



## ***Ebola Interventions***

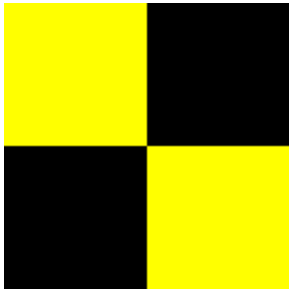
# EBOLA INTERVENTIONS

- 1.Barrier: Quarantine or Isolation
- 2.Diagnosis
- 3.Drug Therapy



# Quarantine or Isolation

Signal flag "Lima" also called the "Yellow Jack" when flown in harbor now means ship is under quarantine. (Quarantine was invented in 1403 in Venice)



“the gear they’re wearing in West Africa now treating patients, it’s like comparing a stainless steel vault to a cardboard box.”



*Dr. Elke Muhlberger, Boston*



Charité hospital in Berlin.

Early stage disease cure rate close to 100% in Europe and USA

Isolated in Sierra Leone – 70% mortality

**Isolation has proven to be difficult**

**and other methods in addition to isolation need to be applied-**

**Isolation rate in Sierra Leone is low in some reports only 13%**

# Diagnostics

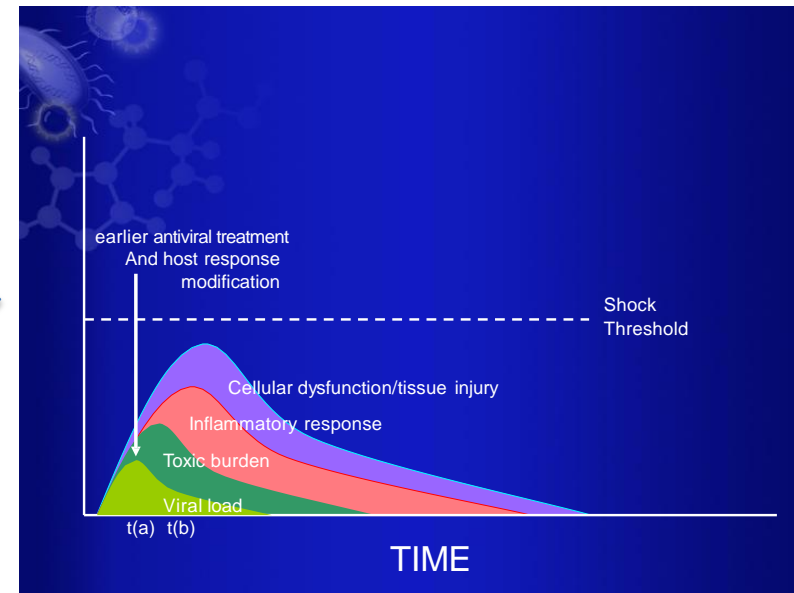
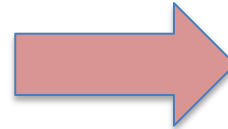
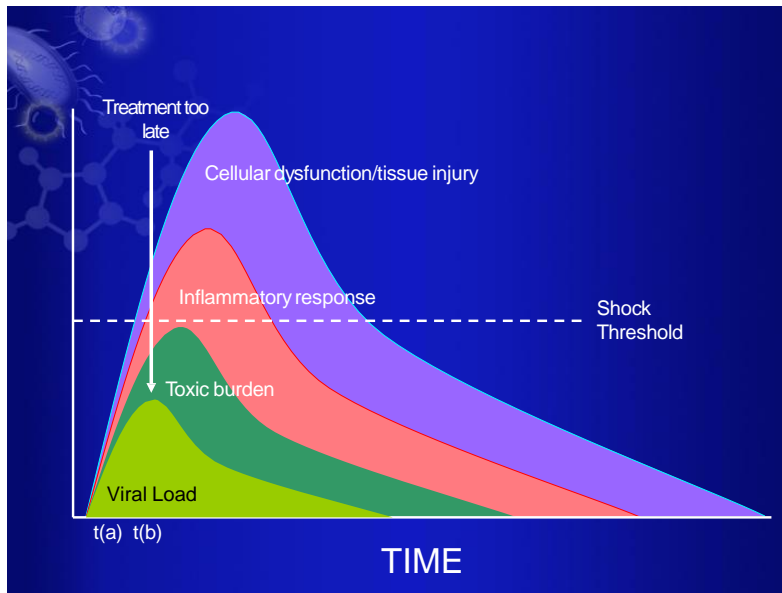
- Early diagnostics combined with early Treatment lowers Mortality and Transmission
- Early diagnostics followed by measures stopping transmission rapidly controls the outbreak

