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Agency

Hepatitis E virus (HEV)

A farm investigation of within-herd transmission & factors affecting risk of infection in slaughter pigs

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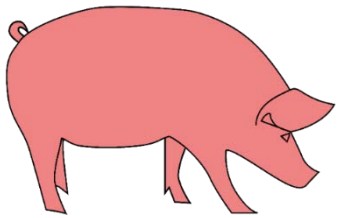

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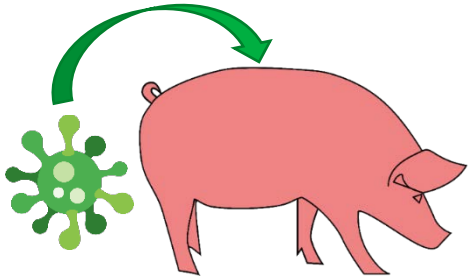
HEV in UK pigs

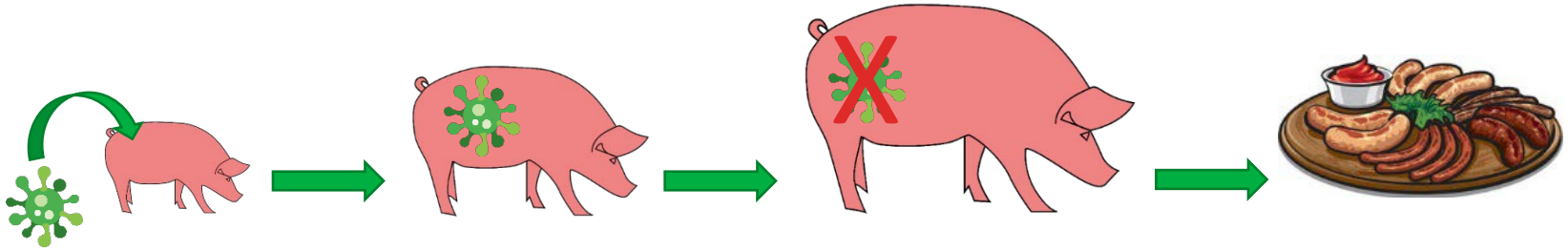
Recent emergence of zoonotic swine-associated HEV in Europe

- Widespread in UK pig herds
  - Seroprevalence @ slaughter **92.8%** (Grierson et al. 2015)
- Unknown infection sources, environmental persistence
- No effective pig vaccine in UK



Preventing infection difficult

- Pigs naturally overcome infection
  - Active infection @ slaughter **20.5%** (Grierson et al. 2015)
- How to increase proportion of pigs overcoming infection before slaughter?



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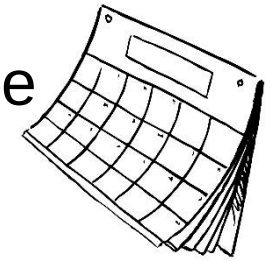
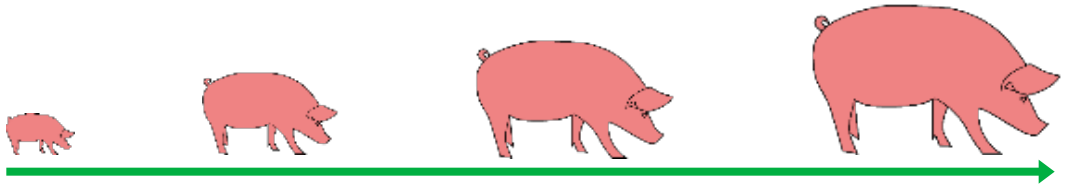
Study aims

