Mapping the Risk of International Infectious Diseases Spread - MRIIDS

International Meeting on Emerging Diseases and Surveillance (IMED 2018)
November 10, 2018
Vienna, Austria

ProMED International Society for Infectious Diseases · HealthMap · healthsites.io · Imperial College London · University of Sussex · USAID From the American People · Center for Accelerating Innovation and Impact · Dalberg Design

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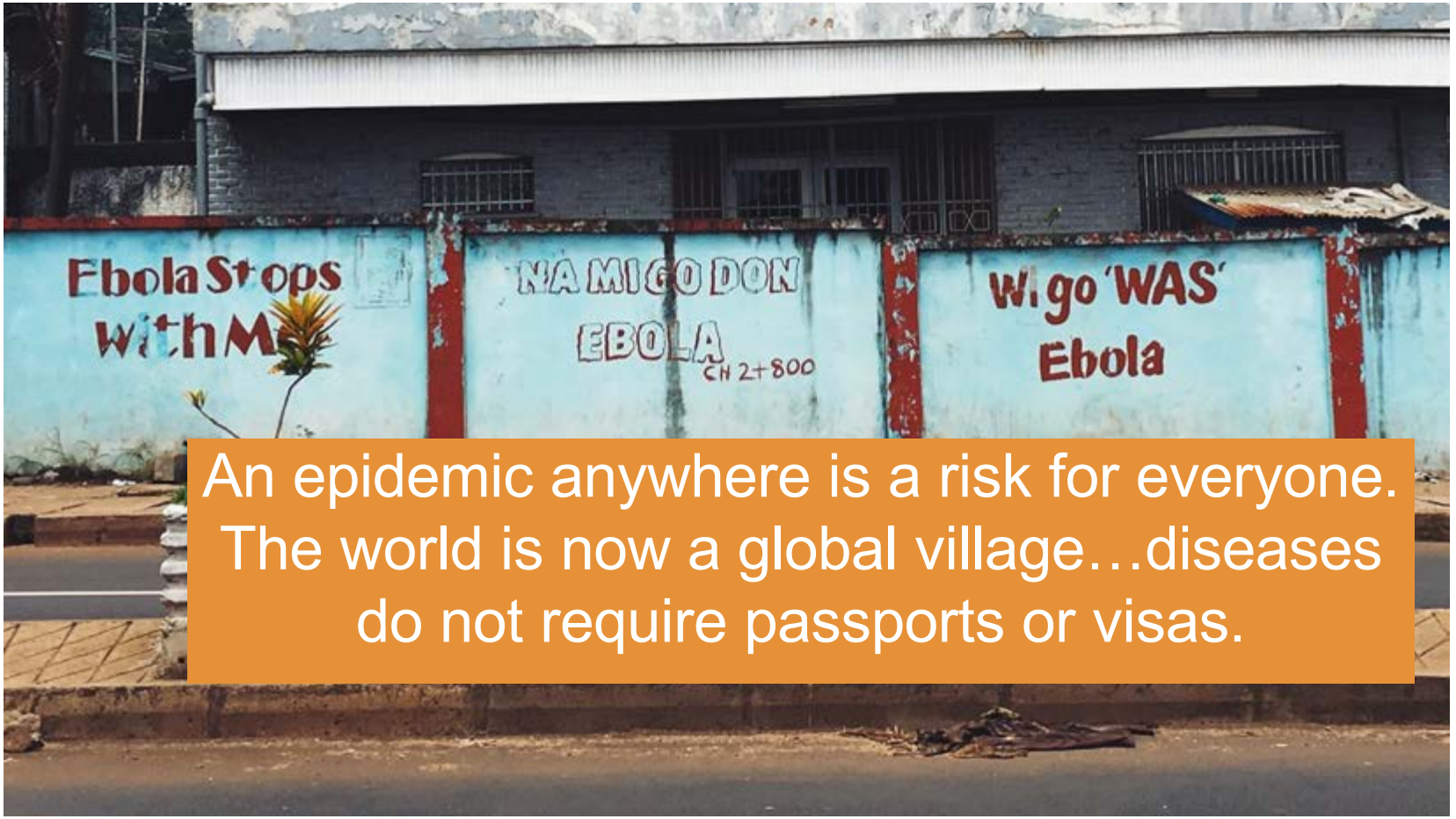
Mriids is funded through USAID's "Combating Zika and Future Threats: A Grand Challenge for Development" program

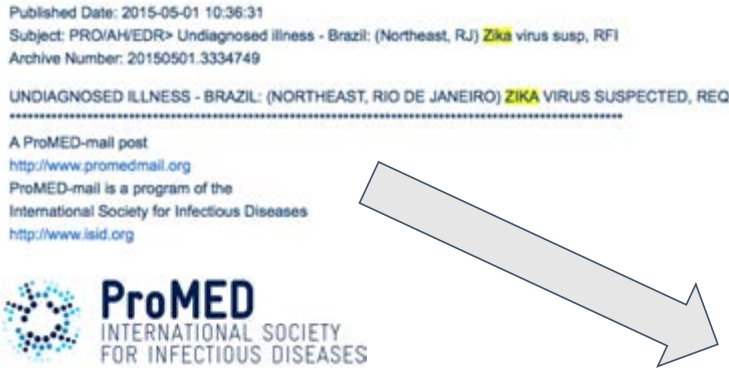


An epidemic anywhere is a risk for everyone. The world is now a global village…diseases do not require passports or visas.

MRIIDS

PROBLEM STATEMENT:

How might we equip key health decision makers with tools that increase their readiness and ability to respond in an informed and timely manner to outbreaks?



SOLUTION

- **Visualizing case data in real time**
- **Combining multiple data streams into a single probabilistic framework to provide short term projections**
- **Providing an intuitive interface that allows customization and data sharing**

MRIIDS User Research

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USER RESEARCH SUMMARY

Dalberg Design

PHASE 1: Remote Interviews
25 interviewees
19 organizations and teams
6 stakeholder categories

PHASE 2: In-country Concept Testing
Senegal and Sierra Leone
34 interviewees
26 organizations and teams
6 stakeholder categories

PHASE 3: In-country Prototype Testing
Senegal
34 interviewees
26 organizations and teams
6 stakeholder categories

76 Interviewees

45 organizations and teams

6 stakeholder categories*

*Public Health, Academics, Funders, Business/Security, Media, General

USER NEEDS

1 PREPAREDNESS

Most of the participants indicated that when there is no ongoing outbreak, their focus is on surveillance, monitoring and training. They wanted to better understand disease trends, areas with high risk, implement preventive methods and make sure that SOPs are updated and accessible for outbreak scenarios.

USER NEEDS

- **HISTORIC DISEASE DATA**
- **AREAS UNDER RISK**
- **CONTEXTUAL AND DEMOGRAPHIC DATA**

OPPORTUNITY AREA

How might we equip national and province/regional health decision makers with appropriate visualisations and data sets, to help in monitoring and training in order to better prepare for an outbreak?

2 OUTBREAK RESPONSE

Participants explained that during an outbreak their mindset shifts to response and action. They expressed a desire to get a quick understanding of the current situation, make fast decisions on appropriate course of action, mobilise relevant resources to achieve results and manage the response process efficiently.

USER NEEDS

- **SITUATION SNAPSHOT**
- **PRIORITISATION AND EFFICIENCY**
- **COORDINATION**

OPPORTUNITY AREA

How might we equip national health decision makers with snapshot views and prioritisation tools to help in quick decision making, coordination and efficient mobilization efforts during an outbreak?


OUTBREAK RESPONSE
"I would like to see a map visualisation of the ongoing outbreak with case counts, epi-curve, health facilities & health staff at the country level and zoom into the regional levels."
Dr. Matar Camara, Policy & Health Specialist, USAID + Abt Associates, Dakar


RISK MAPPING
“Risk mapping is important during preparation phase when there is no outbreak, as it is during peace that we prepare for the war.”
Dr Alioune Badara Ly, Deputy In-charge at COUS, MoH, Dakar
Gambia
Guinea-Bissau

MRIIDS – Data and Methods

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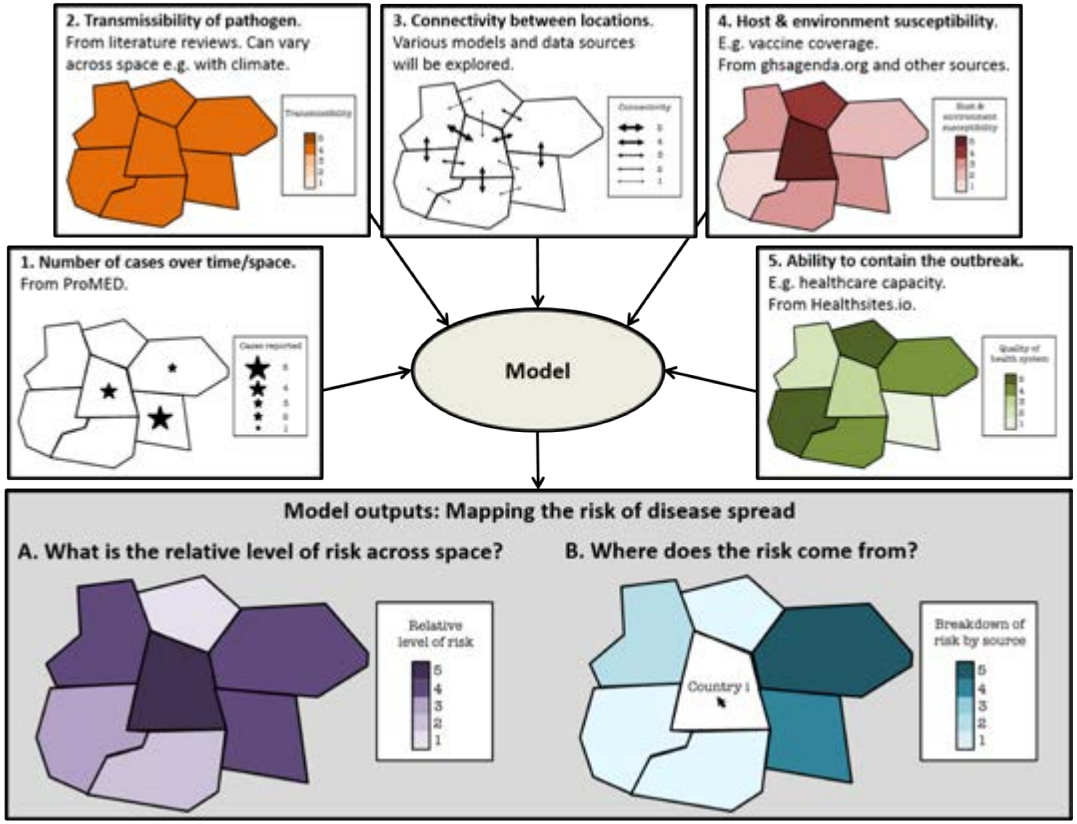
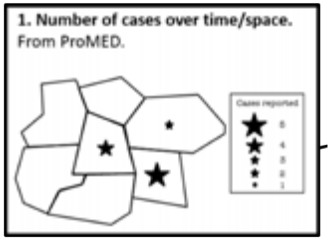

