Beyond Threshold Dosing University of Glasgow A Process Control Approach to **Donkey** Sanctuary Sustainable Worm Management



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Traditional Worm Control Strategies

• Since the introduction of the first anthelmintic class in the 1960s, nematode control for equids in the western world has centred around interval dosing of all animals every 6 to 8 weeks • This consistent exposure of the parasites to anthelmintics has introduced a strong selective pressure within parasite populations • As a result, resistance to the Benzimidazoles developed in many cyathostomin populations by the late 1980's • Resistance to all other available classes of anthelmintic has followed



• Indiscriminate interval dosing of all animals is no longer recommended



Cyathostomin species have demonstrated resistance to all anthelmintics available for use in equids

Threshold Dosing Strategies

- Faecal Worm Egg Count (FWEC) from individual animals are highly over-dispersed, so the majority of pasture contamination originates from a small number of individuals
- Targeted selected therapy aims to treat only the highest shedders
- One strategy uses monthly FWEC on all animals, and treats those whose FWEC is above a given threshold
- However, variability in FWEC from the same animal means that a

FWEC can be used to quantify the contribution of individuals to the total pasture contamination

Beyond Threshold Dosing

- More judicious use of anthelmintic dosing could be achieved by utilising the following information to select animals to be dosed:
 - Multiple historic FWEC from individuals (mitigates the effects of fluctuation and measurement error in individual FWEC)
 - Group mean FWEC (represents infective pressure from pasture)
 - Additional co-variants affecting future FWEC such as age, sex, weather, pasture hygiene management and season
- This control strategy, conceptually based on statistical process control, would be more useful in controlling cyathostomin populations whilst minimising the use of anthelmintic

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single observation does not reliably identify a high shedder

• The thresholds used are also typically quite arbitrary



The Donkey Sanctuary has a large population of equids with individual FWEC performed monthly

Implementation at the Donkey Sanctuary

User interface of the statistical treatment program being developed

- A statistical model is used to predict future FWEC of each individual of a group using the covariates mentioned previously
- If the prediction is for the group mean FWEC to become 'uncontrolled', anthelmintic dosing is implemented on a proportion of the group to prevent the predicted rise in pasture infectivity
- Selective dosing of animals based on their expected shedding and efficacy reduces repeated exposure of resistant worms
- A bespoke software interface (written in Python) is used to enter monthly FWEC, predict future FWEC, and instruct operators to dose individual animals with anthelmintic based on these rules