

USING SMS DATA TO MONITOR EXPOSURE TO THE EBOLA OUTBREAK AND TO ESTIMATE ITS IMPACT ON HEALTH SEEKING BEHAVIOUR IN LIBERIA

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In brief

- Knowledge and awareness of Ebola is high throughout the country, with 87.4% of 7,500 respondents reporting knowing the symptoms of Ebola.
- Roughly one third of respondents (31.5%) report knowing at least one person with the symptoms of Ebola.
- Rates of facility-based births for those surveyed were high 12 months prior to the outbreak at a reported 80.7% and appear to decline only slightly during the peak of the epidemic.
- Survey results suggest that there has been widespread knowledge of and exposure to the Ebola outbreak throughout the country.
- However, contrary to widespread belief, little impact of the outbreak on non-Ebola health seeking behaviour is found among survey respondents.

Introduction and background

The Ebola Virus Disease (EVD) outbreak of West Africa is the largest and most devastating outbreak of the virus in history. As of 27 May 2015 there have been 27,013 reported cases in the three most heavily affected countries of West Africa and 11,134 reported deaths.¹ Since the start of the outbreak, Liberia has recorded 10,666 confirmed, probable and suspected cases of EVD and 4,806 deaths. Liberia was declared Ebola free on 9 May 2015.²

The first case of EVD was reported in Guinea on 23 March 2014. A little less than a week later, the first case of

1. Ebola Situation Report - 27 May 2015 | Ebola. apps.who.int. <http://apps.who.int/ebola/en/current-situation/ebola-situation-report-27-may-2015> (accessed May 28, 2015).

2. WHO Declares Liberia Free of the Ebola Virus Disease; Program of Celebration and Thanksgiving Scheduled for Monday, May 11, 2015. emansion.gov.lr. 2015; published online May 9. http://www.emansion.gov.lr/2press.php?news_id=3277&related=7&pg=sp (accessed May 28, 2015).

EVD in Liberia was confirmed on 29 March 2014³ in Lofa county, which borders the area in Guinea where the outbreak is believed to have originated.⁴ Through mid-April, there were 27 cumulative cases of the virus in Liberia, mainly contained to the area bordering Guinea.⁵ However, on 17 June 2014 the first known deaths of the disease were reported in Monrovia, Liberia's capital city.⁶

Until mid-July there were less than 30 new weekly cases reported throughout Liberia. But in mid-July there was a rapid increase in the rate of new cases, which eventually peaked during the week of 22-28 September 2014 when there were 442 new cases. Reports of new cases then began to precipitously drop off through early-November, at which point there was a slower rate of decline through the end of the year. By early 2015, there were fewer than 10 new cases a week in Liberia. The last case of EVD was reported in mid-March 2015 in a single isolated case believed to have been sexually transmitted from a survivor.⁷ Liberia was the first heavily affected country to be declared Ebola free on 9 May 2015 - 42 days after the last reported case had died.

As was true in all heavily affected countries, the early response to the outbreak was inadequate to fully contain the outbreak. There were no dedicated hospital beds available to treat EVD cases in Liberia until mid-August.⁸ By the end of September there were nearly 500 hospital beds with Ebola Treatment Unit (ETU) designation available in Liberia, most of them in Monrovia. Many more ETUs were not opened until the end of 2014.⁹

International support to the outbreak did not take off until August and it was not until mid-September that substantial resources were pledged to help fight the outbreak.¹⁰ The United States government was the main supporter of the response in Liberia having dedicated troops and

3. Ebola virus disease, Liberia (Situation as of 30 March 2014) - WHO | Regional Office for Africa. WHO AFRO. 2014; published online 30 March. <http://www.afro.who.int/en/clusters-a-programmes/dpc/epidemic-a-pandemic-alert-and-response/outbreak-news/4072-ebola-virus-disease-liberia.html> (accessed Feb 3, 2015).

4. Baize S, Pannetier D, Oestereich L, et al. Emergence of Zaire Ebola Virus Disease in Guinea. *N Engl J Med* 2014; 371: 1418–25.

5. Ebola virus disease, West Africa (Situation as of 16 April 2014). WHO AFRO. 2014; published online 16 April. <http://www.afro.who.int/en/clusters-a-programmes/dpc/epidemic-a-pandemic-alert-and-response/outbreak-news/4100-ebola-virus-disease-west-africa-16-april-2014.html> (accessed May 28, 2015).

