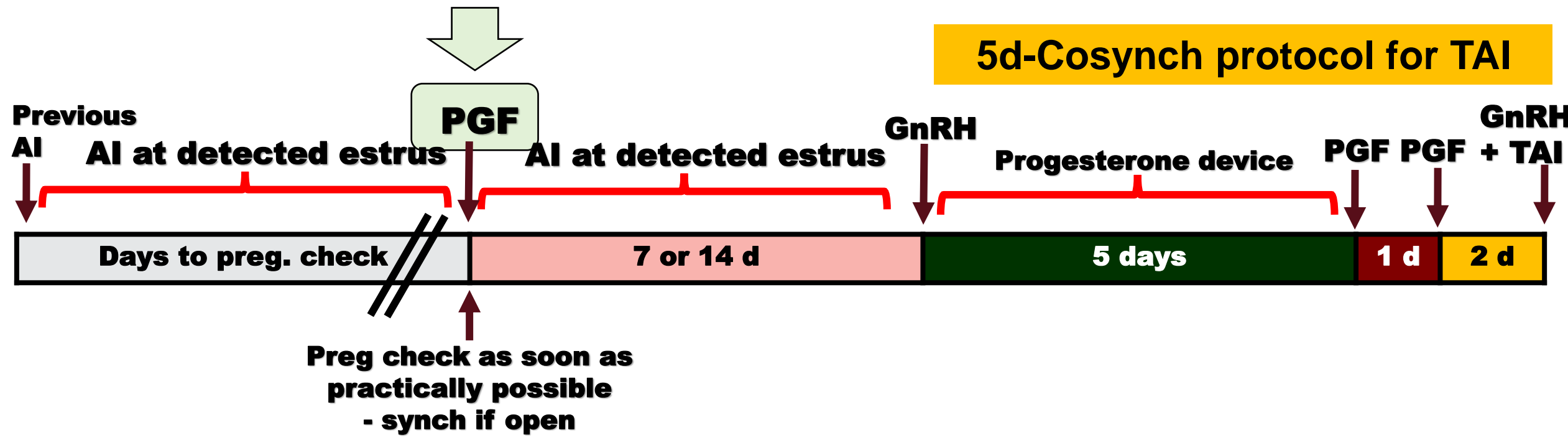
- Use any PGF to re-breed more heifers at detected estrus after pregnancy testing. Will need TAI in very few heifers.
- Use synchronization protocol that allows TAI and leads to good fertility
- Will help reduce days to pregnancy by earlier re-breeding

Combine estrous detection + TAI for re-breeding heifers



- Use any PGF to re-breed more heifers at detected estrus after pregnancy testing. Will need TAI in very few heifers.
- Use synchronization protocol that allows TAI and leads to good fertility
- Will help reduce days to pregnancy by earlier re-breeding

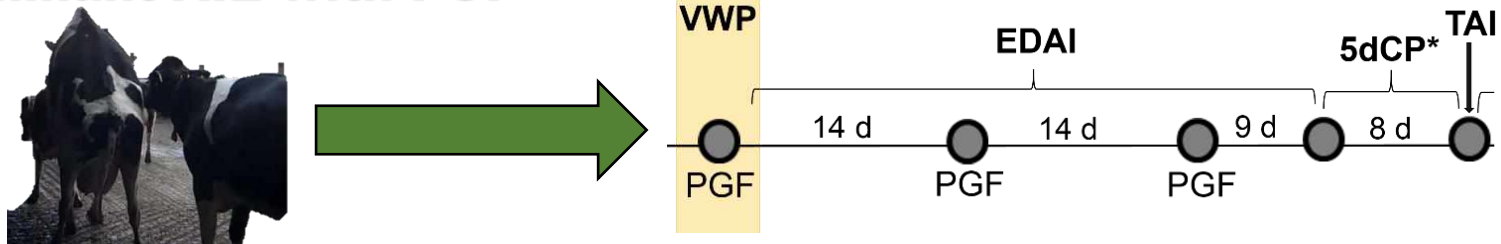
Combine estrous detection + TAI for re-breeding heifers



