

PRRS, PED and Biosecurity: What has changed and lessons learned

Luc Dufresne DMV

December 4th, 2024



DEMETER

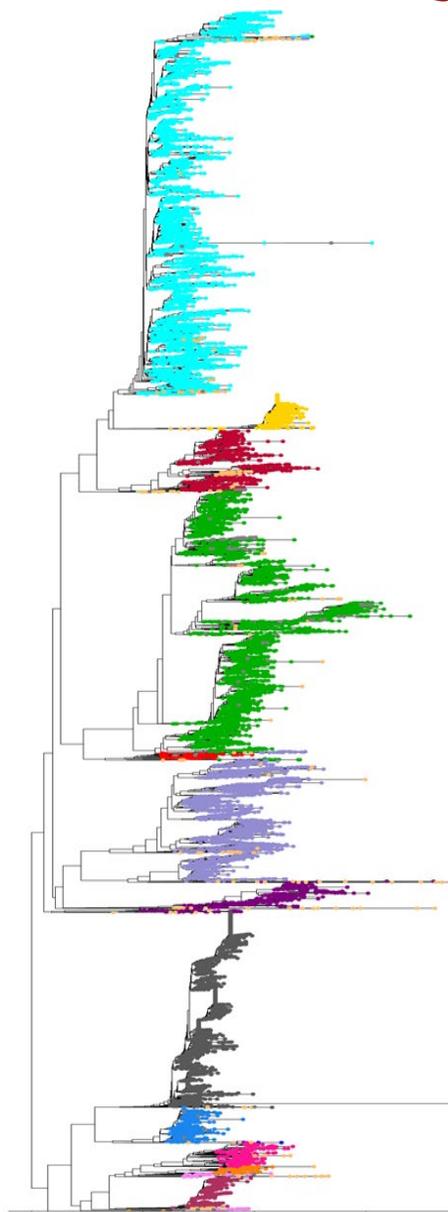
Veterinary Services Inc.

PRRSv Update



How we classify PRRSV-2?

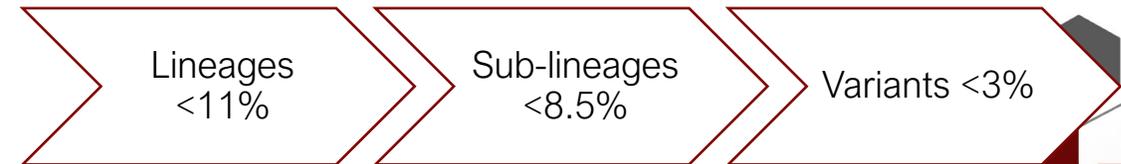
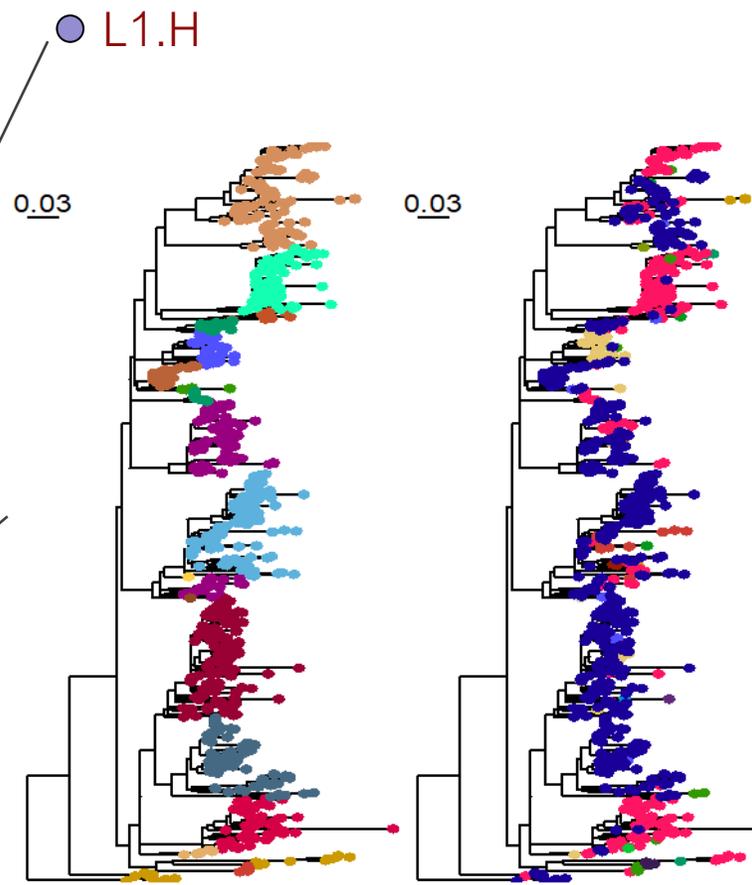
- 1A
- 1B
- 1C
- 1D
- 5A
- 6
- 7
- 8A
- 8B
- 8C
- 9A
- 9C
- 9D
- 9E
- undetermined
- NA
- 1E
- 1F
- 1H
- 4



L1

Other lineages

- L1A
- L1C
- L1H
- L1E



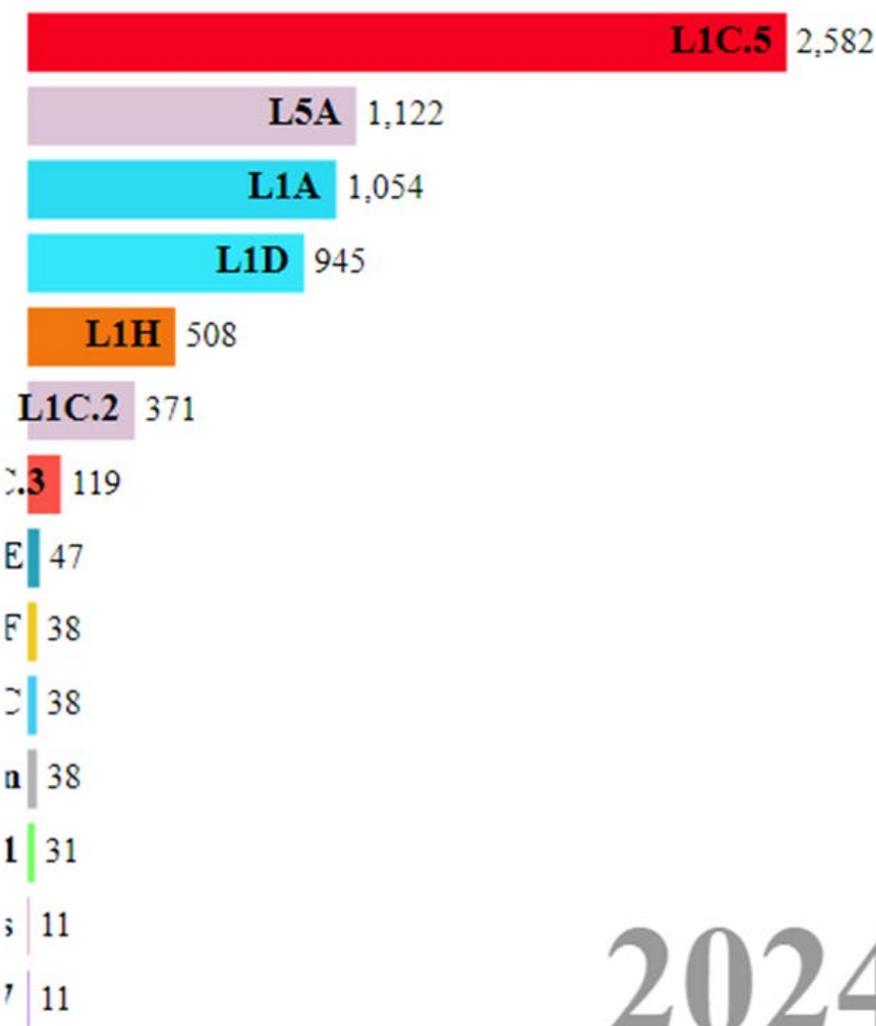
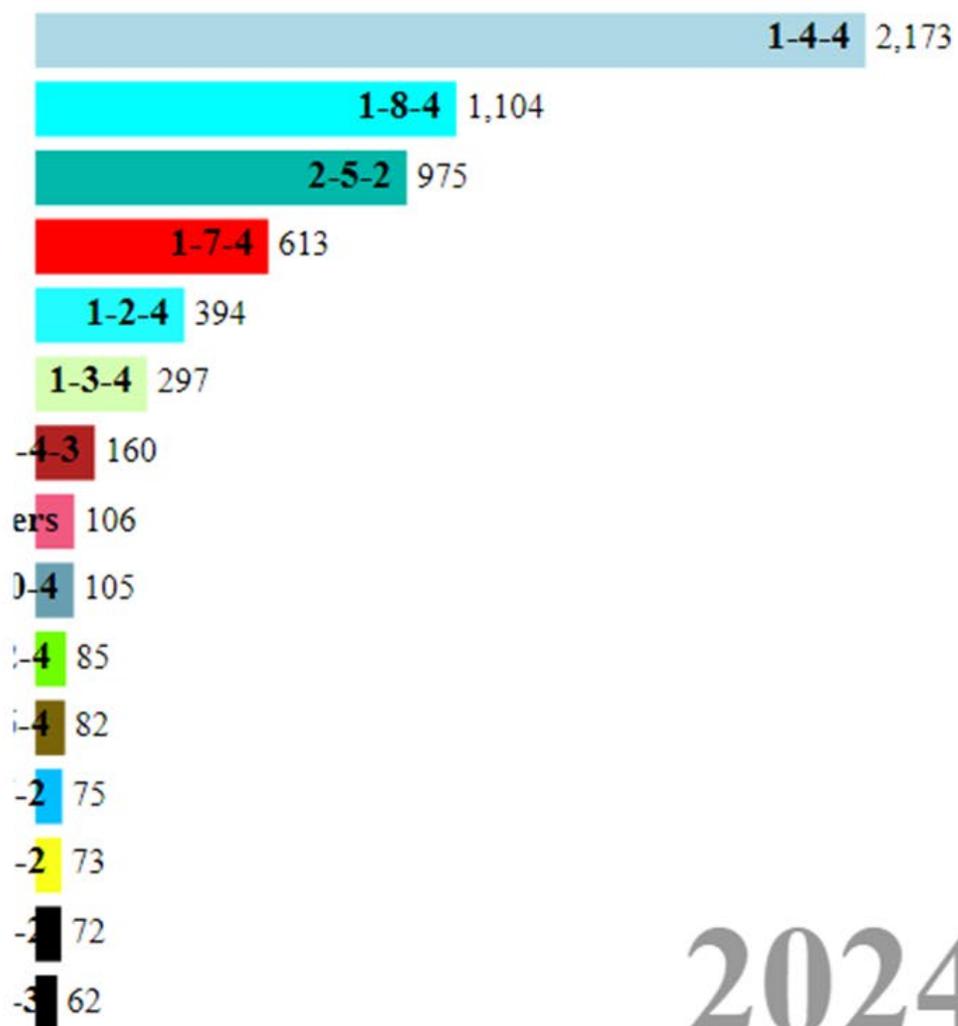
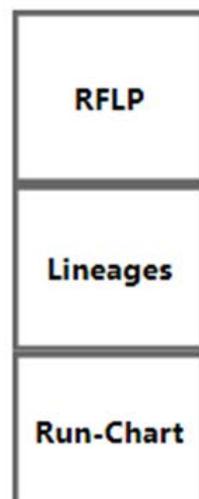
Paploski et al. 2021, Vaccines

VanderWaal et al. 2024. Frontiers in Virology



PRRSV RFLP patterns

PRRSV Lineages



2024

2024

The numbers on the top of the bars represent the RFLP pattern or Lineage. The number on the bars' right side represents the number of submissions having a PRRSV ORF5 sequence within the year. Number changes indicate the variation in the number of ORF5 sequences recovered from one year to another.



