Ebola by the Numbers: Not a Small-scale Killer Anymore
Ebola in West Africa

- Previously confined to Central African countries
- Emerged in Guinea at end of 2013

Two phases of the outbreak

- Initial cases recorded in Guinea
- In late May, cases increased rapidly in Sierra Leone & Liberia

2,630 deaths and 5,357 cases reported on Sep 14.
An already historic outbreak

- Current outbreak has already killed more than all previous Ebola outbreaks combined

*Figures up to 23 July 2014
Source: WHO
Reactions to outbreak data

• 3 types of reactions:
  – This is the next pandemic, whole world is at risk
  – Ebola is still a “small-scale killer”, which “steals attention from other diseases” like Malaria or HIV
  – This is a terrible outbreak, but primarily because of its “collateral damage”
EBOLA AS THE NEXT GLOBAL PANDEMIC
The next global pandemic?

• Concerns generally focused on exportation of Ebola cases from west African countries to US, UK, France etc…

• Which prevention measures?
  – Prevent travel, ground flights
  – Screening at airports
Concerns re: international spread

Vespignani et al. 2014, *Plos Currents*

- Computer models suggest more countries may be affected, but generally very small outbreaks (e.g., USA)
EBOLA AS A SMALL-SCALE KILLER
Concerned about Ebola? You’re worrying about the wrong disease

There Are Far Higher Public Health Priorities For Africa Than Ebola

How Ebola is stealing attention from illnesses that kill more people
Ebola vs. other diseases

- Frequent comparisons with Malaria, HIV/AIDS and other diseases
  - In Africa, Malaria causes as many deaths every 2 days as Ebola has caused since 1976
  - Even at level of affected countries, Ebola dwarfed by other causes of death
  - “Steals all the attention”, “Kardashian of diseases”

The Economist, 8/16
Ebola vs. other diseases

• Comparisons rest on two misconceptions:
  1. **Geographic fallacy:** compares Ebola (spreads in 3 countries) to other diseases that are endemic in many more places
  2. **Temporal fallacy:** ignores the fact that this is an unfolding outbreak → low number of deaths now, but death toll may be much different in 10, 20 or 30 days.
Ebola vs. other diseases in Liberia

• Focus on countries/areas where the virus is spreading

• Compare to available data on mortality from other causes of death (CoD):
  – 2012 World Health Organization data
  – 2010-2013 Global burden of disease study
Ebola vs. other diseases in Liberia

Average since September, 1st

Average since start of the outbreak (5/27)

Notes: counts of deaths due to Ebola last updated on September, 14th. Data on deaths due to other causes are obtained from the 2012 WHO estimates.
Ebola vs. other diseases in Liberia

- **Up to 9/14: 1,459 recorded Ebola deaths**

- How does that total compare to yearly totals from other causes?
  - More than road traffic (850 deaths per year), Maternal deaths (1,000 deaths per year).
  - Comparable to diarrheal diseases (1,600 deaths per year)
The Ebola undercount

- In scrutinizing Ebola death counts, important to remember that numbers may not accurately represent the burden of disease
  - Some may never seek care and either die at home or recover
  - A lot of non-confirmed cases (suspected/probable)
  - Health officials in 3 countries suggest the count may be several times higher
Ebola epidemic dynamics in Liberia

- Number of cases can increase very rapidly depending on the reproduction number of the epidemic
  - i.e., average number of persons infected by a case
  - Exponential growth (2, 4, 8, 16, 32...)
### Epidemic dynamics in Liberia

- Estimates of $R_0$ between 1.4 and 1.8 → epidemic is expanding

<table>
<thead>
<tr>
<th>Month</th>
<th>Number of deaths per day</th>
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<tbody>
<tr>
<td>June</td>
<td>2 deaths / day</td>
</tr>
<tr>
<td>July</td>
<td>6 deaths / day</td>
</tr>
<tr>
<td>August</td>
<td>18 deaths / day</td>
</tr>
<tr>
<td>September</td>
<td>42 deaths / day (until 9/14)</td>
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</tbody>
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- How long would it take for Ebola to match Malaria totals? Become leading CoD?
When will Ebola become the leading CoD?

Extrapolated epidemic growth

Nov 10th:
Ebola > IHME Malaria estimate
(7,700 deaths)

Recorded Ebola deaths

Oct 12th:
Ebola > WHO Malaria estimate
(2,900 deaths)

Number of deaths due to Ebola

Time since June, 1st 2014 (in days)
How bad can it get? Projections

- Multitude of models, based on patterns of exponential growth & additional parameters

Projected deaths vary based on scenarios
- 20k-275k cases by end of the year
- Vs. 215k total deaths in 2012 in all 3 affected countries

Source: Shaman Group at Columbia

Fisman et al. 2014, *PLOS CURRENTS*
EBOLA AND ITS COLLATERAL DAMAGE
Why most of the people Ebola kills may never actually contract it

How Ebola Can Kill You — Even When You Don’t Have Ebola

Most hospitals and clinics in Liberia are closed so people are dying of preventable complications.

With Ebola crippling the health system, Liberians die of routine medical problems.
How does Ebola cause collateral damage?

• “Other diseases kill more [than Ebola], but Ebola kills hospitals that care for them”

• Ebola paralyzes health systems:
  – HCWs infected, overworked, on strike, or resign.
  – HCWs may refuse services due to lack of PPE
  – Patients stop attending health facilities

➔ Other CoDs to spike during outbreak
Collateral damage > Ebola death toll?

• We don’t know because of very limited information on trends in other causes of death
  – Recent report from Liberia Ministry of Health describing lower utilization of health services
  – Weak statistical systems & limited vital registration
  – No real time data on mortality from other causes of death (i.e., other than Ebola)
Extensive collateral damage?

• Outbreak affects many aspects of life, well beyond access to healthcare.
  – Some may be detrimental for health, e.g., food insecurity
  – Others may be protective of health, e.g., reduced contact between individuals, increased hand-washing & sanitation, reduced mobility
Extensive collateral damage?

• Weak health systems even before the outbreak
  – Liberia had 2\textsuperscript{nd} highest maternal mortality ratio
  – Sierra Leone the highest under-5 mortality rate
  – Guinea provided recommended anti-malarials to only 1% of children with fever

→ A significant % of deaths from other causes documented by journalists would likely have occurred in the absence of an Ebola outbreak
Extensive collateral damage?

• New cause of death (i.e., Ebola) also mechanically reduces the *number* of deaths due to other causes in a population (“competing risks”)
  – Some folks who would have died of Malaria or HIV in “normal” year may die of Ebola this year
Extensive collateral damage?

- Ebola focused on adult ages (caregivers)
- Competing risk strongest for adult CoDs (e.g., maternal deaths), weakest for childhood diseases

Age distribution of Ebola cases in Guinea:

- 0 - 4 ans: 51
- 5 - 14 ans: 74
- 15 - 29 ans: 263
- 30 - 44 ans: 297
- 45 ans et +: 250
Extensive collateral damage?

- In short, magnitude of the collateral damage may not be as large as we think.

- It likely depends on:
  - Diseases & conditions, probably strongest for vaccine-preventable diseases of childhood
  - Magnitude of the Ebola outbreak itself (the larger the outbreak, the higher the competing risk)
Conclusion

• Reactions to the growth of the epidemic in West Africa have often tried to put Ebola outbreak in perspective or to emphasize its consequences

• Based on epidemic trends, it is high time to focus debate on preventing a huge death toll from the outbreak itself
Conclusion

• Huge role for data in addressing the outbreak
  – Need stronger statistical & vital registration systems to monitor collateral damage in real time