1. Investigate presence of HEV on farm over time



2. Investigate environmental sources of HEV on farm

3. Observe infection dynamics in a cohort over time



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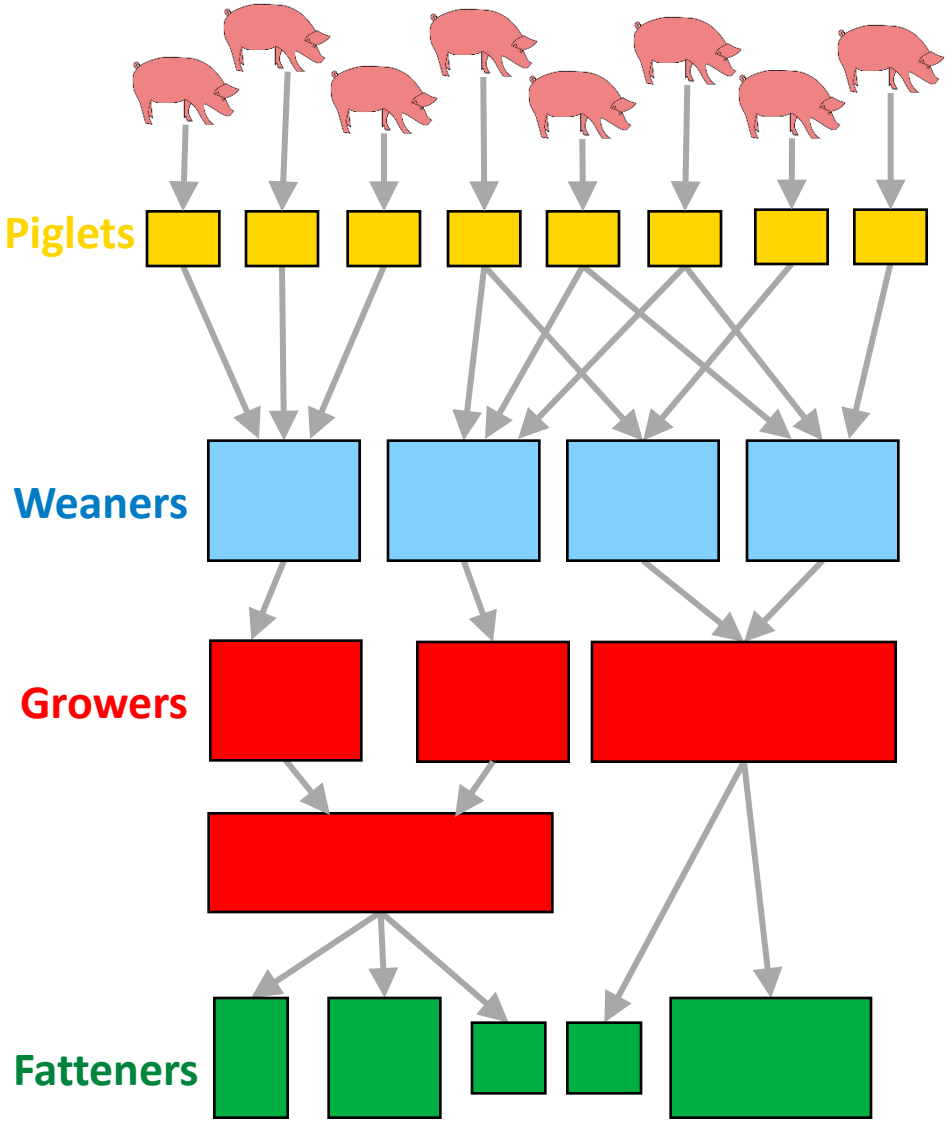
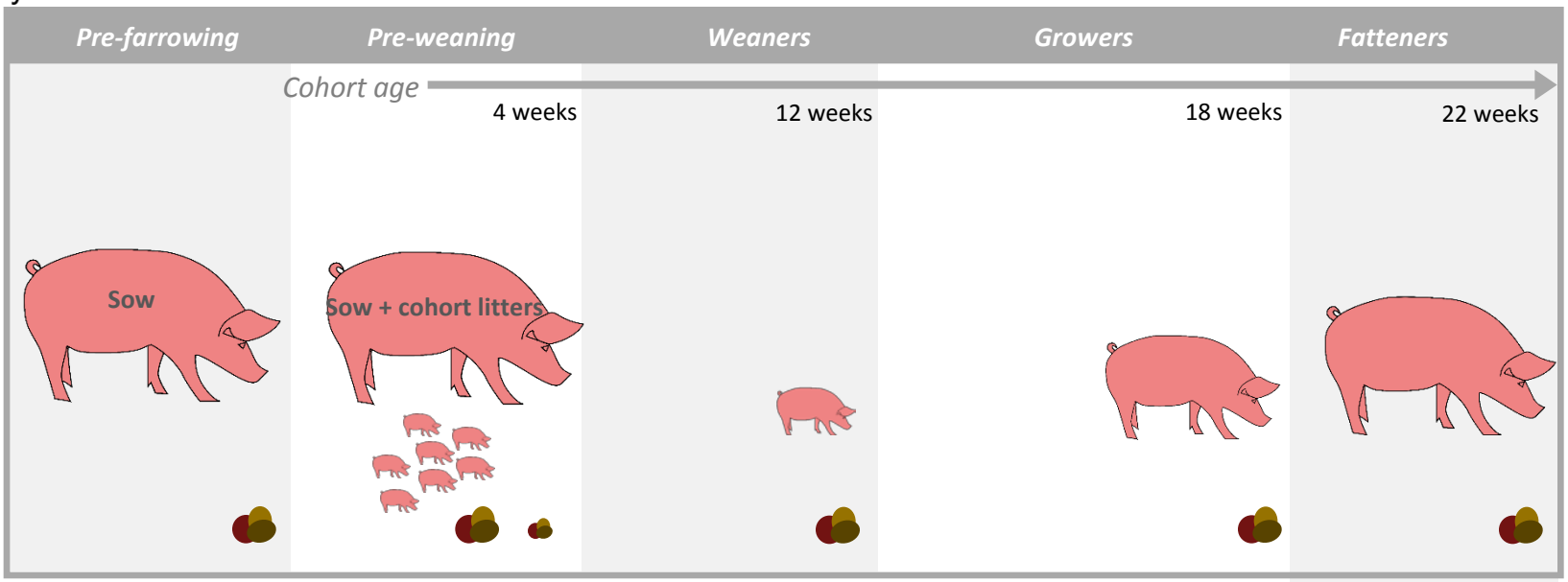
The farm

