

From the Department of Global Public Health
Karolinska Institutet, Stockholm, Sweden

CONTAGIOUS (MIS)COMMUNICATION

THE ROLE OF RISK COMMUNICATION AND MISINFORMATION IN INFECTIOUS DISEASE OUTBREAKS

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Contagious (Mis)Communication – the role of risk communication and misinformation in infectious disease outbreaks

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To Jonas and our Bub

ABSTRACT

Background: The largest outbreak of Ebola virus disease in history happened between 2014-2016 in West Africa. In Sierra Leone, one of the three most affected countries, more than 14,000 people got infected and almost 4,000 died. Risk communication and social mobilization efforts aimed to engage with the public and to educate people to prevent further transmission of the virus. Not much is known how being exposed to this type of information influenced people's knowledge, behaviors and risk perception around Ebola. Misinformation in the Ebola outbreak was widespread, but effective methods to counter real-life infectious disease misinformation have not been studied in a low-income setting.

Aims: To determine the role of risk communication in the Ebola outbreak in Sierra Leone and to test the effectiveness of methods to debunk misinformation about infectious diseases.

Methods: Four nationwide cross-sectional surveys among the general population of Sierra Leone were carried out at different timepoints of the Ebola outbreak (August 2014, n=1,413; October 2014, n=2,087; December 2014, n=3,540; July 2015, n=3,564). The four surveys were pooled (n=10,604) and the associations between exposure to various information sources and Ebola-specific knowledge, misconceptions, protective behavior and risk behavior were assessed using multilevel modeling. The associations between exposure to information sources and the perceived susceptibility to Ebola (i.e. risk perception), as well as the associations between Ebola-specific knowledge, misconceptions, behaviors and risk perception were measured in the pooled sample of the first three surveys (n=7,039). Qualitative, semi-structured interviews were conducted with 13 Sierra Leonean journalists who reported during the outbreak. Using thematic analysis, their perceived roles were mapped. After the epidemic, a three-arm, prospective, randomized controlled trial (RCT) (n=736) was carried out among adults in Freetown who were in possession of a smartphone with WhatsApp, to test whether 4-episode audio drama interventions could reduce the belief in typhoid-related misinformation.

Results: Exposure to information sources was associated with increased Ebola-specific knowledge and protective behavior, but also - to a smaller extent - with misconceptions and risk behavior. Exposure to new media (e.g. mobile phones, internet) and community sources (e.g. religious/traditional leaders) as well as having Ebola-specific knowledge and engaging in frequent hand washing, was associated with increased risk perception. Having Ebola-specific misconceptions and avoiding burials on the other hand, was associated with lower risk perception (Adjusted Odds Ratio (AOR) 0.7, 95% Confidence Interval (CI) 0.6-0.8 and AOR 0.8, 95% CI 0.6-1.0, respectively). Sierra Leonean journalists adopted various roles over the course of the outbreak; from being skeptical about the existence of an outbreak, to being eye-witnesses themselves. Through training about the virus, they later turned into public mobilizers and instructors, stepping away from their journalistic independence. Results from the RCT showed that the audio drama interventions significantly reduced the belief in typhoid-related misinformation compared to the control group. In Intervention Group A (in which the audio dramas actively engaged with the misinformation) and in Intervention Group

B (where only the correct information was given), the belief that typhoid always co-occurs with malaria was significantly reduced (Intervention Group A: AOR 0.3, 95% CI 0.2-0.5, Intervention Group B: AOR 0.6, 95% CI 0.4-0.8). Actively engaging with the misinformation, instead of only focusing on the correct information, resulted in the largest reductions in belief in misinformation.

Conclusions: The associations between information sources and knowledge, misconceptions and behaviors show the need to have clear, transparent and contextualized information available during the entire course of an epidemic. The mixed findings regarding risk perception and various protective behaviors likely point to the complex interplay between behavior and risk perception, whereby adopting a behavior has an effect on how the risk of disease is perceived. As trusted, community-based sources, local journalists can be vital partners in an outbreak response. Making use of trusted sources is also one of the elements that will likely increase the chances of successfully countering real-life misinformation. Other elements include ensuring that the corrective information is in line with worldviews and repeated exposure to the information. A strategy which actively engages with the misinformation is likely to be more successful in debunking than merely focusing on the correct information. Taken together, the studies show that risk communication and misinformation management should be key pillars in health emergency response and preparedness and should be rooted in communities.