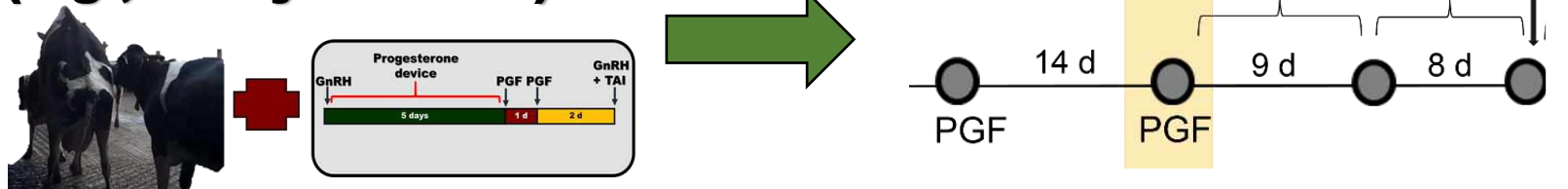
- 🐄 Use any PGF to re-breed more heifers at detected estrus after pregnancy testing. Will need TAI in very few heifers.
- 🐄 Use synchronization protocol that allows TAI and leads to good fertility
- 🐄 Will help reduce days to pregnancy by earlier re-breeding

Example proven **first breeding** reproductive programs for heifers

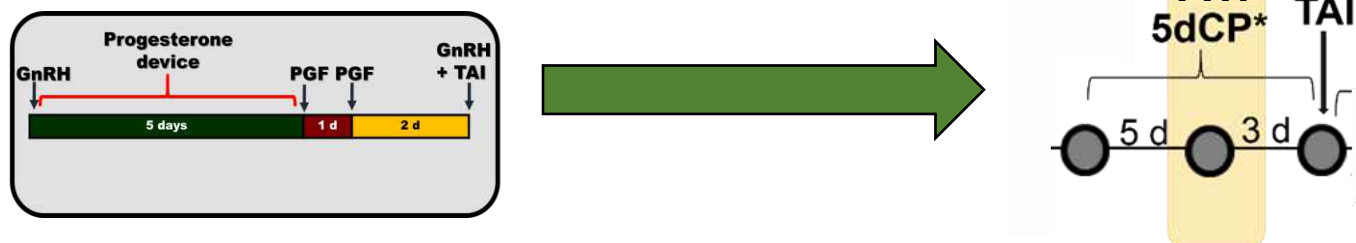
Predominant AIE with PGF



Combined AIE + TAI (e.g., Presynch + TAI)