# Treating Serious Infections to *Prevent* Fluid loss & Organ failure

## A Paradigm Shift for Ebola:

From Late Intervention

To Early Treatment



“Speed is Life”

# Drug-therapy

1. Treating Patients
2. Pre-Exposure Prophylaxis
3. Post-Exposure Prophylaxis
4. Vaccines



# Drug Therapy

- Drug therapy in early stage of the disease can lower mortality dramatically
- It is an incentive for people to get diagnostics and enter into a treatment center or hospital
- Lowers transmission if people do not get diarrhea, vomiting and bleeding.



# PROPHYLAXIS

- Post-exposure prophylaxis of family members and other people close to patients decreases transmission further
- Pre-exposure prophylaxis may keep the local healthcare workers alive. They have now a 100x greater chance of getting infected





# IBM Research Support for Ebola Response

- IBM's Kenya Lab operating a citizen contact tracing and analytics service by mobile phone (voice call or SMS) in Sierra Leone
- Lead open source project through Eclipse Foundation
  - ✓ Spatiotemporal Epidemiological Modeler (STEM) is a platform for rapidly creating new mathematical models of emerging infectious disease.
  - ✓ Ebola Model available now
  - ✓ Interventions
- Hosting with Eclipse foundation an global Ebola Modeling Community call, wiki, and forum. [https://wiki.eclipse.org/Weekly\\_Community\\_Ebola\\_Modeling\\_Phone\\_Call](https://wiki.eclipse.org/Weekly_Community_Ebola_Modeling_Phone_Call)

## Participants from:

[Arizona State University](#)

[College of William and Mary](#)

[ISPM University of Bern](#)

[Johns Hopkins and US NRL](#)

[Murdoch Children's Research Institute and  
Melbourne School of Population and Global  
Health](#)

[OperonLabs](#)

[Peking University](#)

[Skoll Global Threats](#)

[U.S. CDC Modeling Unit, Ebola Task Force](#)

[UAE University](#)

[UC San Francisco](#)

[University of Illinois Urbana](#)

[University of Melbourne](#)

[University of Nevada](#)