2. Transmissibility of pathogen.
From literature reviews. Can vary across space e.g. with climate.
3. Connectivity between locations.
Various models and data sources will be explored.
4. Host & environment susceptibility.
E.g. vaccine coverage.
From ghsagenda.org and other sources.
1. Number of cases over time/space.
From ProMED.
Model
5. Ability to contain the outbreak.
E.g. healthcare capacity.
From Healthsites.io.
Model outputs: Mapping the risk of disease spread
A. What is the relative level of risk across space?
Relative level of risk
5
4
3
2
1
B. Where does the risk come from?
Country i
Breakdown of risk by source
5
4
3
2
1

Data stream 1: case numbers

Example of the 2013-16 West African Ebola epidemic

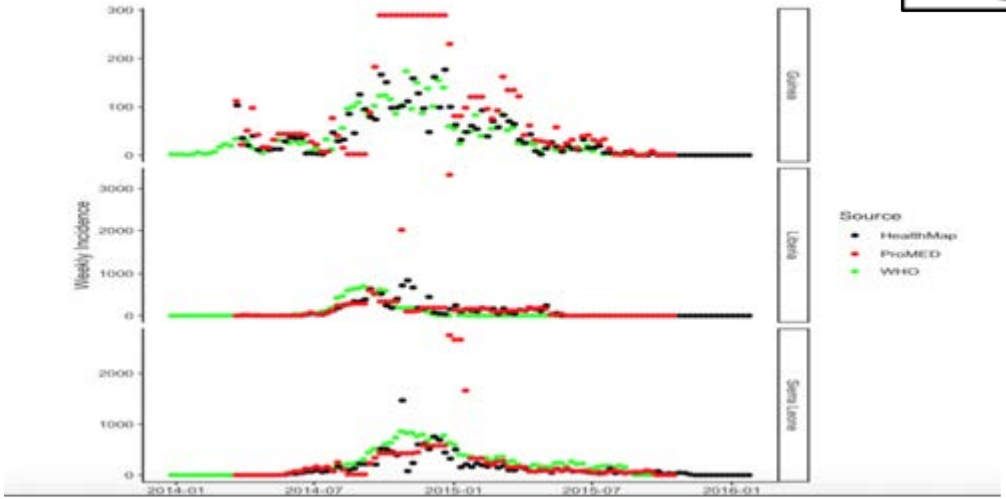


Innovative Diseases Surveillance:

- ProMED
- HealthMap

Traditional Disease Surveillance:

- WHO

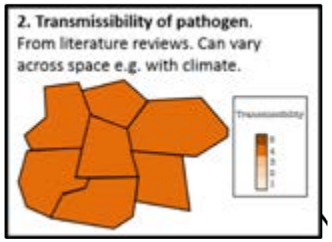


World Health Organization

HealthMap

ProMED
INTERNATIONAL SOCIETY FOR INFECTIOUS DISEASES

Data stream 2: transmissibility



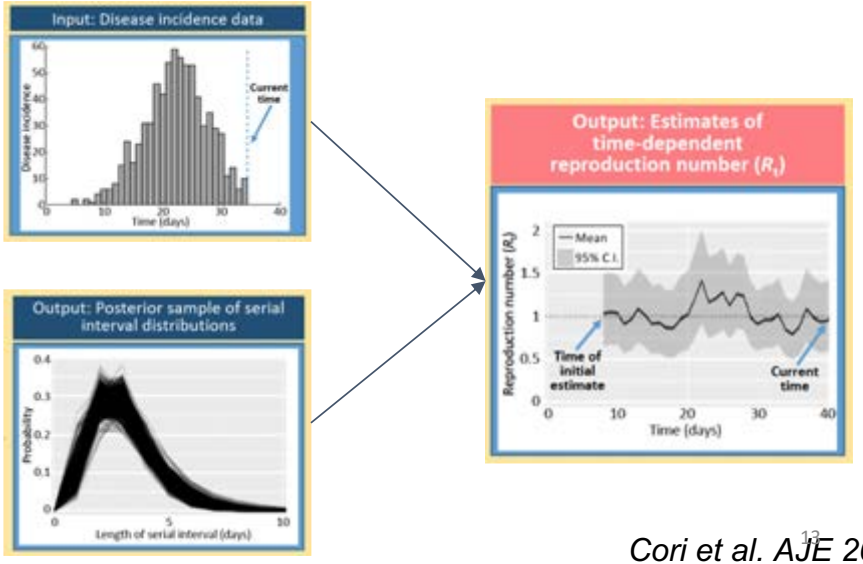
Retrieved from the literature…

A review of epidemiological parameters from Ebola outbreaks to inform early public health decision-making

Maria D. Van Kerkhove, Ana I. Bento, Harriet L. Mills, Neil M. Ferguson & Christl A. Donnelly

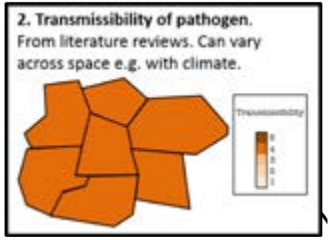
Scientific Data 2, Article number: 150019 (2015) | Download Citation

