



Protecting Livestock – Improving Human Lives

Veterinary vaccinology in the One Health perspective

European Veterinary Vaccinology Workshop, Edinburgh, UK

Dr A Colston, Regional Director R&D, Nairobi, Kenya

22 May 2018





Protecting Livestock – Improving Human Lives

Introduction



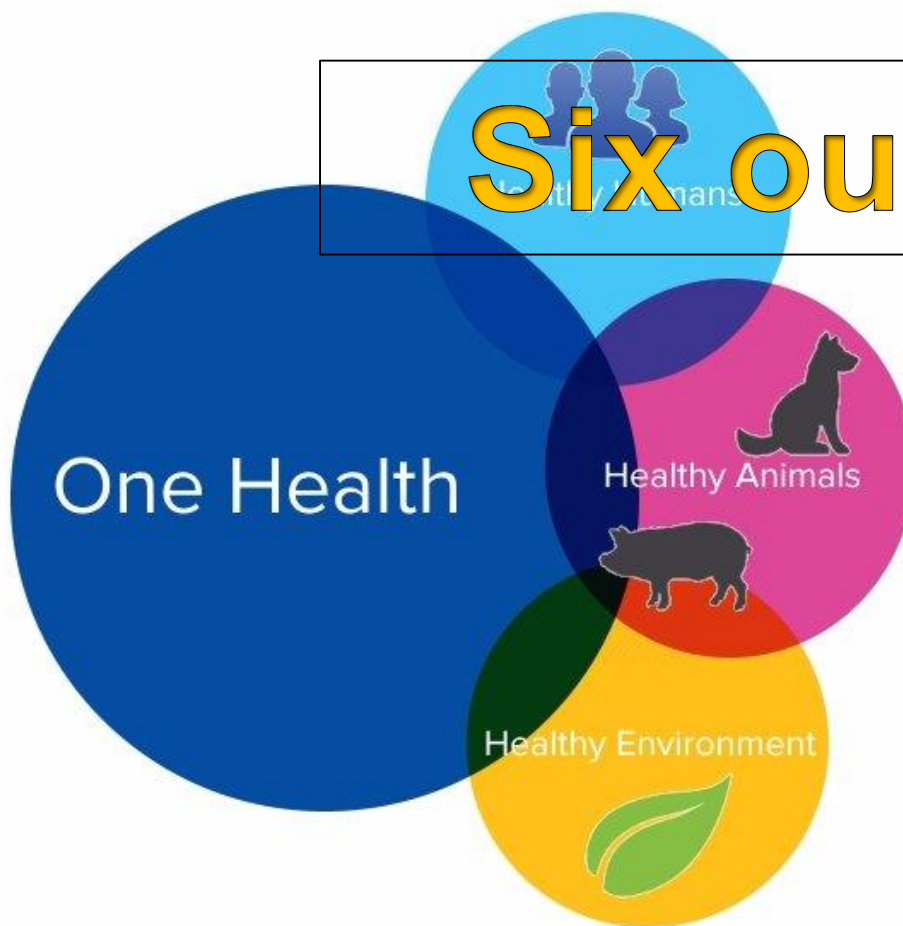
1. Product Development



2. Market Development



Backed by a broad range of project support functions



Six out of Ten