PRRS lineage in Canada

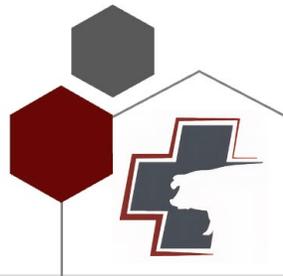
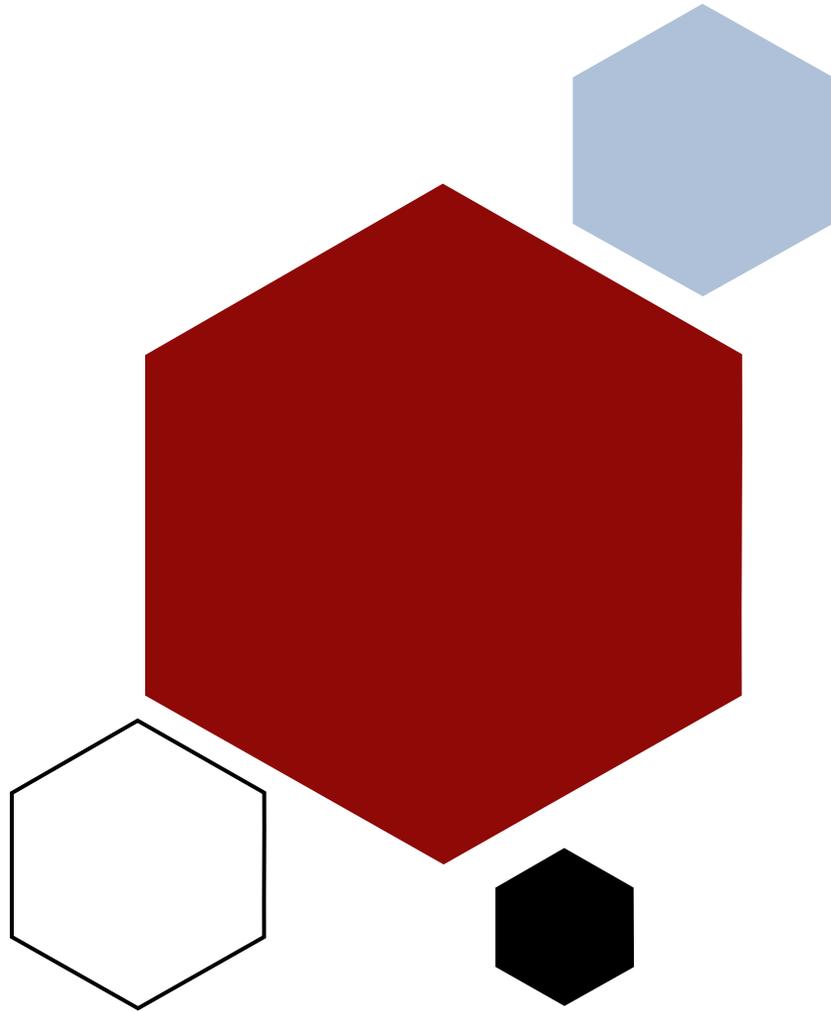
- Lab in Quebec started using lineage classification on new PRRS strain sequences
- Can be done on ISU PRRS View website
 - <https://prrs.vdl.iastate.edu/seqtool.php>
- Copy and paste
 - Lineage tool
 - ORF Blast tool



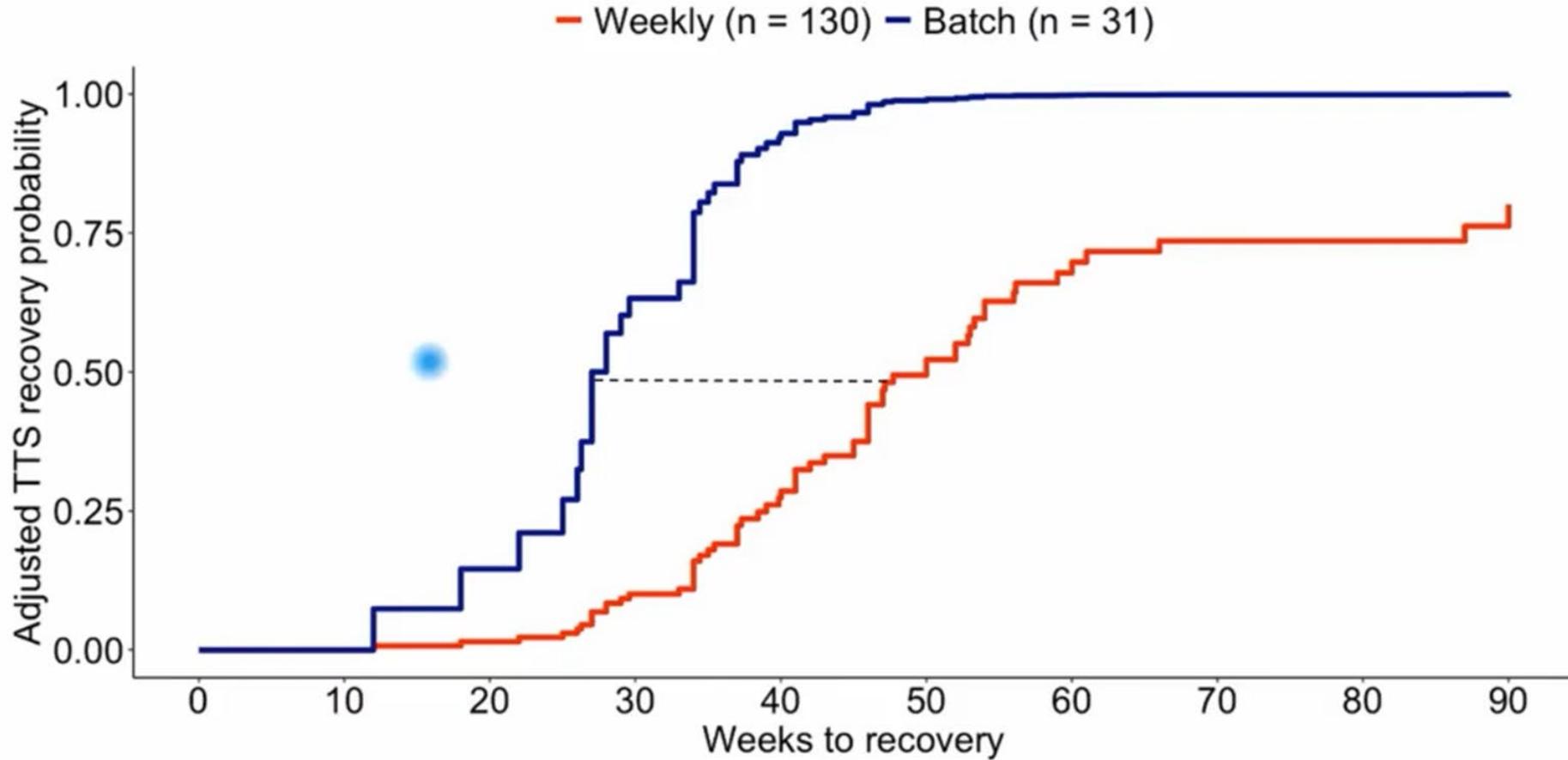
ISU PRRS Outbreak Management Program

Enrollment Data

- POMP Database Overview
 - 447 Farm outbreaks 2010 – 2024
 - 20 farm systems that are currently enrolled
 - 269 farms achieved stability
- Some preliminary data analysis....

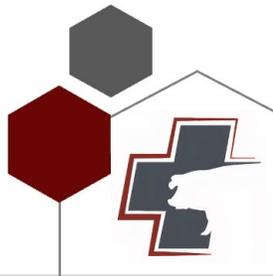


Impact of Batch Farrowing on TTS

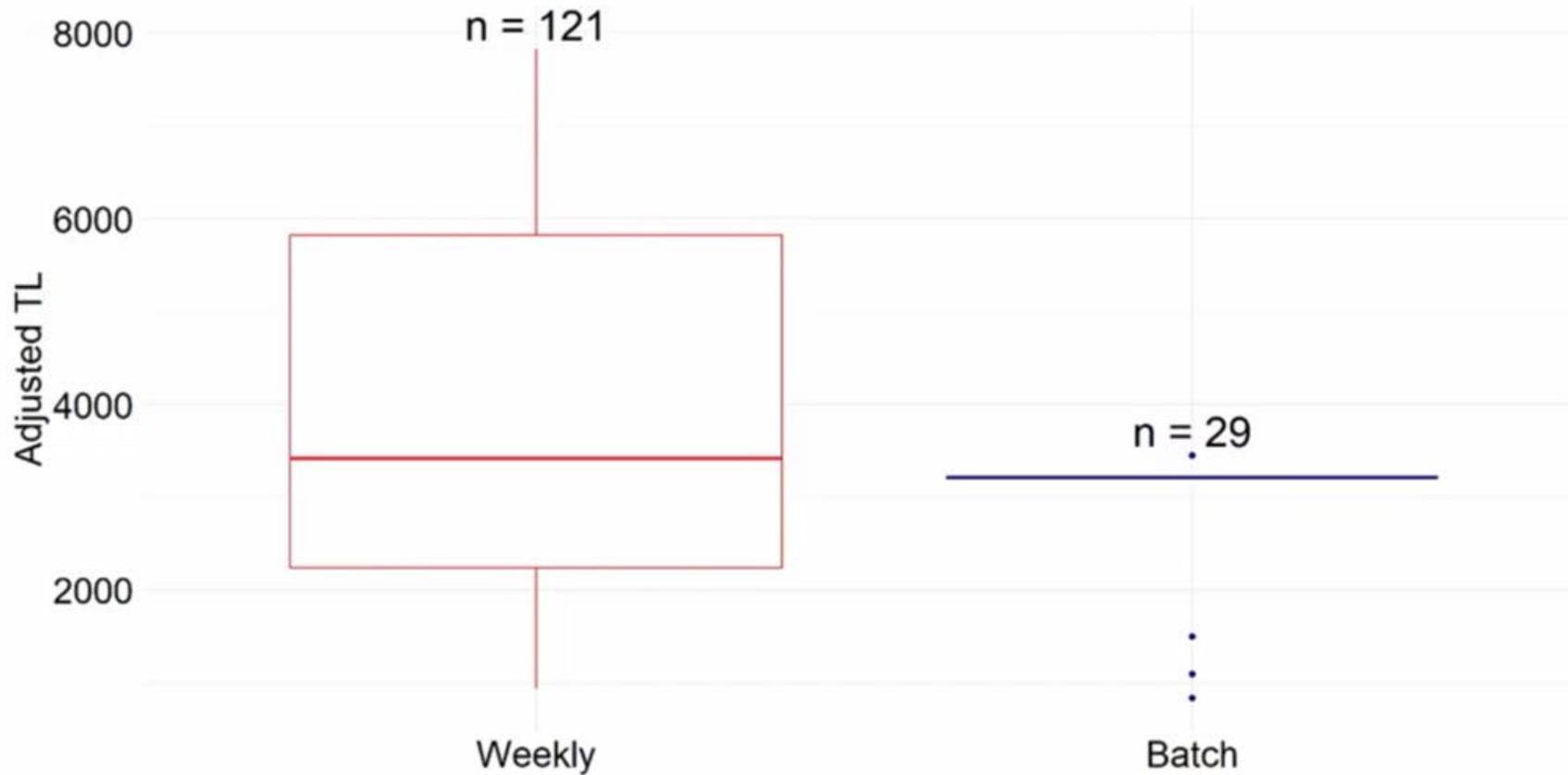


No difference in TTBP

TTS was achieved significantly faster (25 weeks) in sites have batch flow



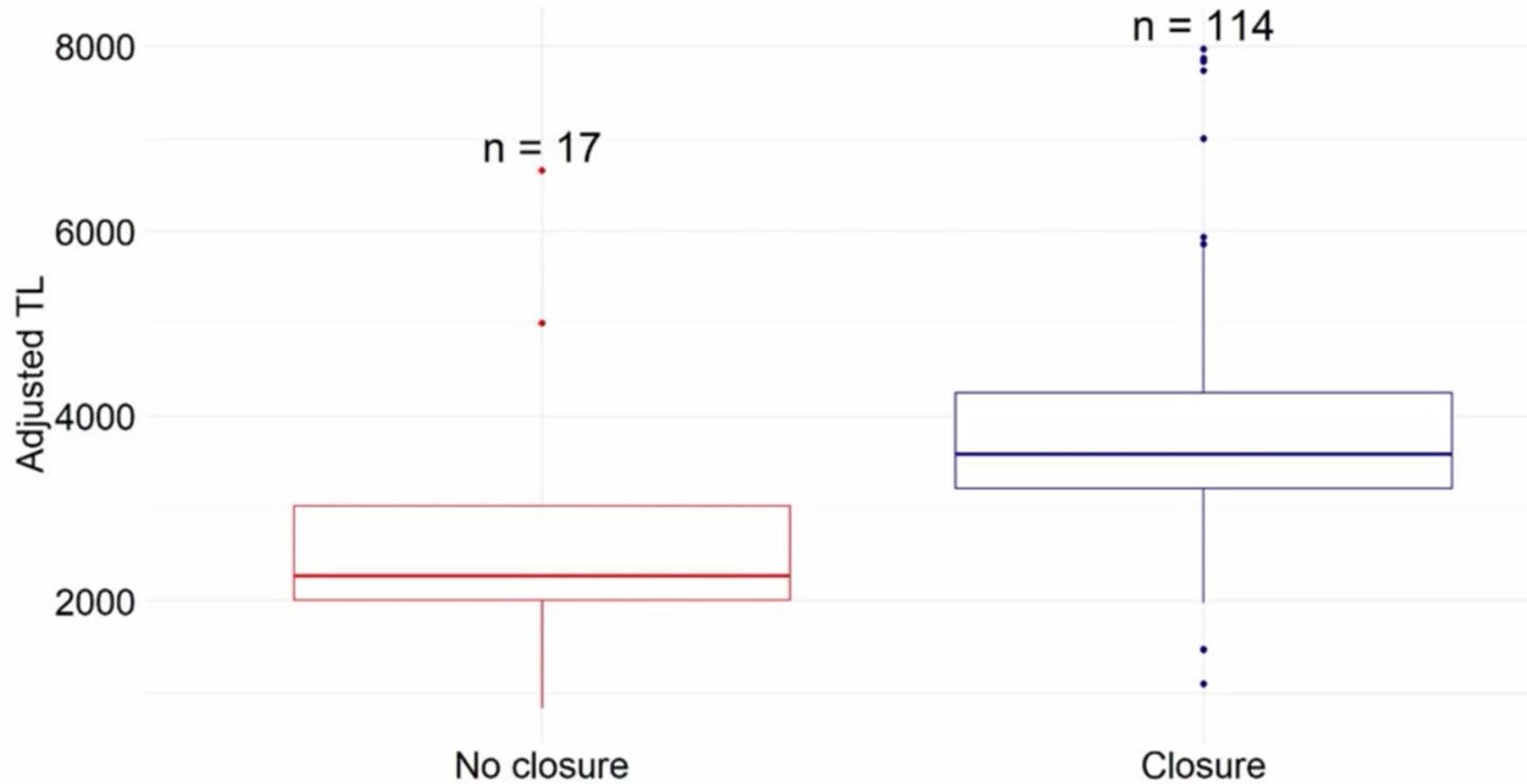
Impact of Batch Farrowing on Total Losses (TL)



