Data Modeling Behavior Change in Health Emergencies Project

1. Overview.

Behavioral and social factors play a critical role in shaping disease transmission and how health and emergency services are used in response to an infectious disease emergency. During the 2014-15 Ebola Outbreak in West Africa, it is widely understood that changes in behavior and cultural practice within communities was essential in ending transmission. Yet despite much sociological and anthropological research pointing towards significant community-led change in regards to Ebola-safe behavior, this is yet to be quantitatively verified against the observed epidemiology.

The Bill & Melinda Gates Foundation and Global Good's Institute for Disease Modelling (IDM) are bringing together research scientists, development practitioners, health professionals and policy-makers to guide mathematical modelling and qualitative testing using epidemiological and behavior change data from the outbreak in Sierra Leone.

The primary objective of the project is to contribute to efforts focused on quantifying and testing analytical behavior change disease modeling using the extensive empirical data gathered during the Ebola response in Sierra Leone. This will demonstrate linkages between behavior change and disease transmission and contribute to an evidence base supporting more concerted efforts focus on community engagement and behavior change in future health emergency responses. The project aims to build a broad coalition of international and domestic stakeholders to champion the role of community engagement in responding to future health emergencies, and who are equipped with the evidence they need to make the case for prioritization of community engagement interventions.

The goals of the 'Data Modeling Behavior Change in Health Emergencies Project' include:

- Identifying associations between reported behavioral trends and changes in disease epidemiology during the Sierra Leone Ebola outbreak;
- Testing hypotheses around predominant theories of behavior change in health emergencies, and the relative quantitative impacts of different control measures and community engagement on Ebola spread.
- Determine the potentiality for reducing future disease transmission through modelling that will inform resource allocation and implementation for community engagement at timescales short enough to prevent significant mortality and morbidity.

2. Behavior Change and Community Engagement During Ebola.

Numerous external reviews of the 2014-15 Ebola Outbreak in West Africa have highlighted issues related to low trust, fear, poor initial communications messages and community confusion about Ebola response measures that likely slowed down control and response efforts.[1][2] However, reports have also found that behavioral and social factors were essential for curtailing the outbreak, and that the role of interventions focused on community engagement played a positive role in accelerating positive behavioral changes.[3][4][5] The centrality of behavior change based on the

[1] DuBois et. al (2015), *The Ebola Response in West Africa,* Overseas Development Institute.
[2] WHO (2015), Final Report of the Ebola Interim Assessment Panel, July 2015.
[3] Fast et. al (2015), 'The Role of Social Mobilization in Controlling Ebola Virus in Lofa Country', Liberia in PLOS Currents Outbreaks, 15 May 2015. Edition 1.
[4] Richards, P. (2015). *Village responses to Ebola Virus Disease in rural central Sierra Leone.* Freetown: Njala University.
[5] DuBois et. al (2015), *The Ebola Response in West Africa,* Overseas Development Institute.

social, cultural and political context was also well-documented from previous Ebola outbreaks.[6]

While it is understood that behavior change - along with the community engagement initiatives that played a role in supporting communities to recognize risk, identify behaviors and make change – was a major factor in ending transmission, [7] this is yet to be systematically quantified at scale using the existing data. There remains is a gap in research on how both community behaviors affected the disease dynamics, and the extent to which community engagement interventions employed by the development community quantifiably impacted transmission.

3. Advancing Modeling for Behavior Change in Health Emergencies.

While adaptive human behavior is understood to change the course of disease transmission during epidemics, this is not always adequately reflected in epidemiological modeling and is often only included implicitly.[8] As a result, there is a dearth of systematic research and modeling of the impacts of behavior on disease transmission that is rigorously grounded by field data.[9]

Where it has been undertaken, mathematical modeling that has incorporated human behavior has suggested that knowledge coming from both central sources and local social networks could impact disease outbreak, [10] and that if information is disseminated fast enough, disease transmission can be stopped or curtailed more effectively.[11] However, this modeling has often been based on anthropological observations, anecdotal evidence or 'common sense' and rarely has this been validated with quantifiable observations.[12]

When faced with a disease threat, health-seeking behavior can be guided by a combination of the understanding and belief of risk based on existing information, along with the prevalence and immediacy of the disease.[13] Understanding each of these explanations for behavior - belief-based and prevalence-based - along with the interventions that may have supported or hindered these behaviors, will greatly benefit preparation for future health emergencies.