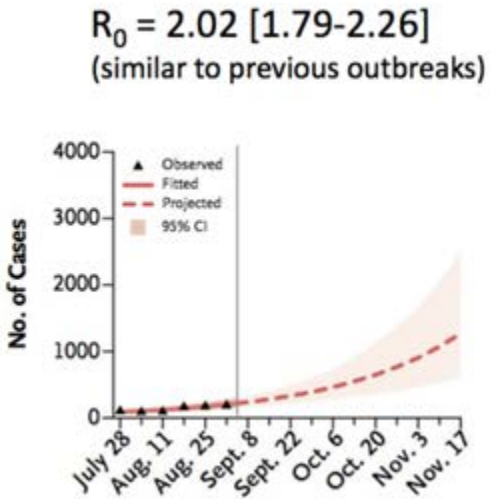
Or estimated in real time

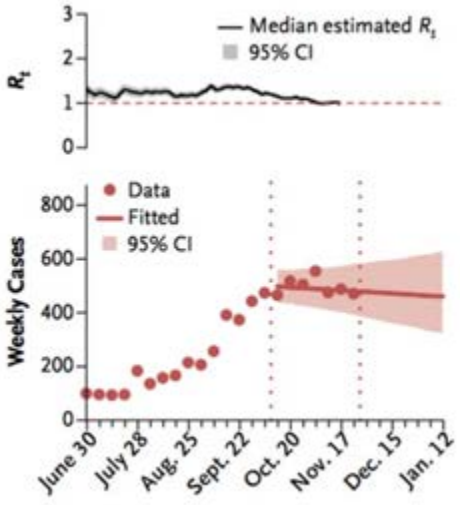


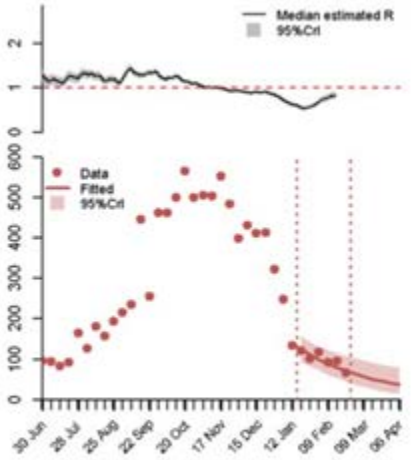
Cori et al. AJE 2013

Estimated transmissibility in real-time



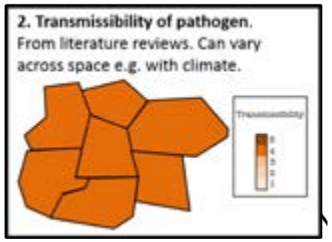


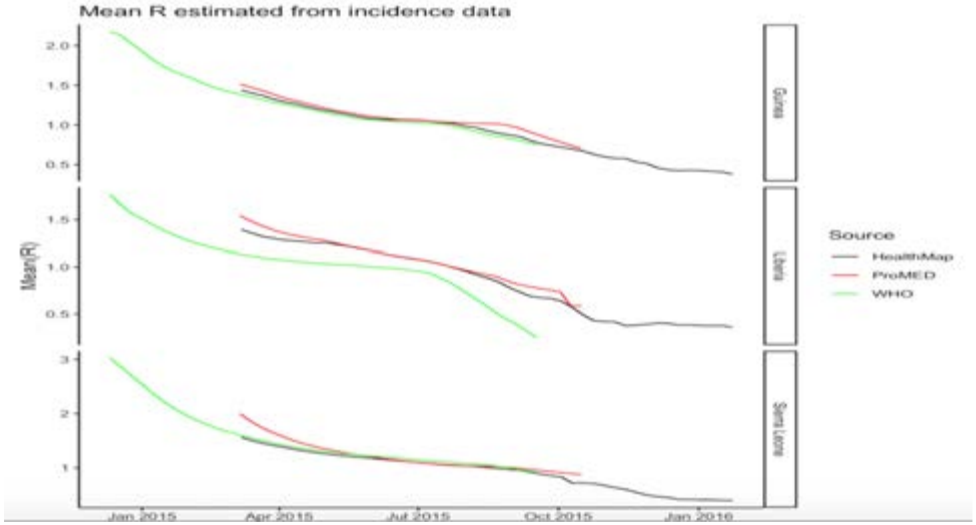




WHO Ebola Response Team NEJM 2014, 2015,
Nouvellet et al. Epidemics 2017

Comparing transmissibility based on different data sources



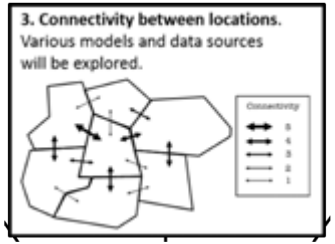


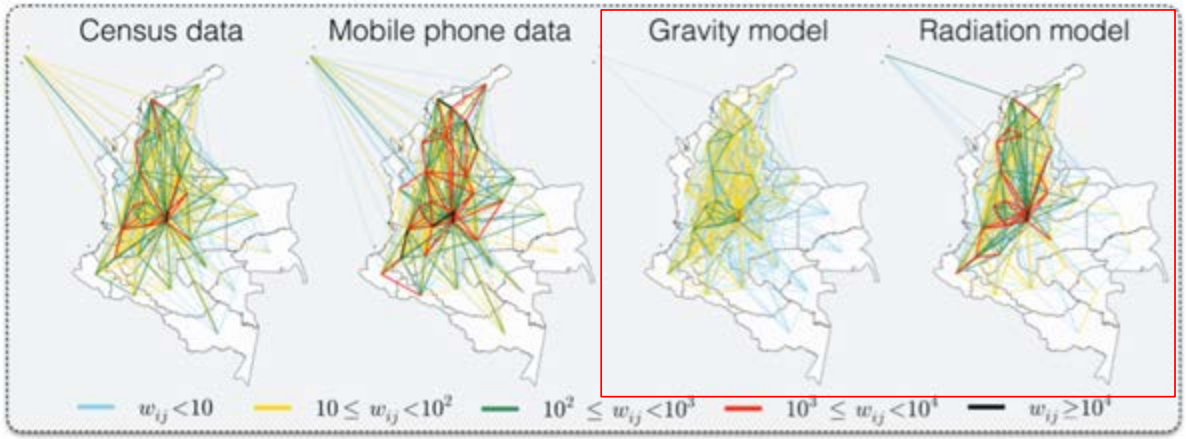
World Health Organization

HealthMap

ProMED
INTERNATIONAL SOCIETY FOR INFECTIOUS DISEASES

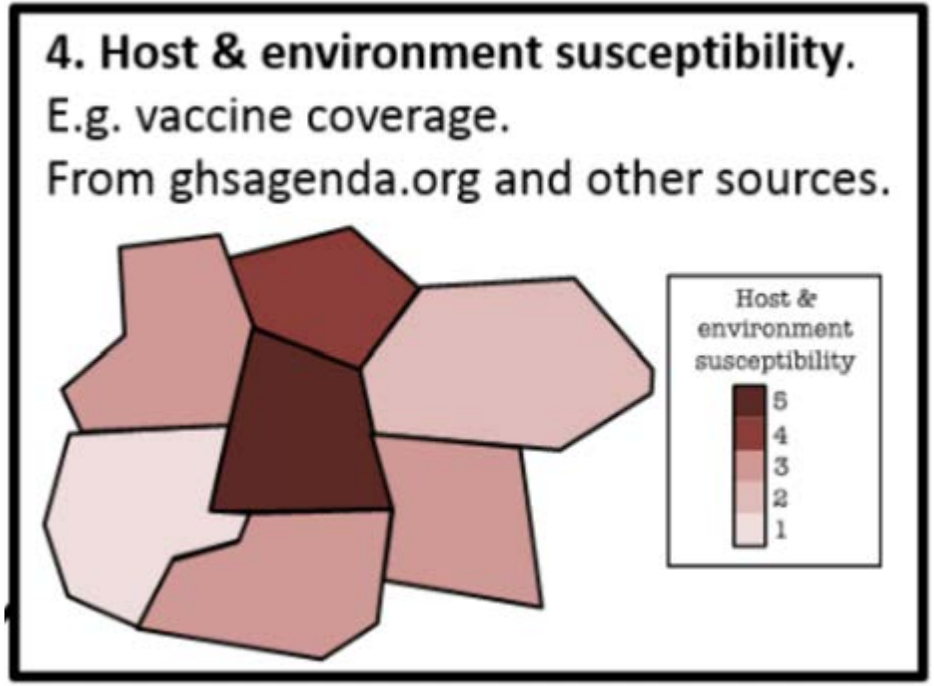
Connectivity



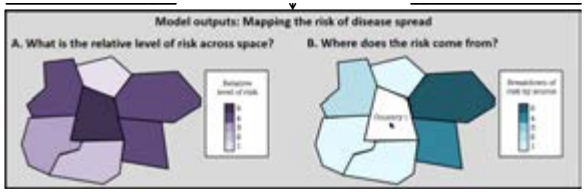


https://www.unglobalpulse.org/

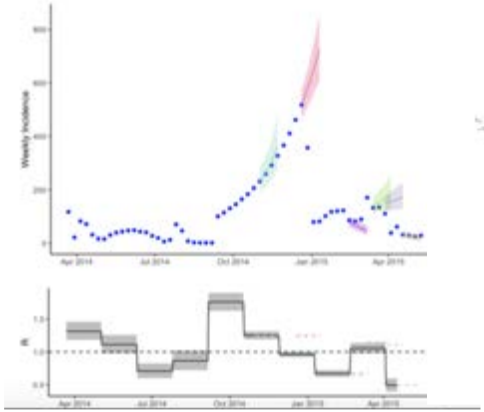
Local susceptibility?



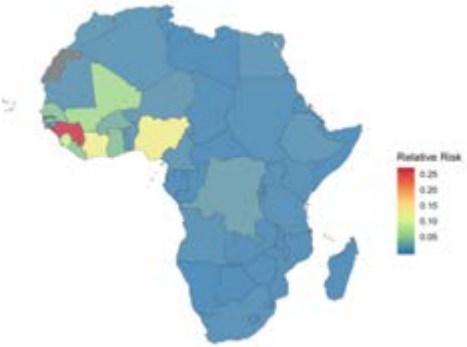
Model validation



Predicted continental spread of the 2013-16 West African Ebola epidemic

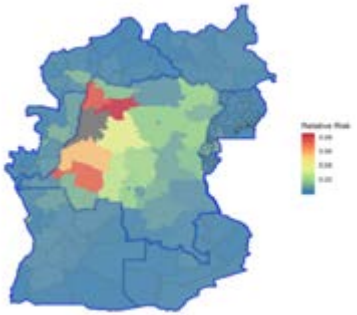


Guinea, 2014-15



21 Nov 2014

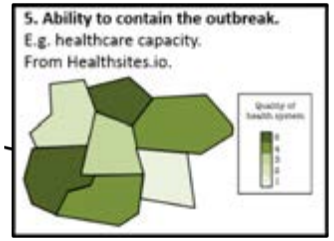
Predicted regional spread of the 2018 Ebola outbreak from Equateur, DRC



21 May 2018

Challenges in quantifying healthcare capacity:

Healthsites - Valuable attributes vs Attributes shared



Valuable attributes in terms of Epidemic Preparedness include :

- ICU beds
- ventilators
- hospital beds
- number of Doctors
- number of Nurses

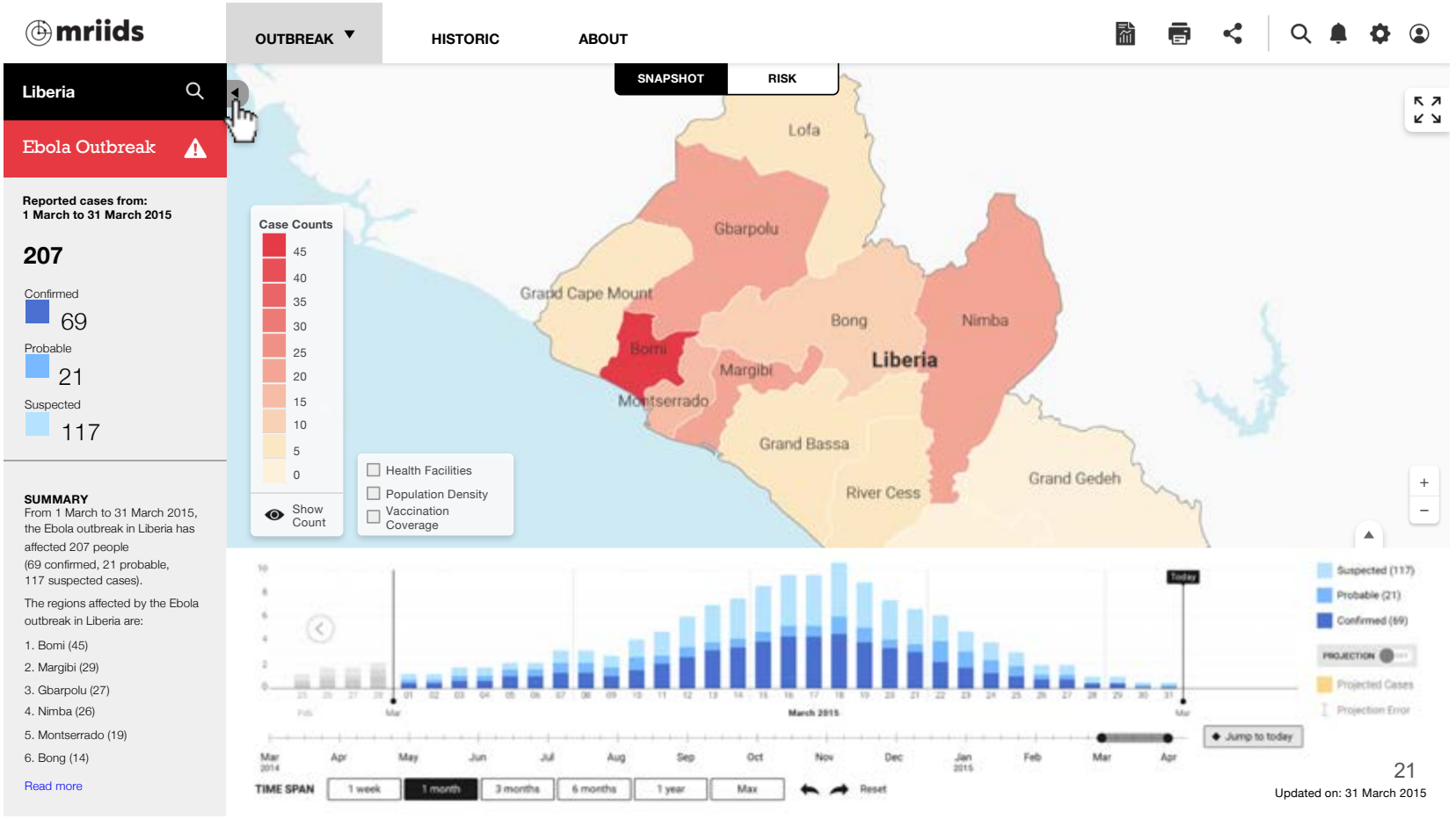
The attributes that have been shared ..