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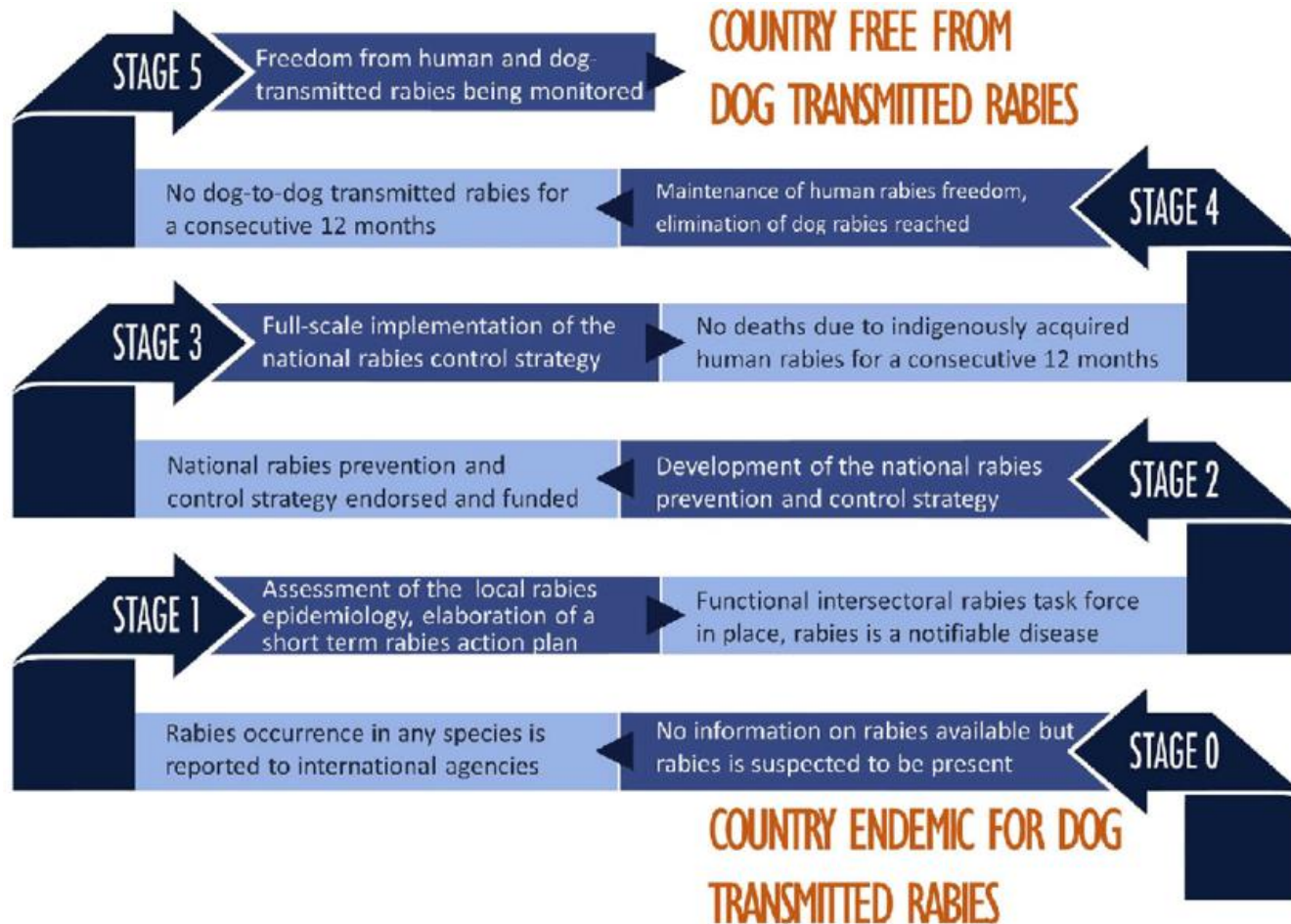
Benefits of a one health approach: An example using Rift Valley fever

Melinda K. Rostal^a, Noam Ross^a, Catherine Machalaba^a, Claudia Cordel^b, Janusz T. Paweska^c, William B. Karesh^{a,*}

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OF PATIENTS.

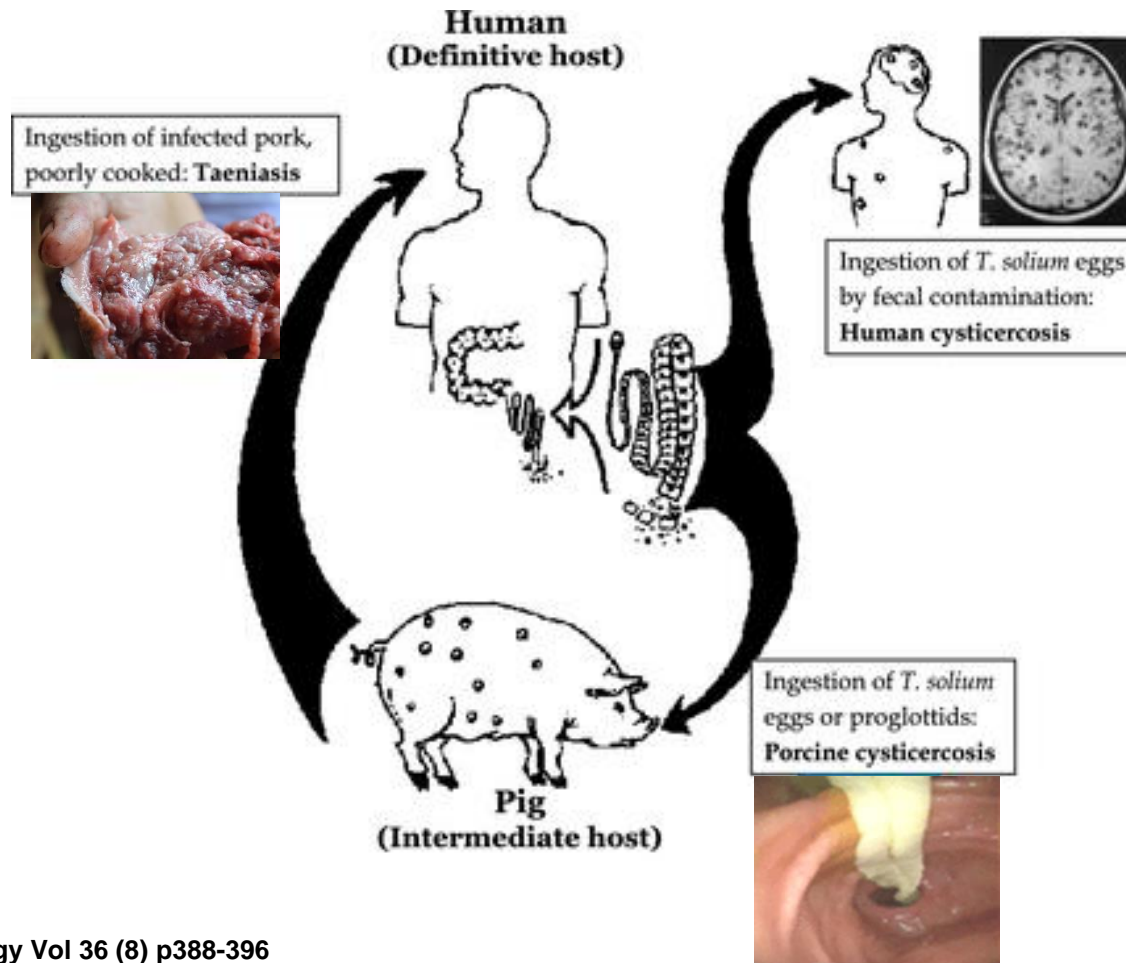


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Cysticercosis - a public health issue