POPULAR SCIENCE SUMMARY

Infectious disease outbreaks can be terrifying. When it happens, many questions inevitably pop up: how deadly is the disease, how does it transmit, how do I keep myself and my loved ones safe? During the Ebola outbreak that ravaged through West Africa between 2014-2016, the public similarly needed information about what was happening. Over the course of the epidemic, it became clear that just by adding more hospital beds, the outbreak would not get under control. People needed information and guidance on how to stay safe, and what to do in case someone got sick. Various risk communication and social mobilization interventions were set up during the outbreak and collaborations with local media outlets were created. Studies in this thesis show that people who were exposed to information sources such as religious/traditional leaders or the internet, were more likely to have knowledge about Ebola, to engage in protective behaviors and to have a higher perception of risk around Ebola. Unfortunately, exposure to these information sources (and other sources, such as radio) was also associated with having misconceptions about Ebola and engaging in risk behaviors, but these associations were not as strong. Sierra Leonean journalists adopted many different roles over the course of the outbreak. From being skeptical about the existence of an outbreak in the beginning, to acting like instructors towards the end – giving practical tips about how to stay safe, while leaving their journalistic independence behind.

When a virus spreads, something else tends to spread as well: misinformation. The current COVID-19 pandemic and concurrent ‘infodemic’ has made this abundantly clear. Countering misinformation is not an easy task, and can sometimes even backfire. The scientific evidence on how to best debunk misinformation is quite limited when it comes to health-related misinformation. Plus, studies often target misinformation that doesn’t exist in real life, but that is made up for the study. In the Contagious Misinformation Trial (Study IV of this thesis), real-world misinformation about typhoid in Sierra Leone was targeted, using audio dramas that were sent via WhatsApp. The dramas that discussed the misinformation and then provided the correct alternative, were more successful in reducing the belief in misinformation than the audio dramas that only focused on the correct information.

Together, the studies show the important role risk communication can play in outbreaks– in both a positive and a negative way. It shows that it is vital to provide clear, accurate and contextualized information to local journalists and to the general public throughout an outbreak. Even though the sheer amount of misinformation in an outbreak might seem overwhelming, the results of the Contagious Misinformation Trial give some reason for hope. Misinformation can successfully be targeted, ideally by engaging with the misinformation and explaining why the correct information is true. Risk communication and debunking misinformation can therefore not only help to bring an epidemic under control, but an infodemic as well.

LIST OF SCIENTIFIC PAPERS

- I. **Winters M**, Jalloh MF, Sengeh P, Jalloh MB, Conteh L, Bunnell R, Li W, Zeebari Z, Nordenstedt H. Risk Communication and Ebola-Specific Knowledge and Behavior during 2014-2015 Outbreak, Sierra Leone. *Emerging Infectious Diseases*. 2018;24(2):336-344. doi: <https://doi.org/10.3201/eid2402.171028>
- II. **Winters M**, Jalloh MF, Sengeh P, Jalloh MB, Zeebari Z, Nordenstedt H. Risk perception during the 2014-2015 Ebola outbreak in Sierra Leone. *BMC Public Health*. 2020;20(1539). doi: <https://doi.org/10.1186/s12889-020-09648-8>
- III. **Winters M**, Nordenstedt H, Mölsted Alvesson H. Reporting in a health emergency: The roles of Sierra Leonean journalists during the 2014-2015 Ebola outbreak. *PLoS Neglected Tropical Diseases*. 2020;14(5):e0008256. doi: <https://doi.org/10.1371/journal.pntd.0008256>
- IV. **Winters M**, Oppenheim B, Sengeh P, Jalloh MB, Webber N, Pratt SA, Leigh B, Mölsted Alvesson H, Zeebari Z, Sundberg CJ, Jalloh MJ, Nordenstedt H. The Contagious Misinformation Trial: Evidence from a randomised controlled trial on debunking infectious disease misinformation in Sierra Leone. Submitted