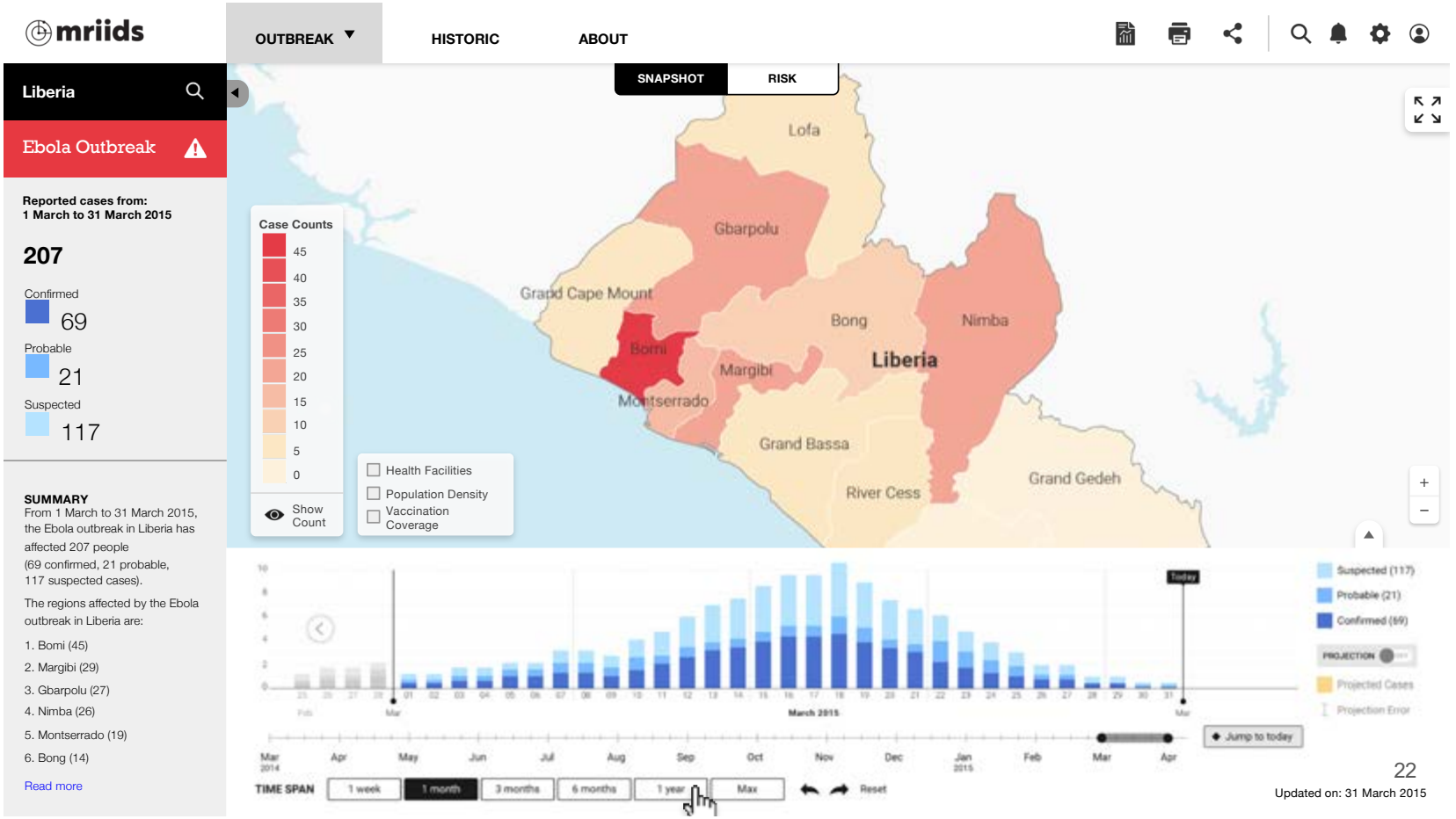
- Name - BOURGUIBA - Poste de Santé
- Nature of facility - Poste de Santé
- Ownership - Public
- Latitude - 14.71477948
- Longitude - 17.45315688
- Source of info name - Ministère de la Santé du Sénégal
- Source of info URL - https://senegal.dhis2.org

What stops the Ministry of Health sharing the number of Doctors at each facility?
What is the risk?
What is the incentive to share?

healthsites.io

PRODUCT DESIGN AND DEVELOPMENT


mriids
OUTBREAK
HISTORIC
ABOUT
Liberia
Ebola Outbreak
Reported cases from:
1 March to 31 March 2015
207
Confirmed
69
Probable
21
Suspected
117
SUMMARY
From 1 March to 31 March 2015, the Ebola outbreak in Liberia has affected 207 people (69 confirmed, 21 probable, 117 suspected cases).
The regions affected by the Ebola outbreak in Liberia are:
1. Bomi (45)
2. Margibi (29)
3. Gbarpolu (27)
4. Nimba (26)
5. Montserrado (19)
6. Bong (14)
Read more
SNAPSHOT
RISK
Case Counts
45
40
35
30
25
20
15
10
5
0
Show Count
Health Facilities
Population Density
Vaccination Coverage
Lofa
Gbarpolu
Grand Cape Mount
Bong
Nimba
Bomi
Margibi
Liberia
Montserrado
Grand Bassa
River Cess
Grand Gedeh
Suspected (117)
Probable (21)
Confirmed (69)
PROJECTION
Projected Cases
Projection Error
Today
March 2015
Jump to today
TIME SPAN
1 week
1 month
3 months
6 months
1 year
Max
Reset
21
Updated on: 31 March 2015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3 months
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1 year
Max
Reset
22
Updated on: 31 March 2015

Liberia

Ebola Outbreak

Reported cases from:
1 April 2014 to 31 March 2015

6,525

Confirmed
2,508

Probable
1,239

Suspected
2,778

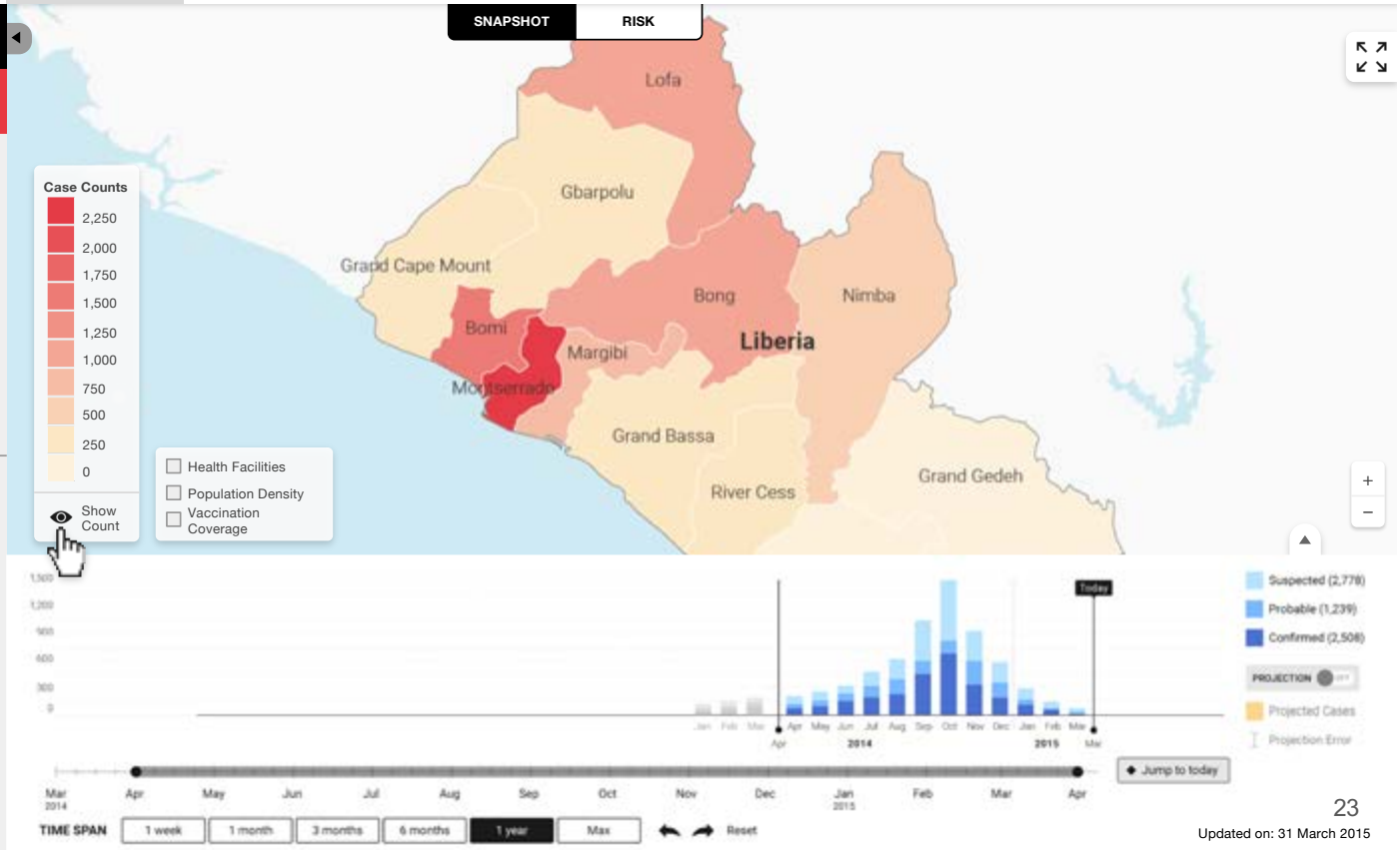
SUMMARY

From 1 April 2014 to 31 March 2015, the Ebola outbreak in Liberia has affected 6,525 people (2,508 confirmed, 1,239 probable, 2,778 suspected cases).

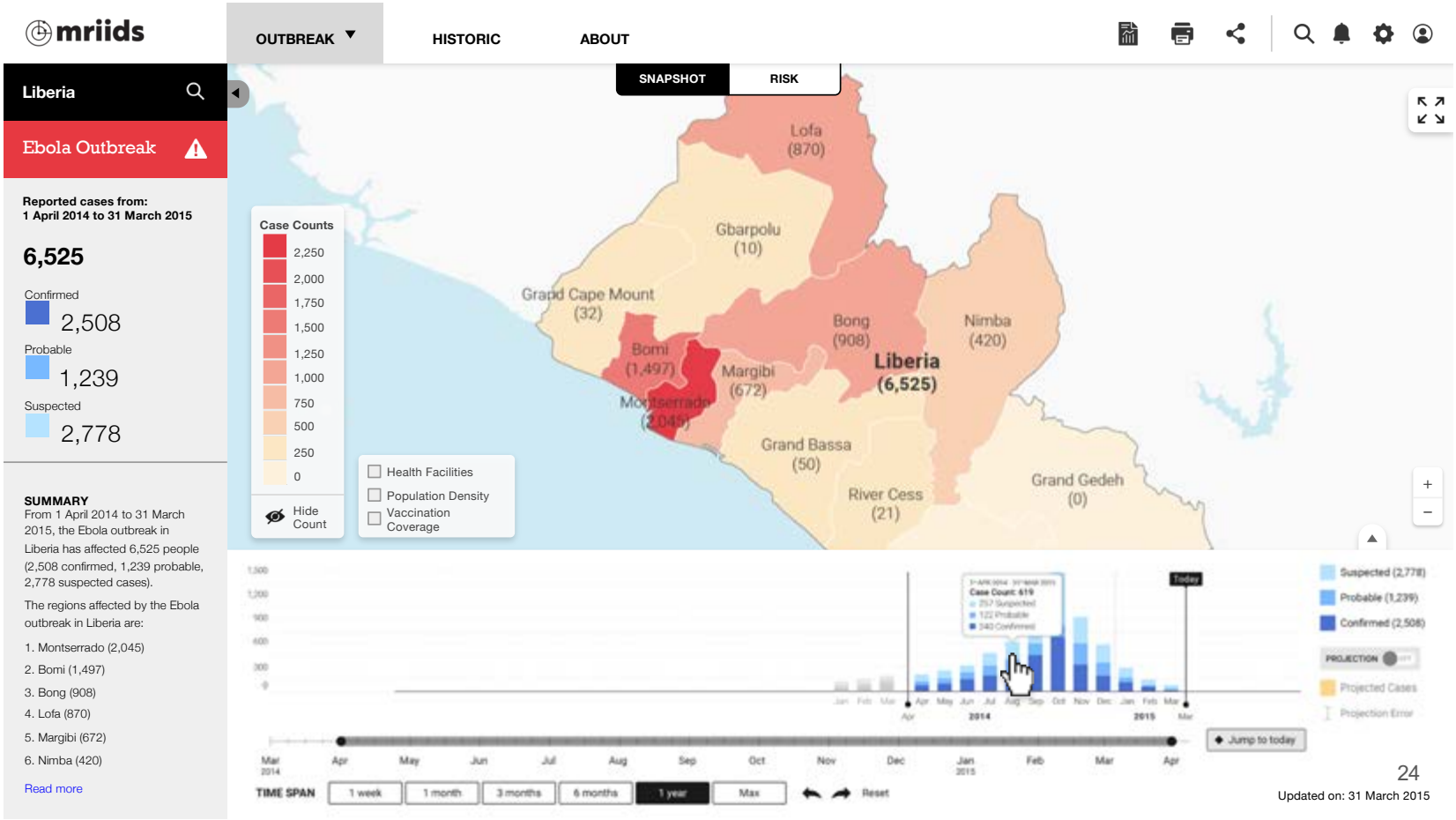
The regions affected by the Ebola outbreak in Liberia are:

