Genetic Predictions for Pulmonary Arterial Pressure

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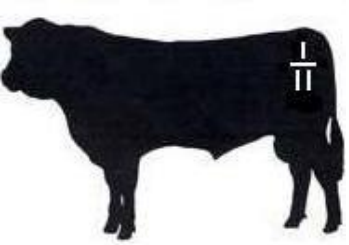

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EPD development process

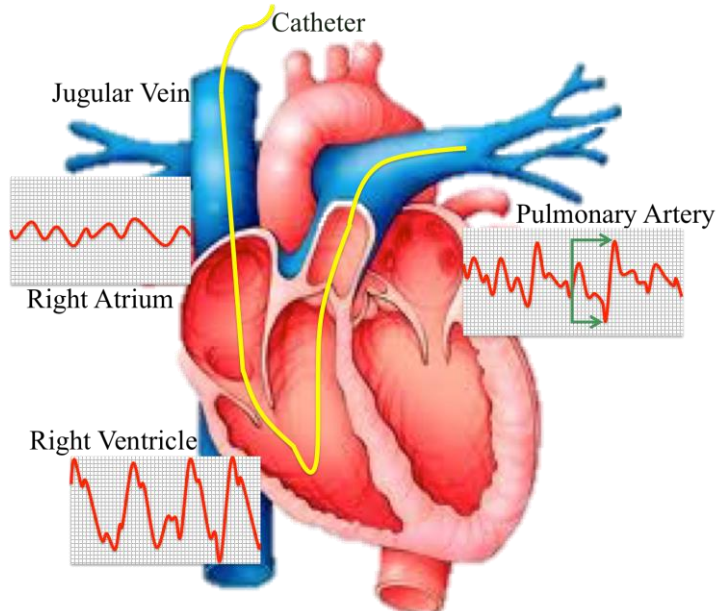
- Is there sufficient data for trait of interest?
  - Data integrity check and verification of sufficient observations
- Estimate heritability and genetic correlations (as appropriate)
- Calculate EPD
- Transitioning from within herd to breed wide predictions
- Education

Background

- Pulmonary hypertension can develop into high altitude disease (HAD)
  - Brisket Disease
  - High altitude regions (>1500m)
  - Increased death loss
  - Pulmonary arterial pressure (PAP) is indicator

Background

- Phenotypic Pulmonary arterial pressure (PAP)
  - < 41 mmHg considered low risk
  - 41 – 48 mmHg acceptable for animals at altitude
  - > 48 mmHg considered high risk



(Holt et al., 2007)

PAP Heritability

Study	Heritability	Breed
Enns, et al. 1992	0.46	Angus (Seedstock, registered)
Shirley, et al., 2008	0.34	Angus (Seedstock, registered)
Crawford, 2016	0.26	Angus (Seedstock, research)
Zeng, 2013	0.56 (weaning) 0.31 (yearling)	Angus (Seedstock, research)
Pauling, 2016	0.25	Angus (registered)
Culbertson, et al., 2016	0.29	Multi-breed, 7+ breeds

Put this in perspective

Study	Heritability	Breed
Koots et al., Weaning weight WW maternal Yearling weight Carcass weight	 0.37 0.28 0.33 0.55	Across breeds
Stayability	0.11 to 0.18	CSU-CGEL

Various Genetic Correlations with PAP

	Shirley et al. (2008) [1]	Zeng (2013) [2]	Crawford (2016) [2]	Pauling (2017) [2]
Birth Direct	0.49	0.22	0.15	-0.08
Birth Maternal	0.01		0.14	0.56
Weaning Direct	0.51	0.16	0.22	0.16
Weaning Maternal	-0.05	0.10	-0.03	-0.15
Yearling Direct		0.11	0.12	0.02
PWG		0.03	-0.10	-0.06
BF				-0.03
REA				0.24
IMF				-0.04
RUMP				0.10