Batch farrowing was associated with 32% lower TL compared to weekly farrowing ($p = 0.001$)

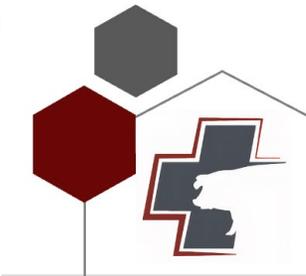


Impact of Herd Closure on TTS



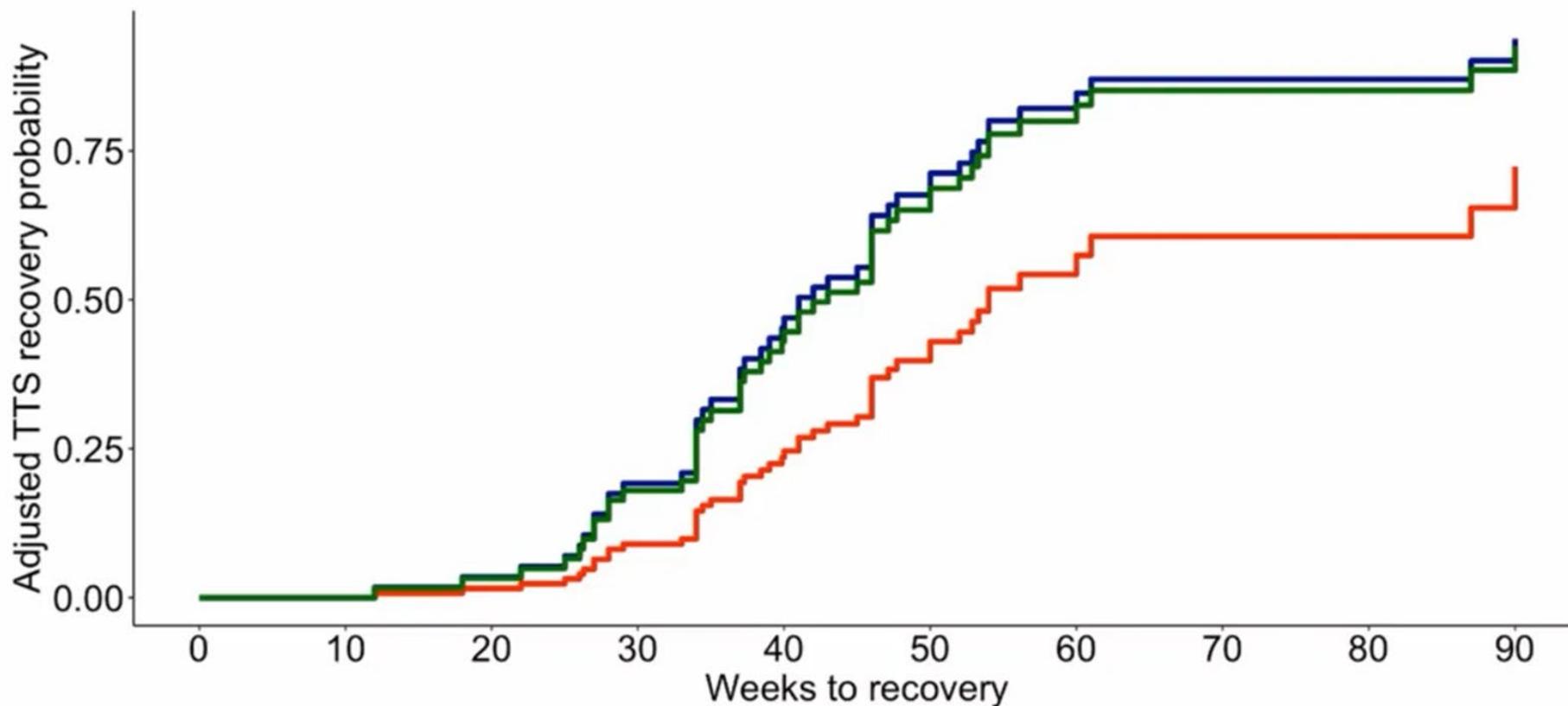
No difference in TTBP

Herd closure was associated with 20% higher TL compared to no closure ($p = 0.001$)



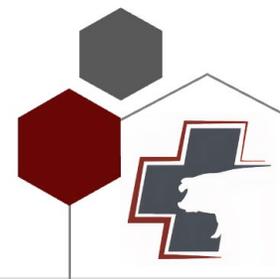
Impact of Immunological Solution at Outbreak on TTS

— MLV (n = 74) — LVI (n = 17) — LVI+MLV (n = 38)

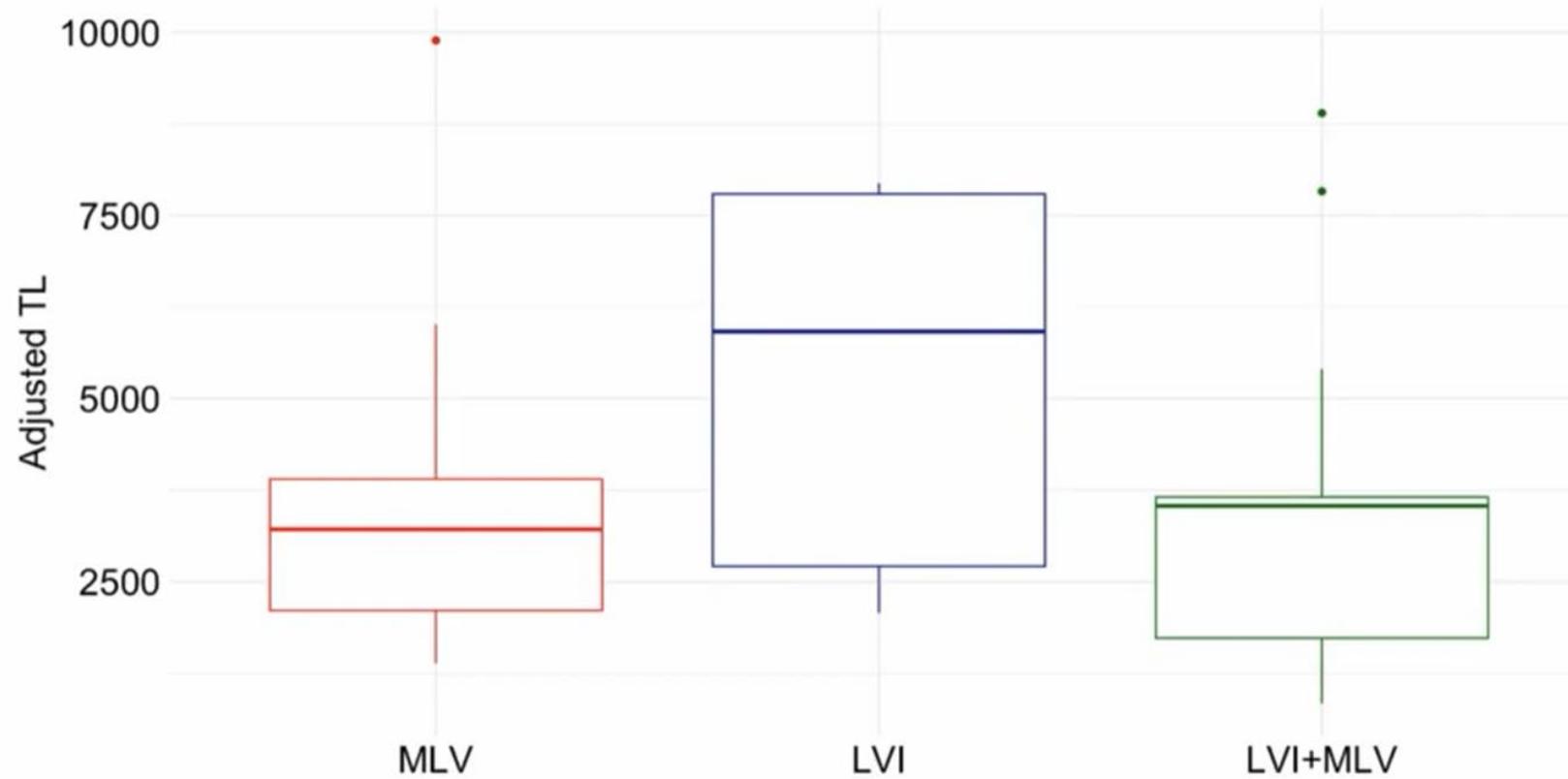


No difference in TTBP

TTS was achieved faster (10 weeks) in sites that used LVI + MLV than MLV alone (p=0.031)

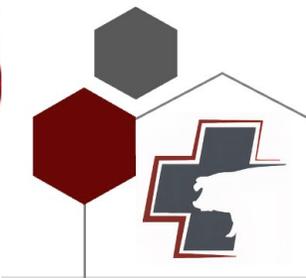


Impact of Immunological Solution at Outbreak on TL

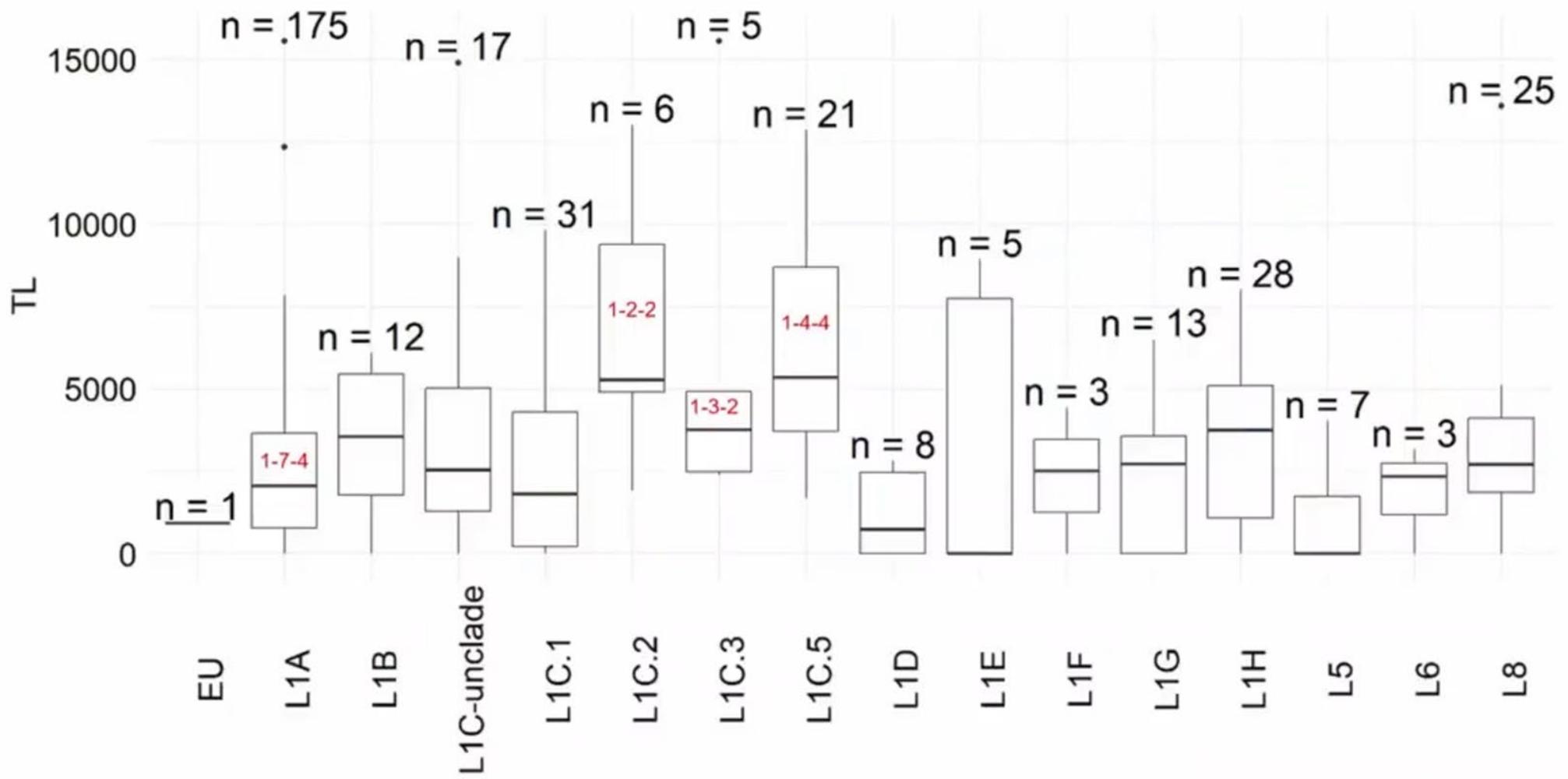


No difference in TTBP

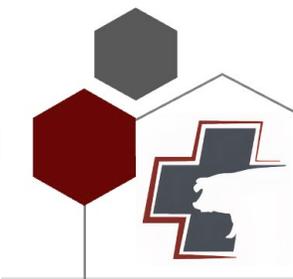
LVI was associated with 40% higher TL or compared to MLV and LVI+MLV ($p = 0.001$)