1. Montserrado (2,045)
2. Bomi (1,497)
3. Bong (908)
4. Lofa (870)
5. Margibi (672)
6. Nimba (420)

Read more



Updated on: 31 March 2015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RISK
Case Counts
2,250
2,000
1,750
1,500
1,250
1,000
750
500
250
0
Hide Count
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Liberia (6,525)
Montserrado (2,045)
Grand Bassa (50)
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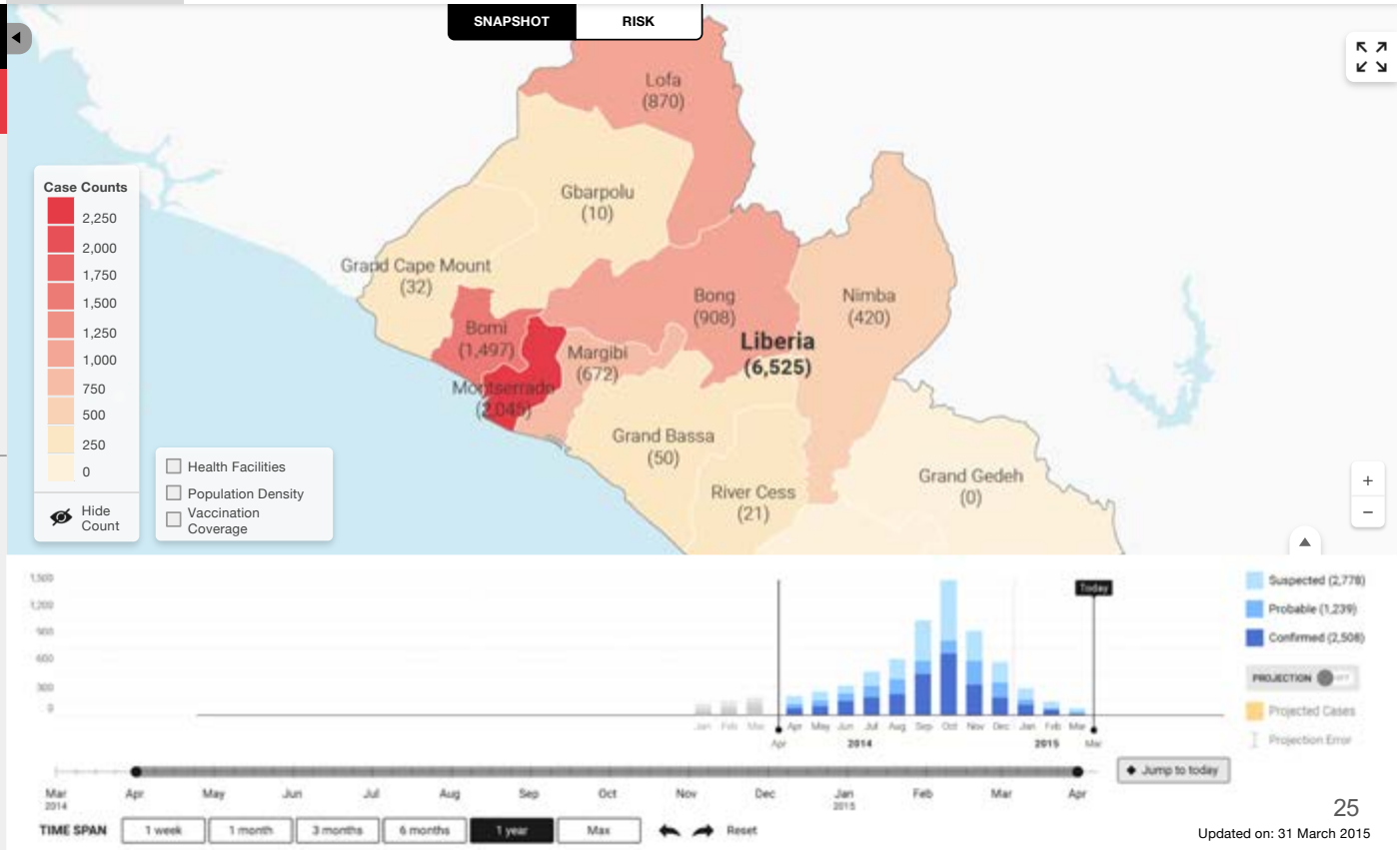


Updated on: 31 March 2015

Bomi, Liberia

Ebola Outbreak

Reported cases from:
1 April 2014 to 31 March 2015

1,497

Confirmed
589

Probable
287

Suspected
621

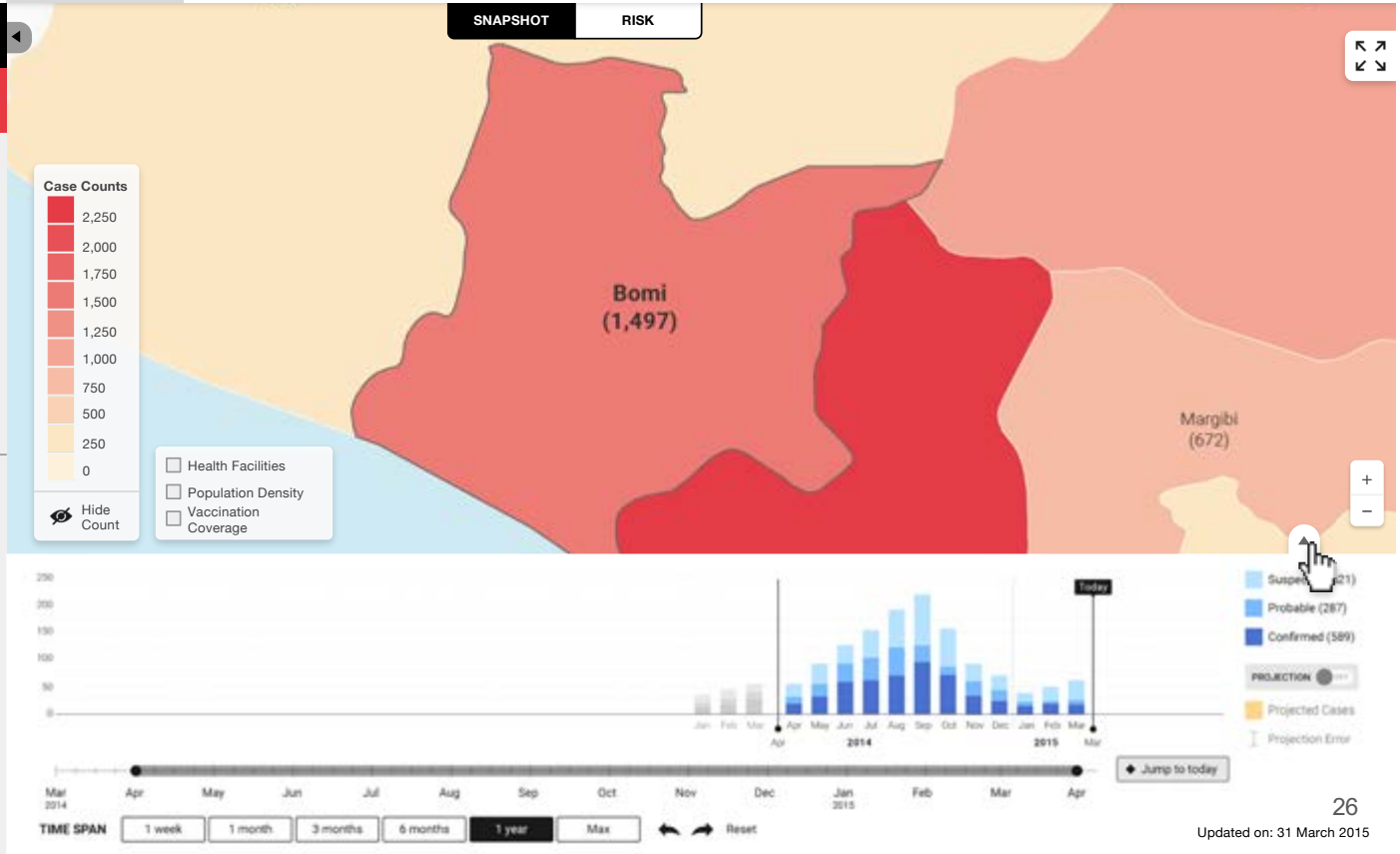
SUMMARY

From 1 April 2014 to 31 March 2015, the Ebola outbreak in Liberia has affected 6,525 people (2,508 confirmed, 1,239 probable, 2,778 suspected cases) and the region of Bomi has reported 1,497 cases (589 confirmed, 287 probable, 621 suspected).

