Vaccines and diagnostics—The case for regional One Health centres of excellence

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Overview

• **One health**
  – Definitions
  – ILRI working in a OH paradigm
  – OH addressing vaccine delivery and use

• **Case studies**
  – East Coast Fever vaccine
  – Newcastle disease vaccine
  – Diagnostics for TBD

• **Conclusions**
Health is “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (World Health Organisation).

One Health "the collaborative effort of multiple disciplines — working locally, nationally, and globally — to attain optimal health for people, animals and the environment” (One Health Commission).

Ecohealth “recognizes complex biophysical, social, cultural, political and economic relationships between the ecosystem and human health” (National Council for Science and the Environment).
Human health

Animal Health

Societies, cultures, Economies, institutions, Policies

Agroecosystem health

EcoHealth

Wildlife health

Plant health

One health

Vet
Pub
Health
International Livestock Research Institute

- a member of the CGIAR Consortium, ILRI conducts livestock, food and environmental research
  - to help alleviate poverty
  - and improve food security, health & nutrition,
  - while protecting the natural resource base.
International Livestock Research Institute

- Founded in 1974
- Budget: around US$80 million
- Staff: 750: Senior scientists from 39 countries: >half from developing countries
- 34% of internationally recruited staff are women --and 50% of the senior leadership team
- Main campuses in Kenya and Ethiopia, and offices in 16 other countries around the world
ILRI experiences: Knowledge transfer, disease control and innovation in vaccines and diagnostics

• **East Coast fever vaccine**: ILRI involved development, manufactured and transferred vaccine use to northern Tanzania and manufacturing to CTTBD in Malawi

• **Newcastle disease vaccine for village poultry**: ACIAR led development, widely promoted, recently evaluated by ILRI in Tanzania

• **Tick borne disease diagnostics**: ILRI developed and runs diagnostics
East Coast fever (ECF)

- ECF present in 12 countries; it could spread to 8 more
- Caused by a tick-transmitted protozoan – *Theileria parva*
- ~28 million cattle at risk; ~1 million deaths/year; losses > 300 $ million a year
- Small-holder farmers who would benefit from control: ~ 20 million
- Not zoonotic: affects food supply, livelihoods, and vulnerable groups
The Cow-Pock — or — the Wonderful Effects of the New Inoculation!
Control milestones

- 1911-14: 283,000 cattle vaccinated in S. Africa, low success rate
- 1911-1940: “T” brand oxen Kenya- exposed & immune
- 1980: DANIDA projects in Malawi, Zambia, Zimbabwe, Kenya
- 1983: Field use endorsed by FAO expert panel
- 1996: First commercial vaccine batch produced at ILRAD
- 2012: Authorized for dairy cattle in Kenya
- 2014: CTTB Malawi launched
- 2016: vaccine used Malawi, Kenya, Tanzania, Uganda
Research contributions

- 1928: Tick homogenates produce immunity and can be stored (Theiler & du Toit)
- 1953: OTC prevent reactions after vaccination (Neitz in S Africa)
- 1954-57: Cocktail method developed in the Congo and Rwanda (Jezierski et al)
- 1973: Sporozoite stabilates (Cunningham in Kenya)
- 1975: Muguga cocktail
- 1993: 30% solution

Donor investments

- 1967: UNDP funded tick program at EAVRO develops ITM: continues at KARI and ILRAD
- 1980: DANIDA projects in Malawi, Zambia, Zimbabwe, Kenya
- 1996: First commercial vaccine batch produced at ILRAD
- 2004: GALVmed founded – ECF a disease of focus
- 2014: CTTB Malawi launched
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Challenges to availability of appropriate new products

A technical and market-based approach to delivery

Discovery Research
- Technical challenges.
- Lack of appropriate product profiles
- Ill-designed proofs-of-concept

Development
- Lack of funding for development studies - high risk, high cost.
- Poorly designed, poorly controlled field trials.

Registration
- Unclear and varied regulatory requirements.
- Lack of QA/QC.
- Multiple regulatory authorities.

Production
- No commercial interest
- Expensive processes
- No process development

Commercialisation
- Lack of market pull-through
- Poor estimates of need or demand
- Inappropriate pack-sizes
- Lack of knowledge or education on proper use

Sustained delivery
- Inconsistent supply
- Counterfeit products.
- Lack of patent protection.
- Poor quality and efficacy.