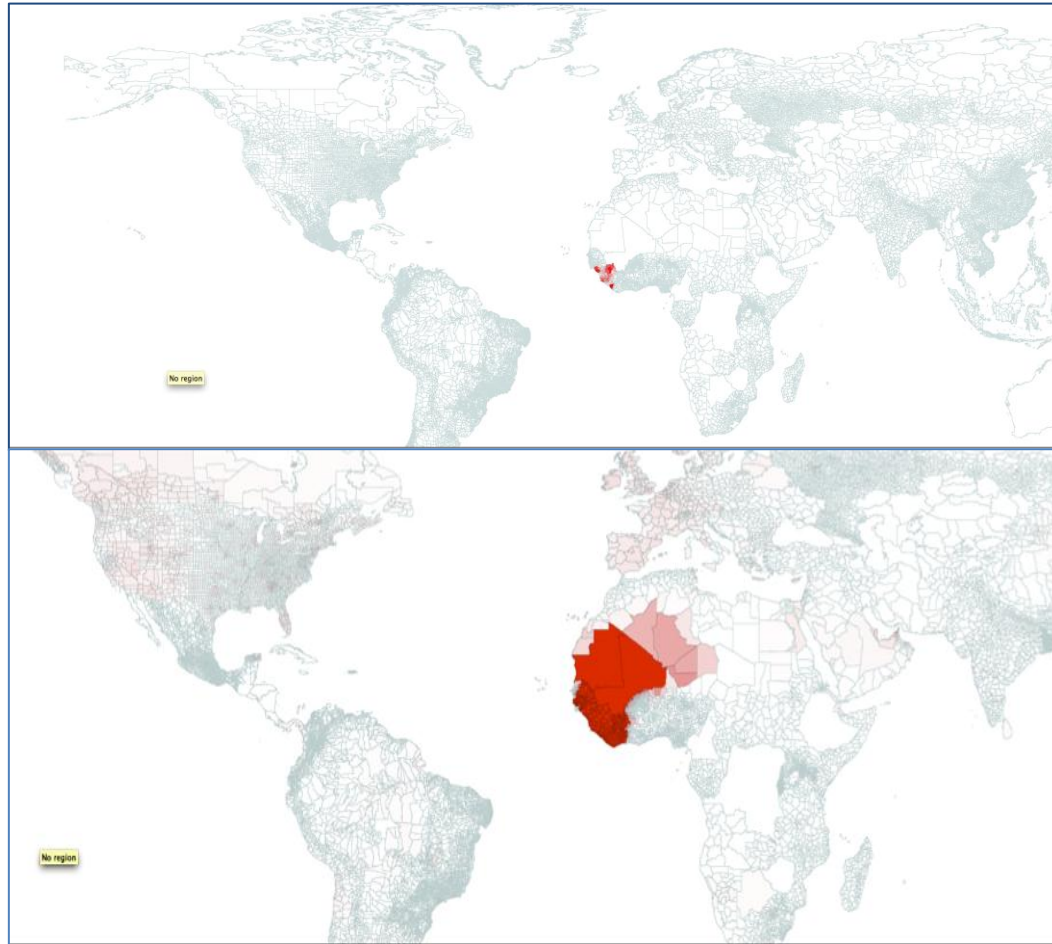
[US Naval Research Laboratory](#)

[Virginia Tech](#)

# Open Source Ebola Model

Effects of Airport screening on a global scale

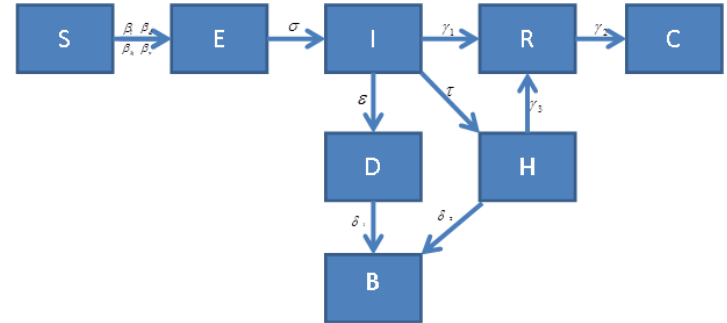
see: [https://wiki.eclipse.org/Ebola\\_Models](https://wiki.eclipse.org/Ebola_Models)



Predicts effects of interventions on Epidemic (Reproductive Number)

$$R_0 = \frac{\beta_i + \beta_d \frac{\mu}{\delta} + \beta_h^* \frac{\tau}{\mu + \gamma_2}}{\mu + \tau + \gamma_1}$$

**Released Eclipse Open Source Ebola Model**  
Includes clinical transmission and effects of burial customs



$$\frac{dS}{dt} = \mu - \beta_i SI - \beta_h SH - \beta_d SD - \beta_r SR - \mu S$$

$$\frac{dE}{dt} = \beta_i SI + \beta_h SH + \beta_d SD + \beta_r SR - \sigma E - \mu E$$