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LIST OF ABBREVIATIONS

AOR	Adjusted Odds Ratio
CDC	U.S. Centers for Disease Control and Prevention
CERC	Crisis and Emergency Risk Communication
CI	Confidence Interval
COVID-19	Coronavirus Disease
DRC	Democratic Republic of the Congo
Ebola	Ebola Virus Disease
ETU	Ebola Treatment Unit
GoSL	Government of Sierra Leone
HBM	Health Belief Model
HCW	Health Care Worker
KAP	Knowledge, Attitudes, and Practices
NGO	Non-Governmental Organization
ODK	Open Data Kit
OR	Odds Ratio
PHEIC	Public Health Emergency of International Concern
PPE	Personal Protective Equipment
RCT	Randomized Controlled Trial
SCT	Social Cognitive Theory
SE	Standard Error
UNICEF	United Nations Children’s Fund
UNMEER	United Nations Mission for Ebola Emergency Response
WHO	World Health Organization

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1 CONTAGIOUS (MIS)COMMUNICATION

Do you remember where you heard the news of the first confirmed cases of COVID-19 in your country? Were you afraid of what would happen? What all of us around the world have in common in scary and uncertain situations like these, is that we want to know what is going on. Who did you trust for information on COVID-19? On what kind of information did you base your decisions? Did you change your behavior, to avoid getting infected?

Disease outbreaks are exceptional situations and proper risk communication is vital. The public needs to know what actions to take to avoid getting infected or infecting others. The COVID-19 pandemic, caused by the SARS-CoV-2 virus, was (and still is) marked by a non-stop flow of breaking news. But alongside this stream of information is an avalanche of misinformation.^{1,2} Questionable theories about the origins of the coronavirus are shared widely on social media, just like promotions of untested miracle drugs and treatments. For many people living in Europe or the USA, this might be the first real experience with an uncontrolled disease outbreak and its (mis)information overload. But for people in Sierra Leone it probably brings back vivid memories of misinformation during the Ebola outbreak between 2014 and 2016. In the midst of that outbreak, a powerful rumor woke people all over Sierra Leone up in the middle of the night. They were urged to get up and immediately wash themselves with salt and hot water. By doing so, they would be protected against Ebola.³ Many people followed the advice, got up and frantically washed themselves. Better safe than sorry, right? Indeed, the washing in itself might seem harmless. But the perceived immunity to Ebola might have encouraged people to engage in risky behaviors.³

It is not surprising that misinformation thrives during infectious disease outbreaks.³⁻⁵ Especially the beginning of an outbreak comes with many uncertainties; the mortality rate of the disease, the transmissibility, the impact public health measures will have on one's life. Facts are not established yet, and as more data pours in, will be adapted to the newly acquired knowledge. Thirst for information cannot be fully quenched with so many unknowns. It creates fertile grounds to seed misinformation.⁶

How do people make sense of all this (mis)information, and how can they make informed decisions? What role does risk communication and misinformation play in infectious disease outbreaks? This thesis will dive into this, by analyzing data from the Ebola outbreak and through a randomized controlled trial that aimed to counter prevalent misinformation in Sierra Leone.

2 EBOLA IN WEST AFRICA

Meliandou is a small, poor village in Guinea with just 31 houses, surrounded by farmland and close to the borders with Liberia and Sierra Leone. It is an unremarkable place normally, but received worldwide attention when the first West African Ebola patient was traced back to the village.⁷ Patient zero turned out to most likely be a 2-year old boy who fell ill with an – at the time – mysterious disease, accompanied by fever, black stools and vomiting.⁸ It killed him four days later, on the sixth of December 2013. Just 50 meters from where little Emile and his family used to live, stood a large hollow tree. Emile loved to play in the tree with his friends, trying to catch the bats that lived in it. It is believed, although conclusive evidence is still lacking, that one of those insectivorous bats infected Emile with Ebola.⁷ Emile in turn infected his 3-year old sister, his mother and his grandmother – all of whom died.⁹ A village nurse and midwife succumbed to Ebola in January 2014. Family members attending the victims' funerals in Meliandou similarly fell ill and died, taking the virus with them to their own villages. The virus kept spreading. By the end of January 2014, a medical alert was sent to district health officials about cases of fatal diarrhea.¹⁰ But it was not until mid-March 2014 that Guinea's Ministry of Health sounded the alarm bells over a mysterious disease. Ten days later, the WHO officially declared an Ebola outbreak.¹⁰ By then, the virus was already spreading in Conakry, Guinea's capital. An uncontrolled, rapidly expanding outbreak in one of the world's poorest regions. A recipe for disaster.

