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Technical challenges associated with the eradication of TADs in southern Africa with special reference to FMD

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Background

- ".... elimination and eradication programmes (for diseases) are laudable goals (but) careful and deliberate evaluation is a prerequisite before embarking on any programme. Elimination and eradication are the ultimate goals .... the only question is whether these goals are to be achieved in the present or some future generation" (Dowdle, 1999)
  - Implication is that it is unwise to embark on eradication programmes before the critical success factors (CSF) are in place
  - CSF can be technical, logistic or financial

Background (cont.)

- Smallpox was the first major infectious disease to be globally eradicated – announced by UN in 1980
- Rinderpest followed in 2011
- Many other diseases including polio, measles, guinea worm, lymphatic filariasis, leprosy, onchocerciasis, Chaga's disease, FMD, CSF, CBPP & porcine cysticercosis have been ear-marked for eradiction
  - there are programmes for these human diseases
- For animal diseases no feasibility studies have been conducted (not in the public domain anyway)
- Question: What determines whether an animal disease is eradicable or not?

Rinderpest

- What rendered rinderpest eradicable?
  - Universally recognized as a devastating plague
  - Favourable epidemiological characteristics
  - Cheap & effective vaccine (1 dose = life-long immunity), i.e. excellent intervention tool
- So the imperative & intervention mechanism were instituted in s-SA (PARK & PACE); nevertheless, it took >40 years & about $250 million in direct expenditure
- This experience ⇨ idea that eradication is usually/ always possible ⇨ trade with regions where disease still occurred was unwise ⇨ inducement & punishment for good/poor performance

Technical requirements for TADs eradication (adapted from human diseases)

- Intervention tools are available to reduce R_0 <1
- Detection strategies & tools with sufficient sensitivity and specificity are available to detect levels of infection that can lead to transmission

  - high rates of sub-clinical infection create a problem!
- The definitive domestic animal host(s) is (are) essential for the life-cycle of the agent

  - free-living hosts/vectors able to maintain the infectious agent represent a killer factor (disqualifies most TADs, e.g. RVF, BT, AHS, ASF etc)
- The agent is unable to persist or multiply in the environment in the absence of an animal host

Comparison between rinderpest & SAT-serotype FMD in s-SA/SA

Factor	Rinderpest	SAT serotype FMD
Intervention mechanism available to reduce R_0 <1	+	+/-
Adequate surveillance tools & strategies to detect transmissible infection	+	+/- (surveillance in wildlife inefficient)
Definitive domestic host essential for life-cycle	+	-
Agent does not persist or multiply in the environment	+	+

What does this tell us?

- SAT serotype FMD very unlikely to be eradicable in SA with existing technology
- However, crude assessments (i.e. + or -) for the 4 crucial factors are inadequate – so we have developed matrices for each of the elements that make up each critical factor (i.e. the subset of elements which collectively comprise each CSF)
- Based on statistical evaluation of matrix results for different TADs, we have derived comparative values for 'eradicability', using rinderpest as the base-line
- We hope to refine this approach & publish the results in the near future

Example: Intervention strategy (mass vaccination) for SAT virus FMD in SA

Mass vaccination of cattle	Score (potential =5)
Induction of 'sterile immunity'	2
Duration of vaccinal immunity	1
Requirement for multiple vaccinations to maintain effective immunity	2
Requirement for cold-chain	3
Safety of vaccine (acceptability to livestock owners)	5
Access to a high proportion of the susceptible target population for vaccination (cattle)	3
Efficacy of supporting measures: auditing of vaccination programmes	1
Average score	2.4

Overall result for rinderpest & SAT FMDV serotypes in s-SA

- Rinderpest = 51.3/125
- SAT serotypes = 19.1/125

- Conclusion: From a *technical perspective* FMD would be >2 times as difficult (& likely expensive) to eradicate as rinderpest
- Reason: Mostly a combination between inadequate intervention capacity & also epidemiological features of the disease (complex virus populations [quasi-species] & their maintenance by wildlife)

Ranking 'eradicability'of some TADs using this matrix system in s-SA

Disease	Index score
Rinderpest	51.3
Eurasian FMD serotypes (A & O)	39.8
Peste des petits ruminants (PPR)	35.7
Sheep & goat pox	34.8
Classical swine fever	32.1
Lumpy skin disease	31.4
Anthrax	24.6
Contagious bovine pleuropneumonia	24.3
SAT FMD serotypes (SAT 1-3)	19.1

Overall conclusion

- In the foreseeable future, very few if any major TADs are technically eradicable from s-SA generally & SA specifically
  - this ignores major non-technical issues!
- The problem is international standards & guidelines for managing diseases & trade in animal commodities & products are based on the presumption that 'freedom from infection' (i.e. at least regional eradication) is achievable
- So we have to live more effectively with TADs & there are possibilities in this respect!

  - needs better recognition in international standard-setting!