Parasite Immunology Vol 36 (8) p388-396
<http://onlinelibrary.wiley.com/doi/10.1111/pim.12126/full#pim12126-fig-0001>

In 1993 it was identified as one of six potentially eradicable diseases

Poliomyelitis

Rubella

Meningitis

Dracunculiasis

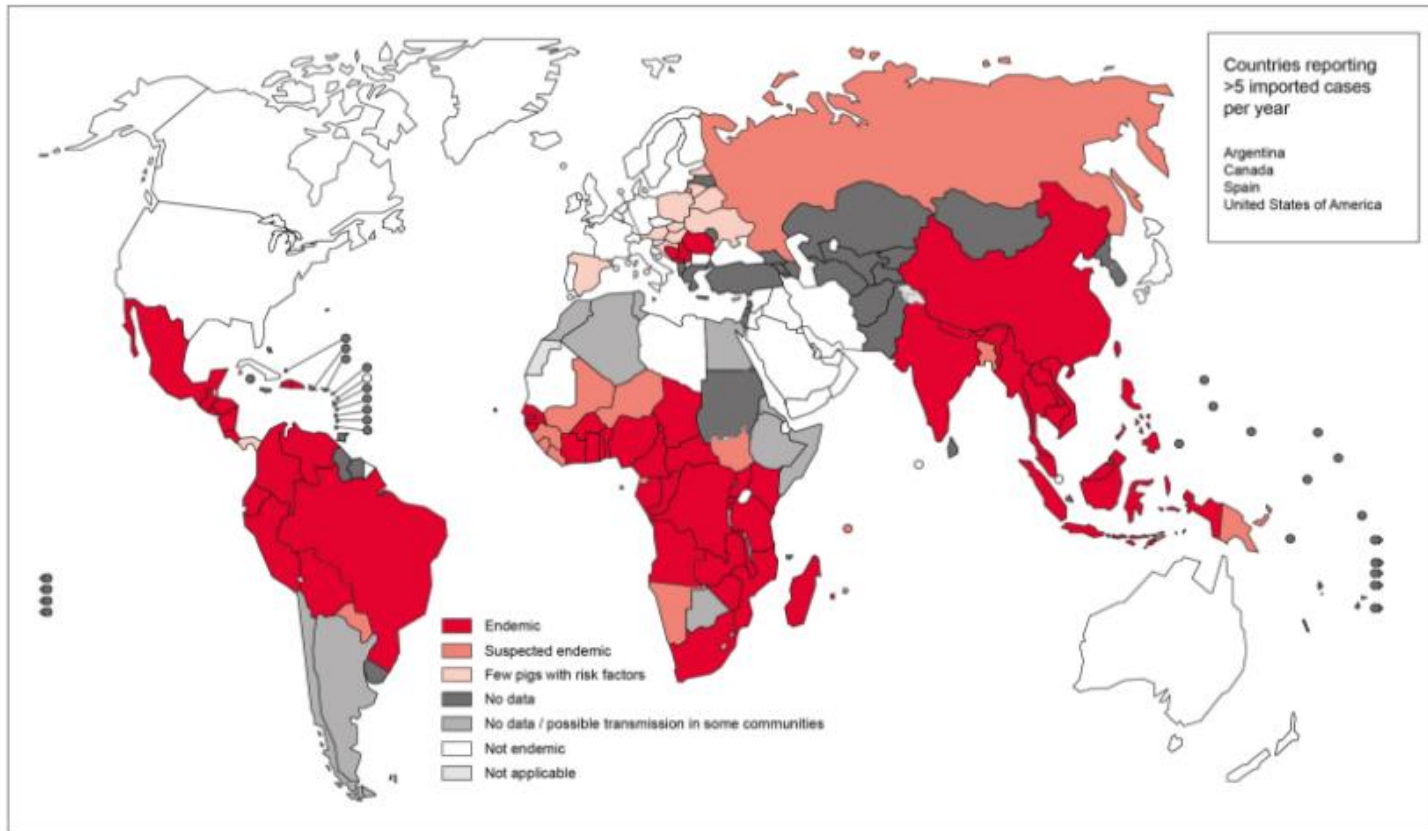
Lymphatic filariasis

Taeniasis/cysticercosis

[International task force for disease eradication – The Carter Centre](#)