Before the West African outbreak, Ebola outbreaks were largely confined to a few countries in central and east Africa; mainly Uganda, the Democratic Republic of the Congo (DRC), Gabon and South Sudan.¹¹ It owes its name to the Ebola river close to where the first known outbreak was described in the DRC in 1976.¹¹ Until the West African outbreak started in 2014, more than 20 other outbreaks have been described. The largest of which was in Uganda's Gulu, where 425 people contracted the disease and 224 patients died of it.¹¹ The deadliest outbreak until 2014 was the very first outbreak in the DRC, where 318 people got infected and 280 people lost their lives to Ebola.¹¹

It is up to today unknown where in nature the Ebola virus hides – the natural reservoir of the virus has still not been confirmed. However, it is widely believed that bats host the virus, and that through handling or eating an infected bat, or fruits that have been partially eaten by bats, the virus could spill over to humans.¹²⁻¹⁵ This is what likely happened to Emile in Meliandou. After the first spillover to humans, the West African Ebola outbreak continued spreading through human-to-human transmission. Infection can only happen through direct contact with blood, secretions, organs or other bodily fluids of infected people, through broken skin or contact with mucous membranes.¹³⁻¹⁵ Surfaces or materials (like bedding or clothes) can also be contaminated with the virus.¹⁶ Because of their potential contact with bodily fluids from Ebola patients, healthcare workers are at an increased risk of contracting the disease.¹⁷ Health centers taking care of Ebola patients should therefore be equipped with isolation units and health personnel should wear personal protective equipment (PPE) when looking after Ebola patients.¹⁷

In theory, to stop Ebola transmission, Ebola patients need to be isolated and people should simply avoid touching them (or do so using PPE). In reality, this proved to be an enormous challenge. When Emile fell ill in December 2013, it happened in a region where Ebola had never appeared before: West Africa. The virus strain that made him sick also happened to be the deadliest of the five known strains: the Zaire ebolavirus strain.¹⁰ Previous Ebola outbreaks mostly occurred in rural areas, which made them easier to control. The fact that Ebola was spreading in the urban settings of Conakry in March 2014, was reason for alarm.

Unfortunately, the fragile health system in Guinea was unable to bring the outbreak under control. Just one week after the WHO officially declared the Ebola outbreak, the first two cases were reported in Liberia's Lofa county,¹⁸ close to the border with Guinea. Early April, 21 Ebola cases were reported, with 10 deaths – one of them in Liberia's capital Monrovia. While many people feared an explosive outbreak at this point, it looked like the outbreak was under control. Very few new cases were reported in the weeks that followed, until the outbreak gained traction in Monrovia in June.¹⁸

In the meantime, people in Sierra Leone held their breath while case counts of Ebola went up in neighboring Guinea and Liberia. It was not until May 2014 that Sierra Leone reported its first cases, which could later be traced back to the funeral of a traditional healer in the Kailahun district, an area in the east of Sierra Leone, close to the border with Guinea and Liberia.^{19,20} Ebola patients from Guinea crossed the border to Sierra Leone, hoping to be treated by her. The traditional healer fell ill with Ebola herself, and subsequently died of it. She was a well-known healer in the region and her funeral was visited by hundreds of people from Sierra Leone and Guinea. Ebola spread freely among the mourners – it is now estimated that as many as 365 Ebola deaths could be linked to that funeral.^{20,21}

