Arboviral Vector Control

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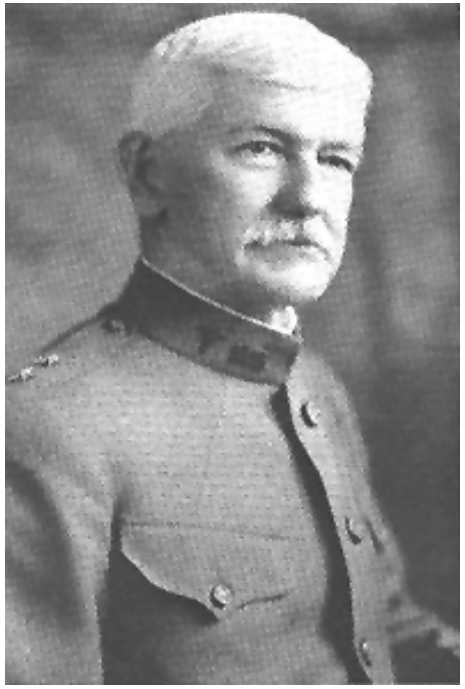
Successful Yellow Fever Control

William Gorgas (1904)



Fred Soper (1947-1970)

- Vertically structured
- Disease prevention

- During 1970s–1980s Singapore and 1980s–1990s Cuba used adult and larval control to reduce dengue

Elevating the Evidence Base for Vector Control

Review

Trends in Parasitology August 2015, Vol. 31, No. 8

CellPress

Evidence-based vector control? Improving the quality of vector control trials

Anne L. Wilson[1], Marleen Boelaert[2], Immo Kleinschmidt[3], Margaret Pinder[1,4], Thomas W. Scott[5,6], Lucy S. Tusting[7], and Steve W. Lindsay[1]

- Outline design features of Phase III vector control trials, provide guidance for improving study design
- **Rigorous, evidence-based vector-borne intervention assessments** will enhance innovation in disease reduction

World Health Organization

HOW TO DESIGN VECTOR CONTROL EFFICACY TRIALS

World Health Organization 2017

Guidance on phase III vector control field trial design provided by the Vector Control Advisory Group

Arbovirus Vector Control Landscape
Current Interventions

Immature mosquitoes

- Source reduction: Removal of breeding sites
- Breeding site treatments: IGRs (methoprene, pyriproxfen), chemical insecticides, biologicals (Bti), and predation (larviporous fish, copepods)

Adult mosquitoes

- Space spray: ULV from trucks, aircraft, hand-held portables, and perifocal treatment
- Personal protection: Topical repellents (Deet, pericaradin)
- Indoor residual spray: PAHO 2019 Manual for Indoor Residual Spraying in Urban Areas for *Aedes aegypti* Control

Two complementary approaches:

- **Reactive:** Intervention in reaction to an increase in cases using adulticides to quickly lower the adult vector population density and kill virus-infected vectors
- **Proactive:** Block outbreaks before they begin, combinations of adult and immature vector control – **merits greater emphasis and attention**

Arbovirus Vector Control Landscape Innovation

In development:

1) Larval control: Entomopathogenic fungi and autodissemination (pyriproxfen)
2) Population suppression: *Wolbachia,* sterile insect technique (SIT), SIT combination with a *Wolbachia*-based incompatible insect technique, attractive toxic sugar bates, insecticide treated materials, and lethal ovitraps
   - Release of insects carrying a dominate lethal gene (RIDL): Oxitech in Brazil commercially for households, communities, and businesses nationwide, available in all states
3) Population modification: Homing endonuclease genes, CRISPR-Cas9 gene drive systems to create virus-resistant mosquito strains, and Cas9-guide RNA constructs for population modification (virus resistant strains) and population reduction (sterile females or reduced female survival)