Endemicity of *T. solium* 2015

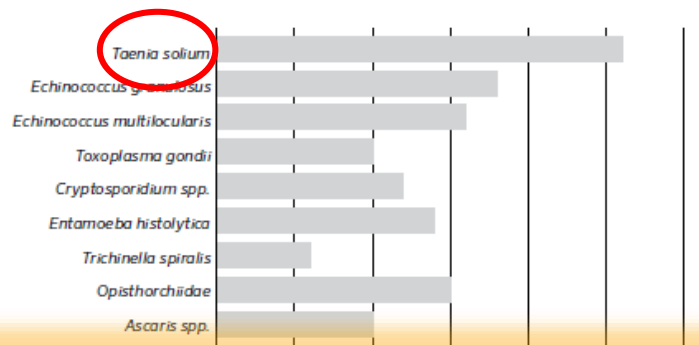


The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement. © WHO 2016. All rights reserved

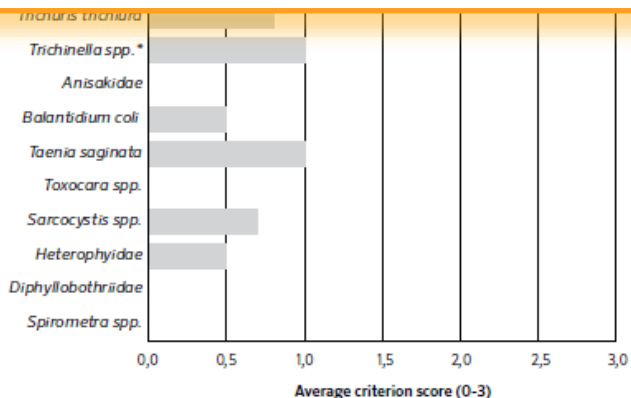
Data Source: World Health Organization
Map Production: Control of Neglected Tropical Diseases (NTD)
World Health Organization



http://www.who.int/taeniasis/Endemicity_Taenia_Solium_2015.jpg?ua=1



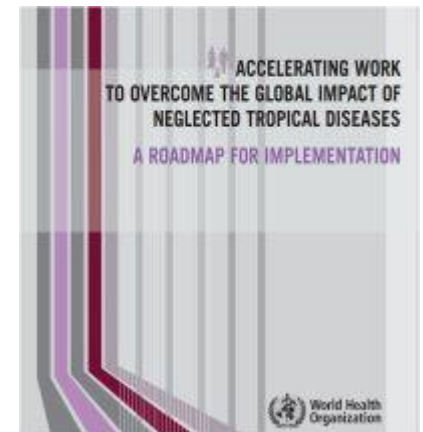
Taenia solium ranked top of 24 food-borne parasitic diseases of global importance



Disease	2015	2020
Taeniasis/ cysticercosis	Validated strategy for control and elimination of <i>T. solium</i> taeniasis/cysticercosis available	Interventions scaled up in selected countries for <i>T. solium</i> taeniasis/ cysticercosis control and elimination

http://www.who.int/neglected_diseases/NTD_RoadMap_2012_Fullversion.pdf

WHO publish roadmap to implement control of 17 neglected tropical diseases



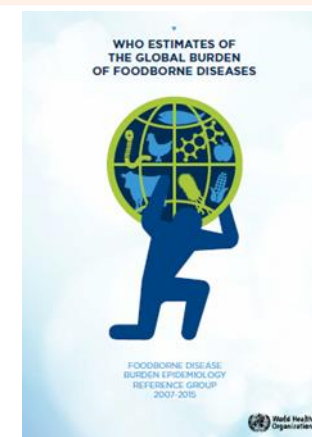
Economic Burden of Foodborne Hazards 2015

Rank	Pathogen	New cases/yr	Deaths/yr	Economic burden (DALYS)
1	Non-typhoidal <i>S. enterica</i>	78 707 591	59 153	4 067 929
2	<i>Salmonella Typhi</i>	7 570 087	52 472	3 720 565
3	Enteropathogenic <i>E. coli</i> – EPEC	23 797 284	37 077	2 938 407
4	<i>Taenia solium</i>	370 710	28 114	2 788 426

Ranked fourth highest out of 31 foodborne hazards (Foodborne Disease Burden Epidemiology Reference Group)

http://apps.who.int/iris/bitstream/10665/199350/1/9789241565165_en_g.pdf?ua=1

BUT this is based on costs of epilepsy alone, other symptoms headaches, psychiatric disorders, learning difficulties are not included in these estimates



Impact of Epilepsy

Worldwide 65 million people have epilepsy

More than 80% people with epilepsy live in developing countries

Globally 50 million cases, 50,000 deaths each year

Among people with epilepsy in endemic countries, 29% estimated NCC.

Annual proportion of deaths estimated 6.9% Cameroon, 0.5% Mexico.