6. Seven die in Monrovia Ebola outbreak. BBC News. 2014; published online 17 June. <http://www.bbc.com/news/world-africa-27888363> (accessed 28 May 2015).

7. Christie A, Davies-Wayne GJ, Cordier-Lasalle T, et al. Possible sexual transmission of ebola virus - liberia, 2015. *MMWR Morb Mortal Wkly Rep* 2015; 64: 479–81.

8. Drake JM, Kaul RB, Alexander LW, et al. Ebola cases and health system demand in liberia. *PLoS Biol* 2015; 13: e1002056.

9. Onishi N. Empty Ebola Clinics in Liberia Are Seen as Misstep in U.S. Relief Effort. *NYTimes.com*. 2015; published online April 11. <http://www.nytimes.com/2015/04/12/world/africa/idle-ebola-clinics-in-liberia-are-seen-as-misstep-in-us-relief-effort.html> (accessed May 29, 2015).

10. Grépin KA. International donations to the Ebola virus outbreak: too little, too late? *BMJ* 2015; 350: h376–6.

substantial resources specifically to Liberia.⁹

From July 2014 to January 2015, the government implemented a number of restrictions aimed at reducing the spread of the disease including the banning of all public gatherings, closing of schools, and a 6 p.m. curfew had been put into effect. Interpersonal touching, such as handshaking, was discouraged. Other campaigns were launched to effect wide scale behaviour change, such as hand washing and safe burial practices.

The outbreak took a heavy toll on the Liberian health system,¹¹ which was already weak after the 14-year civil war. Many of the health facilities were shuttered during the war and half of those who remained opened were operated by international non-governmental health organisations at the end of the war.¹² Many of its health professionals had fled the country: by 2009 there were only a little more than three thousand clinical health personnel in Liberia, a country with a population of a little more than 4 million inhabitants. Less than 100 of those health professional were physicians, which already ranked pre-Ebola Liberia as one of the countries with the lowest density of health human resources in the world.¹² Low levels of trust in the health system has been reported in Liberia.¹³

While hospitals and clinics effectively remained open throughout the outbreak, given the restrictions on movement, potential fear of infection, as well as the potential disruption to normal operations due to the scale up of Ebola treatment activities, it is unclear what impact the outbreak has had on the non-Ebola health and health seeking behaviour in Liberia. It is widely believed that service provision effectively came to a halt and that the health of Liberians has suffered tremendously due to the outbreak,^{14, 15, 16} although there is little data to support these claims and to inform policy discussions about the priorities for rebuilding health systems in the recovery phase. At the same time, improvements in healthy behaviours (e.g. hand washing) and restriction on movement might have actually had positive effects on health outcomes.

11. The World Health Organization. Health worker Ebola infections in Guinea, Liberia and Sierra Leone. WHO. 2015; published online 21 May. <http://www.who.int/csr/resources/publications/ebola/health-worker-infections/en/> (accessed May 29, 2015).

12. Varpilah ST, Safer M, Frenkel E, Baba D, Massaquoi M, Barrow G. Rebuilding human resources for health: a case study from Liberia. *Hum Resour Health* 2011; 9: 11.

13. Svoronos T, Macauley RJ, Kruk ME. Can the health system deliver? Determinants of rural Liberians' confidence in health care. *Health Policy Plan* 2014; published online July 27. DOI:10.1093/heapol/czu065.

14. Walker PGT, White MT, Griffin JT, Reynolds A, Ferguson NM, Ghani AC. Malaria morbidity and mortality in Ebola-affected countries caused by decreased health-care capacity, and the potential effect of mitigation strategies: a modelling analysis. *Lancet Infect Dis* 2015; published online April 23. DOI:10.1016/S1473-3099(15)70124-6.

15. Takahashi S, Metcalf CJE, Ferrari MJ, et al. Reduced vaccination and the risk of measles and other childhood infections post-Ebola. *Science* 2015; 347: 1240–2.

16. Check Hayden E. Maternal health: Ebola's lasting legacy. *Nature News* 2015; 519: 24–6.

Under normal circumstances there is limited data available on health and health seeking behaviours in Liberia, most of which has historically been derived from the high quality household surveys known as the Demographic and Health Survey (DHS). The last DHS in Liberia was conducted in 2013 before the onset of the EVD outbreak. However, it has been infeasible to launch a household survey of this nature in the midst of the Ebola outbreak to understand how health-seeking behaviours have changed as a result of the outbreak. While some administrative data does exist, due to the issues of trust and the disruption of administrative systems, data collected at health facilities in the midst of the crises is unlikely to capture a full picture.