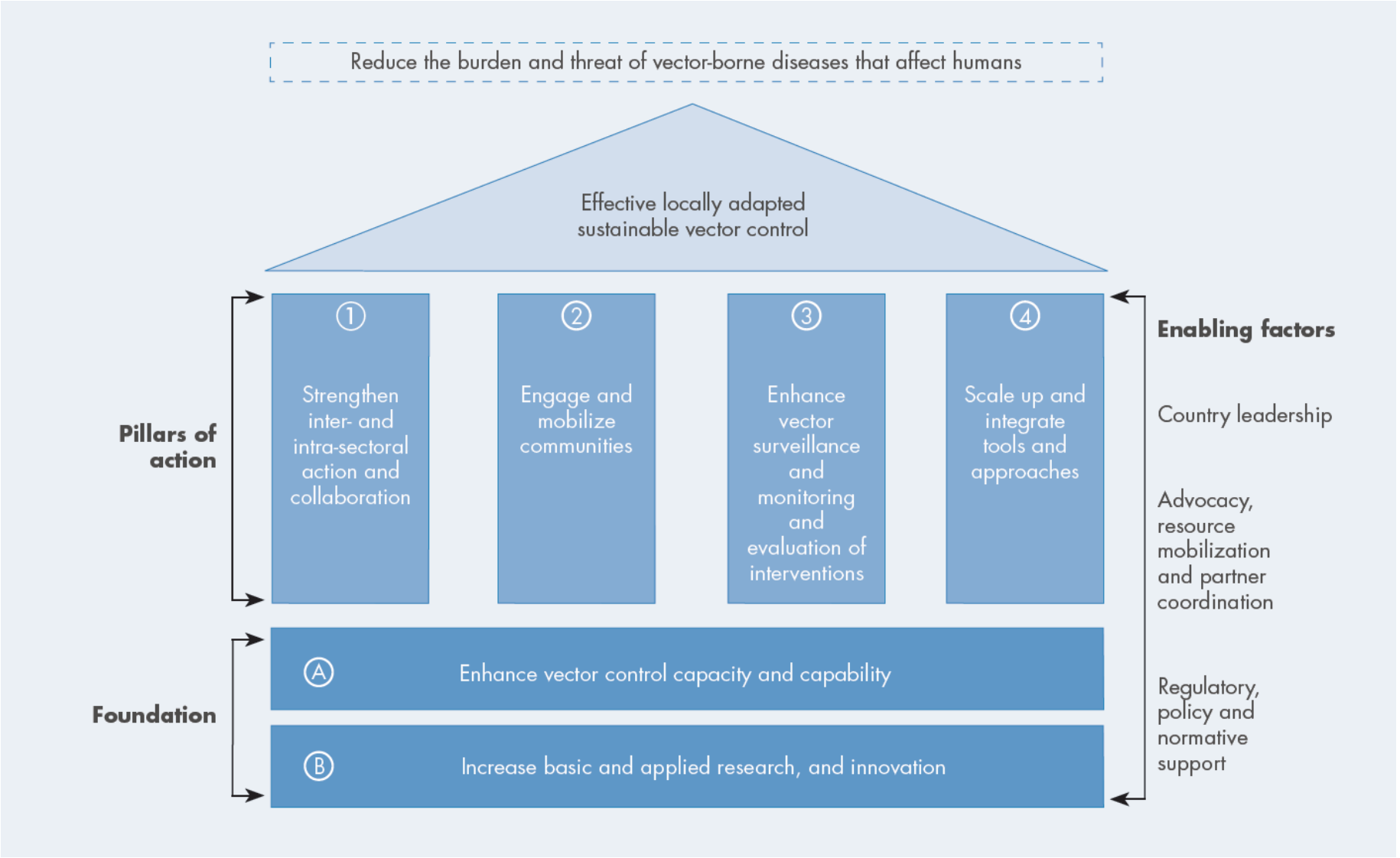
In or completed Phase III clinical trials:

1) Population modification *Wolbachia* in Indonesia 77% protection VCD, 2nd trial in Brazil, World Mosquito Program in Brazil building an automated rearing facility for release by 2024
2) Community Mobilization (Camino Verde) Nicaragua and Mexico 30% reduction in DENV seroconversion
3) Spatial Repellent (transfluthrin) in Peru reduced arbovirus infection by 34%, 2nd trial in Sri Lanka, SC Johnson Guardian™ efficacy of 1 year
4) TIRS in Australia with contact tracing reduced DENV infection ~90%, trial in Mexico (Actellic 300CS)

GLOBAL ARBOVIRUS INITIATIVE

- GLAI is an integrated strategic plan to tackle emerging and re-emerging arboviruses with epidemic and pandemic potential.
- Six Pillars: 1) Monitor risk and anticipate, 2) Reduce epidemic risk, 3) Strengthen vector control, 4) Prevent and prepare for pandemics, 5) Enhance innovation and new approaches, and 6) Build a coalition of partners.