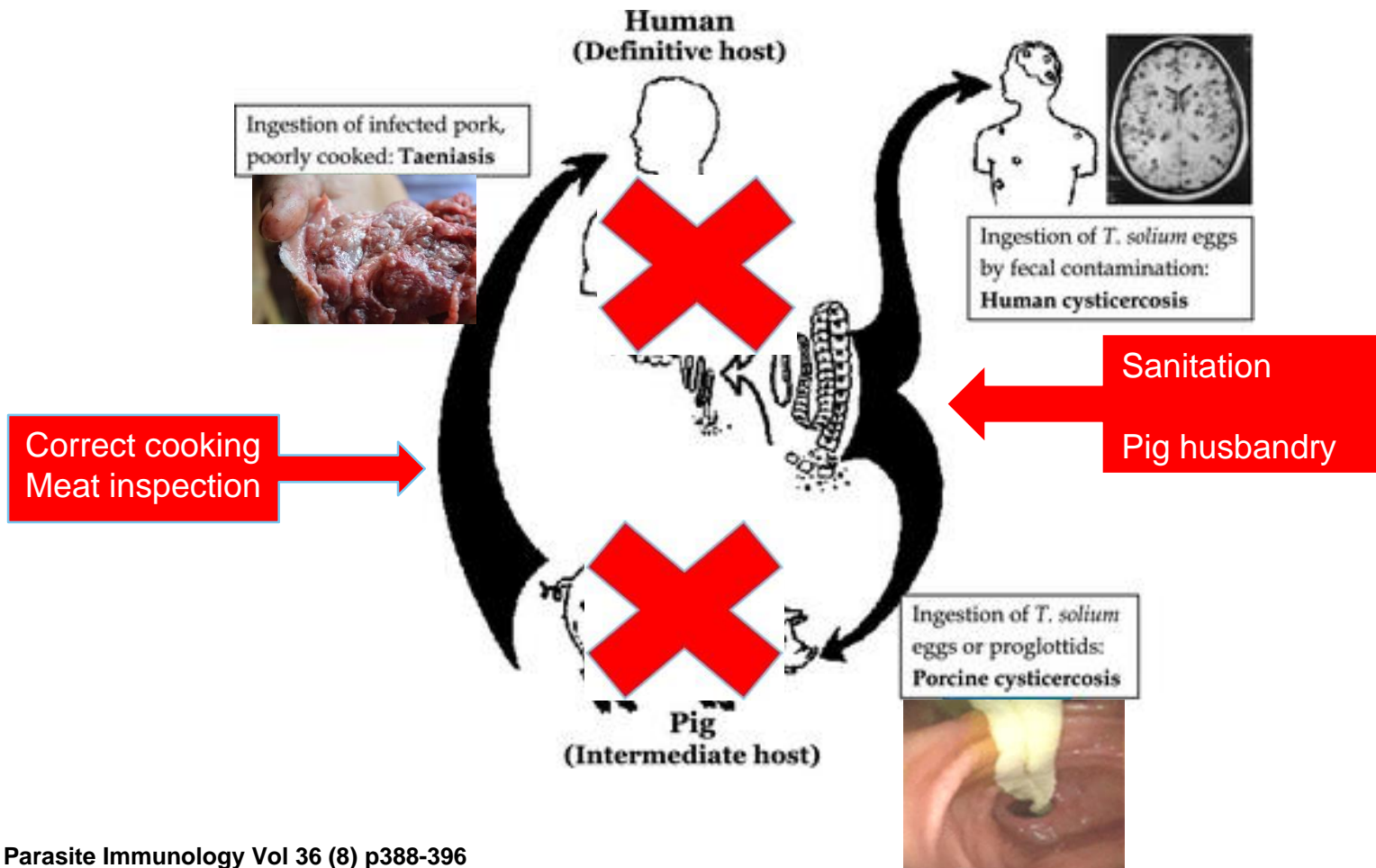
Symptoms of NCC, cause 2/3 of wage earners to lose their jobs, and only 61% are able to again engage in wage earning activities.

Stigmatisation, reduced capacity to work, incapacitation, mortality.



Source: Sustaining the drive to overcome the global impact of neglected tropical diseases: Second WHO report on neglected tropical diseases. WHO, 2013.

Controlling the disease



Parasite Immunology Vol 36 (8) p388-396
<http://onlinelibrary.wiley.com/doi/10.1111/pim.12126/full#pim12126-fig-0001>

International vaccine trials

Five separate controlled vaccine studies in pigs made by four independent research groups in four countries, achieving protection of:

- 99.5% and 100% (Mexico)
- 100% (Cameroon)
- 99.5% (Peru)
- 99.3% (Honduras)

In addition, similarly high levels of protection (94 to 100%) were achieved using TSOL18 expressed in *Pichia pastoris* in combination with the adjuvant ISA 206 in studies conducted in China (Cai *et al.*, 2008) and in Peru in a comparative efficacy study (GALVmed Study 604/SUI/11/011)

Large field trials in Peru: 105 villages, 80,000 people, 55,000 pigs over 7 years (Garcia *et al* 2016).

Objectives:

- To support the TSOL 18 vaccine (Cysvax™) and oxfendazole (Paranthic™) development and ensure availability
- To demonstrate an effective PC disease control strategy appropriate for different regional settings and
- To generate a data package that will attract human health partner(s) to drive phase 2 programme.