Methods

The primary aim of this study was to better understand the impact of the EVD outbreak on the health and health seeking behaviour of households of Liberia during and in the immediate aftermath of the outbreak. We also hope to estimate individual awareness and exposure to the outbreak across the country. Poor health can have many potential negative effects on the livelihoods of households, in particular in low-income settings. Given the challenges in conducting large-scale household surveys in the midst of or in the immediate aftermath of a humanitarian crisis, we launched an SMS-based mobile phone survey.

There is evidence that in developing countries with high rates of cell phone penetration, it is possible to collect data on a relatively representative set of respondents using SMS surveys.¹⁷ While the penetration of mobile phones in Liberia is still relatively low, we felt it was reasonably high to warrant investigation as a means of data collection. Further, this method can provide a unique window that is otherwise unattainable. Therefore the secondary aim of this study was to test the feasibility of collecting health and health system data in a low-income setting, in the midst of a humanitarian crisis

To conduct the study, we contracted with GeoPoll, a commercial SMS survey firm with operations in Liberia to conduct the survey. GeoPoll works with the cell phone companies to collect a list of recently active cell phone users in Liberia. It recruits potential respondents to the service by asking a short set of screening questions, which include mainly demographic information. We specified to GeoPoll that we hoped to get a sample that was reflective of the geographic distribution of respondents at the county level and at least 50% female (this was not properly communicated on the first round, hence only 40% of respondents in round 1 were female). Survey respondents were provided \$0.50 USD in phone credit as an incentive for correctly completing the survey.

17. Leo B, Morello R, Mellon J, Peixoto T, Davenport ST. Do Mobile Phone Surveys Work in Poor Countries? SSRN Journal 2015. DOI:10.2139/ssrn.2597885.

Between March and May 2015, we conducted 3 rounds of surveys (roughly 1 month apart). Each round returned exactly 2,500 completed surveys for a total of 7,500 completed surveys. We plan to field round 4 in early June 2015. The questions asked about their knowledge of Ebola symptoms, whether they knew people with Ebola symptoms and whether any of the people they knew of Ebola died, and if so, when did they die. Respondents were also asked to provide information on any recent health and health seeking behaviour including whether or not there was a recent pregnancy in the household, whether any child under the age of five had been sick, and if so whether treatment had been sought, and whether any adult in the household had been sick, and again if treatment had been sought. Adults who did not seek care were asked for the reasons for not seeking care. The survey also asked respondents to provide some demographic and socio-economic details including their age, occupational status, and education. Finally, respondents were asked about who they would like to be responsible for health service delivery in their communities.

Findings

Table 1 summarises the main demographic, geographic and socio-economic variables of the respondents broken down by survey round. In the coming weeks, we plan to provide comparisons of these data with other known surveys (i.e. the most recent census and the 2013 DHS). The survey method returned results from a relatively young population (although we have reason to believe it is comparable to the average age in Liberia, which is quite young based on comparison to age distributions from the 2008 census data). It provided reasonable coverage of most counties, with a few important exceptions most notably Gbarpolu, Grand Kru, Rivercess, River Gee, and Sinoe. None of these counties were the site of substantial cases of EVD as reported through the WHO data. Our sample also appears to be very highly educated. Nearly 40% of the sample reports being unemployed at the time of the survey.

Figure 1 graphically summarises the density of surveys collected by county. We have more completed surveys per capita in some of the most heavily populated counties, namely Bong, Margibi, and Maryland. This suggests that representation is highest in the most populous regions, but it is also worth noting that it is not simply the case that our survey reached those living in the capital city Monrovia, which is located in Montserrado county. Although not shown, most of the counties most heavily affected by the outbreak, namely Montserrado, Bomi, Margibi, Lofa, Bong, and Nimba are all well represented in our survey respondents.

Figure 2 summarises the proportion of respondents who report knowing the symptoms of Ebola by county. We find that there is a high level of self-reported knowledge of the Ebola symptoms. Due to the limit on questions in an SMS survey, we were unable to verify whether in fact they were knowledgeable about the true symptoms of Ebola.

Figure 3 summarises the proportion of respondents who report personally knowing at least

one person who had the symptoms of Ebola. Roughly a third of respondents reported knowing someone with the symptoms of Ebola. As a next step, we plan to see how this correlates with the actual number of cases of Ebola by county.