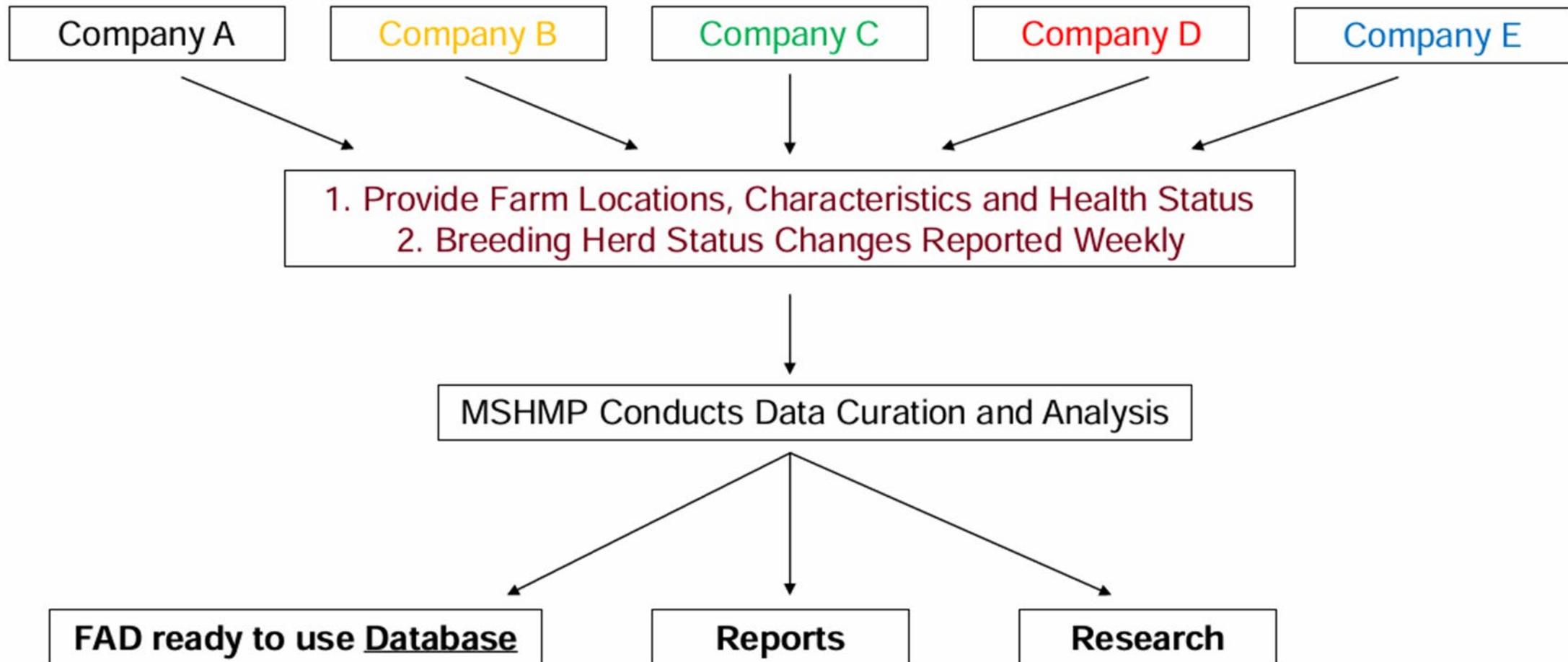
Impact of Lineages on TL



L1C.X were associated with the highest Total Losses



Morrison Swine Health Monitoring Project: A Voluntary Project by Producers, for Producers



PRRS occurrence in the U.S. breeding herd

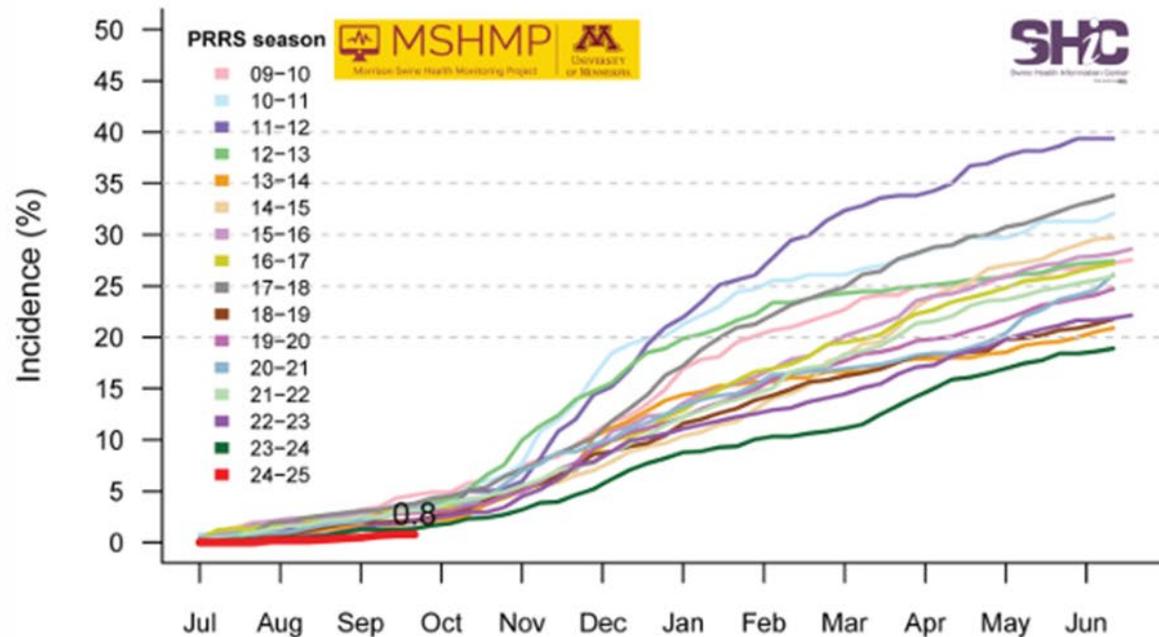
Morrison Swine Health Monitoring Project

3.6+ Million sows

1,000+ sow farms

15 years' worth of data

Chart 1 – PRRS cumulative incidence as of September 25, 2024



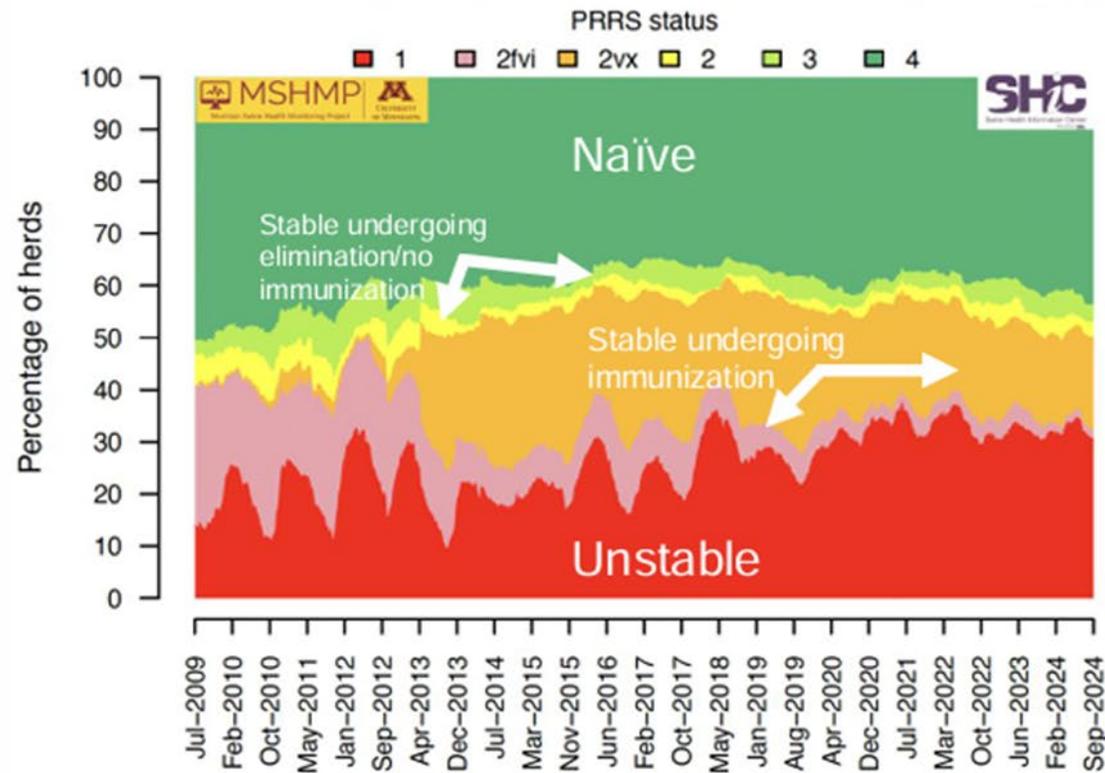
- In 12 out of 15 years' worth of data, 20-30% of the herds have reported an outbreak each year
 - There are multiple viruses co-circulating
 - Farm, company, region and state levels
 - Outbreaks are clustered in time and space
 - Pig farm regional density does not always explain PRRS occurrence

PRRS prevalence in the U.S. breeding herd

Morrison Swine Health Monitoring Project

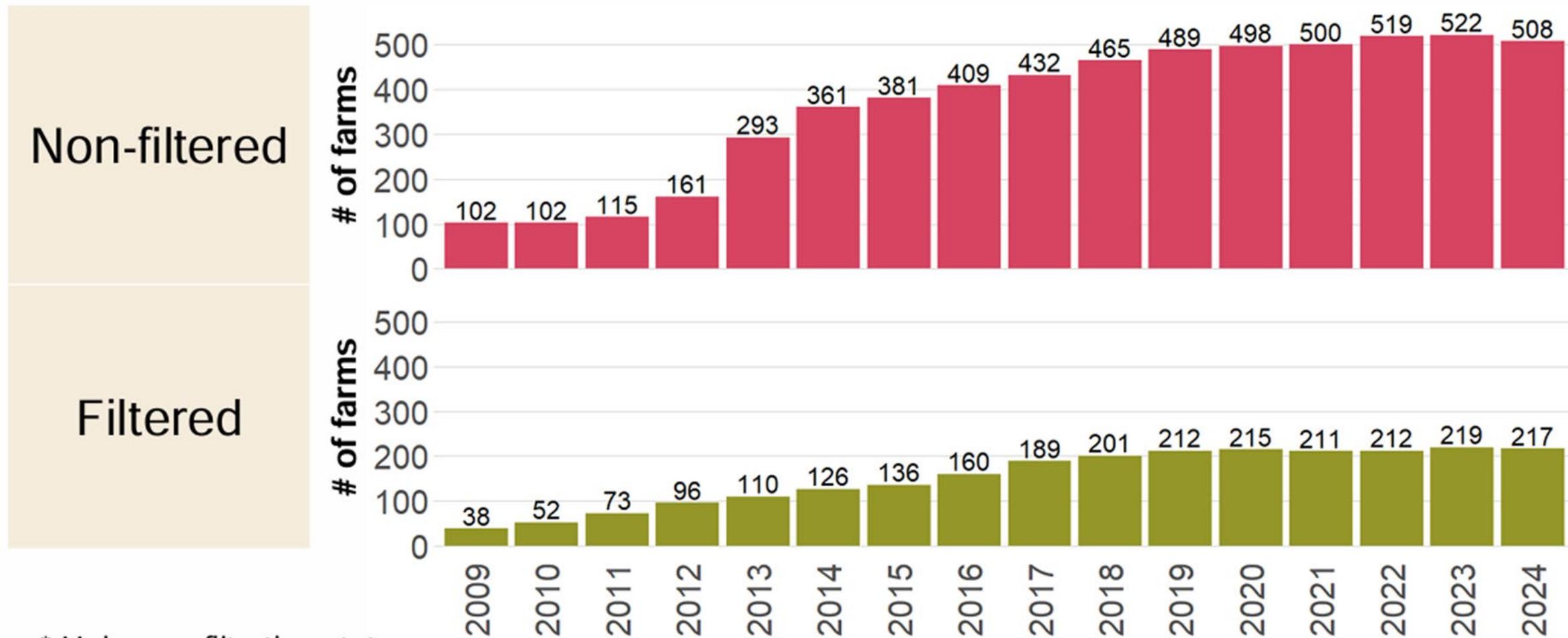
3.6+ Million sows 1,000+ sow farms 15 years' worth of data