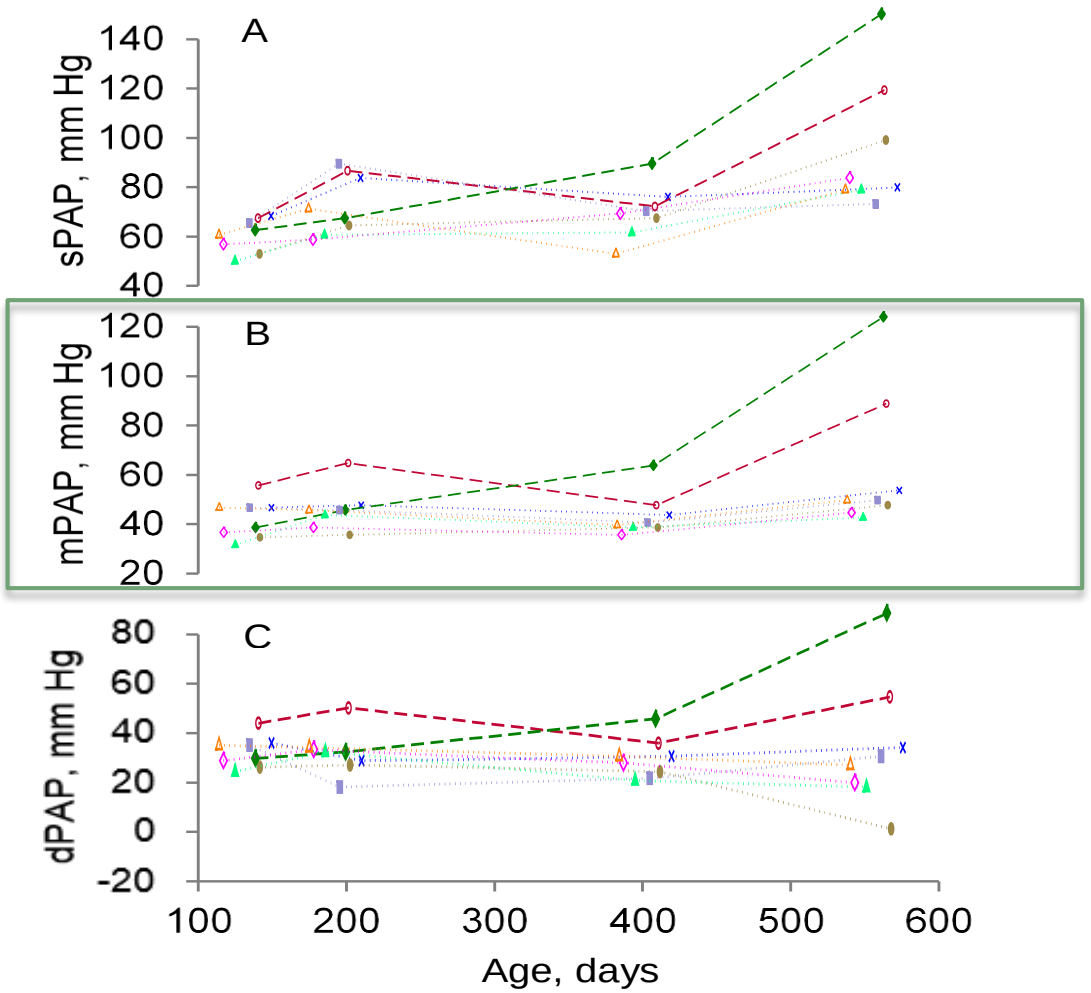
[1]Weaning PAP
[2]Yearling PAP

Non-Genetic / Systematic Influences on PAP

- Age ~ 18 months ideal
- Breed
- Body Condition
  - Fat thickness
- Contemporary Group
- Elevation
  - PAP increases ~ 1 to 1.5 mmHG / 1000 feet
  - ~33% of individuals will increase more
- Parasite load
- Ration
  - % Concentrate
  - Ionophores
- Respiratory Disease
  - Any lung damage
- Sex
- Technician
- Weather

Age influence on PAP

- Regression of PAP Score on age → 0.031mmHg



Neary et al., 2015

Breed Differences

Table 2. Results of model means and coefficients for pulmonary arterial pressure by breed.

Breed	Unadjusted Mean	Estimate	Standard Error
Intercept [A]	45.138	50.140	3.601
AN/Gelb	44.000	-8.196	4.253
Angus	47.656	-0.297	1.351
Composite	43.051	-4.447	1.240
Gelbvieh	46.038	1.271	1.599
Hereford	42.685	-4.830	1.404
Limousin	43.769	-1.402	2.078
Maine Anjou	47.200	1.546	5.670
Other [B]	43.506	-2.754	1.749
P. Hereford	42.316	-3.378	1.708
Red Angus	46.723	2.889	1.403
Salers	39.500	-7.587	3.985
Simmental	53.120	5.440	1.819
System1	46.921	1.817	1.300