$$\frac{dI}{dt} = \sigma E - (\gamma_1 + \epsilon + \tau + \mu) I$$

$$\frac{dR}{dt} = \gamma_1 I + \gamma_3 H - (\gamma_2 + \mu) R$$

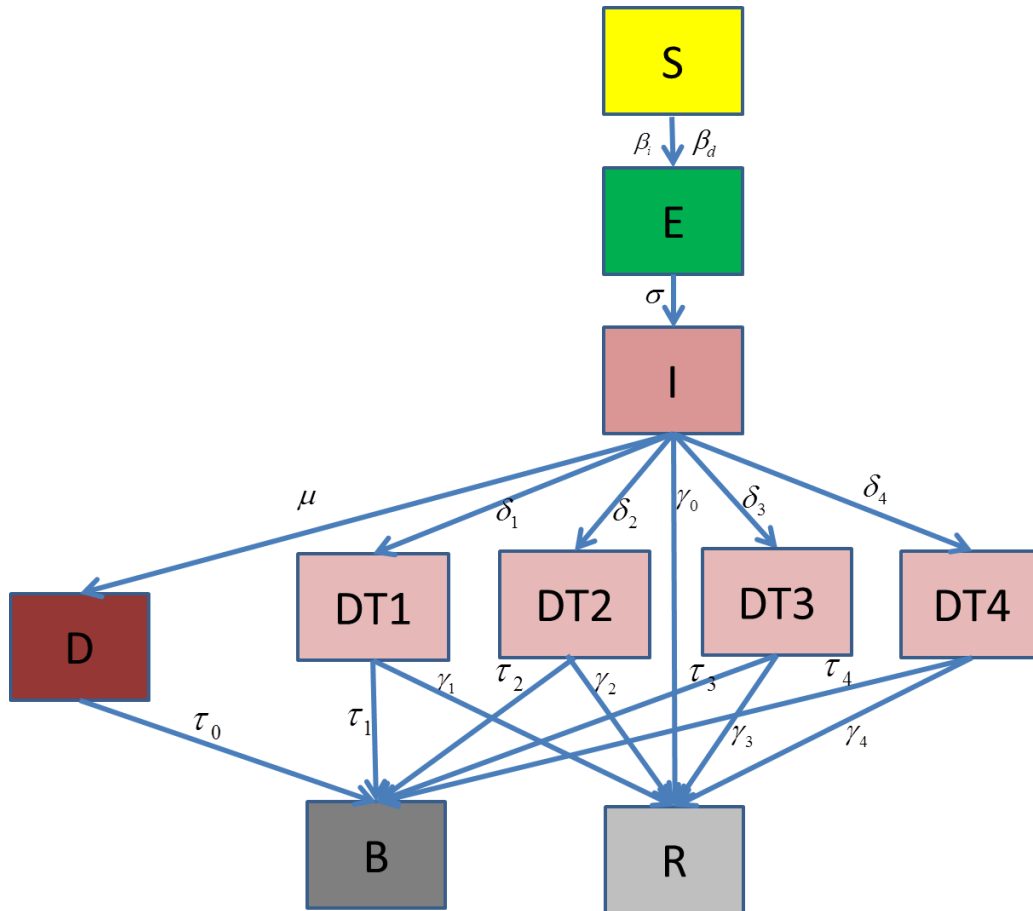
$$\frac{dD}{dt} = \epsilon I - \delta_1 D$$

$$\frac{dH}{dt} = \tau I - (\gamma_3 + \delta_2 + \mu) H$$

$$\frac{dB}{dt} = \delta_1 D + \delta_2 H$$

$$\frac{dC}{dt} = \gamma_2 R - \mu C$$

# Preliminary Model for Ebola Diagnosis and Treatment Response



$$\frac{dS}{dt} = -\beta_i SI - \alpha_1 \beta_i S D T_1 - \alpha_2 \beta_i S D T_2 - \alpha_3 \beta_i S D T_3 - \alpha_4 \beta_i S D T_4 - \beta_d S D$$

$$\frac{dE}{dt} = \beta_i SI + \alpha_1 \beta_i S D T_1 + \alpha_2 \beta_i S D T_2 + \alpha_3 \beta_i S D T_3 + \alpha_4 \beta_i S D T_4 + \beta_d S D - \sigma E$$

$$\frac{dI}{dt} = \sigma E - (\mu + \delta_1 + \delta_2 + \delta_3 + \delta_4 + \gamma_0) I$$