The districts affected by the Ebola outbreak in Bomi are:

1. Dewoin (765)
2. Klay (332)
3. Mecca (258)

Read more



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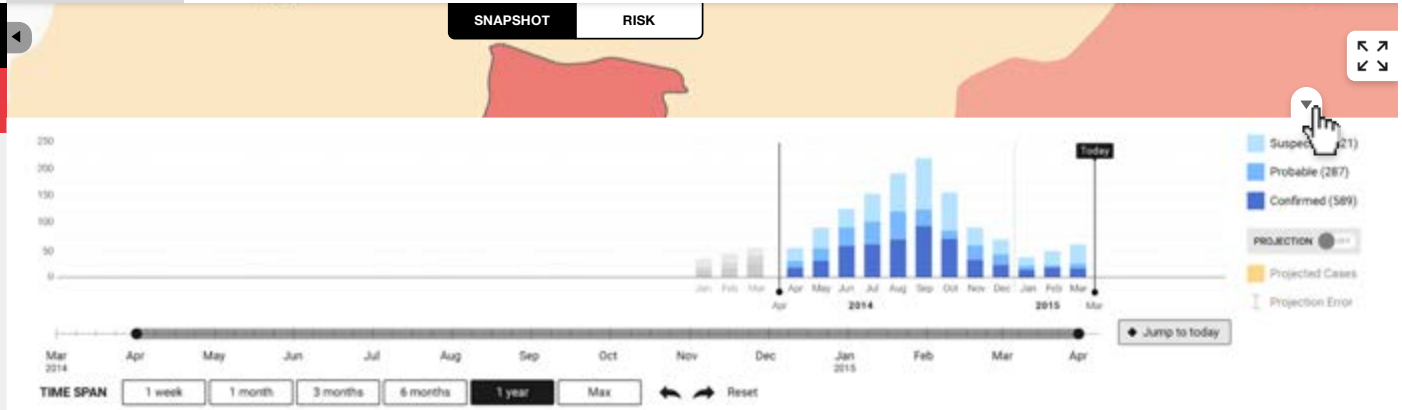


TABLE OF REPORTED CASES

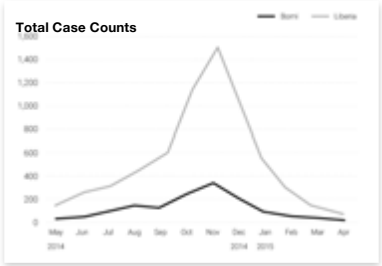
Reported cases for Ebola outbreak in Liberia from 2nd May 2014 to 2nd April 2015.

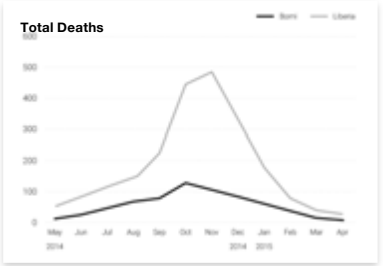
DOWNLOAD TABLE

Region	Confirmed	Probable	Suspected	Case count	Deaths
Montserrado	732	276	1037	2045	1025
Bomi	**589**	**287**	**621**	**1497**	**629**
Bong	362	92	454	908	330
Lofa	365	244	261	870	301
Margibi	237	188	247	672	161
Nimba	176	118	126	420	185
Grand Bassa	21	14	15	50	28
Grand Cape Mount	13	10	9	32	24
Rivercess	9	6	6	21	8
Gbarpolu	4	4	2	10	6
River Gee	0	0	0	0	0
Sinoe	0	0	0	0	0
Grand Gedeh	0	0	0	0	0
Grand Kru	0	0	0	0	0
Maryland	0	0	0	0	0
TOTAL	2508	1239	2778	6525	2697

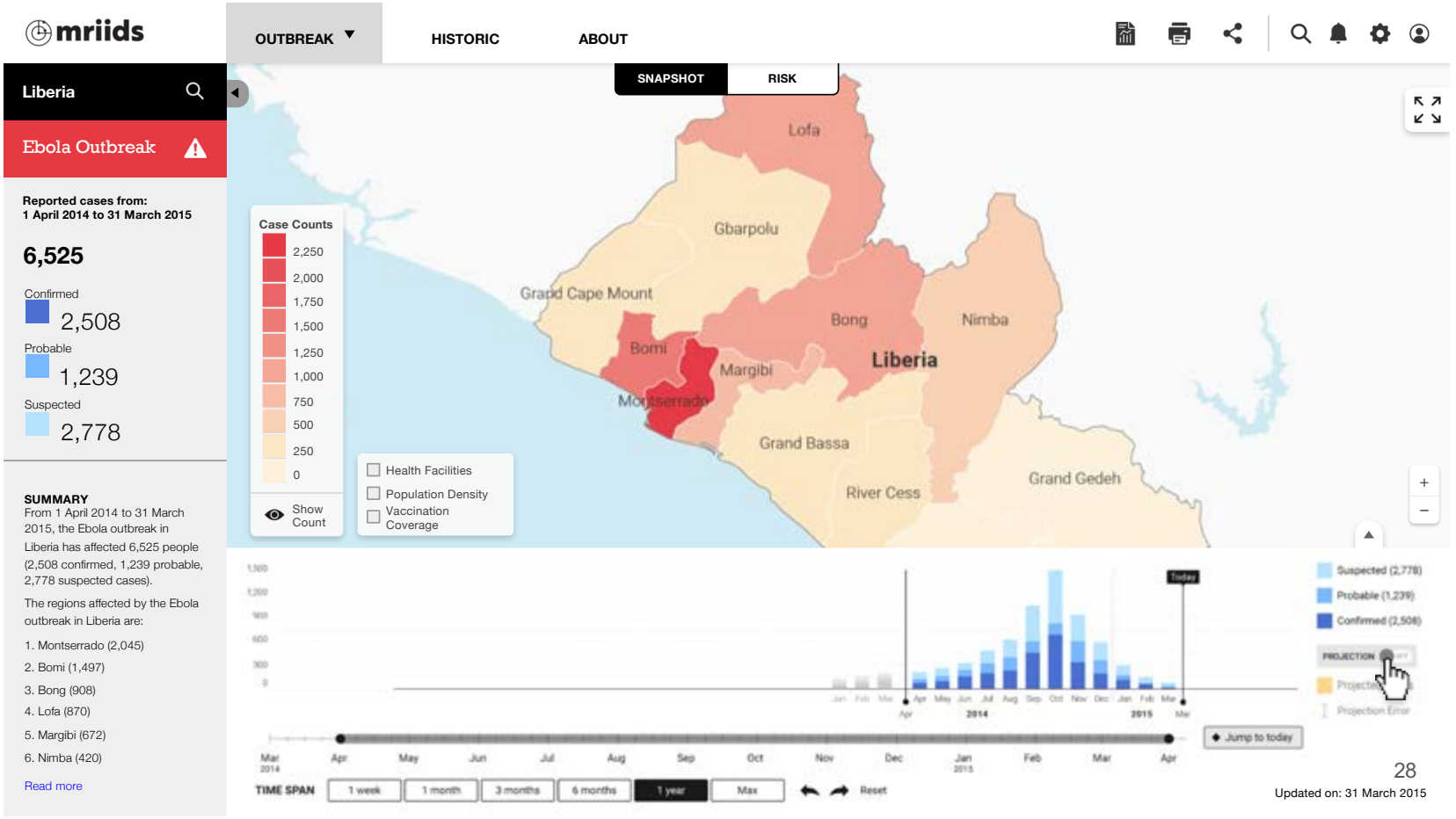
LIBERIA v/s BOMI

Comparison of total case counts and deaths between Liberia and Bomi from 2nd May 2014 to 2nd April 2015.





Updated on: 31 March 2015



Updated on: 31 March 2015

Liberia

Ebola Outbreak

Projected cases from:
1 April 2014 to 31 March 2015

197

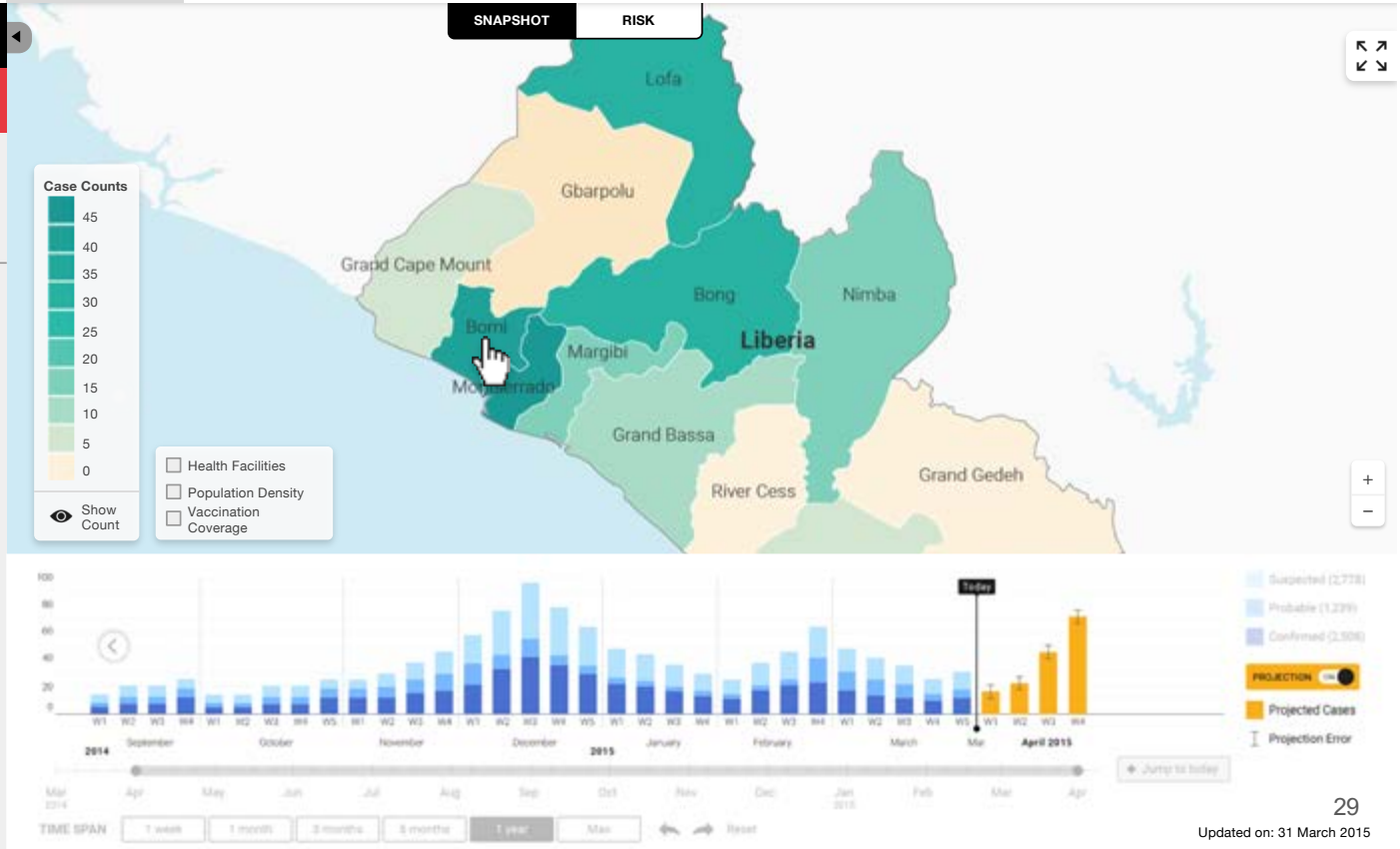
SUMMARY

From 1 April 2014 to 31 March 2015, the Ebola outbreak in Liberia has affected 6,525 people (2,508 confirmed, 1,239 probable, 2,778 suspected cases).