[A] Zeroed for Charolais breed

[B] Breeds unknown

Crawford et al., 2013

Contemporary Group

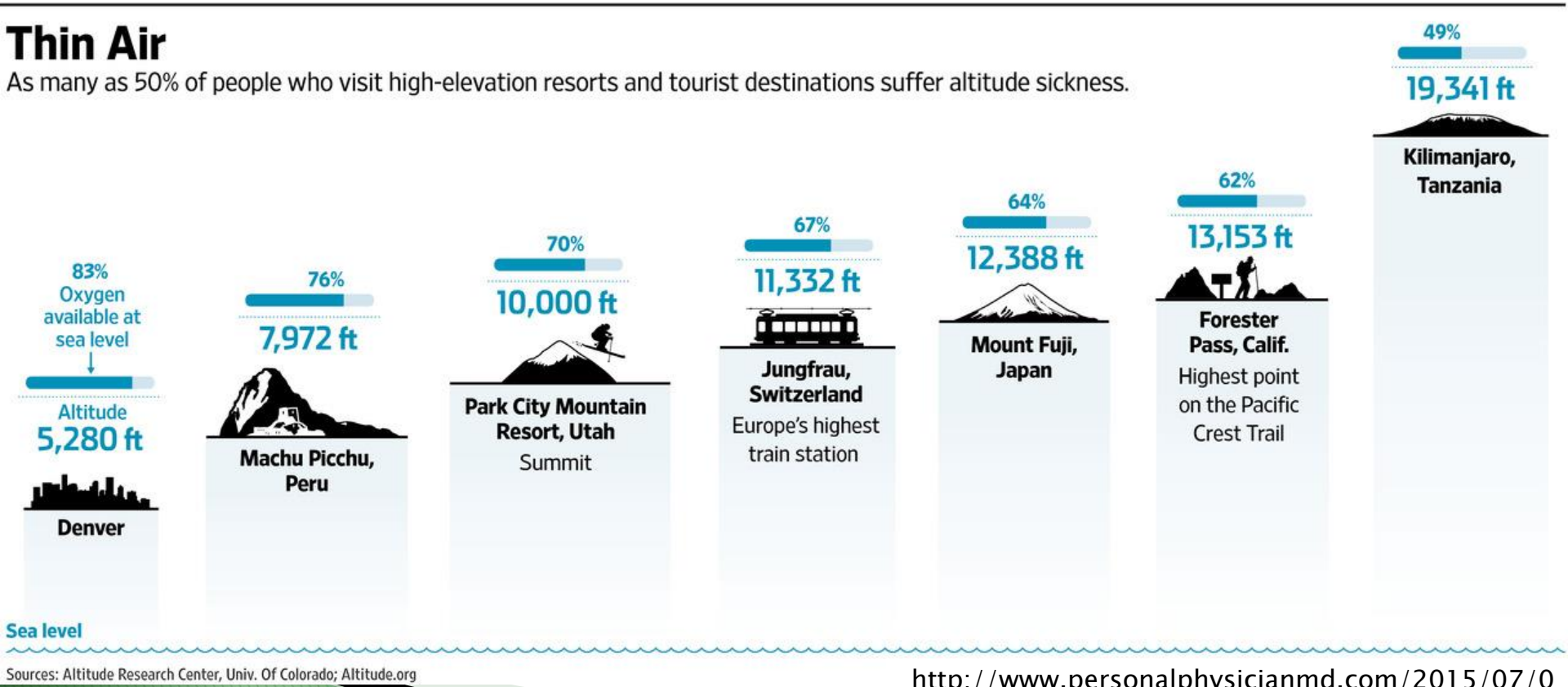
- Genetic Evaluation methodology compares individuals within a contemporary group

- Defined
  - Yearling management, Yearling Date, PAP date, Elevation, Ranch, Disease Status, etc.
  - PAP Technician

- Important
  - Greatly influences resulting predictions
  - Particularly if ranch accounts for elevation differences.