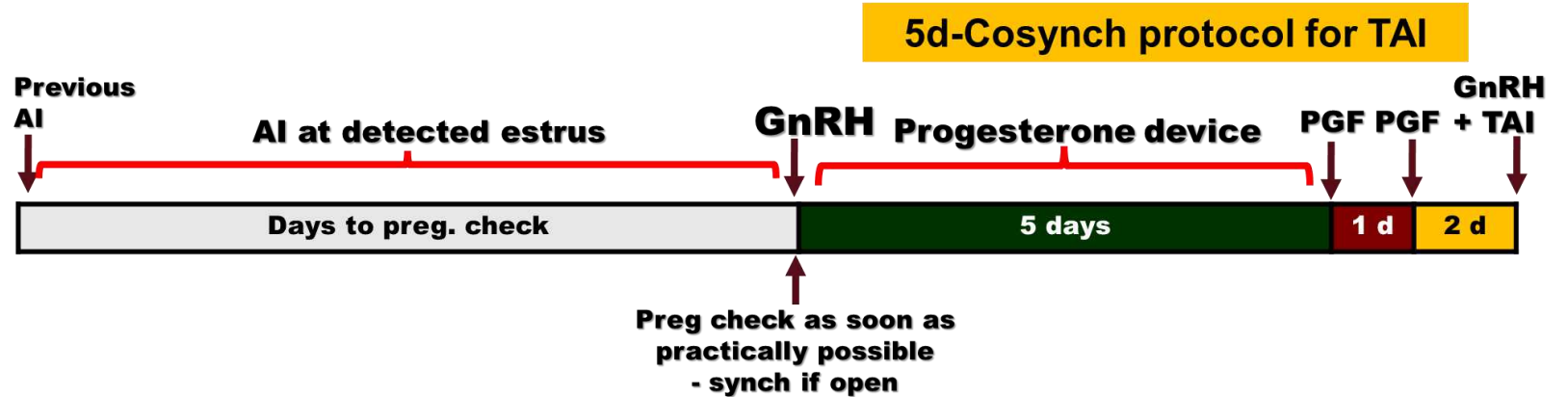


ALL-TAI

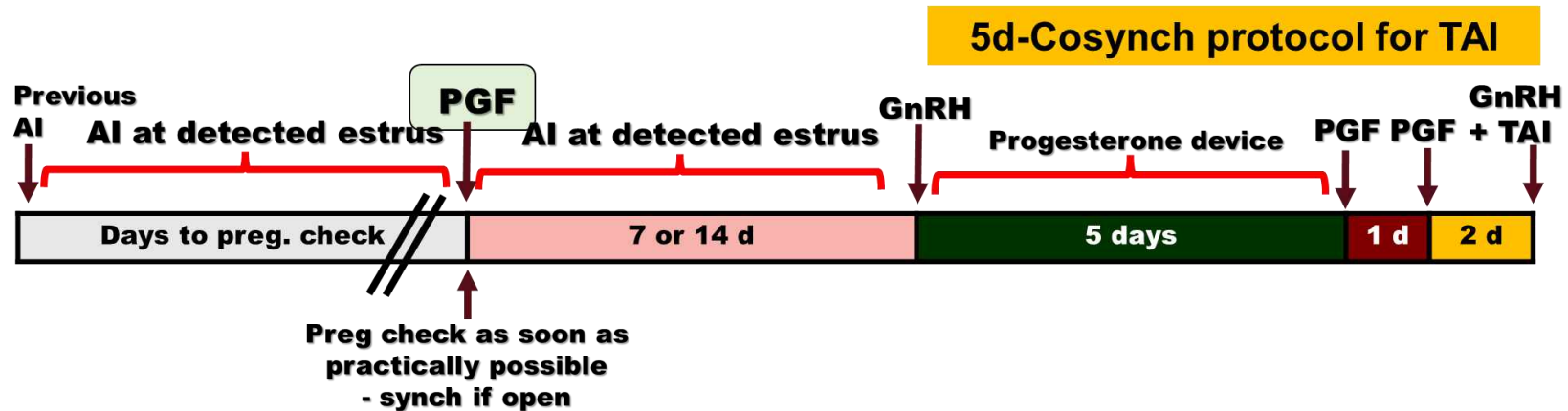
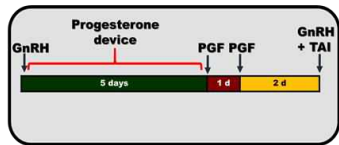


Example proven **second+ breeding** programs for heifers

Promote AIE with PGF after Pregnancy testing



Combined AIE with TAI after pregnancy diagnosis



Summary

🐄 Simple programs for **promoting AI in estrus** or more complex **TAI** programs **available** and **effective**

🐄 Optimal reproductive program for heifers highly influenced by **estrous detection efficiency**

🐄 **Combined (AIE + TAI)** or **all TAI** for 1st AI may be more profitable than **predominant estrus detection** programs even for farms with reasonable estrous detection efficiency

🐄 Consider an **aggressive re-breeding program** including pregnancy testing and TAI



Acknowledgement



Cornell University
College of Agriculture and Life Sciences

Dairy Cattle Biology & Management Laboratory



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United States Department of Agriculture
National Institute of Food and Agriculture

This work was supported by the **USDA National Institute of Food and Agriculture**, Animal Health Program **Project # 2017-67015-26772**, **Hatch project NYC-2020-21-255**, and **Multistate project 1021189**. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the National Institute of Food and Agriculture (NIFA) or the United States Department of Agriculture(USDA)”.



Commercial dairy farms

Thank You! Questions?