A Platform for Comprehensive, Integrated Arbovirus Vector Control



Surveillance and control of arboviral diseases in the WHO African Region:

Box 5. Identified weaknesses in routine vector surveillance and control

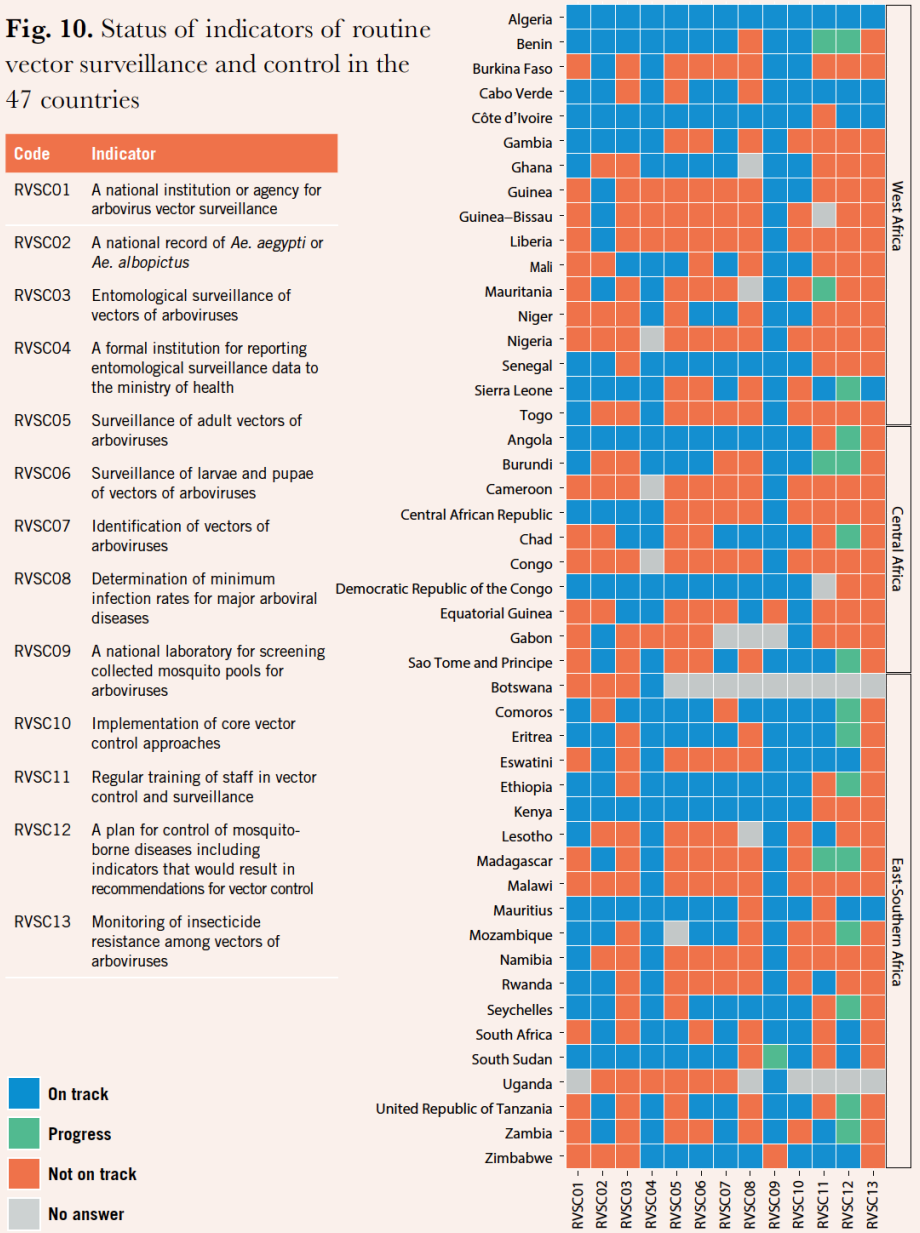
- Limited programme or structure dedicated to *Aedes* vector surveillance
- Poor entomological surveillance of *Aedes* mosquitoes
- Limited control of the vectors of arboviruses
- Lack of expertise in entomology and vector control with respect to arboviral diseases
- Lack of surveillance of resistance of *Aedes* to insecticides
- No regular training sessions for specialists in vector control and surveillance of *Aedes* vectors

3.5 *Routine vector surveillance and control*

These capacities were assessed on the basis of 13 indicators (Fig. 10).