- Farrow-To-Finish
- Indoor
- Weekly farrowing, crates
- Rear all replacement gilts
- Multiple buildings per stage
- **Mixing** throughout rearing



Sampling strategy



- 5 visits
- Individual floor faecal samples, tested for HEV RNA by qPCR
  - Samples from all cohort pens
  - All non-cohort grower and fattener pens
- Samples from the farm environment

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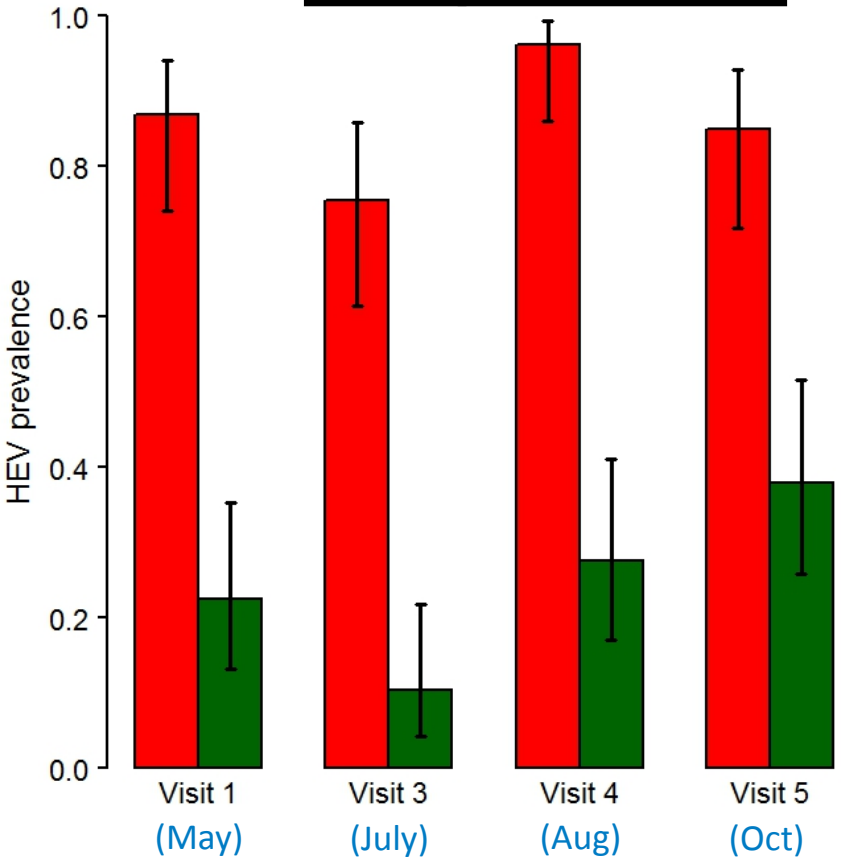
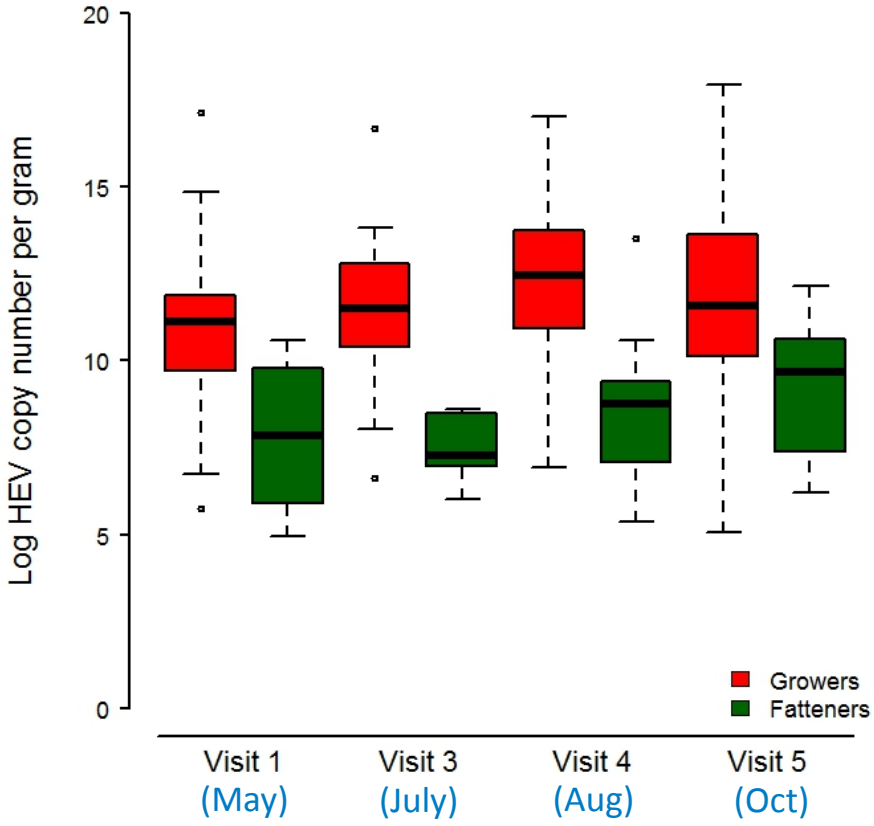
Presence over time