Key activities:

- Registration activities
 - Support TSOL 18 vaccine (Cysvax™) and oxfendazole (Paranthic™)
- Pilot trials leading to data supporting use in pigs and potential health care benefit

Recombinant porcine cysticercosis vaccine



First registered vaccine for porcine cysticercosis
nears sale in India

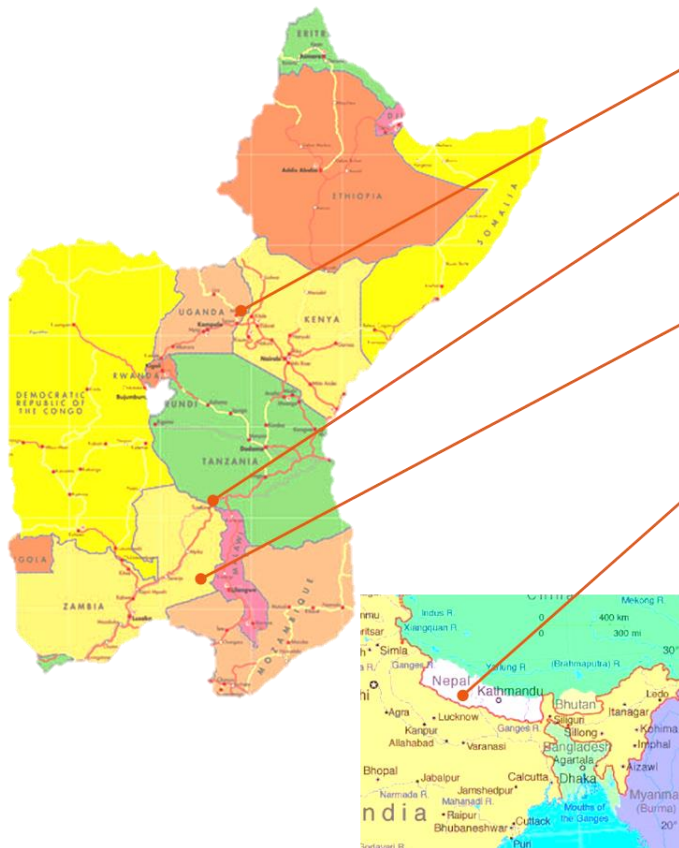
By Malcolm Flanagan
Published: 20 July 2016 01:51 PM



Target Product Profile

	Attribute	Minimum	Ideal
1	Antigen	Taenia solium derived Antigen	Taenia solium derived Antigen Lat Am & Asia: combined w/ CSF Africa: combined w/ASF
2	Indication for use	For active immunisation of pigs to reduce incidence of PC	For active immunisation of pigs to prevent infection
3	Recommended species	Pigs	Pigs
4	Recommended dose	1 ml	1 ml
5	Pharmaceutical form	Reconstituted injectable solution/suspension	Ready to use solution/suspension
6	Route of administration	Intramuscular	Intramuscular or needle-less (including oral or IN)
7	Regimen - primary vaccination	Two doses given 3 - 4 weeks apart	Single lifetime dose
8	Regimen - booster	First booster 3 weeks - 4 months after first vaccination followed by six-monthly boosters	Lifelong immunity after primary vaccination
9	Epidemiological relevance	Single vaccine for global use	Single vaccine for global use

	Attribute	Minimum	Ideal
10	Recommended age at first vaccination	From 2 months of age	From 1-2 months of age (as early as possible)
11	Onset of immunity	2-3 weeks following first vaccination and first booster	One week following primary vaccination
12	Duration of immunity	Six months following first booster	Lifelong immunity
13	Expected efficacy	> 80% protection	> 99% protection
14	Expected safety	Mild and transient injection site reactions and pyrexia lasting less than 14 days in up to 20% of vaccinated animals	Mild and transient injection site reactions and pyrexia lasting less than 7 days in up to 10% of vaccinated animals. Safe for pregnant animals.
15	Withdrawal period	Less than 4 weeks for meat	Nil
16	Special requirements for animals	Do not vaccinate un-healthy animals	Do not vaccinate un-healthy animals
17	Special requirements for persons	None	None
18	Package size	50 doses	Multiple pack size from 5 doses
19	Shelf-life as packaged for sale	12 months at 4-8° C	> 24 months 4-8° C and/or 48 hours at 30° C
20	In-use stability	2 hours	> 24 hours



UGANDA: Kumi and Bukedea districts
454 households enrolled, the majority had less than five pigs
Between 1599 and 2310 pigs treated at each intervention

TANZANIA: Mbozi and Mbeya districts
890 households enrolled, the majority with less than five pigs
Between 777 and 1359 pigs treated at each intervention

ZAMBIA: Katete district
271 households surveyed, the majority had less than five pigs
237 pigs treated

NEPAL: Banke district
184 households enrolled, the majority of farmers had less than five pigs
Between 213 and 253 pigs treated at each intervention



PC Field Trials Summary

Country	Reference	Design	Duration	No of rounds	Started	Status
Nepal	NPL/SUI/015/058	Cysvax + Paranthic every three months v Control	12 months	4	Yes	Completed
Tanzania	TZA/SUI/015/061	Cysvax + Paranthic and Paranthic every four months	12 months	3	Yes	Completed
Uganda	UGA/SUI/015/059	Cysvax + Paranthic every three months v Control	18 months	6	Yes	Completed
Zambia	ZMB/SUI/015/070	Cysvax + Paranthic + MDA every four months and Paranthic only every 12 months v Control	24 months	6	Yes	Completed