2.1 SUPER SPREADERS

It would not be the last time a funeral turned out to be a super spreader event in the West African Ebola outbreak.^{12,22,23} The viral load of an Ebola patient is highest around the time of death. Even after someone dies of Ebola, the body still sheds the virus.^{14,15} Because burial practices in West Africa commonly involve washing and touching the body of the deceased, funerals formed high-risk events during the outbreak.¹² The burial of the traditional healer in Sierra Leone's Kailahun was an extreme case. Other unsafe burials have resulted in 30 new cases in Sierra Leone and more than 60 in Guinea.^{22,23} It is estimated that on average, every unsafe burial in West Africa caused three new Ebola cases.²⁴

Apart from funerals, taking care of Ebola patients increased the risk of Ebola transmission, both in Ebola Treatment Units (ETUs) and at home.²⁵ It is difficult to avoid touching an Ebola patient or their clothes and bedding when living in small, poor households shared with many family members. Despite the recommendation to stay away from an Ebola patient, family members often felt an immediate need to take care of their loved one.²⁶ While during the outbreak, people were encouraged to seek medical care in ETUs, these centers did not always have enough capacity.²⁶ Many people feared and distrusted the ETUs and families of

hospitalized patients were stigmatized by their communities.^{26–28} The distrust, especially in the first months of the outbreak, and the overwhelmed response system, made that people often took care of their loved one at home – posing a great risk for further infections.^{26,28}

In health facilities, the situation was dire as well, especially in the first months of the outbreak.²⁹ The lack of clear standard operating procedures in health facilities, shortage of PPE and hand washing facilities, and delayed laboratory diagnosis of Ebola cases all contributed to unsafe surroundings where Ebola could easily spread.^{29–31} One study looking at Ebola cases between May and October 2014 in Sierra Leone, estimated that the risk of contracting Ebola was more than 100 times higher for healthcare workers (HCWs) than non-HCWs.³⁰

After getting in contact with infectious fluids, it takes between 2 to 21 days to develop Ebola symptoms – most patients fall ill between 5-9 days after exposure to the virus.^{14,32} Ebola patients can only transmit the virus when they have symptoms of the disease, which usually starts with a sudden onset of fever, muscle pain, headache and a sore throat. Later on, this is accompanied by vomiting, diarrhea, rash and impaired kidney and liver functions.¹³ Hemorrhage, often depicted in the media and in movies as the key symptom of Ebola, was only reported in about 18% of Ebola cases.³³ Symptoms such as fever, headache and muscle ache are common for other diseases such as malaria, typhoid and meningitis – diseases that are endemic to Guinea, Sierra Leone and Liberia.¹³ Ebola infection therefore needs to be confirmed through diagnostic tests, whereby blood samples of suspected Ebola cases should be collected and tested in laboratories.^{34,35}

At the start of the West African Ebola outbreak, there was no licensed treatment available.³⁶ Therefore, all that could be given to patients was mere supportive care. This mainly involved oral or intravenous rehydration and electrolytes. Often, drugs to reduce vomiting and diarrhea and to treat fever and pain were administered.³⁶

2.2 CURBING AN OUTBREAK

Given its mode of transmission, the main way to prevent infection is to avoid contact with bodily fluids or items that have come in contact with bodily fluids of an Ebola patient.¹⁴ Furthermore, one should not attend burial rituals that involve touching or washing a dead body and avoid contact with semen of an Ebola survivor, as it has been shown that the virus can survive in immune privileged sites like testes for more than a year after recovery.³⁷ Since Ebola outbreaks have been reported among nonhuman primates, it is advisable to stay away from these animals and to avoid consuming their meat.^{38,39} The same goes for bats, as they are suspected to be the reservoir of the Ebola virus.³⁹

But in order to curb an ongoing outbreak, more needs to be done. A multidisciplinary approach to the outbreak response is needed.¹⁵ This involves early case detection, rapid isolation, contact tracing, safe clinical management of Ebola patients, safe and dignified burials and health promotion and community engagement.¹⁵ Early case detection is crucial, as this lowers the risk of further spread of the virus in the community. Safe care of patients

should ideally be done in specialized ETUs, to minimize the risk of transmission within hospital settings.²⁹

All these measures work very well on paper.