Growers
Fatteners

HEV prevalence



HEV concentration



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HEV widespread in the farm environment

Sample type	Farrowing	Weaners	Growers	Fatteners	General	Total
Standing water	0/2		7/7	4/4	2/2	13/15
Rodent faeces		1/2	0/1	1/3	0/1	2/7
Wild bird faeces		0/4				0/4
Domestic dog faeces			0/1			0/1
Farm vehicles					9/10	9/10
Outdoor tap					0/3	0/3
Pig herding boards		1/1	1/1	1/1		3/3
Ear tagger	0/1					0/1
Mucking out tools	1/1	0/1	2/2	1/3		4/7
Indoor dust	1/1			2/3		3/4
Indoor walkways		1/1				1/1
Feed shovel		1/1				1/1
Drinkers/feeders/toys		3/3		1/4		4/7
Cleaned pens			3/3			3/3
Total	**2/5**	**7/13**	**13/15**	**10/18**	**11/16**	**43/67**

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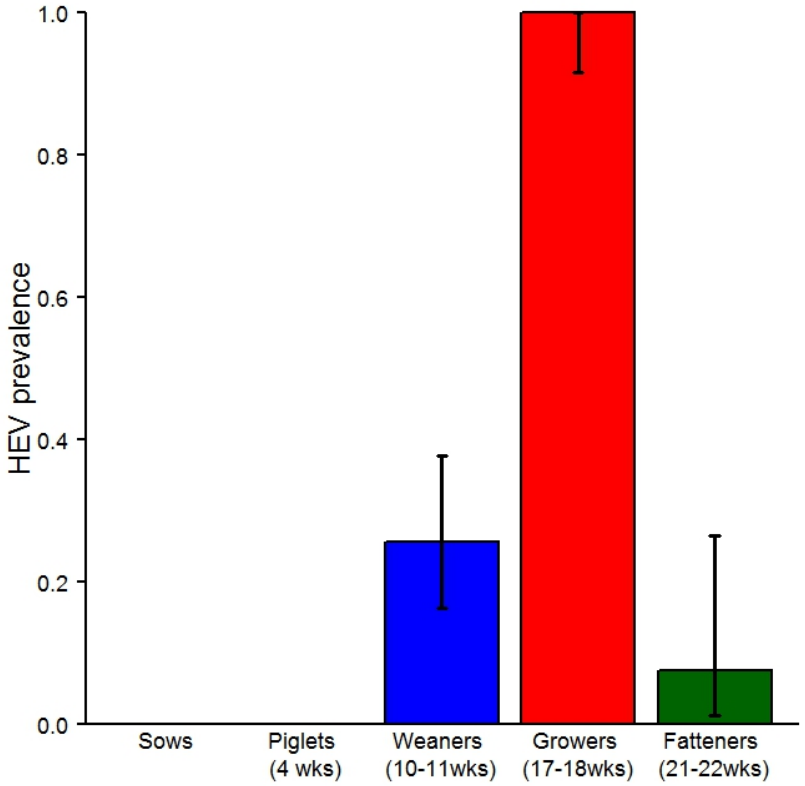
Infection dynamics in a cohort

Sows	Piglets	Weaners	Growers	Fatteners
0/75 0%	0/98 0%	18/70 26%	53/53 100%	2/26 8%

- No detectable shedding in sows (n=18)
  - Pre- or post-farrowing
- No detectable shedding in 4wk old piglets (15 litters)
- First detection of HEV as **weaners** (but pen variation….)
- Prevalence and shedding levels in **growers** > **fatteners**