4. Taking Advantage of a Unique Data Opportunity.

The challenge of addressing the complexity of disease modeling that incorporate behavior is usually paired with a lack of comprehensive data to quantifiably test both the models and their associated theories of behavior change.

The 2014-15 Ebola Outbreak in West Africa was a unique health emergency, both in terms of the scale and patterns of transmission. The international biomedical and community engagement response of the Government of Sierra Leone and the international community was unprecedented in both size and scope, generating an historically unique set of both epidemiological and community-level behavior change intervention and longitudinal data on the knowledge, attitudes and practices of communities.

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[6] Hewlett and Hewlett (2008), *Ebola, Culture and Politics, the Anthropology of an Emerging Disease,* Thompson Wadsworth: Belmont, USA.

[7] Polygeia, (2016), 'Lessons from Ebola Affected Communities: being prepared for future health crises', report commissioned by UK's Africa All-Party Parliamentary Group, February 2016.

[8] Fenichel E, Castillo-Chavez C, Ceddia M, Chowell G, Gonzalez Parrae P, et al. (2011) 'Adaptive human behavior in epidemiological models'. Proc Natl Acad Sci USA 108: 6306–6311.

[9] Funk S, Salathé M, Jansen VAA (2010) 'Modelling the influence of human behavior on the spread of infectious diseases: a review'. J R Soc Interface 7: 1247–1256.

[10] Funk S., Gilad E., Watkins C., Jansen V. A. A. 2009 The spread of awareness and its impact on epidemic outbreaks. *Proc. Natl Acad. Sci. USA* 106, 6872–6877

[11] Kiss et. al (2009).

[12] Kiss I. Z., Cassell J., Recker M., Simon P. L. (2009). 'The impact of information transmission on epidemic outbreaks'. *Math. Biosci.* 225, 1–10.

[13] Funk et. al. (2010) 'Modelling the influence of human behavior on the spread of infectious diseases: a review'.

In its initial stages, the project plans to incorporate data that includes:

- Epidemiological VHF data;
- A national-level, longitudinal behavior change data set covering more than 20,000 community visits;
- National-level, longitudinal, knowledge, attitudes and practices surveys;
- Modifying data such as formal alerts mechanisms and quarantines.

The Bill & Melinda Gates Foundation and IDM are working with partner organizations and the Government of Sierra Leone to access these comprehensive data sets in order to undertake several rounds of progressively complex modeling, with a focus on understanding how behavior impacted transmission, testing targeted behavioral theories and modeling the impact of interventions and their timing.

5. Contributing to Informed Community Engagement Policy and Practice.

The fact that behavior change is a process that can take time, coupled with pressure to produce immediate results in terms of disease containment, can lead to community engagement taking a backseat to bio-medical and service delivery aspects of health emergencies.

There can be several reasons why behavior change communication and community engagement is not prioritized within the context of health emergencies or international development. These may include the lack of prioritization in response budgets when compared to biomedical response,[14] necessity of undertaking lengthy formative research prior to implementation,[15] the repeated experience of poorly designed and implemented community engagement strategies, or a lack of appreciation from policy-makers and governments for the importance of comprehensive community engagement strategies.

Despite the calls for prioritizing funding and planning for community engagement following the Ebola outbreak, the lack of quantifiable research demonstrating the efficacy of specific behavior change and behavior change interventions makes funding and developing effective community engagement and behavior change communication more complicated. During the process of modeling, the project intends to work with interested stakeholders to:

- Develop model hypotheses, parameters, assumptions for modeling and testing.
- Understand partner perspectives on gaps in both institutional and sector knowledge regards policy, practice and measurement of behavior change and community engagement.
- Discuss implications for policy and practice for future health emergencies and garner partner input into how evidence can be best focused/structured for maximum impact.
- Discuss implications of findings for future health emergencies and the development sector more broadly.

6. Participation and Results.

Initial rounds of consultation and analysis are being conducted between August 2016 – April 2017, with ongoing remodeling work to be undertaken by IDM through 2017-18. Results of the Data Modelling for Behavior Change in Health Emergencies Project will be made available to all interested stakeholders and initial findings are expected in early-2017.

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[14] Polygeia, (2016), 'Lessons from Ebola Affected Communities: being prepared for future health crises'.
[15] World Bank, (1999), Communication for Behavior Change in Nutrition Projects': World Bank: http://siteresources.worldbank.org/NUTRITION/Resources/Tool9-frontmat.pdf.