In the setting of a real and deadly epidemic, prevention and control measures are not as straightforward. The West African Ebola outbreak made this painfully clear. Because Ebola surfaced in one of the poorest parts of the world, health systems were fragile and governments were unable to adequately address the threat they were facing.⁴⁰ In countries where there are only 2-9 doctors per 100.000 people (to compare: Sweden has around 400 doctors per 100.000 people),⁴¹ safe clinical management, early case detection and contact tracing was not feasible without support from the international community.

Another factor hampering the response was widespread fear.^{27,42,43} Fear quickly spread around the world, fed by horrific images of the situation on the ground.^{42,43} However, the existence of the outbreak was in the first months largely denied in Sierra Leone, Guinea and Liberia.^{40,44} Trying to make the public understand the reality and the severity of the disease, the main risk communication messages in the first months stated that ‘Ebola is real, Ebola has no cure’.^{40,45} Hearing that the disease had no cure rightfully terrified people. They feared not only the virus, but the entire response to it. Adding deep-seeded mistrust and viral rumors to that mix, made people hide infected family members, and bury their deceased loved ones secretly.^{27,42,46} Risk communication and community engagement proved to be a very difficult task.

It was against this backdrop that the Ebola outbreak quickly spiraled out of control in 2014 in Sierra Leone, Guinea and Liberia. By July 2014, Ebola cases were reported in the capital cities of all three countries.¹⁰ Case numbers grew exponentially between June and September 2014; the national case numbers in Guinea, Sierra Leone and Liberia doubled between 16 and 30 days (see figure 1).⁴⁷ While the outbreak was accelerating, the international response came off to a slow start. The WHO has been widely criticized for not declaring a Public Health Emergency of International Concern (PHEIC) earlier – it was finally done on August 8, 2014.^{40,48} By then, there were more than 1,750 reported cases and nearly 1,000 deaths.⁴⁹