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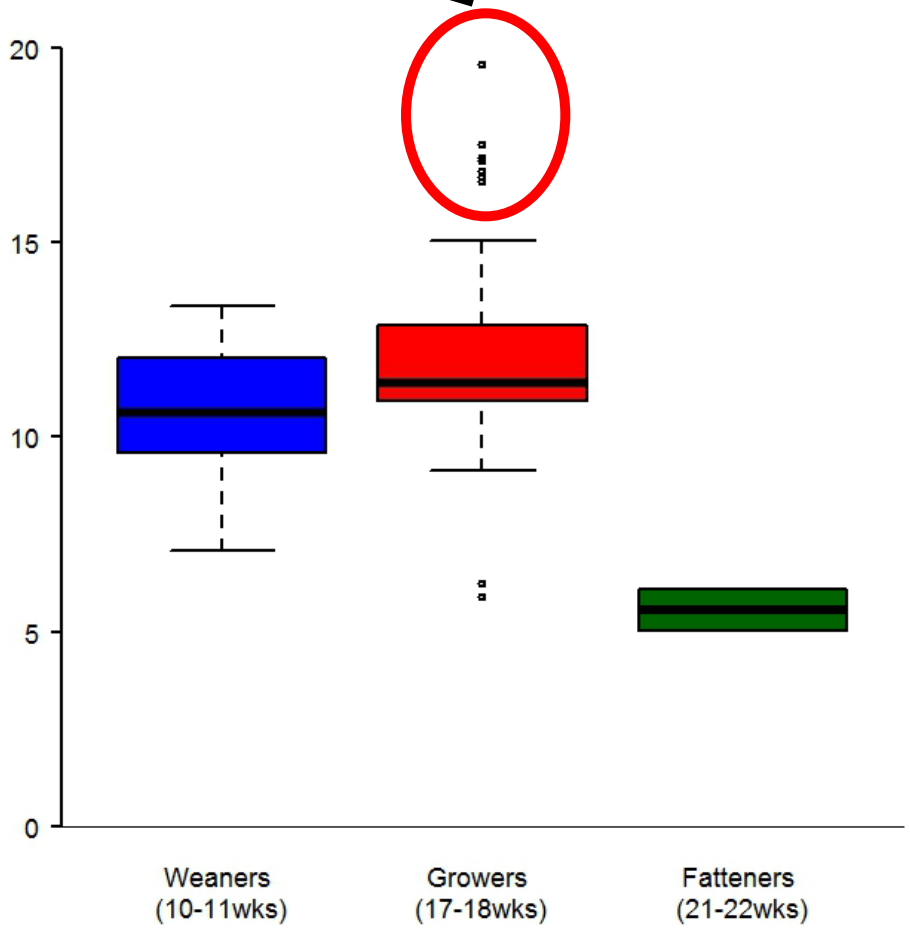
Super-shedding?

Log HEV copy number per gram of faeces



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Weaner variation in HEV presence

- HEV detected in only 2/7 groups
- What was different about positive groups?
    1. Pigs weaned earlier
    2. More early mixing