Fig. 10. Status of indicators of routine vector surveillance and control in the 47 countries

Code	Indicator
RVSC01	A national institution or agency for arbovirus vector surveillance
RVSC02	A national record of *Ae. aegypti* or *Ae. albopictus*
RVSC03	Entomological surveillance of vectors of arboviruses
RVSC04	A formal institution for reporting entomological surveillance data to the ministry of health
RVSC05	Surveillance of adult vectors of arboviruses
RVSC06	Surveillance of larvae and pupae of vectors of arboviruses
RVSC07	Identification of vectors of arboviruses
RVSC08	Determination of minimum infection rates for major arboviral diseases
RVSC09	A national laboratory for screening collected mosquito pools for arboviruses
RVSC10	Implementation of core vector control approaches
RVSC11	Regular training of staff in vector control and surveillance
RVSC12	A plan for control of mosquito-borne diseases including indicators that would result in recommendations for vector control
RVSC13	Monitoring of insecticide resistance among vectors of arboviruses



GLOBAL ARBOVIRUS INITIATIVE

GLOBAL VECTOR CONTROL RESPONSE 2017–2030

Dadzie *et al. Parasites & Vectors* (2022) 15:381
https://doi.org/10.1186/s13071-022-05507-0

Parasites & Vectors

MEETING REPORT Open Access

Building the capacity of West African countries in *Aedes* surveillance: inaugural meeting of the West African *Aedes* Surveillance Network (WAASuN)

Samuel K. Dadzie[1*], Jewelna Akorli[1], Mamadou B. Coulibaly[2], Koffi Mensah Ahadji-Dabla[3], Ibrahima Baber[4], Thierry Bobanga[5], Ali Ould Mohamed Salem Boukhary[6], Tiago Canelas[7,8], Luca Facchinelli[8], Adéritow Gonçalves[9], Moussa Guelbeogo[10], Basile Kamgang[11], Ibrahima Kalil Keita[12], Lucien Konan[13], Rebecca Levine[14], Nicole Dzuris[14], Audrey Lenhart[14] and WAASuN contributors

PLOS NEGLECTED TROPICAL DISEASES December 6, 2018

Integrated *Aedes* management for the control of *Aedes*-borne diseases

David Roiz[1]*, Anne L. Wilson[2], Thomas W. Scott[3], Dina M. Fonseca[4], Frédéric Jourdain[1], Pie Müller[5,6], Raman Velayudhan[7], Vincent Corbel[1]*