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Success of ITM in Zambia and Tanzania

Since 1990s around 1.5 million cattle vaccinated – 1% of cattle at risk during that time
Most in Zambia and Tanzania

1982-2002 Belgian veterinary support project
• Local Katete strain
• Calf mortality reduced from 33% to 3%. Cost $10
• First year of charging: only 10% of farmers brought calves

2008-2014 IFAD project $15 million
• 300,000 vaccinated – around 20% of the at risk population
• Farmers pay 15% cost – revolving fund – unlikely to be sustainable
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1995- 1998 ITTBD in Northern Tanzania
• 10-20,000 a year vaccinated
• Pastoral areas

2004-16 VetAgro private sector,
• Around 80,000 a year, up to 80% of calves
• full cost recovery ($10 a calf)
• 2006 FAO subsidy, 2012-13 GALVMed, 2014 USAID
Transfer, impact and challenges

- MC produced on commercial basis by CTTBD
- GALVmed targets 2 million doses a year

Technology
- Live vaccine
- Production demanding
- Breakthrough infections
- Liquid nitrogen cold chain

Delivery
- Relatively high cost $9-17
- Distribution has high financial risk
- Production and much delivery outside private sector
Newcastle disease

- Worldwide distribution; caused by virus; emergence potential
- Major poultry disease: 30-80% of village chickens die each year
- Minor zoonoses; impacts on livelihoods and food & nutrition security
- Strong gender dimension: most owned by women
- Epidemic disease and hence communal action important
History of Newcastle disease vaccination

- 1927 virus isolated from outbreak in Newcastle
- Spread rapidly in Asia and more slowly to rest of the world
- Second pandemic in late 1960s, devastated poultry industries
- Brought under control using live vaccines
- 1984 ACIAR started to fund research into ND in village poultry
- A new strain I-2 developed at the University of Queensland for village poultry

2003-2005 SANDCP project funded by Australia
- Mozambique, Malawi and Tanzania
- Participatory, gender-responsive, sustainable, approach
  - Informed by one health thinking
- With support from production to end use and cost recovery
A one health approach to delivery

TRANS-DISCIPLINARITY

PARTICIPATION

EQUITY

Social
Political
Economic
Ecological
The graph shows the distribution of farmer knowledge and practice regarding ND vaccine usage. The categories include:

- Is currently using ND vaccine
- Has ever used ND vaccine
- Knows how they work
- Has heard of ND vaccine
- Heard about vaccine

The data is sourced from Wyatt et al., 2012.
EO: Farmers lie about diseased chicken to get them vaccinated....
I train the vaccinators on handling, giving injections, side affects

Vx: People complain about the amount charged....
3 out of 10 don’t pay.....
I have received no training...

Some sell vaccine to rich households and use water to vaccinate the birds of the poor households to make money

FGD: We are willing to pay 100 TSH (twice the price currently charged)

Wyatt et al., 2012
Best case: losses still high

Wyatt et al., 2012
Tick-borne diseases diagnostics

- Ticks and tick-borne disease
- Important cattle disease; zoonotic potential
ILRI diagnostics for ticks and tick-borne disease

- ELISA for: *Theileria parva*, *Theileria mutans*, *Babesia bigemina*, *B. bovis*, *trypanosomes*, *Anaplasma marginale*

- ELISA tests for 4 major TBDs – developed ~ 20 years ago
  - Used mainly for research
  - Anaplasma and Babesia tests offered commercially

- Point-of-care assays (lateral flow) for human trypanosomiasis (with FIND), cysticercosis (ASARECA) and PPR (Pirbright)
  - Development proof of concept
  - Business plan developed for cysticercosis tests but not funded
Use of tick borne diagnostics

- Explored commercial production but not viable

2012-2014

- In house: 12,503
- External: 7,524
Vaccines: good efficacy but (so far) less impact, Dx: high *impact factors*, hard to attribute impacts
Conclusions

- **Impact that scales:**
  - Vaccines intuitively enormously attractive
  - Adoption by smallholders and pastoralists challenging

- **Evidence that counts:**
  - Insights into disease require investments into infrastructure
better lives through livestock

ilri.org