Chart 2 – PRRS prevalence of sow herd status as of September 25, 2024



- Important level of breeding herd PRRS status diversity
 - 70/30 weaning prrs free/weaning prrs positive
 - 40% of the herds are naïve
 - 30% of the herds are weaning PCR+ piglets
 - There is an underlying population of breeding herds that do not leave the unstable category
 - We have herds that are fighting multi-variant infections

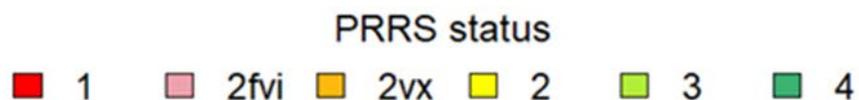
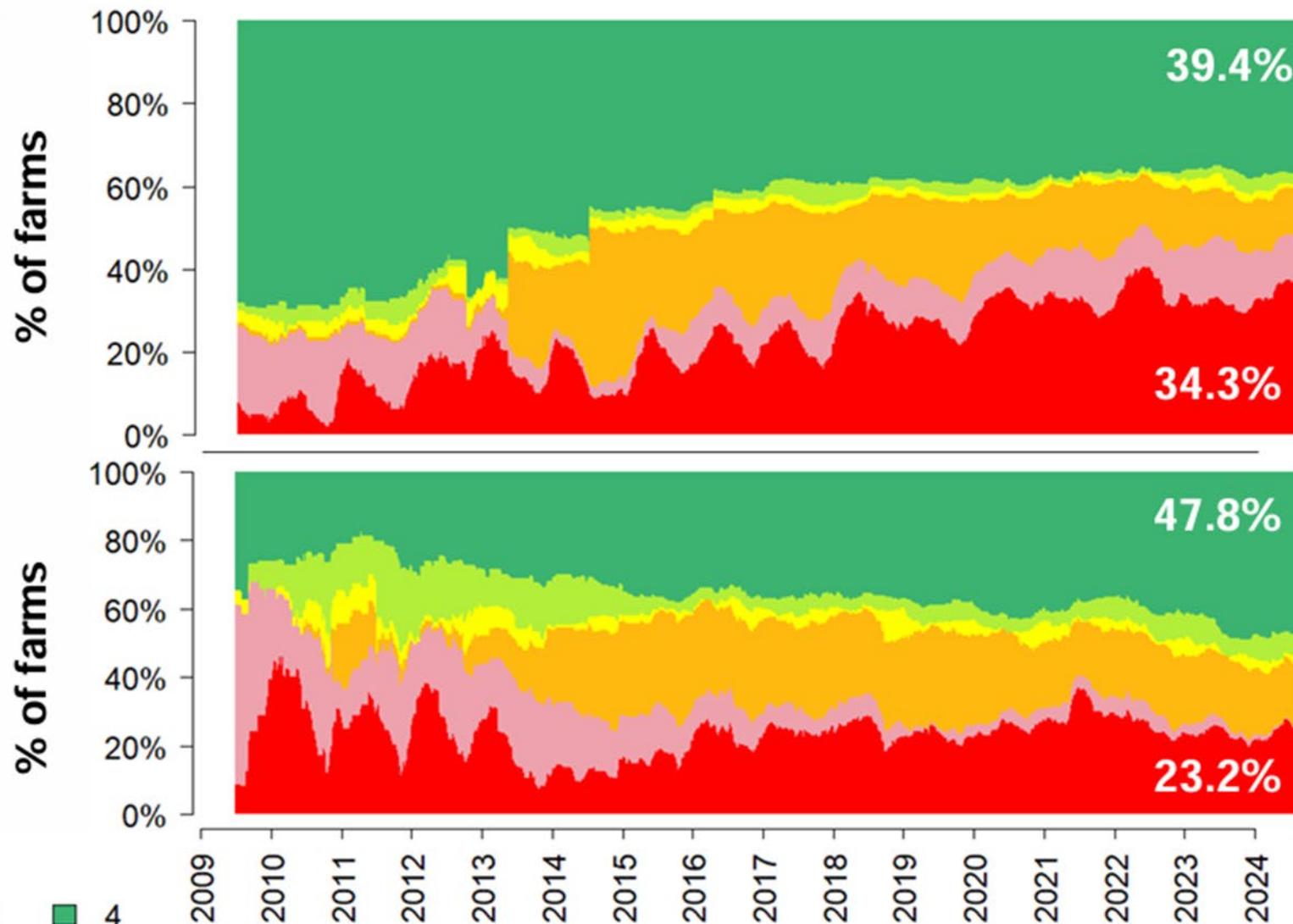
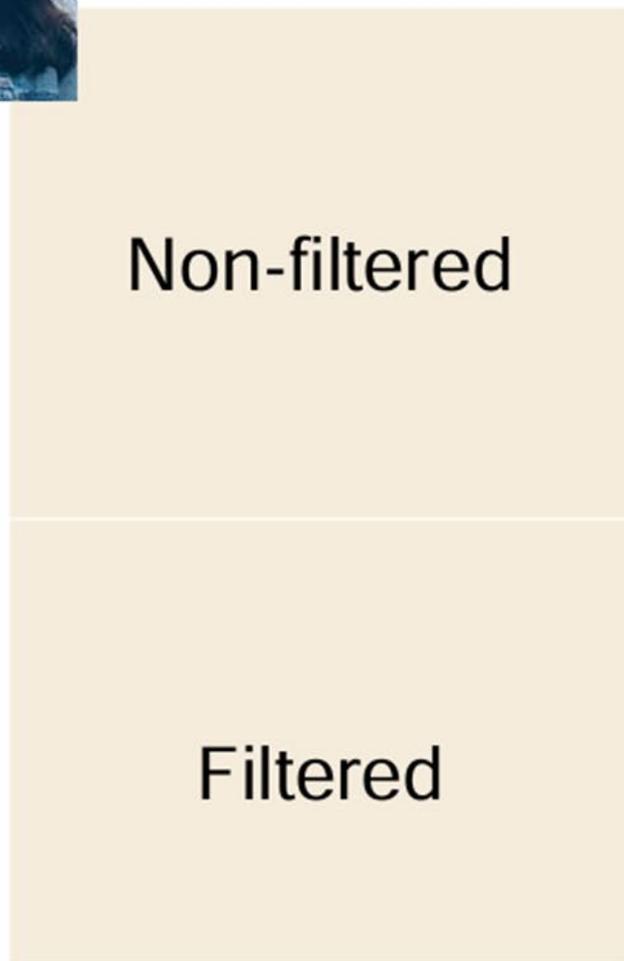
Number of filtered and non-filtered farms



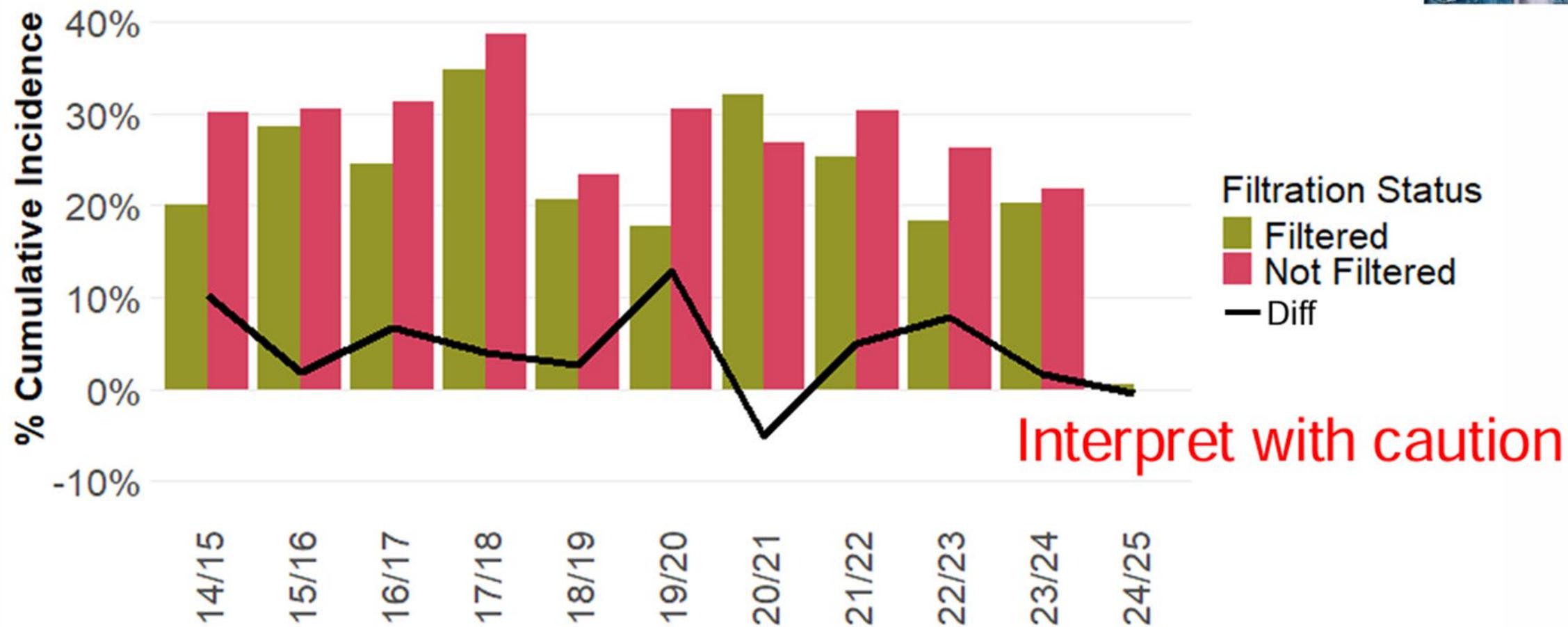
* Unknown filtration status farms are not included



PRRS Prevalence



PRRS cumulative incidence



Filtered farms and PRRS occurrence

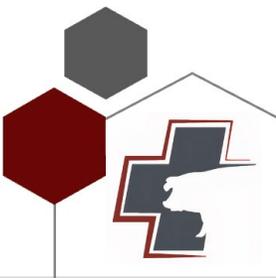
- Positive vs negative vs not filtered

Term	Category	Estimate	IRR	Std Error	p-value	
(Intercept)		-5.826	0.0029	0.144	0.0000	***
No. nearby farms		0.042	1.0429	0.014	0.0024	**
Herds size		0	1.0000	0.000	0.8859	
No. pigs in county		0	1.0000	0.000	0.0001	***
Filtration pressure	Not filtered (ref, n=211)					
	Negative (n=125)	-0.543	0.5810	0.120	0.0000	***
	Positive (n=19)	-0.58	0.5599	0.259	0.0251	*

The rate of PRRS outbreaks is 41.9% lower in negative pressure filtered farms and 44.0% lower in positive pressure filtered farms, compared to not-filtered farms.