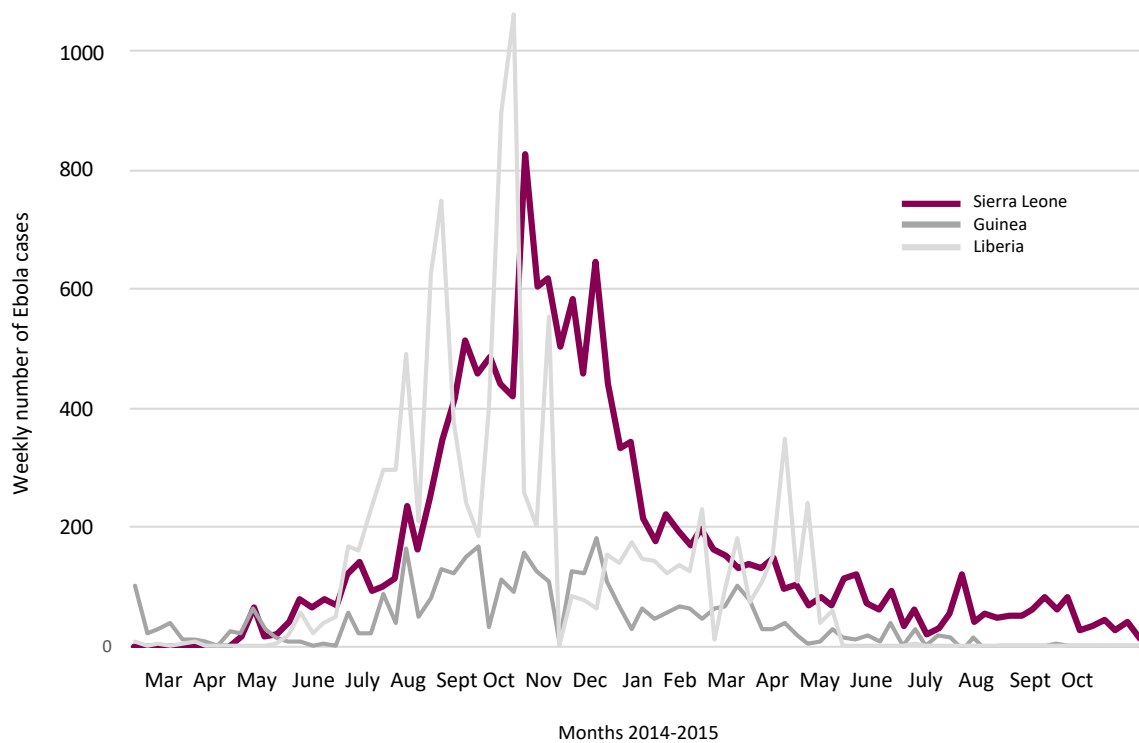


Figure 1. Weekly number of Ebola cases in Sierra Leone, Guinea and Liberia (based on data from CDC⁵⁰)

In September 2014, the United Nations Mission for Ebola Emergency Response (UNMEER) was created. Its strategy to combat the outbreak had five action points:⁴⁰

1. Stop the outbreak
2. Treat the infected
3. Ensure essential services
4. Preserve stability
5. Prevent further outbreaks

These action points indicate the medical focus of the international response. It was believed that the outbreak would be curbed by increasing the number of isolation units, beds and health workers.⁴⁰ What was clearly absent from this strategy was community engagement and risk communication.^{40,45}

2.3 RISK COMMUNICATION AND SOCIAL MOBILIZATION

The WHO's toolkit for behavioral and social communication in outbreak response acknowledges that communication strategies are often not available in the beginning of an outbreak and are often outside operational decision making.⁵¹ Still, the WHO recognizes the importance of risk communication and community engagement in outbreak situations, naming it an 'integral pillar of an outbreak response'.⁵¹ In previous Ebola outbreaks in Uganda, community engagement has proven to be vital.⁵²

Definitions of risk communication and community engagement

The WHO defines **risk communication** as 'the real-time exchange of information, advice and opinions between experts, community leaders or officials and the people who are at risk'⁵³

Community engagement is defined by UNICEF as: 'processes of engaging and motivating a wide range of partners and allies at national and local levels to raise awareness of and demand for a particular development objective through dialogue'⁵⁴

When communities face a deadly threat, they often develop their own protocols for disease control, for instance through isolating sick community members.⁵² During the 2000-2001 Ebola outbreak in Gulu, Uganda, communities had protocols in place to isolate sick community members in a house that was at least 100 meters away from all other houses.⁵² By mapping and understanding these kinds of community-level practices, (inter)national response activities can be developed so that they are aligned with ongoing practices.⁵² This can enhance community ownership and be beneficial for everybody involved.^{45,53,55}

Mathematical models point to the important role that risk communication can play in an outbreak.^{56,57} These models usually start with the premise that information campaigns influence the knowledge of the public, which in turn could influence behavior.^{56,57} Good and accurate reporting could slow down the initial phase of an outbreak and could lower the number of cases during the peak of an outbreak. Inaccurate reporting on the other hand, could lead to an increase in the number of cases.⁵⁶ Another model, based on an influenza outbreak, concluded that awareness and knowledge is attributable to a wide availability of information – highlighting 'the crucial role of mass media and educational campaigns' during an epidemic.⁵⁷ Modeling studies however, are inherently limited in their external validity, as they represent an ideal, standardized situation and will never be better than the variables included in the model.⁵⁸

There are several guidelines for effective risk communication in health emergencies.^{53,59} The Crisis and Emergency Risk Communication (CERC) principles for instance, highlight that different communication techniques are needed in different phases of an outbreak.⁵⁹ In the initial phase, focus should be on the reduction of uncertainty around the risk, as well as promotion of self-efficacy through recommended practices that can be taken up by the public. As the outbreak continues, more information about the risks and protective behaviors are likely known and should be communicated accordingly in the maintenance phase.^{59,60} The WHO emphasizes the importance of building trust with affected communities, so that communities can be effectively engaged in risk communication.⁵³ Risk communication often aims to inform the public, so that they in turn can make informed decisions regarding the adoption of protective behaviors and the avoidance of risk behaviors.⁶¹