The projected cases in Liberia from 2 April to 30 April 2015 will be 197. According to the projection, the regions that will be most affected in Liberia in the coming 4 weeks will be:

1. Montserrado (45)
2. Bomi (41)
3. Bong (22)
4. Lofa (21)
5. Margibi (16)
6. Nimba (15)
7. Grand Bassa (10)
8. Grand Cape Mount (6)
9. Sinoe (5)
10. River Gee (3)

Read more



Updated on: 31 March 2015

mriids

OUTBREAK ▼ HISTORIC ABOUT

Bomi, Liberia

Ebola Outbreak

Projected cases from:
1 April 2014 to 31 March 2015

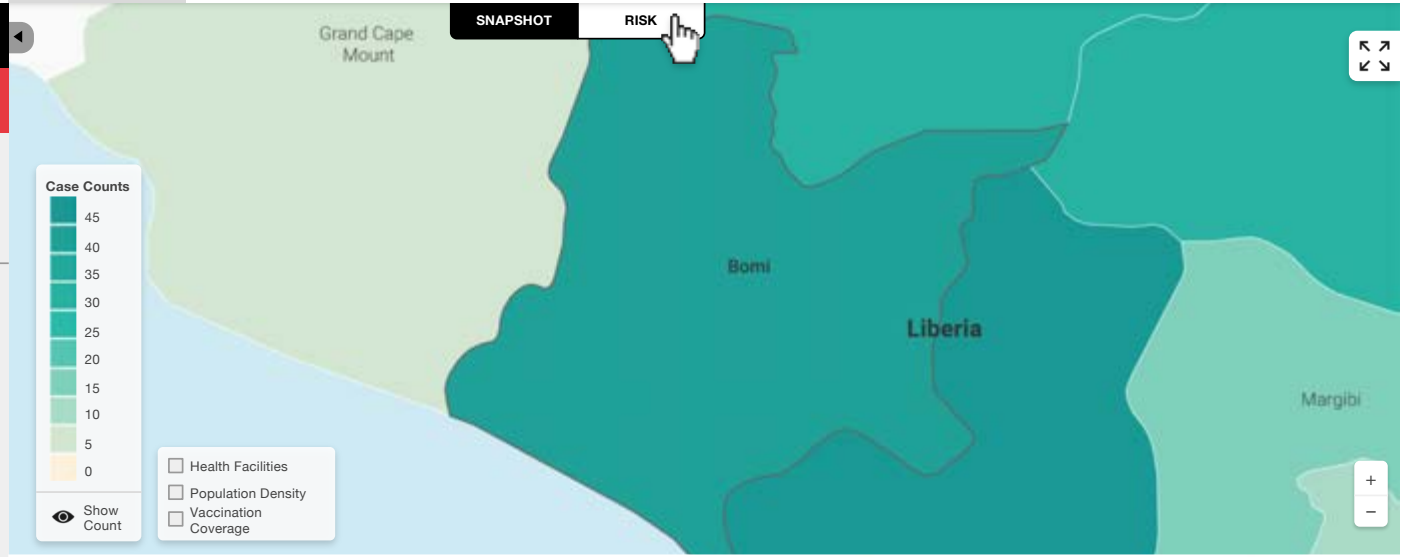
41

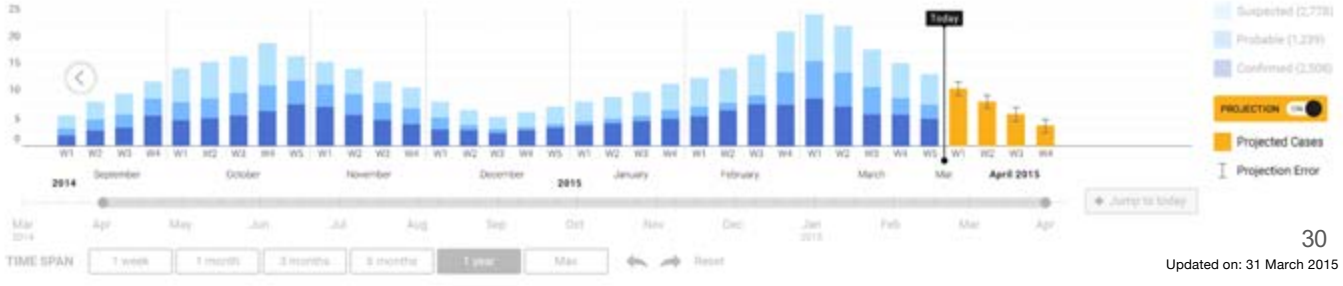
SUMMARY

From 1 April 2014 to 31 March 2015, the Ebola outbreak in Liberia has affected 6,525 people (2,508 confirmed, 1,239 probable, 2,778 suspected cases) and the region of Bomi has reported 1,497 cases (589 confirmed, 287 probable, 621 suspected).

The projected cases in Bomi from 2 April to 30 April 2015 will be 41. According to the projection, the districts that will be most affected in Bomi in the coming 4 weeks will be:

1. Dewoin (21)
2. Klay (12)
3. Mecca (8)





Updated on: 31 March 2015

mriids

OUTBREAK ▼ HISTORIC ABOUT

Liberia

Risk of Ebola

SUMMARY
From 1 April 2014 to 31 March 2015, the Ebola outbreak in Liberia has affected 6,525 people (2,508 confirmed, 1,239 probable, 2,778 suspected cases).

The top six regions in Liberia under the highest risk of importing Ebola to Bomi region are:

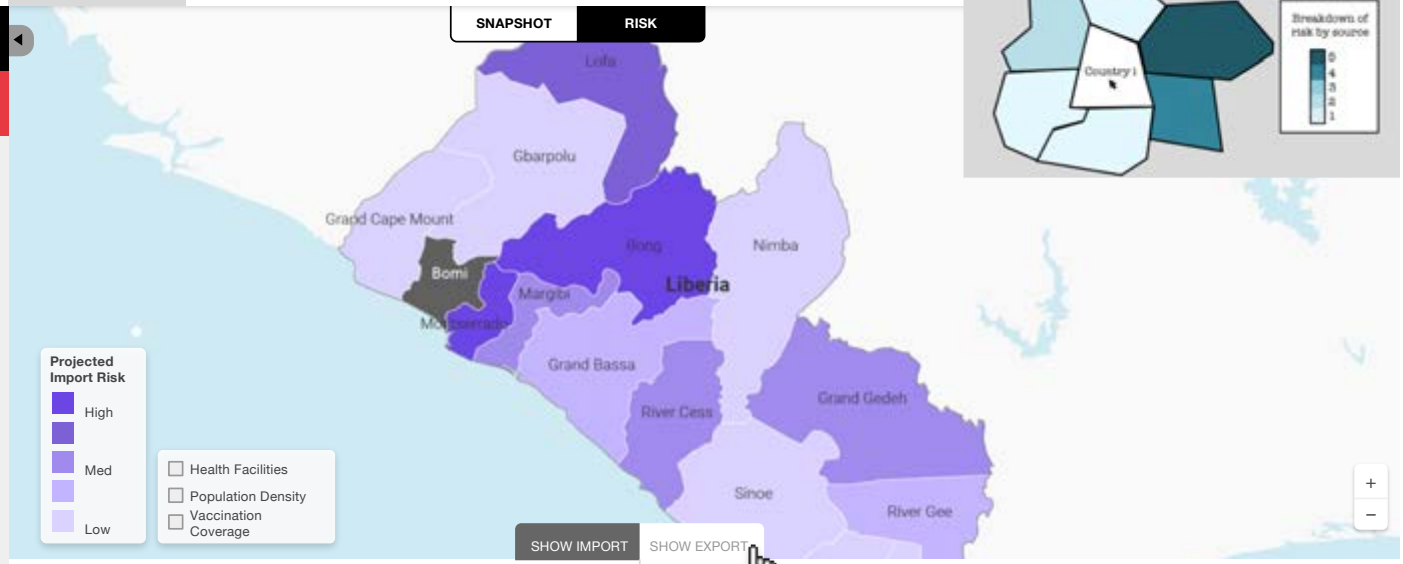
1. Montserrado (high)
2. Bong (high)
3. Lofa (medium-high)
4. Margibi (medium)
5. River Cess (medium)
6. Grand Gedeh (medium)

The top six regions in Liberia under the highest risk of getting Ebola exported from Bomi region are:

1. Grand Cape Mount (high)
2. Montserrado (high)
3. Gbarpolu (medium-high)
4. Grand Bassa (medium-high)
5. Sinoe (medium-high)
6. Margibi (medium)

To learn more about the data sources and risk model used, please see the About section.

SNAPSHOT RISK



IMPORT RISK TO BOMI

Montserrado	Grand Gedeh	Gbarpolu
Bong	Grand Bassa	Grand Cape Mount
Lofa	River Gee	Grand Kru
Margibi	Sinoe	Maryland
River Cess	Nimba	

EXPORT RISK FROM BOMI

Grand Cape Mount	Margibi	Bong
Montserrado	Lofa	Grand Gedeh
Gbarpolu	Nimba	Grand Kru
Grand Bassa	River Cess	Maryland
Sinoe	River Gee	

Updated on: 31 March 2015

mriids

OUTBREAK ▼ HISTORIC ABOUT

Liberia

Risk of Ebola

SUMMARY

From 1 April 2014 to 31 March 2015, the Ebola outbreak in Liberia has affected 6,525 people (2,508 confirmed, 1,239 probable, 2,778 suspected cases).

The top six regions in Liberia under the highest risk of getting Ebola exported from Bomi region are:

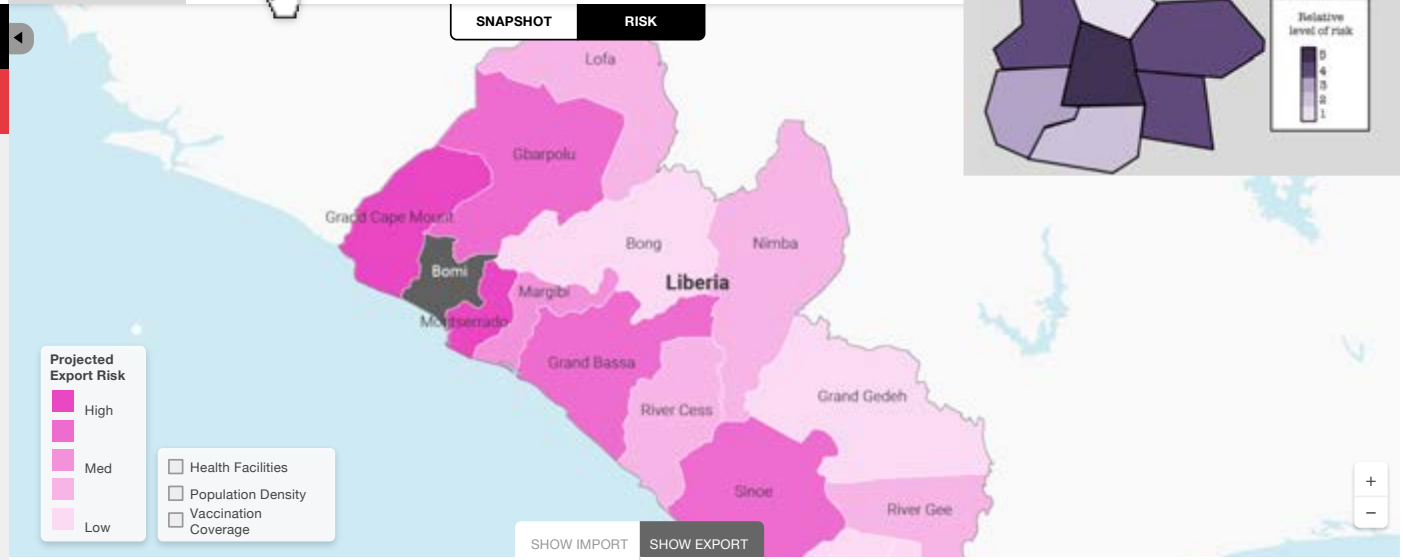
1. Grand Cape Mount (high)
2. Montserrado (high)
3. Gbarpolu (medium-high)
4. Grand Bassa (medium-high)
5. Sinoe (medium-high)
6. Margibi (medium)

The top six regions in Liberia under the highest risk of importing Ebola to Bomi region are:

1. Montserrado (high)
2. Bong (high)
3. Lofa (medium-high)
4. Margibi (medium)
5. River Cess (medium)
6. Grand Gedeh (medium)

To learn more about the data sources and risk model used, please see the About section.