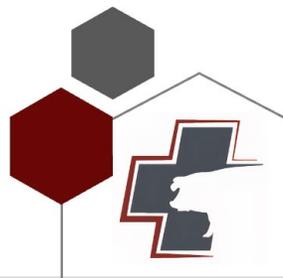
PRRS inactivated killed vaccine

- No or little efficacy on its own
- Maternal IV vaccination with prior exposure to MLV or LVI
 - Increase transfer of neutralizing antibodies to piglets for PRRSv (Hause et al. 2019)(Kirk et al. 2021)(Nolan et al. 2022)
 - Can improve protection of pre-weaning piglets against PRRSv (Kirk et al. 2021)



The effect of a quadrivalent heterologous inactivated PRRSv vaccine on time-to-stability for an infected breeding herd (*Betlack et al.*)

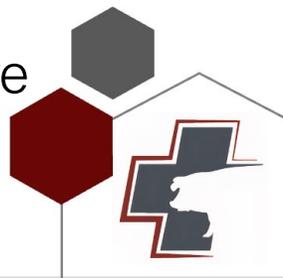
- The ability to eliminate PRRSv from herds
 - More challenging
 - Median time-to-stability (TTS) for herds undergoing a herd-closure
 - Past decade was 36 weeks
 - 10 weeks longer than 2011
 - Use of alternative methods such as inactivated vaccine arise and their ability to impact TTS and aid in disease elimination



The effect of a quadrivalent heterologous inactivated PRRSv vaccine on time-to-stability for an infected breeding herd (*Betlack et al.*)

A case study was conducted on a commercial 2700-head Category 1A PRRS infected sow farm

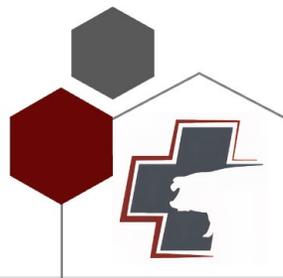
- The variant was characterized via ORF5 sequencing as wild type, PRRSv RFLP 1-2-4 lineage 1C.5
- Farm underwent a herd closure with live-resident virus inoculation (LVI), which was administered at three time points to aid in the establishment of 'day 0'
- A PRRSv quadrivalent heterologous inactivated vaccine was utilized, with $\leq 97.9\%$ nucleotide similarity to the field variant
 - Vaccine was administered at the following time points:
 - Whole herd at 1) recipient's last LVI and 2) 4-weeks later
 - 3- and 5-weeks pre-farrow, starting at 3-weeks post last LVI until end of closure



The effect of a quadrivalent heterologous inactivated PRRSV vaccine on time-to-stability for an infected breeding herd (*Betlack et al.*)

Results

- Weekly processing fluids were collected throughout the closure. Moreover, 30 blood samples were periodically collected from due-to-wean pigs.
 - Samples were submitted for the detection of PRRSV genetic material using qRT-PCR
 - After 12-weeks post last LVI, processing fluids resulted PRRSV PCR negative throughout the closure, except from two time points (i.e., 19- and 21-weeks post last LVI)
- Throughout the closure, all serum samples were PRRSV PCR negative.
- Time-to-stability was 34-weeks



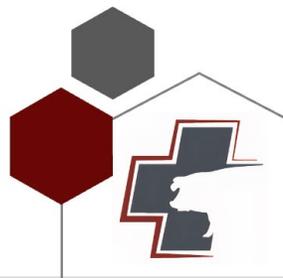
The effect of a quadrivalent heterologous inactivated PRRSv vaccine on time-to-stability for an infected breeding herd (*Betlack et al.*)

Table 1. Comparison of time-to-stability for the enrolled herd with respect to remaining herds within the same production system that broke with PRRSV during 2018 to 2023.

	TTS ¹ (weeks)		
	Enrolled herd	Production system	
	1-2-4 L1C.5 variant (n=1)	All variants (n=21)	Other L1C.5 variants ² (n=12)
Min.	---	28	28
25 th percentile	---	36	38
Median	34	45	46
75 th percentile	---	70	53
Max	---	92	87

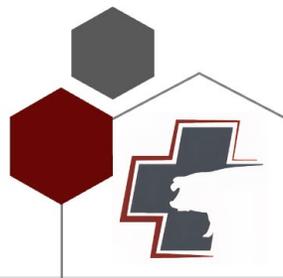
¹TTS=time-to-stability.

²PRRS classification based on Paploski et al. (2021) and Yim-im et al. (2023) guidelines.



The effect of a quadrivalent heterologous inactivated PRRSv vaccine on time-to-stability for an infected breeding herd (*Betlack et al.*)

- Results of this case study showed the TTS was 34-weeks, which was numerically shorter by 12-weeks compared to other PRRSv L1C.5 breaks that occurred within the system.
- Limited published information on the efficacy of inactivated vaccines on PRRSv control in breeding herds.
 - Previous research showed the use of inactivated vaccines to aid in lower median total losses per 1000 sows compared to herds that used modified-live vaccine (Rawal et al. 2020).
 - Additional research on the use of inactivated vaccines during PRRSv closures should be conducted to strengthen these findings.

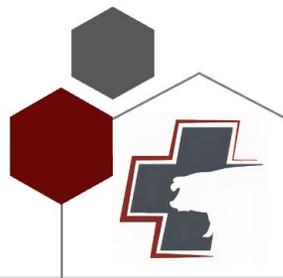


PED Update



PED Update

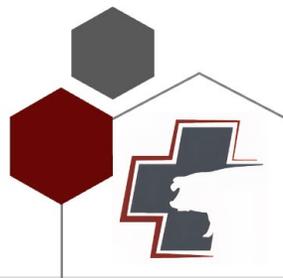
- Québec last cases
 - March 2023: cases finisher
- Manitoba last cases
 - October 2023: finisher
- Ontario last cases
 - November 14, 2024: farrow to wean



PED Update - Testing Québec 2023 (voluntary)

Recommandations (EQSP)

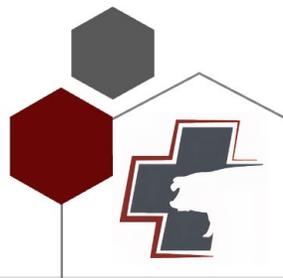
- Test unloading docks at least once a day with PCR-PED testing. In this process, also test certain sections of the barn, particularly if pigs have diarrhea.
- Systematically test all pig transport trailers that deliver pigs from Ontario.
- Test a number of pig transport trailers from Quebec based on random sampling determined by each slaughterhouse to maintain an adequate level of confidence in detecting potential circulation of PED virus by Quebec carriers.
- Report all test results to the EQSP on a regular basis, ideally each week, in order to allow a compilation and publication of these results.
- Four slaughterhouses representing a total of seven slaughterhouses continued their respective testing strategy based on the EQSP recommendations during 2023.



PED Testing Results 2023

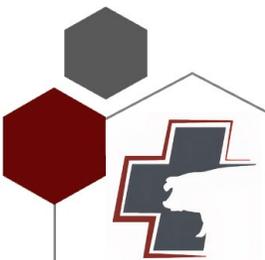
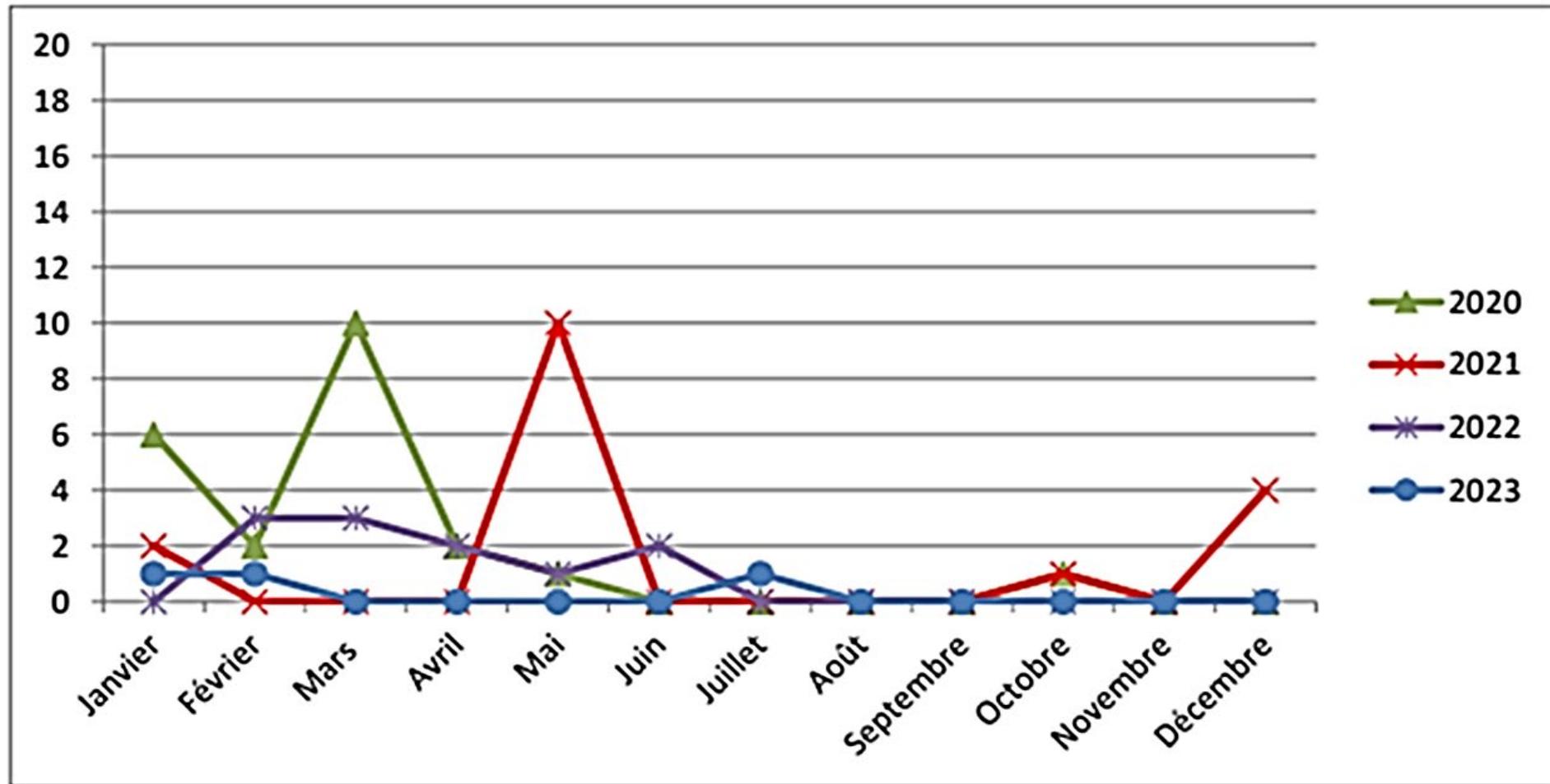
- For positive PCR-PED results, two trailers from Quebec that transported pigs from a positive farm
 - Follow-ups were done with the abattoirs to schedule deliveries with the necessary safety measures
- The other four trailers from Ontario

	# of test	Negative results	Positive results	% positive
Unloading dock slaughterhouse	4507	4504	3	0.07%
Market haul trailer	7109	7103	6	0.08%
Assembly yard and carrier	359	359	0	0%
Feed mill	693	693	0	0%
Total	12668		9	0.07%



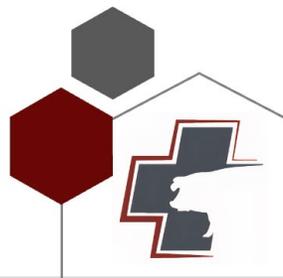
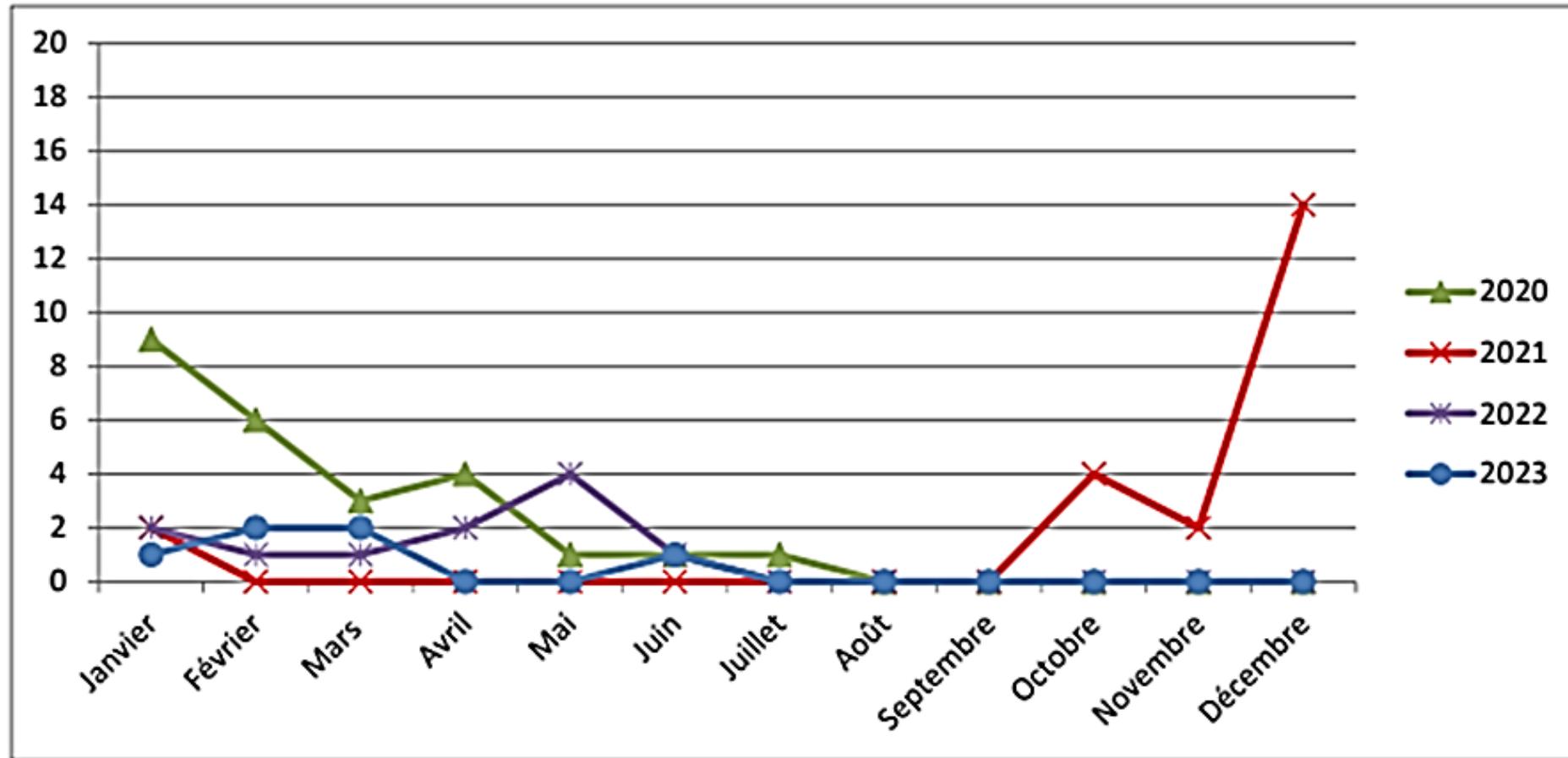
Positive results of PCR-PED tests on unloading docks at slaughterhouses for the years 2020, 2021, 2022 and 2023

Graphique 11 : Résultats positifs des tests de PCR-DEP sur les quais de déchargement aux abattoirs pour les années 2020, 2021, 2022 et 2023.