$$\frac{dD T_1}{dt} = \delta_1 I - (\tau_1 + \gamma_1) D T_1$$

$$\frac{dD T_2}{dt} = \delta_2 I - (\tau_2 + \gamma_2) D T_2$$

$$\frac{dD T_3}{dt} = \delta_3 I - (\tau_3 + \gamma_3) D T_3$$

$$\frac{dD T_4}{dt} = \delta_4 I - (\tau_4 + \gamma_4) D T_4$$

$$\frac{dD}{dt} = \mu I - \tau_0 D$$

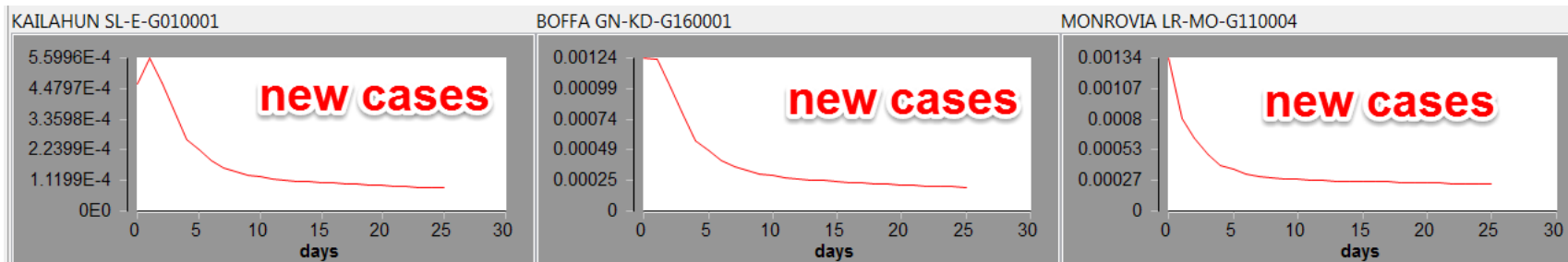
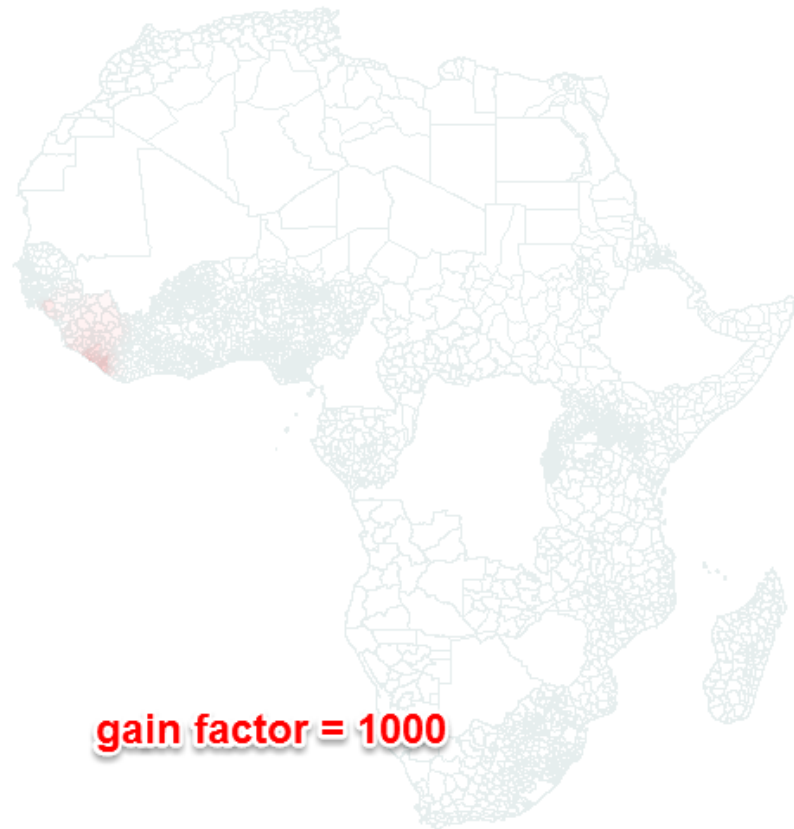
$$\frac{dB}{dt} = \tau_0 D + \tau_1 D T_1 + \tau_2 D T_2 + \tau_3 D T_3 + \tau_4 D T_4$$

$$\frac{dR}{dt} = \gamma_0 I + \gamma_1 D T_1 + \gamma_2 D T_2 + \gamma_3 D T_3 + \gamma_4 D T_4$$