- Baseline Survey
 - 95% pigs have access to latrines
 - 90% see cysts but don't know causes disease
 - PC prevalence of 29% (carcass dissection)
- 184 households enrolled
- Four interventions
 - Around 90% or more coverage
 - 828 pigs vaccinated/ dewormed



PC prevalence

	Base	End
Control	24%	17%*
Oxf + TSOL18	35%	0%

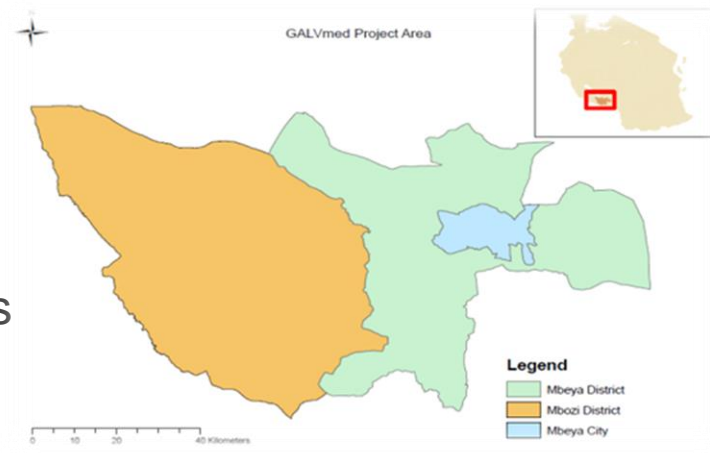
* Significant (P=0.016)



PC Tanzania Results I

- Baseline Survey

- PC prevalence 12% (note nearly 3% had *T. hydatigena*)
- Seroprevalence 22% (Ag ELISA)
- 95% had latrines, only 45% accessible to pigs
- 51% had seen cysts in meat and 64% were unaware it caused disease



PC Tanzania Results II

- 890 households enrolled
- Three interventions completed
- 3309 pigs vaccinated and/or dewormed
- 85% coverage; 1 AE (0.0003%)
- ASF outbreak affected some villages (rumours that deaths were due to drug/vaccine/eartags!)

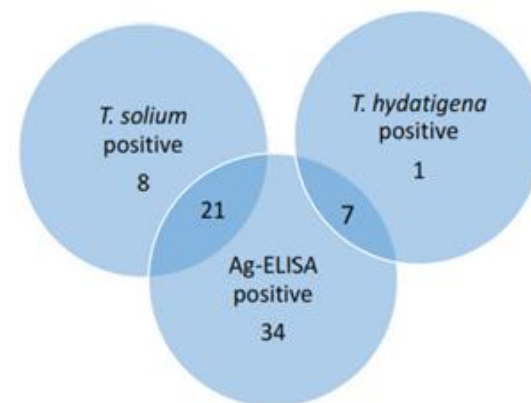
PC prevalence

STG	Base	End
Oxfendazole	12%	3%*
Oxf + TSOL18	12%	0%*
Control	n.d.	4%**

* Sig P=0.002

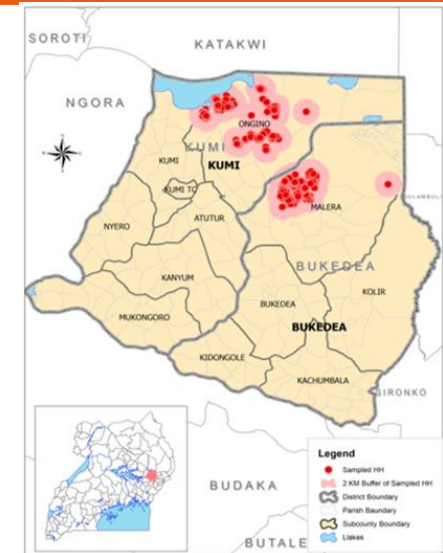
**Non-sig P=0.087

Relationship between *T. solium*, *T. hydatigena* and Ag-ELISA positive pigs in Mbozi and Mbeya rural districts



PC Uganda

- Baseline PC prevalence 15%
- 450 households enrolled
- KAPs survey
 - 70% have latrines and 40% pigs have access to latrines; Low awareness of disease
- 6 interventions completed
 - 12,000 pigs vaccinated/ dewormed
 - 90-95% coverage



PC prevalence

STG	Base	End
Control	13%	11%
Oxf + TSOL18	17%	0%*

* P=0.001



“I was able to get much money than before vaccination”

“pigs are healthy now fetch more money”

“I won't buy the pigs with cysts”

Malera sub county butcher



“It is difficult now for traders to cheat the farmers, They sell the pigs at the right price”

District Veterinary Officer, Bukedea District

PC Zambia I

- Baseline PC prevalence 54% (note 10% *T. hydatigena*)
- Lingual palpation only 6% PC positive
- PC seroprevalence 41% (Ag ELISA)
- 144 households enrolled
- Six interventions completed
 - 489 pig interventions in two years
 - 63-100% coverage
 - No adverse effects reported