Positive results of PCR-PED tests on pig transport trailers (Quebec and Ontario) at slaughterhouses for the years 2020, 2021, 2022 and 2023

Graphique 12 : Résultats positifs des tests de PCR-DEP sur les remorques de transport de porcs (Québec et Ontario) aux abattoirs pour les années 2020, 2021, 2022 et 2023



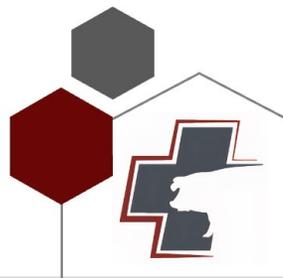
Manitoba Control Program (voluntary)

PREVENTION

- Regular surveillance on-farm and at high traffic sites
- **Testing animals before movement off-farm**
- Enhanced biosecurity within the high-risk area

INTERVENTION

- Rapid and aggressive elimination of new infection
- **Strict biocontainment of infected farms**
- Limiting high-risk animal movements



PED Surveillance in Manitoba

1. Farms in South-East - weekly samples (highly recommended by Manitoba Pork and CVO)

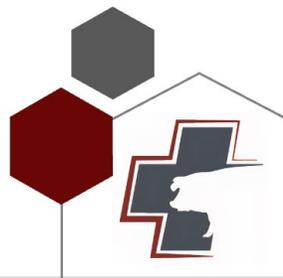
- No funding available. Done by the 2 large integrators, not sure about other producers
- Risk base sampling?

2. Federally inspected slaughter plants - daily swabs of receiving doors

- Funding available

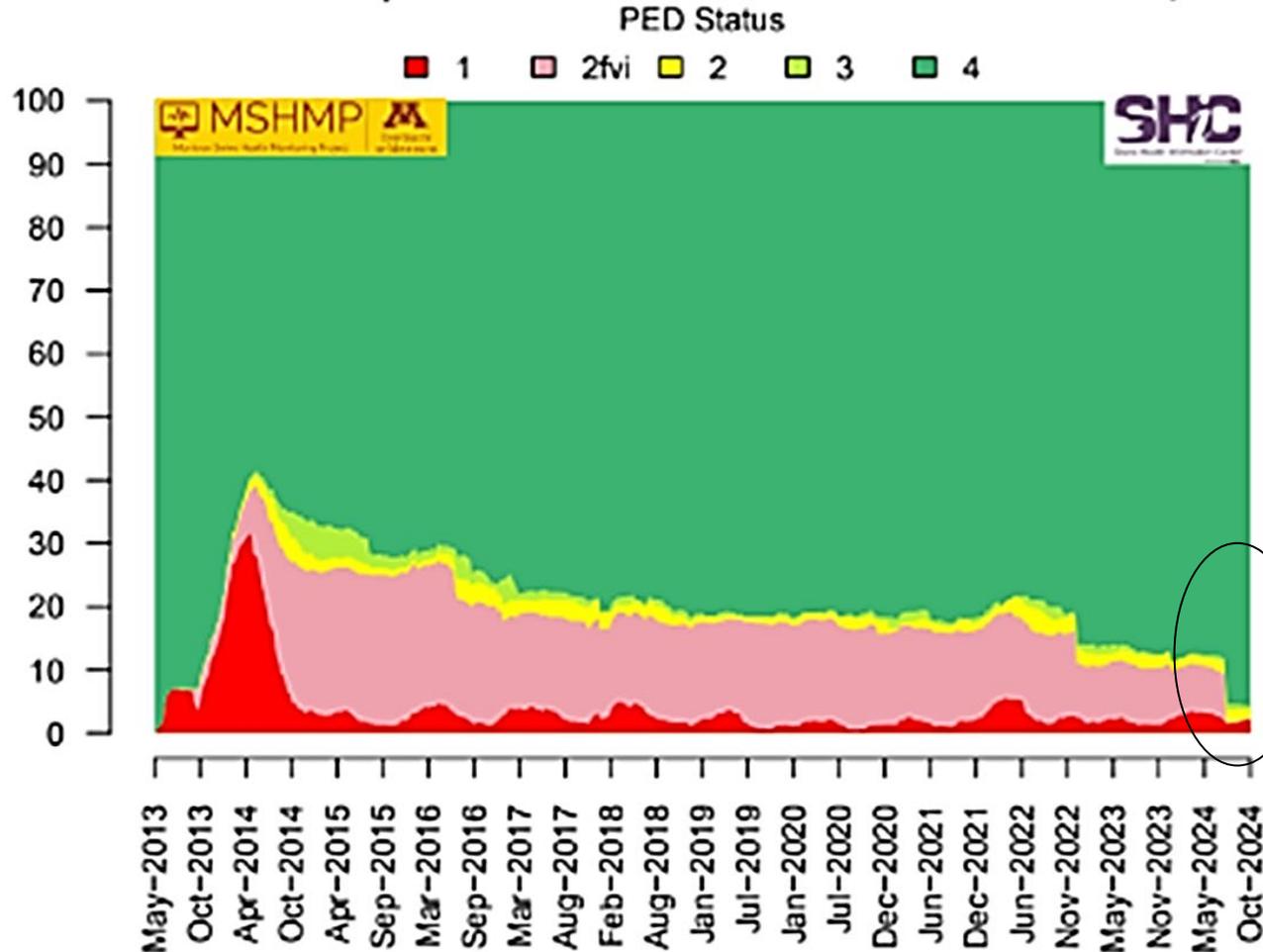
3. Assembly yards are tested occasionally. Some are known to be positive and are continuous flow and never empty, so it's more about monitoring than detection...

- Funding available
- Same with provincial slaughter plant. Some test sometimes, some don't
 - Funding available
- HyLife, monitor truck wash located in the South East (testing the drain)



PED Prevalence in the US (SHMP)

Chart 2 – PED prevalence of sow herd status as of October 30, 2024

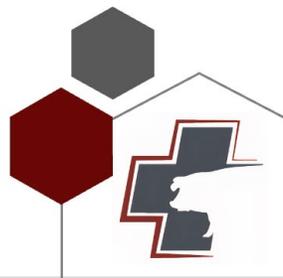


- Most system have stopped exposing gilts
- No regional or state swine association monitoring program!



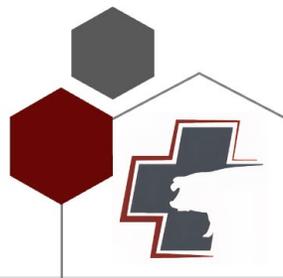
Proposed PED Monitoring Program

- Slaughterhouse unloading dock
 - Daily
 - Swiffer or booties
 - Cost \$60 to \$100 per day
- In low prevalence time to detect emerging infection
 - Trailer sampling
 - Booties per driver
 - Swiffer of floor at gate before unloading
 - Test only if unloading dock tested positive
- Assembly yard
 - Once per week
 - Depopulation of site once PED is eliminated from sow herd in the province

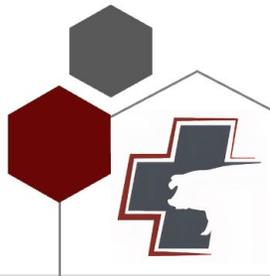


Movement Control on Positive Herd

- Risk associated with highly infected pigs on the road
- Pre-shipment
 - Monitor pigs for sign of scour
 - Sample and test if scour present
 - Cancel movement if positive for PED
 - How long? 4-weeks after infection started
 - **Open communication and collaboration is the only way this can work on a voluntary program**
- Biosecurity
 - Control loading protocol
 - Clean trailer
 - First load
 - Large continuous flow site

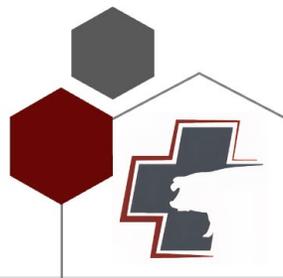


Thermo Assist Drying and Disinfection (TADD)



TADD Research Project

- Determine the washing time
 - Regular wash vs. high-pressure quick rinse followed by a detailed wash after four rinse and cook cycles



4th Rinse

Day4 Pre-bake



Day4 Post-bake



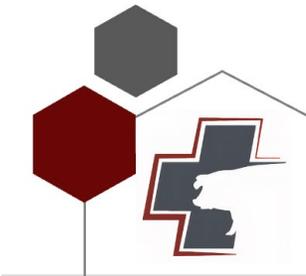
- Project 1: Washing time
 - Regular washing: 90 minutes
 - High-volume rinses: 27 minutes
 - Detailed wash: 118 minutes
 - Combined Time: 44 minutes
- Doubles the number of washes

Regular wash after 4 days of rinsing, baking

Day5 Pre-bake

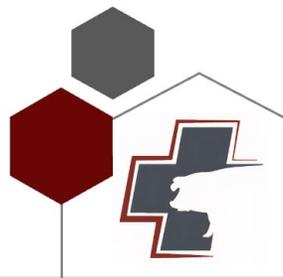


Day5 Post-bake



TADD Research Project

- Determine the washing time
 - Regular was vs. high-pressure quick rinse followed by a detailed wash after four rinse and cook cycles
- Test PEDv inactivation in TADD
 - Gilt feces exposed to PEDv
 - Placed on the trailer floor
 - Bake cycle at 160 F for 15 minutes
 - Feces collected after cooking and given orally to naïve piglets





Pre-bake Diamond Floor

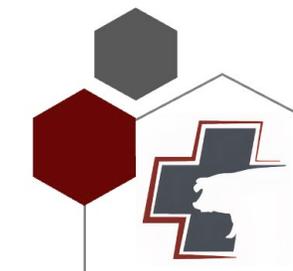


Post-bake and rinse Diamond Floor

Test	CT PED PCR after bake	# piglet with diarrhea 40 hrs after inoculation	CT PCR Intestine 40 hrs after inoculation	
			CT	PCR
1	23.21	0	1	38.04*
2	18.27	0	0	>40
3*	22.4	0	0	>40

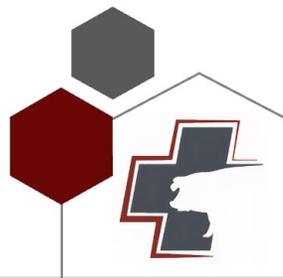
*Bake time of twelve minutes.