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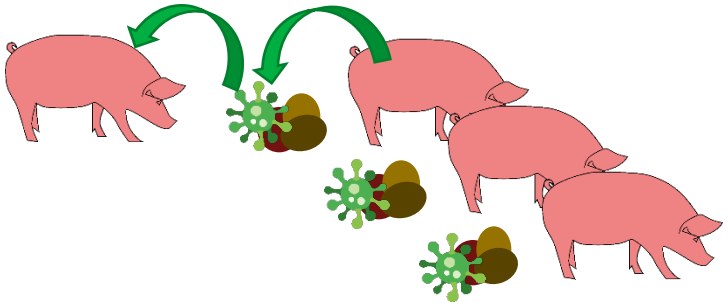
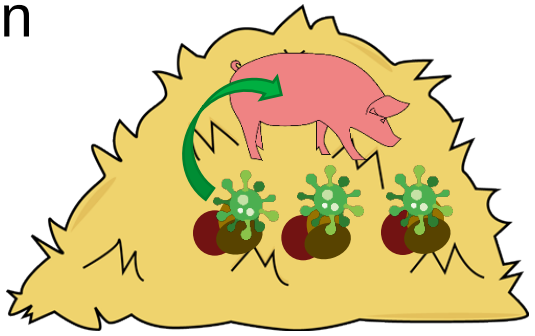
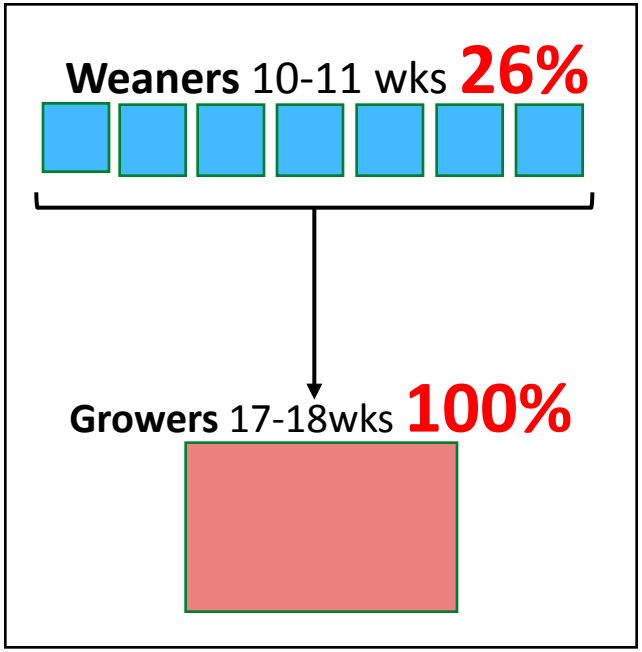
Rapid spread of virus within cohort

1. Large group size, increased pen contamination



2. Deep straw bedding, accumulation of HEV in pen





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Decline in cohort prevalence by slaughter age

- No late-stage mixing
- Low risk of transmission to naïve pigs?
- Low risk of introducing novel strains to the group?

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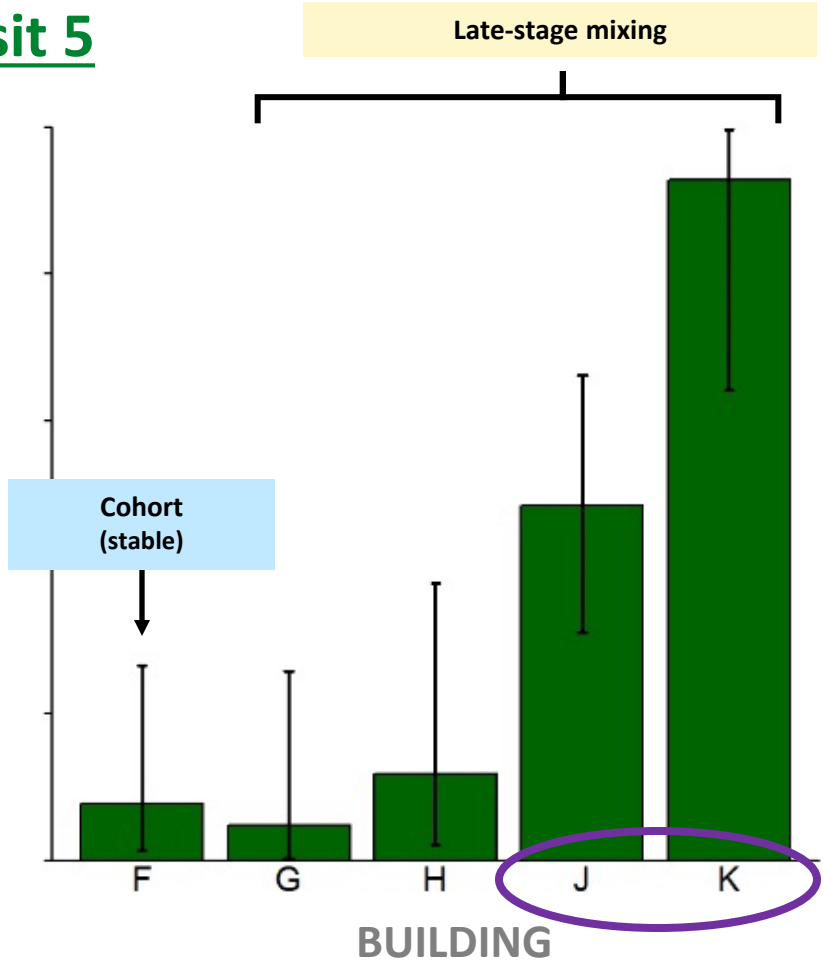
But low prevalence in some highly mixed groups too…