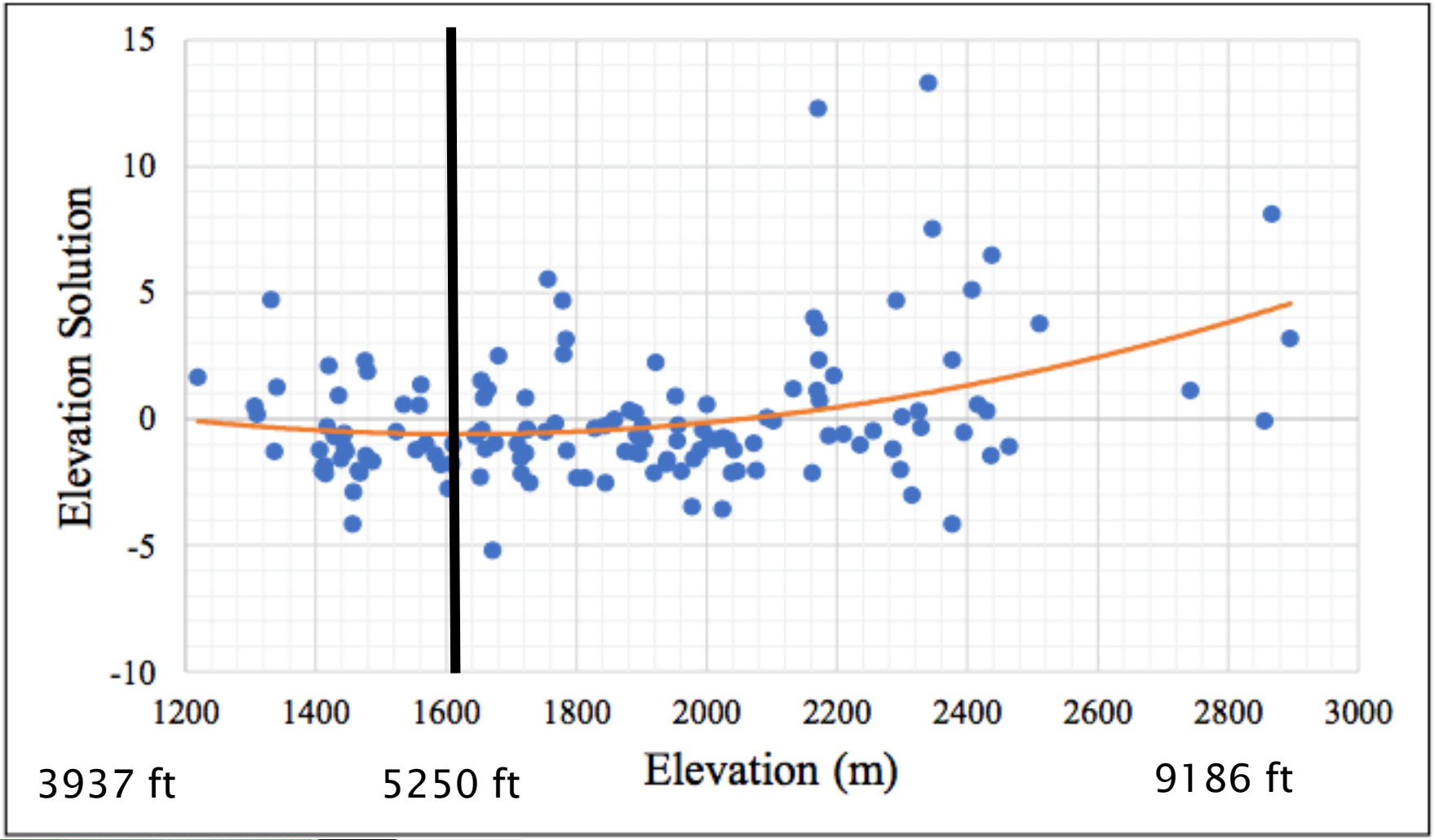
Elevation

- Genetic or Environmental influence?



http://www.personalphysicianmd.com/2015/07/01/preventing-mountain-sickness/

Elevation and its relationship with PAP



Pauling, 2017

Elevation Differences

- High Elevation versus Moderate Elevation

	PAP > 5,500	PAP < 5,500
PAP > 5,500	0.37 ± 0.10	0.79 ± 0.23
PAP > 5,500		0.26 ± 0.08

Culbertson et al., 2016

	PAP > 5,250	PAP < 5,250
PAP > 5,250	0.34 ± 0.03	0.83 ± 0.15
PAP > 5,250		0.29 ± 0.09

Pauling et al., 2018

- Heritability on the diagonal.
- Genetic correlation above diagonal.

PAP EPD Summary

- There is a significant genetic contribution to PAP
  - PAP EPD ranged from -6.9 to 26.6 mmHg.
- Low elevation measures are strongly (not perfectly) related to high elevation PAP measures
- Knowledge of the genetic correlation between various elevations, allows use of Moderate elevation PAP as an indicator of High elevation PAP.
  - Relationship is dependent on the distance between measures
- PAP evaluated breed wide in a NCE setting
  - Likely run as multiple trait analysis

Recommendations for usage…

- Association-wide EPDs for PAP soon to be released.
- Decisions need to be made based on sire usage opportunities.
- Essentially 2 different paths
  - Sires residing at elevation
  - Sires producing progeny at elevation

Sires residing at elevation…

- Consider the genetic model:
  - P = Group Mean + Breeding Value + Environment
- Environmental influences on phenotype are not passed on to offspring.
- It does contribute to the individual's phenotype
- To improve chances of survival at elevation:
  - Individual phenotype cannot be ignored
- For selection to become parents, individuals should be selected based on their EPD

Sires producing progeny at elevation…

- Consider the genetic model:
  - P = Group Mean + Breeding Value + Environment
- Use published EPD
- EPD is a prediction of the genetic merit (“transmittable”) of an individual
- Significant effort is made to reduce environmental variability that is not transmitted from parent to offspring.
- EPD will rank individual animals according to their value as a parent.

Recommendations for usage…

- At elevation
  - Need acceptable PAP EPD AND
  - Need acceptable PAP observation

- EPD
  - Positive EPD → caution with use
  - Zero or below → Good
  - Less than -0.70 → Will improve problems

Questions?