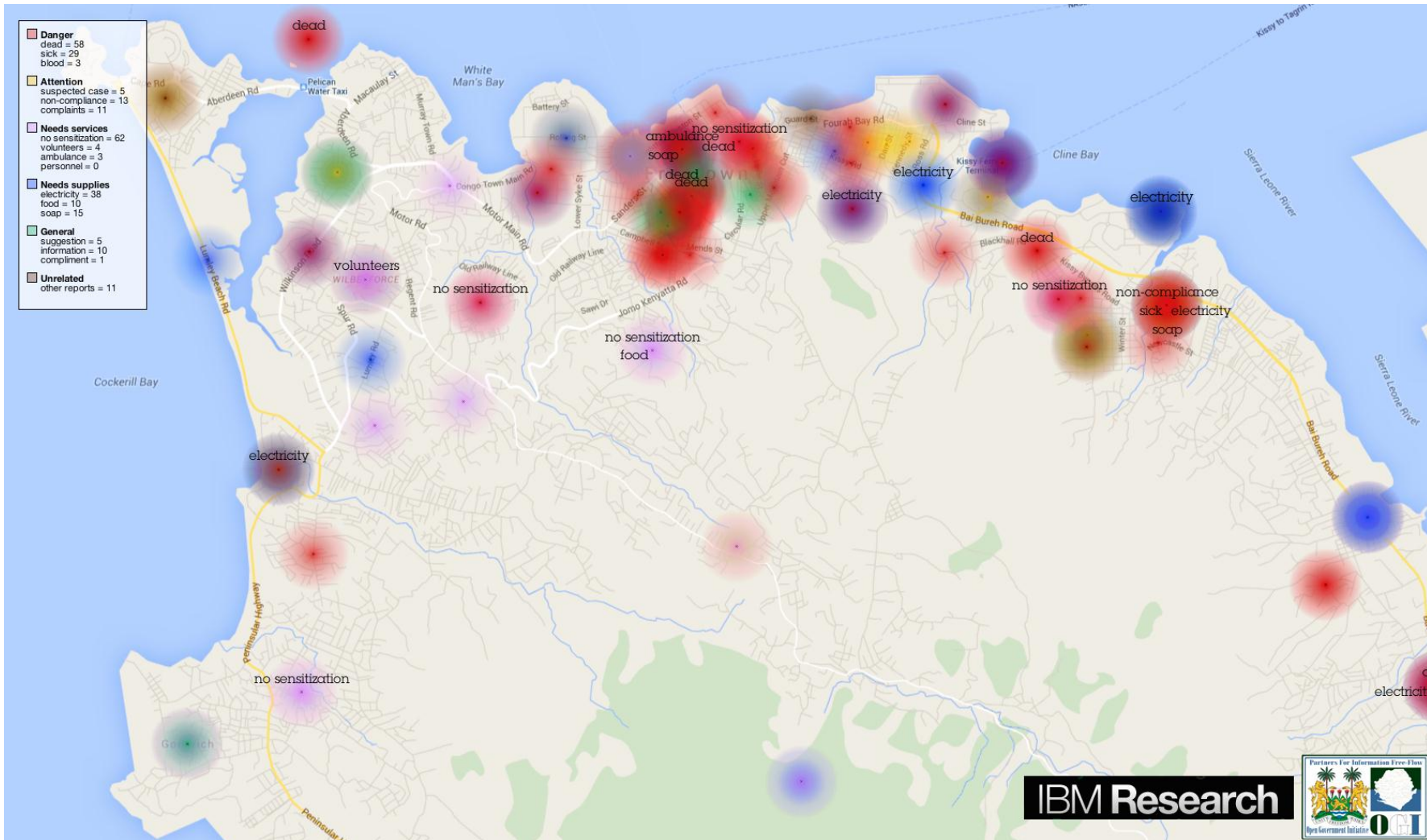
# Modeling Assumption and Result

- Assumptions

- 40% of patients will have confirmed diagnosis on day 1 and will be given antiviral treatment, lower transmission 90%, survival 90%, shorten infectious duration by 1 days
- 40% of patients will have confirmed diagnosis on day 2 and will be given antiviral treatment, lower transmission 70%, survival 80%
- 10% of patients will have confirmed diagnosis on day 3 and will be given antiviral treatment, lower transmission 30%, survival 60%
- 5% of patients will have confirmed diagnosis greater than 3 days and will be given antiviral treatment, no change of transmission, survival 55%
- 5% of patients remain unconfirmed



# Intelligence from IBM SMS based Ebola map can help direct our Resources



# Ebola Project Team

Experienced in Africa

- **Donald de Korte MD**

- Former Executive Director at Merck Sharp & Dohme in Emerging and Developing countries around the Globe
- Head Southern Africa Country Group at Novartis
- Director Malaria Initiatives
- Executive Director HIV/Aids Access Programs at Gates Foundation

- **Nigel Keegan, MD MBA**

- ex SAS officer (UK special forces) eight years
- Healthcare Analyst

- Richard Stokvis, MD, Chief Medical Officer CuresUnited

- Sjaak Vink, CEO CuresUnited



# Best in class founding team

We brought together a unique group of founders from Patient Advocates, Industry Executives and Internet Data Marketing & Gamification Technology:



- **Sjaak Vink Chief Executive Officer CEO**
  - One of the two initiating Founders and the pionering CEO for over two years of myTomorrows.com, within 24 months valued at USD 30mln
  - Boardmember USA Abigail Alliance Better Access Development Drugs, recently initiating successfully the Right to Try Acts in various US States
  - Boardmember USA Cure Accelerator Board Cures Within Reach, scientific evidence based cure redesignation
  - Initiator, together with Nobelprize winners Muhamad Yunus (micro-financing) and Kofi Anan (United Nations), of the Global Manifesto for Entrepreneurial Change