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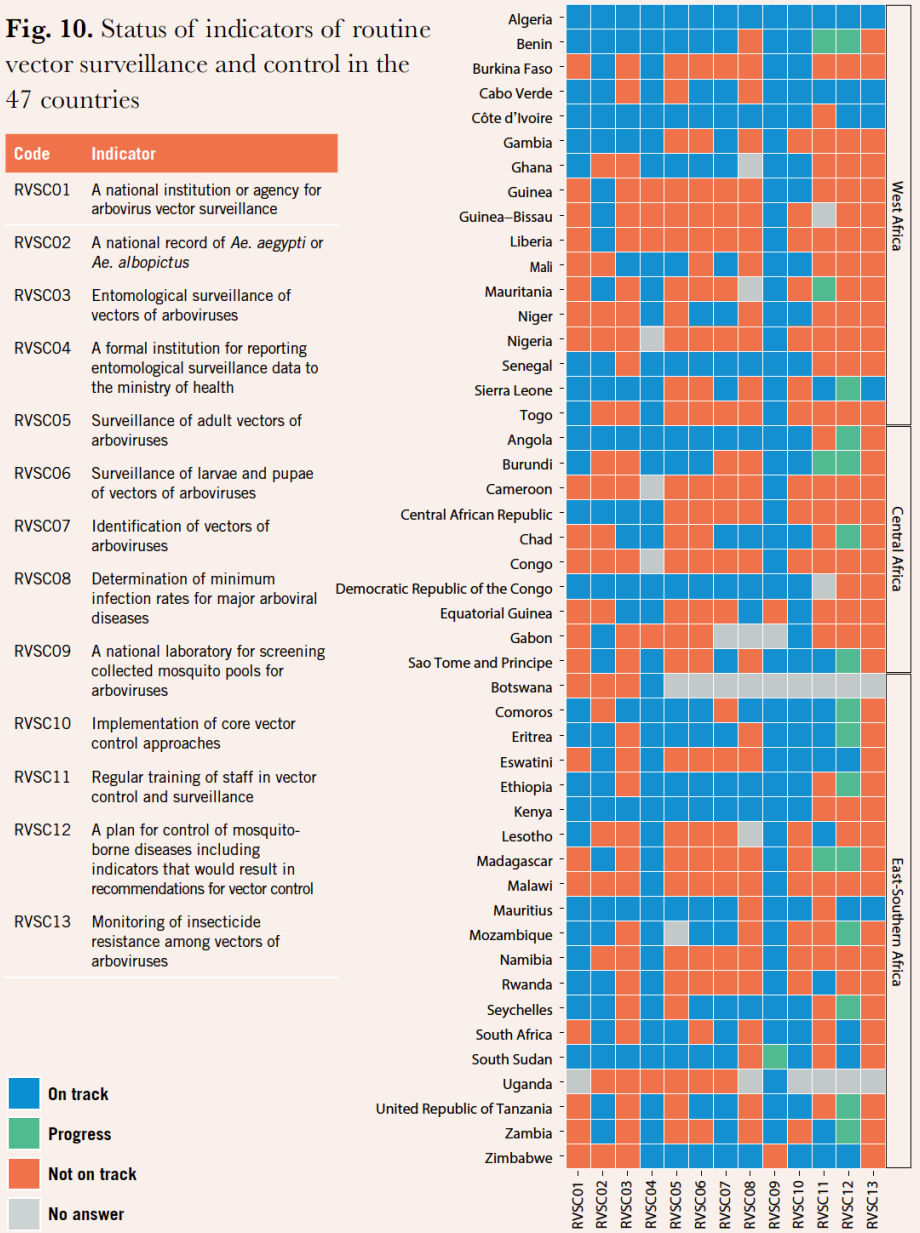

Improving Tick Control

Tick Management Handbook

An integrated guide for homeowners, pest control operators, and public health officials for the prevention of tick-associated disease

Revised Edition

Prepared by:

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Experiment Station, New Haven

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The Connecticut General Assembly

PERSPECTIVE

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 26, No. 4, April 2020

Stemming the Rising Tide of Human-Biting Ticks and Tickborne Diseases, United States

Lars Eisen

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 28, No. 5, May 2022

Effects of Tick-Control Interventions on Tick Abundance, Human Encounters with Ticks, and Incidence of Tickborne Diseases in Residential Neighborhoods, New York, USA

Felicia Keesing,[1] Stacy Mowry, William Bremer, Shannon Duerr, Andrew S. Evans Jr., Ilya R. Fischhoff, Alison F. Hinckley, Sarah A. Hook, Fiona Keating, Jennifer Pendleton, Ashley Pfister, Marissa Teator, Richard S. Ostfeld[1]

Priority Opportunities

1. Current vector control tools and strategies have not been rigorously evaluated for disease prevention (epidemiologic outcomes).
2. There is an impressive and encouraging list of new tools and strategies, with a growing solid evidence base, that are in various stages of development.
3. **Scaling up:** Need for an evidence base for determining the most effective delivery and coverage to reach and sustain disease reduction goals (implementation science).
4. **Multiple Interventions:** Growing consensus that one approach will not solve the problem by itself, we need an evidence base for combinations of interventions; e.g., vector control and vaccine.

Features of Effective Vector Control

- Integrated combinations of interventions most appropriate to the local situation
- Simultaneously target immature and adult vectors with multiple interventions
- Comprehensive delivery, sustainable coverage, and community involvement
- Targeting hotspots may be an efficient use of limited resources
- Measure, analyze, and integrate entomological and epidemiological data
- Implementation and sustainability requires local, national, and intersectoral support