- All piglets exposed with unbaked feces developed diarrhea within 24 hours with PCR positive for PED (CT 14-16)

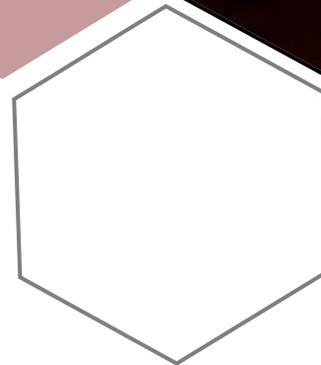
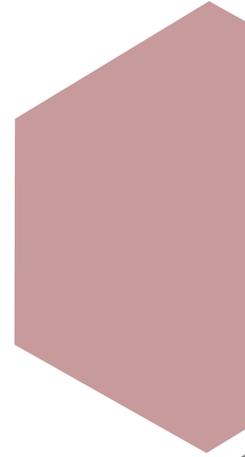
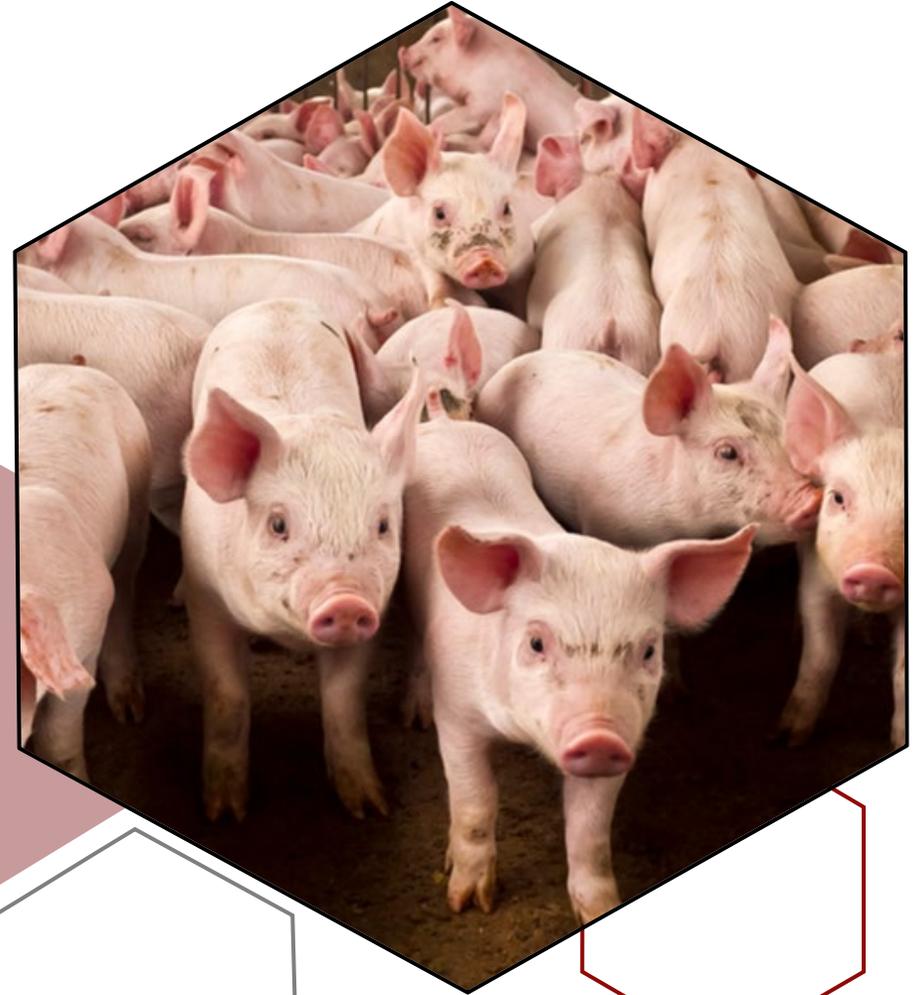


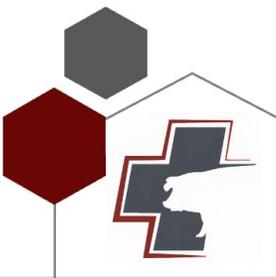
Conclusion

- The addition of a Thermo Assist Drying and Disinfection Station
 - Inactivates viruses
 - Not affected by wash quality
 - Less expensive to build and operate than a car wash
 - Process that can be automated and validated remotely
 - Capacity of 20 trailers per day
- Does it make sense for transport as a risk
- USA
- Infected regions



Biosecurity

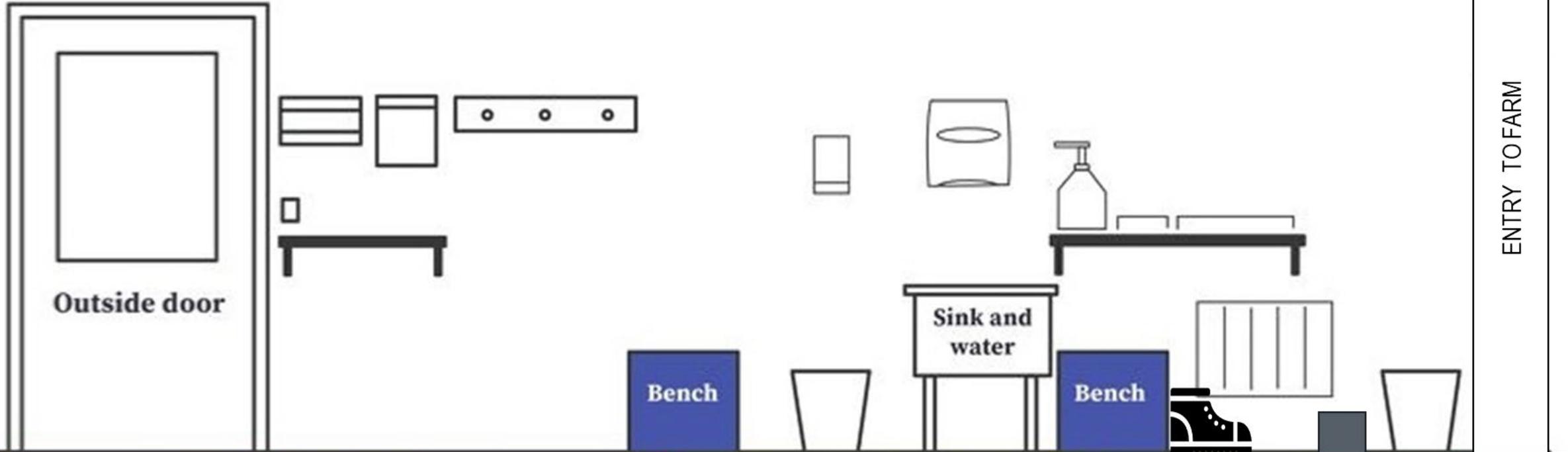






FARM ENTRY (NON SHOWER SET UP)

4 zone Entry

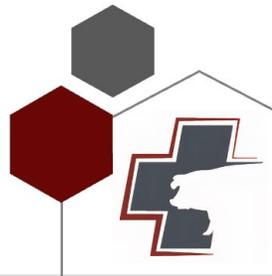


1 ;Dirty zone : shoe zone

2 Buffer zone:

3 Clean zone:

Questions often not clarify : how much do I undress? What happen to my feet(sock? on or off?)



Good

Good

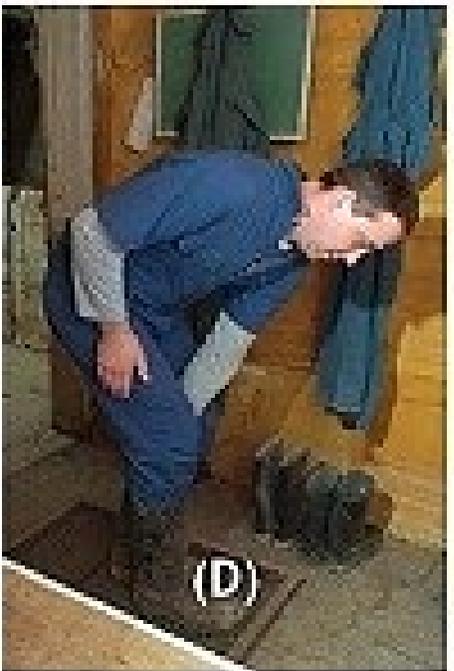
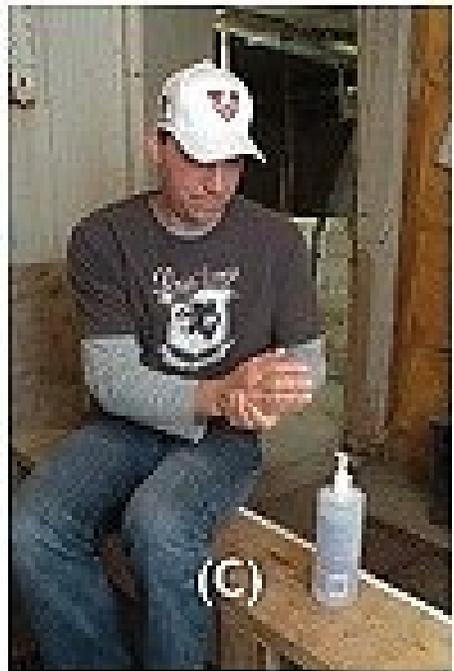
Good if you do it
after taking off your
outer shoes

No buffer zone and no office and
farm area!
you better to put on these boots
directly!

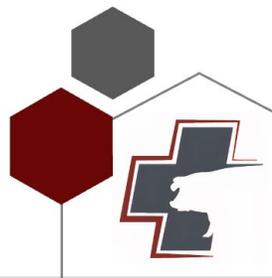
If you touch the ground with your
socks and the floor is dirty
GOOD BIOSECURITY
(if first site!)

POOR BIO-CONTAINMENT

Close the door!!



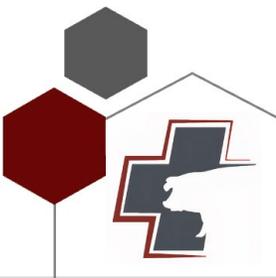
DON'T FORGET YOUR SOCKS!!

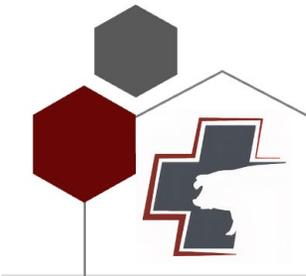
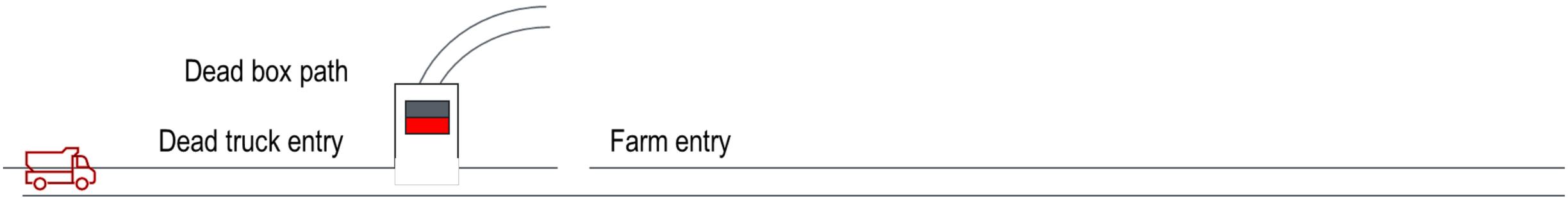
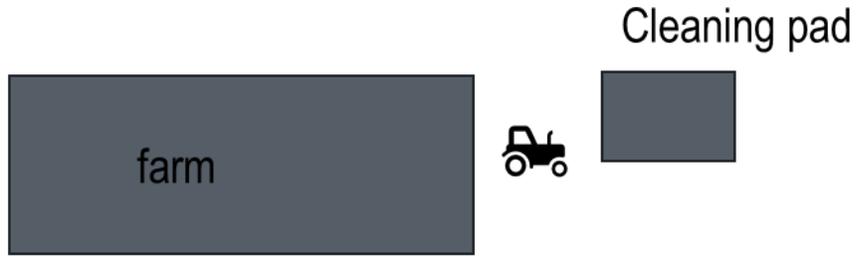


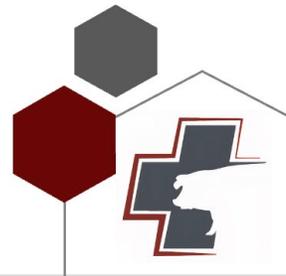
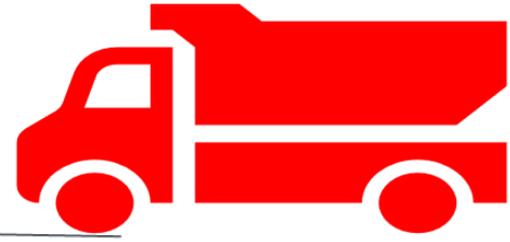
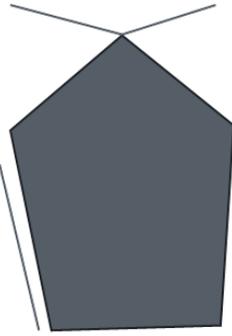
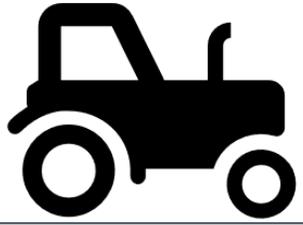
Dead Animal Disposal

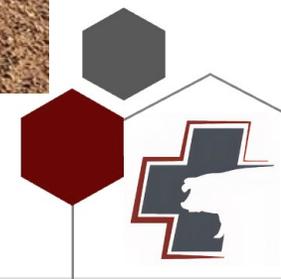


Dead Animal Disposal









Thank you

Dr. Luc Dufresne

ldufresne@demetersv.com

www.demetersv.com