Figure 4 summarises the institutional delivery rate by county in the full sample. In rounds 1 and 2 respondents were asked to report whether or not there had been a birth in the household over the past year (exact wording differed). We noticed a large number of births in the most recent month, which we believed might be due to some reporting error. Plus, we noticed very high rates of households with a recent birth, higher than would be predicted by expected fertility rates. Between rounds 2 and 3 we ran a small pilot survey with roughly 200 respondents to test different combinations of questions to try to overcome these problems but an easy solution was not obtained. Instead, in round 3 we decided to ask this question of only female respondents, which is closer to how the question was asked in the DHS. While we received a much lower number of responses and some clustering at the recent date, we are more comfortable with the results. Figure 3 summarises the data for the whole sample. Roughly between 75% and 85% of reported births took place in a health facility, either public or private across all 15 districts. This rate is nearly twice the expected institutional delivery rate for most counties outside of Montserrat. As a next step, we plan to compare these to estimates obtained from the 2013 DHS.

Figure 5 summarises the institutional delivery rate by month of delivery. What is most striking from this figure is how relatively constant this rate appears to be, even during the peak of the epidemic. While there appears to be a small decline in the rate of institutional deliveries in the sample on the order of 5 to 10 percentage points, at least 75% of births were reported to have taken place in a facility, even during the peak of the outbreak. These findings, if correct, are very different than the assumptions currently being made by the global health community.

Approximately 20% of households reported having at least one child under the age of five who were sick with either a fever or cough in the past 2 weeks. We then asked respondents where they sought care for the child or if no treatment was sought. Most respondents reported that some care was sought outside of the household (97.3%) with government facilities the most common destination for such treatment (42.8%) and followed closely by private health facilities (37.1%).

Respondents were also asked whether or not in the past 30 days anyone in their household was sick enough to not go to work or school. Roughly 15% of respondents answered yes to this question. Again, nearly all respondents reported that some care was sought outside of the home (93.9%) and again government health facilities were the most common source of care (44.7%) and again private health care providers were the next most common source of care (33.0%).

Respondents were also asked who they would prefer to run the health clinics in their community and were given the choice of government, NGOs, the United Nations, Traditional Leaders, or Other. Government was the preferred provider for 37.2% of respondents, followed by 33.7% for

NGOs. Just over one fifth preferred the United Nations to run health facilities.

Next steps

We plan to field round 4 of our survey in the first or second week of June. In terms of next steps, our plan is to try to integrate this data with existing data sets (e.g. the MIT data from Monrovia, the DHS, the World Bank survey data) to provide comparisons of our results. We also plan to augment our data on data from the Ebola outbreak to see how our findings correlate with true prevalence and incidence of disease. We also plan to see what factors predict the various outcomes, including our variable on who they would like to have running the government. We may also add some questions on network size and trust in government in round 4.

Tables and figures

Table 1: Summary of GeoPoll survey respondents

	Round 1	Round 2	Round 3
Dates	6-12 March 2015	13-15 April 2015	18-19 May 2015
Number of queries	23,383	13,832	13,296
Number of responses	2500	2500	2500
% female	40	50	50
Mean age	32.17	29.12	30.97
Min	18	18	18
Max	111	71	96
County % of total			
Bomi	2.9	3.28	3.72
Bong	13.5	13.72	12.48
Gbarpolu	0.2	1.84	1.04
Grand Bassa	6.2	5.92	6.12
Grand Cape Mount	2.7	2.24	2.6
Grand Gedah	4.9	4.4	4.28
Grand Kru	0.2	0.48	0.52
Lofa	7.2	7.32	7.76
Margibi	8.8	8.08	8.88
Maryland	5.2	5.28	4.96
Montserrado	33.3	32	32
Nimba	10.8	12.28	11.4
River Cess	0.6	0.24	0.36
River Gee	1.4	0.96	1.44
Sinoe	2.0	1.96	2.44
Education (% of total)			
No school	3.04	2.76	1.96
Primary school	13.52	14.4	14.16
Secondary school	42.72	47.08	45.64
Post-secondary school	40.72	47.08	45.64
Occupation (% of total)			
Agriculture	13	11.84	9.48
Labourer	8.36	9.16	8.28
Professional of technical	16.6	14	15.64
Sales and services	12.8	11.88	12.44
Unemployed	38.04	41.68	42.12
Other	11.2	11.44	12.04