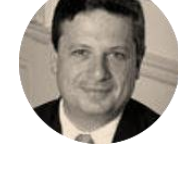
- **Donald de Korte Chief Operations Officer COO**
  - Former Executive Director at Merck Sharp & Dohme in Emerging and Developing countries around the Globe
  - Head Southern Africa Country Group at Novartis
  - Director Malaria Initiatives
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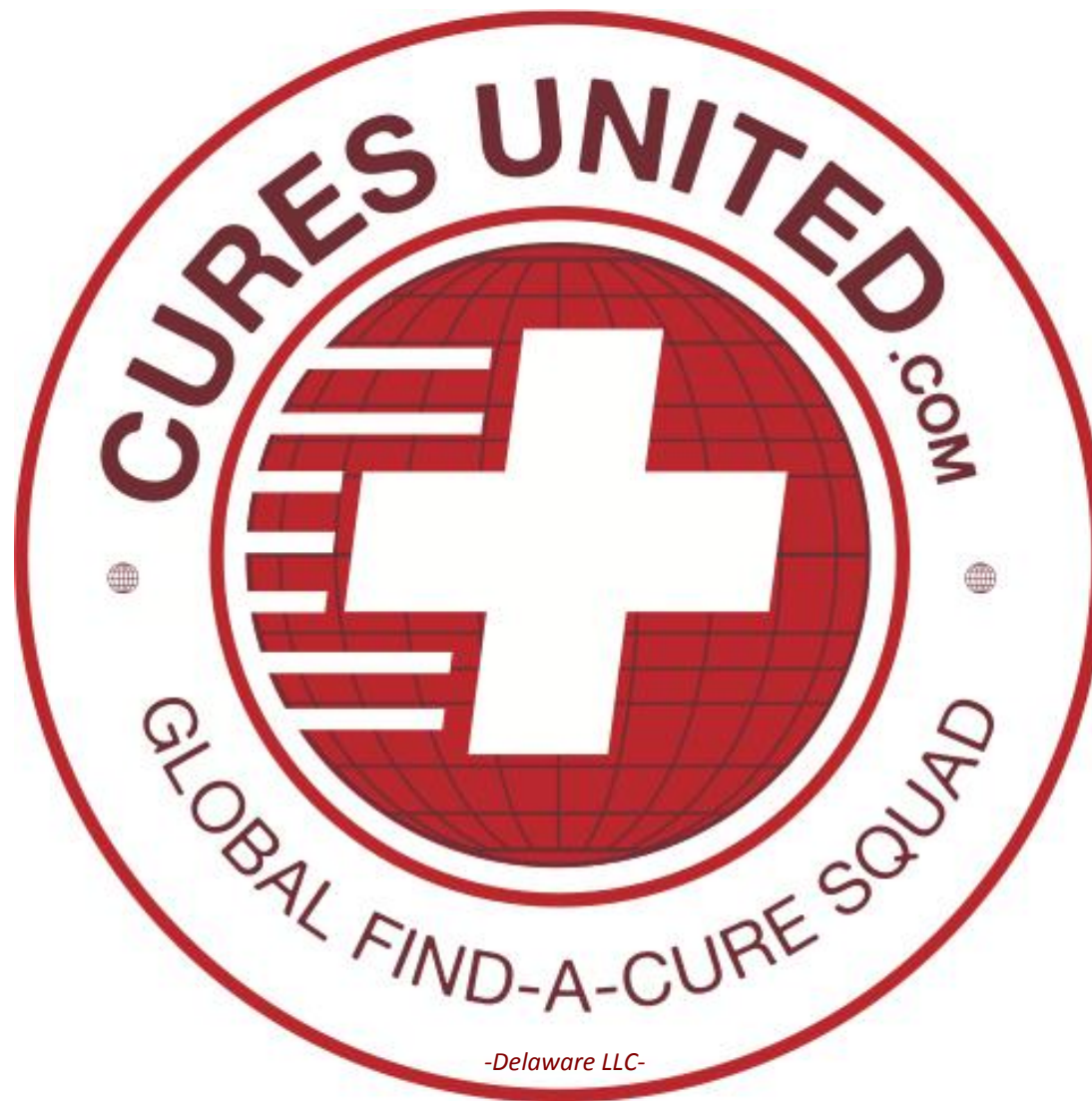
- **Jamie Heywood Chief Scientific & Information Officer CSIO**
  - Founder and President PatientsLikeMe.com, the world's leading community on patient reported outcomes
  - Founding Director, former Ceo and Boardmember ALS Therapy Development Institute
  - Member Roundtable Institue of Medicine
  - Member TEDMED AdvisoryBoard
  - Member Advisory Committee USA Center for Disease Control and Prevention



- **Siobhan Bulfin Chief Online Engagement Officer COEO**
  - Founder and Ceo of Social Code patient & doctor engagement communities (a.o. Sloan Kettering NY)
  - Founder ConnectNow social media Australia
  - Mentor Lightning LaB Digital Accelerator
  - Trustee New Zealand Serious Games, Animation & Visual Effects Trust



- **Richard Stokvis MD Chief Medical Officer & Medical Support Services CMSO**
  - Former Executive at big pharma's Merck & Novartis leading large R&D Projects and probably Europe's largest Remote Data Entry Drug Surveillance Program ever
  - Co-Founder and Ceo of Boston Clinics
  - Founder and Ceo of PhotoBioChem
  - Emergency Medicine and Medevac doctor
  - Recently in Sillicon Valley involved with the development of Wearable Health Diagnostic Sensors and Technologies



***Rapid Access to Life Saving Treatments Globally***

**Social Impact Investment**