HEV prevalence in Fatteners @ Visit 5

- Within-farm exposure high throughout rearing
- Few naïve pigs remain by slaughter age?
- Differences between buildings due to age differences?



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Summary

1. Investigate trends in presence and persistence of HEV

- Continuous presence on farm over the study period
- Little change in overall prevalence in growers and fatteners

2. Investigate environmental sources of HEV on farm

- Widespread in environment

3. Follow a single cohort from pre-weaning to slaughter age

- No shedding detected in farrowing sows
- No shedding detected in young piglets and most weaners
- Infection probably first entered cohort at weaner stage

  ?? Timing ~ Susceptibility (maternal Ab) and Exposure (mixing of pig sources)
- Rapid spread once present

  ?? Facilitated by accumulation of the virus within the pen environment
- Decline in prevalence by slaughter age

  Hope for developing on-farm control strategies

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Acknowledgements

- APHA colleagues:
  - Richard Smith (Dept. of Epidemiological Sciences)
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- Farmer

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HEV presence

	β	S.E.	p	OR (95% C. I.)
Intercept	-1.22	0.26	<0.001*	-
Pig stage Ref: Fatteners				
Growers	3.07	0.27	<0.001*	21.6 (13.1 – 37.1)
Visit number Ref: Visit 1				
Visit 3	-0.81	0.35	0.02*	0.45 (0.22 – 0.89)
Visit 4	0.49	0.34	0.15	1.64 (0.84 – 3.24)
Visit 5	0.53	0.32	0.10	1.70 (0.91 – 3.23)

Binomial GLM, logit link

HEV presence ~ Pig stage + Visit number

(interaction not significant: χ^2=5.93, df=3, p=0.12)

HEV concentration

	β	S.E.	p	OR (95% C. I.)
Intercept	7.87	0.37	<0.001*	-
Pig stage Ref: Fatteners				
Growers	3.15	0.32	<0.001*	23.3 (12.5 – 43.7)
Visit number Ref: Visit 1				
Visit 3	0.33	0.43	0.44	1.4 (0.6 – 3.2)
Visit 4	1.19	0.39	0.002*	3.3 (1.5 – 7.1)
Visit 5	0.86	0.38	0.02*	2.4 (1.1 – 5.0)

ANOVA (HEV-positive samples only)

Factors = Pig stage + Visit number

(interaction not significant: χ^2=5.93, df=3, p=0.12)

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Weaner group variation

Group ID	# samples positive	Group size	# tagged litters		Proportion non-cohort	Presence of early weaned pigs
wn1	9 / 10	32	3	Low	0	Yes (all; 7 days early)
wn2	9 / 10	32	9	High	0.56	Yes (some; 4 days early)
wn3	0 / 10	33	6	High	0.52	No
wn4	0 / 10	33	4	Low	0.30	No
wn5	0 / 10	34	2	Low	0.5	No
wn6	0 / 10	33	1	Low	0.73	No
wn7	0 / 10	33	2	Low	0.42	Yes (some; 4 days early)

Samples per fattener building visit 5

Building	F1	F2	F3	F4	Cohort
Positive/Total	0/11	2/17	7/16	13/14	2/26
N pigs	190	240	260	180	94