Figure 1: GeoPoll surveys per capita

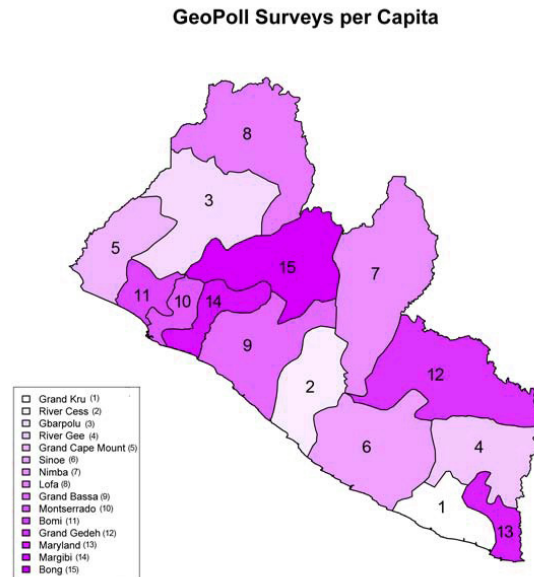


Figure 2: Knowledge of Ebola symptoms, by county

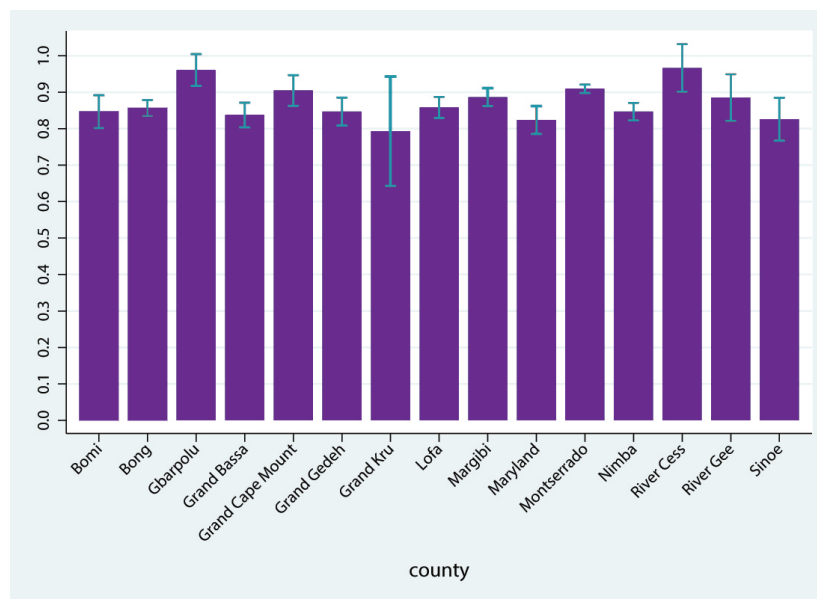


Figure 3: Knows anyone with symptoms of Ebola

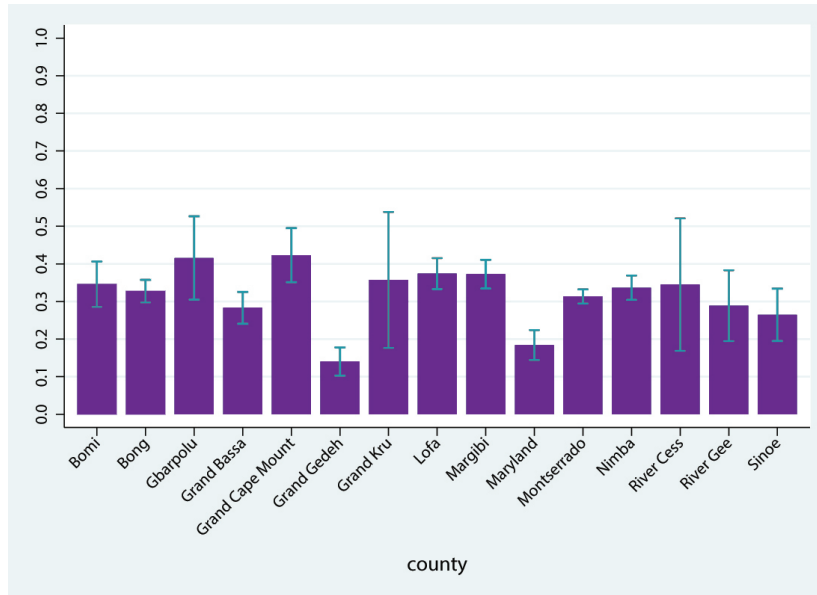


Figure 4: Institutional delivery rate, by county

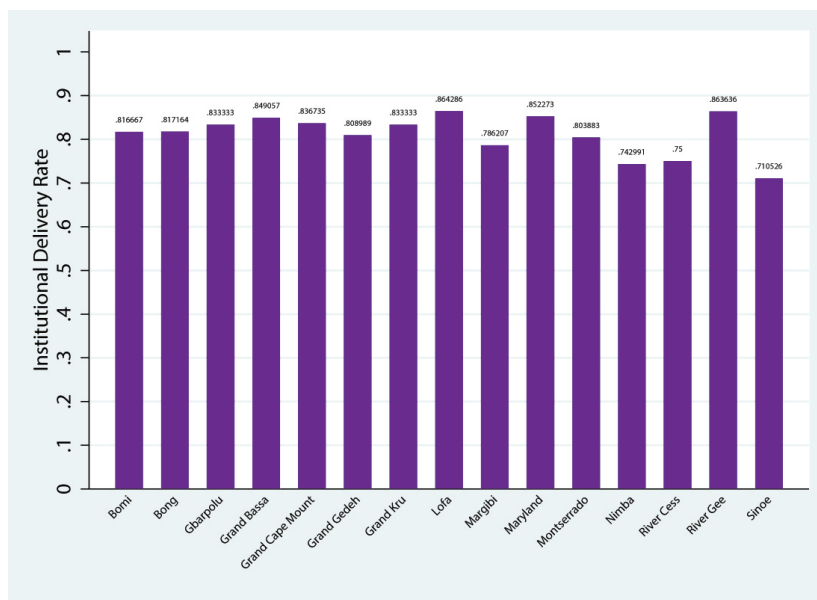
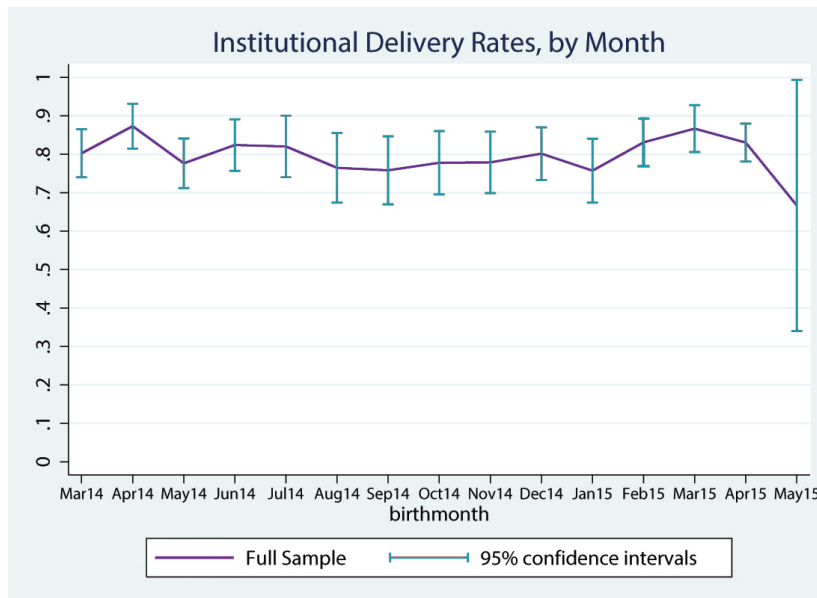


Figure 5: Institutional delivery rate by month of delivery



Economics of Ebola initiative

Early analysis indicates that the economic costs of the Ebola outbreak will be significant, including panic, loss in confidence, reduction in market interactions, the breakdown of formal systems and institutions, a reduced supply of essential goods, and potentially increased prices. The IGC is committed to providing the Governments of Sierra Leone and Liberia, as well as their development partners, with demand-led research and analysis to ensure that policy responses are evidence-based and that corrective actions are effective and well targeted.

In this set of bulletins on the economic impacts of Ebola, the IGC will disseminate the data collected, including key facts and policy recommendations. The IGC will be sharing these bulletins with the broad group of aid agencies, NGOs, and journalists with an interest in the Ebola epidemic.

Previous editions of the IGC's economic impact of Ebola bulletin are available online here: <http://www.theigc.org/project/economics-of-ebola-initiative/>

The IGC has also developed a web page collating the results of IGC and non-IGC research on the economic impacts of Ebola in order to make their policy implications more accessible. This page is available here: <http://www.theigc.org/economics-of-ebola-research/>

About the International Growth Centre

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