SNAPSHOT | RISK



SHOW IMPORT | SHOW EXPORT

IMPORT RISK TO BOMI

Montserrado	Grand Gedeh	Gbarpolu
Bong	Grand Bassa	Grand Cape Mount
Lofa	River Gee	Grand Kru
Margibi	Sinoe	Maryland
River Cess	Nimba	

EXPORT RISK FROM BOMI

Grand Cape Mount	Margibi	Bong
Montserrado	Lofa	Grand Gedeh
Gbarpolu	Nimba	Grand Kru
Grand Bassa	River Cess	Maryland
Sinoe	River Gee	

Updated on: 31 March 2015

4. HISTORIC DISEASE DATA

mriids

OUTBREAK | HISTORIC | ABOUT

Region: West Africa | Disease: Ebola | Year: Show all

Ebola Outbreaks in West Africa from 1999 to 2014

Sort: Earliest | **Latest**

1999 Sudan Ebola Outbreak

Reported Cases:
128

Virus:
Zaire Ebola

SUMMARY
The 1999 Ebola outbreak in Sudan started on 5th June, affected 128 people and killed 75 before it ended on 2nd October 1999.

The Ebola epidemic was caused by a strain of the Sudan ebolavirus and affected the regions of Darfur and Kordofan. Read more

VIEW HEAT MAP

DOWNLOAD DATA

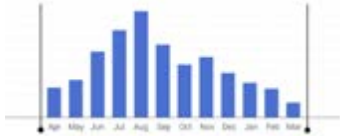
2002 Republic Of Congo Ebola Outbreak

Reported Cases:
113

Virus:
Zaire Ebola

SUMMARY
The 2002 Ebola outbreak in the Republic of Congo started on 15th March, affected 113 people and killed 85 before it ended on 24th April 2003.

The Ebola epidemic was caused by a strain of the Zaire ebolavirus and affected the regions of Brazzaville and Pool. Read more



VIEW HEAT MAP

DOWNLOAD DATA

2005 Democratic Republic Of Congo Ebola Outbreak

Reported Cases:
657

Virus:
Bundibugyo Ebola

SUMMARY
The 2005 Ebola outbreak in the Democratic Republic of Congo started on 1st May, affected 657 people and killed 401 before it ended on 12th December 2005.

The Ebola epidemic was caused by a strain of the Bundibugyo ebolavirus and affected the region of Katanga. Read more

VIEW HEAT MAP

DOWNLOAD DATA

mriids

OUTBREAK ▼ | HISTORIC | ABOUT

Region: West Africa ▼ Disease: Ebola ▼ Year: Show all ▼

- Show all
- 2014
- 2013
- 2012
- 2005
- 2004
- 2003

Ebola Outbreaks in West Africa from 1999 to 2014

Sort: Earliest | **Latest**

1999 Sudan Ebola Outbreak

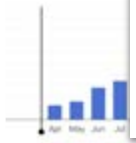
Reported Cases: 128

Virus: Zaire Ebola

SUMMARY

The 1999 Ebola outbreak in Sudan started on 5th June, affected 128 people and killed 75 before it ended on 2nd October 1999.

The Ebola epidemic was caused by a strain of the Sudan ebolavirus and affected the regions of Darfur and Kordofan. Read more



VIEW HEAT MAP

DOWNLOAD DATA

2002 Republic Of Congo Ebola Outbreak

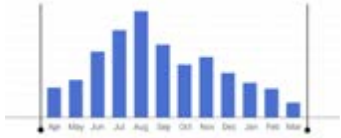
Reported Cases: 113

Virus: Zaire Ebola

SUMMARY

The 2002 Ebola outbreak in the Republic of Congo started on 15th March, affected 113 people and killed 85 before it ended on 24th April 2003.

The Ebola epidemic was caused by a strain of the Zaire ebolavirus and affected the regions of Brazzaville and Pool. Read more



VIEW HEAT MAP

DOWNLOAD DATA

2005 Democratic Republic Of Congo Ebola Outbreak

Reported Cases: 657

Virus: Bundibugyo Ebola

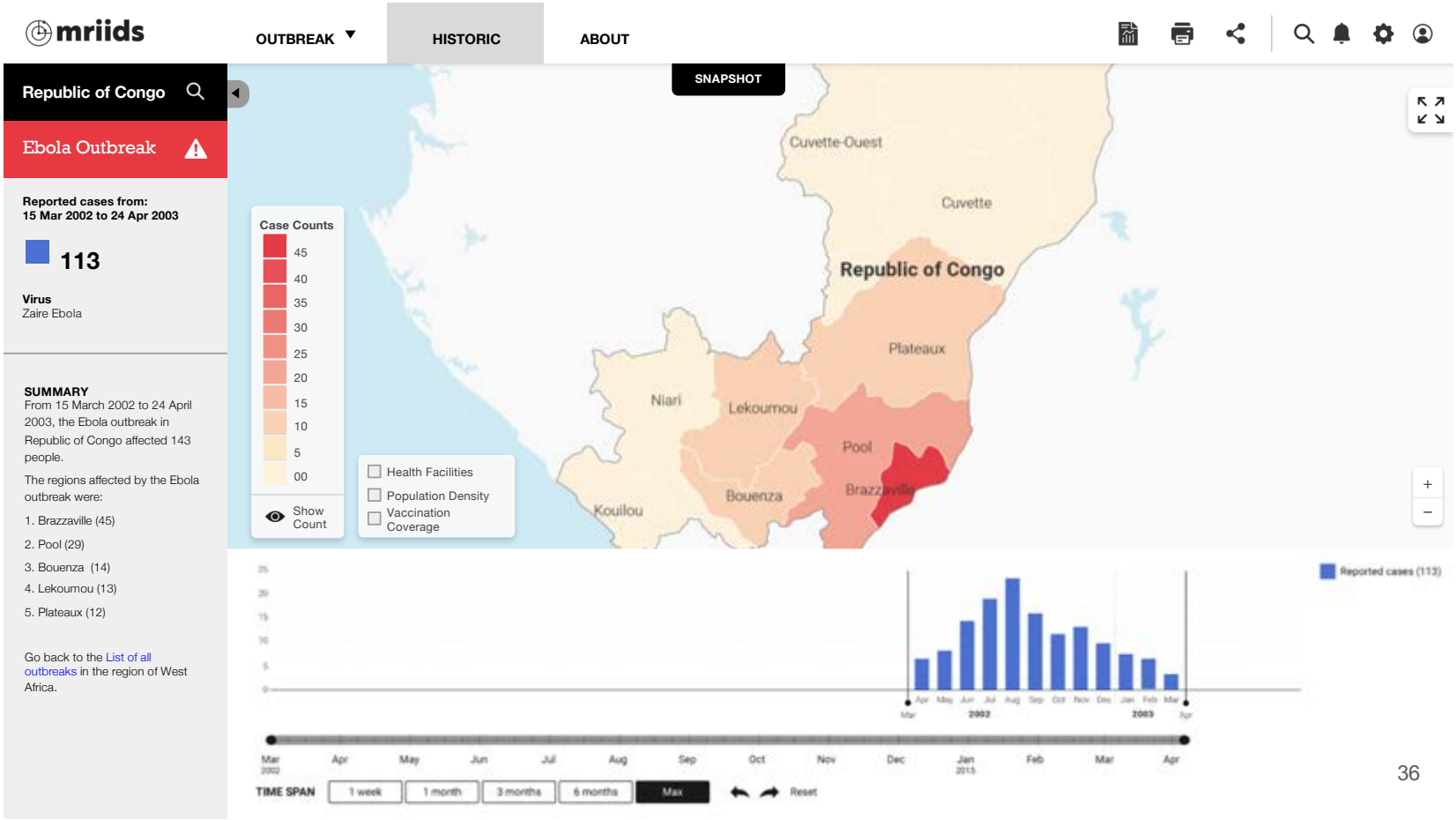
SUMMARY

The 2005 Ebola outbreak in the Democratic Republic of Congo started on 1st May, affected 657 people and killed 401 before it ended on 12th December 2005.

The Ebola epidemic was caused by a strain of the Bundibugyo ebolavirus and affected the region of Katanga. Read more

VIEW HEAT MAP

DOWNLOAD DATA


mriids
OUTBREAK
HISTORIC
ABOUT
Republic of Congo
Ebola Outbreak
Reported cases from:
15 Mar 2002 to 24 Apr 2003
113
Virus
Zaire Ebola
SUMMARY
From 15 March 2002 to 24 April 2003, the Ebola outbreak in Republic of Congo affected 143 people.
The regions affected by the Ebola outbreak were:
1. Brazzaville (45)
2. Pool (29)
3. Bouenza (14)
4. Lekoumou (13)
5. Plateaux (12)
Go back to the List of all outbreaks in the region of West Africa.
SNAPSHOT
Case Counts
45
40
35
30
25
20
15
10
5
00
Show Count
Health Facilities
Population Density
Vaccination Coverage
Cuvette-Ouest
Cuvette
Republic of Congo
Plateaux
Niari
Lekoumou
Pool
Brazzaville
Bouenza
Kouilou
Reported cases (113)
2002
2003
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
TIME SPAN
1 week
1 month
3 months
6 months
Max
Reset

NEXT STEPS

MRIIDS

Build buy in and user base in select countries - Integration with existing healthcare data reporting and analysis platforms such as DHIS-2

Expand to other priority diseases

- Yellow Fever - vector borne and vaccination

Real time, open data sources - develop partnerships with other organization to integrate other available data

Increased automation and integration of different elements

Sustainability/Funding

THANK YOU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FOR INFECTIOUS DISEASES

HealthMap

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