Challenges & Opportunities

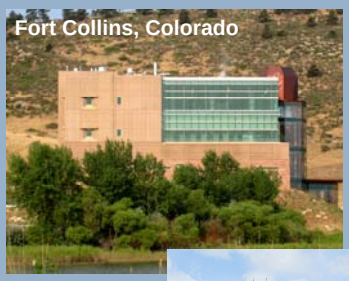
examples from the

Division of Vector Borne Diseases

Division of Vector Borne Diseases

- 250 Staff
  - Entomologists
  - Ecologists
  - Microbiologists
  - Molecular biologists
  - Physicians
  - Veterinarians
- 3 Branches
  - Arboviral Diseases Branch
  - Bacterial Diseases Branch
  - Dengue Branch (Puerto Rico)

Division of Vector Borne Diseases



DVBID Diseases

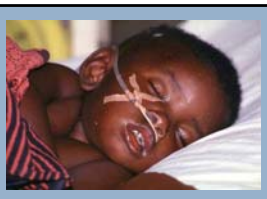
Viruses

- **Alphaviruses: chikungunya, WEE, VEE, EEE**
- **Bunyaviruses: Rift Valley fever, LaCrosse, Crimean-Congo**
- **Flaviviruses: dengue, WNV, yellow fever, Japanese encephalitis, St. Louis**

Bacteria

- **Plague (*Yersinia pestis*)**
- **Tularemia (*Francisella tularensis*)**
- ***Borrelia* (Lyme, tick-borne relapsing fever)**
- ***Bartonella***

An Increasing Threat



7 of 10 WHO TDR Priority Diseases are Vector Borne

- African trypanosomiasis
- Chagas disease
- Dengue
- Filariasis
- Leishmaniasis
- Malaria
- Onchocerciasis

DVBID Epidemics: 2006-2008

- Yellow fever - Sudan
- Japanese encephalitis - India
- Chikungunya – Indian Ocean
- Zika – Micronesia
- Plague – Uganda
- Rift Valley fever – East Africa
- West Nile virus – Argentina
- Dengue – Rio Grande; PR

CDC

Challenge –
Reduce the Risk from Lyme Disease

Problem – A human OspA vaccine has been taken off the market

SmithKline Beecham removed its recombinant outer-surface protein A (rOspA) Lyme disease vaccine (LYMErix) for lack of sales, public suspicion

CDC

Solution -

A Transgenic Rice Vaccine Bait

Pepsin resistant prolamin storage (PB-I):

oral delivery

Cold chain independent

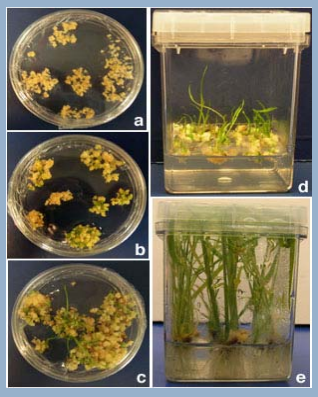
Gt1 promoter expresses transgene endosperm only

Normal reproduction of transformed lines

Confirmed OspA protein expression

8.8% total soluble protein

0.1% rice seed weight



VENTRIA BIOSCIENCE

CDC

Ongoing...

Immunogenicity (conformational integrity?)

injected

oral

Efficacy (does it prevent Lyme infection?)

Acceptability (EPA? Cost?)

CDC

Challenge –

Develop a Multivalent Flavivirus Vaccine

Problem – Many flaviviruses are co-endemic, only yellow fever immunization available

The flaviviruses are the most medically important arboviral risks and invasive threats. Vaccines are not cross-protective

Solution –

A WNV DNA Vaccine Model

Helper & killer T-cell response to VLP

prM & E-domain directed: common to flaviviruses

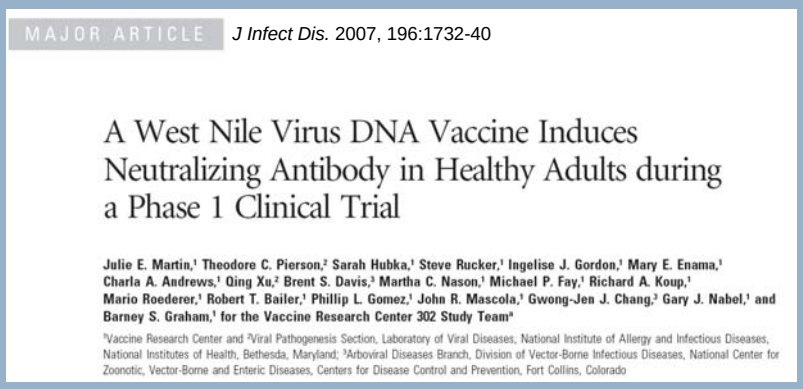
Single plasmid immunization protected from WNV

10,000 IP/LD_{50} challenge

Condor demonstration

Equine vaccine first US licensed DNA vaccine

Ongoing...



MAJOR ARTICLE *J Infect Dis.* 2007, 196:1732-40

A West Nile Virus DNA Vaccine Induces Neutralizing Antibody in Healthy Adults during a Phase 1 Clinical Trial

Julie E. Martin,[1] Theodore C. Pierson,[2] Sarah Hubka,[1] Steve Rucker,[1] Ingelise J. Gordon,[1] Mary E. Enama,[1] Charla A. Andrews,[1] Qing Xu,[2] Brent S. Davis,[3] Martha C. Nason,[1] Michael P. Fay,[1] Richard A. Koup,[1] Mario Roederer,[1] Robert T. Bailer,[1] Phillip L. Gomez,[1] John R. Mascola,[1] Gwong-Jen J. Chang,[3] Gary J. Nabel,[1] and Barney S. Graham,[1] for the Vaccine Research Center 302 Study Team[a]

[1]Vaccine Research Center and [2]Viral Pathogenesis Section, Laboratory of Viral Diseases, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, Maryland; [3]Arboviral Diseases Branch, Division of Vector-Borne Infectious Diseases, National Center for Zoonotic, Vector-Borne and Enteric Diseases, Centers for Disease Control and Prevention, Fort Collins, Colorado

Primate trial of multi-plasmid flavivirus vaccine

Challenge – Control Domestic Ticks

Problem – Reluctance of homeowners to apply acaricides to control Lyme, RMSF vectors

Surveys showed fears of chemical toxicity resulting from area insecticide application was major concern

Solution –

A Natural, Efficacious Acaricide

Alaskan yellow cedar - 14 sesquiterpenes,
4 monoterpenes biocidal or repellent

Many food grade

Nootkatone exceeds DEET at 4 h

2 U.S. Patents, 2 pending

Oregon State University OSU

CDC

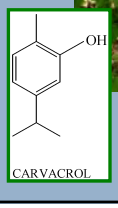
Ongoing...

Ixodes scapularis field test, NJ
5% carvacrol, 78% suppression at 28 d

Formulations, emulsifications

Mosquitocidal mode of action?

Gates Foundation invitation



CDC