PC prevalence

	Base	End
Control	65%	45%*
Oxf + TSOL18	43%	5%**

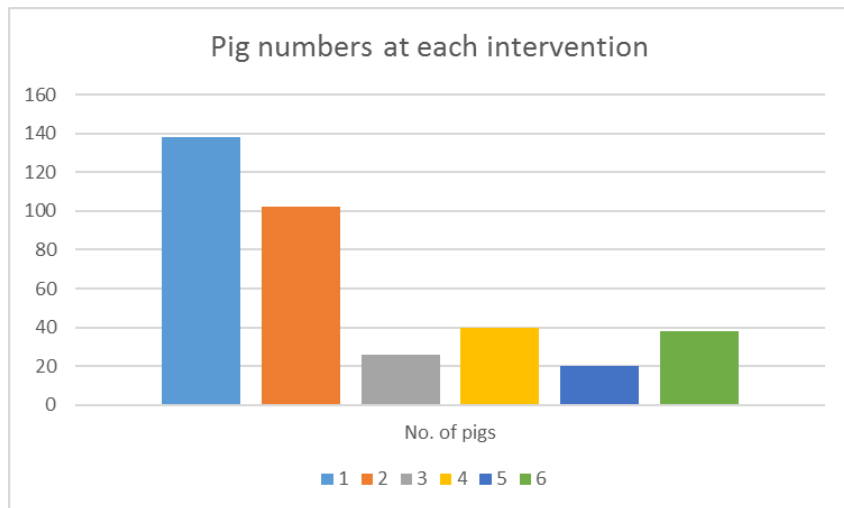
* non-sig

** sig, 1 pig with 2 non-viable cysts (PCR negative)



- ASF outbreak had a drastic effect on pig numbers through the study period
- Four out of 9 PC positive pigs were ELISA positive

- Prevalence was very high despite high levels of use of latrines and restricted access to pigs



Latrines	Count	Percentage
No	20	8%
Yes	251	92%
Use		
Always	248	98.8%
Sometimes	2	0.8%
Never	1	0.4%
Pig access		
No	180	89%
Yes	22	11%



- 12% experienced seizures, 36% severe chronic headaches
- **536 working days lost** per year
- Traders commonly check pigs tongue
- 95% of pig farmers are unable to sell pigs with cysts
- Infected **pigs are worth 45% less**

*Hobbs et al 2017 *Taenia solium* from a community perspective: baseline costing data in the Katete and Sinda districts in eastern Zambia (manuscript submitted)

What did we learn?

- **Practicalities**

- Central point vaccination campaign (UGA) v house-to-house (ZMB, NPL)
- Field team + motorbike
- Pig snares/ boards for handling
- Good vaccine coverage

- **Storage of vaccine**

- Medical centre fridge/ Hotel fridge
- In transit cool boxes/ temperature monitors

	Intervention				No. of Pigs
1					95
1	2				64
1	2	3			28
1	2	3	4		5
1		3			12
1		3	4		1
1	2		4		2
1			4		2
	2				58
	2	3			31
	2	3	4		17
	2		4		3
		3			91
		3	4		20
			4		153

- Three or four monthly interventions with Cysvax™ vaccine and Paranthic™ dewormer eliminated cysts in pigs in all study sites
- The intervention regimen was
 - Safe (no adverse reactions)
 - High level of compliance and acceptance
 - Highly effective in all four sites
- Anecdotal evidence from pig farmers that there were economic benefits

- Mass sensitisation/ market development
- Willing to pay more vaccine if they get a premium price on pork
- Pricing (between \$1.60 and \$6)
- Huge market for dewormers

- Availability of vaccine/ drugs
 - Registration
 - Need for smaller pack sizes of dewormer

- Capacity building/ One Health approach
 - Public private partnership
 - Community led sanitation/ education and sensitisation

Key findings of cysticercosis control stakeholder workshops - Africa

- **Brought together** policy, technical, commercial, and development stakeholders and partners from the animal health and human health sectors in Sub Saharan Africa
- **Shared** information on current cysticercosis control initiatives in Africa and enhanced understanding
 - Landscaping and GAP analysis presented
 - Case studies on control
- **One health** approaches explored
- **Commitment** from policy makers present to take action to control cysticercosis
- Group of **Country Champions** set up to disseminate information on cysticercosis control

- **Engagement** of policy, technical, commercial, and development stakeholders/ funders
- **Commitment** eg policy, funders, farmers
- **Finance** Who?
- **Availability of vaccine/ drugs** registration times are long
- **Sustainability** if one part of the chain drops out

- WHO/FAO/OIE
- Multi Sectorial Consortium
 - Academia
 - Human Health
 - Animal Health
 - Public Health
 - WASH
 - NGOs
 - Civil Society
- Integrated Approach (One Health)
 - Other NTDs control (eg STH, SCI)
 - WASH initiatives
 - Food Safety initiatives
 - Mental Health initiatives

Acknowledgements

GALVmed partners



Nepal



Tanzania



Uganda

C. Ayebazibwe (MAAIF); C. Rutbarika (Anisolutions); Z. Nsadha (U. Makerere)

Zambia



GALVmed funders





Thank you