Unfortunately, even with proper risk communication and an informed public, behavior change is not easily achieved – a phenomenon that is also called the ‘knowledge-behavior gap’.^{62–65} The Health Belief Model (HBM), one of the most applied models of health behavior change, shows that several, modifiable determinants are important to consider:^{66,67}

- the perceived barriers and benefits of the new behavior
- the perceived seriousness of and susceptibility to the disease
- one’s self-efficacy

Cues to action are needed to stimulate people to act upon the perceived benefits and threats. Applying the HBM to risk communication in the Ebola outbreak in West Africa, shows that conveying the severity of an Ebola infection, not only for the affected persons, but also the family, might have increased the perceived threat. It can be argued that while the message ‘Ebola has no cure’ might have increased the level of perceived threat, at the same time it also decreased the level of self-efficacy. It conveyed severity, but also hopelessness.

People’s perceived susceptibility to a disease threat is also known as risk perception. WHO’s risk communication guidelines assign an especially important role to the public’s risk perception, saying that ‘risk perception is the primary predictor for disaster prevention and mitigation behaviors’.⁵³ Various characteristics of a threat can determine how the public perceives the risk. For instance, if a threat is new to the public and has the potential to be fatal, it is likely that the public will have a high perception of risk.^{68,69} Similarly, risk perception will be higher when the threat came involuntarily and is perceived to be beyond the public’s control.^{68,69} The Ebola outbreak ticked all of those boxes.

According to the Social Amplification of Risk Framework, risk perception can be heightened or attenuated by social, psychological and cultural processes.⁷⁰ Communication is important in this framework, through interpersonal communication and the news media.⁷⁰ However, the focus of news media is commonly on the unexpected, unusual and dramatic stories, which in itself can amplify perceptions of risk. A study analyzing news coverage of the West African Ebola outbreak in the United States - a country where 11 Ebola patients were treated - found that 96% of all news stories contained at least one message that could be considered risk-elevating.⁷¹ On the other hand, only 55% of the news stories had at least one message that was risk-minimizing.⁷¹

Journalists are important actors in the framing of news and messages. Agenda-setting theory poses that journalists filter what is happening, and by doing so, focus on core issues while ignoring others.^{72,73} By making the core issues more salient, the public can perceive those as more important than other stories. Over time, these issues can become part of the agenda of the public as well.^{72,73}

According to the theories outlined above, how messages are framed and which messages are highlighted, can all have an influence on people’s knowledge, perception of risk and potentially their behaviors.^{66–68,70,72,73} In Sierra Leone, the message ‘Ebola has no cure’ also

had various effects on the public: it increased people's perception of risk, but also decreased their self-efficacy. And it led to people avoiding health centers.^{28,45} Given the perceived inevitable death (i.e. high perceptions of risk associated with ETUs), people preferred to die at home surrounded by their loved ones, instead of going to a health center.²⁸ Other public health messages had the problem that they did not align with reality. Encouraging people to call an ambulance for instance, is of little value when there are no ambulances available.^{40,74} Furthermore, messages often created more questions than answers. When telling people not to touch a sick person, family members wondered how to take care of their sick loved ones.^{26,75} With a focus on top-down communication, there was little room for people to ask their questions.⁷⁶

2.4 KICK EBOLA OUT OF SIERRA LEONE

While the international response to the outbreak did not clearly prioritize community engagement, the Government of Sierra Leone (GoSL) founded a Social Mobilization Pillar in June 2014. It brought together more than 100 stakeholders, from non-governmental organizations (NGOs) to ministries, to the US Centers of Disease Control and Prevention (CDC) and UNICEF.⁷⁴

A national communication strategy followed in September.⁴⁶ The strategy was informed by results from a nationwide Knowledge, Attitudes and Practices (KAP) survey, that was carried out in August 2014.⁴⁶ The strategy emphasized the importance of dialogue in communication, enabling people to express concerns – a sharp contrast to the international UNMEER response. The messaging guide that was created based on the empirical evidence, focused on protective behaviors.^{3,77}

Examples of risk communication messages from the Message Guide⁷⁷

Celebrate survivors

'People who survive Ebola need hope and social support from family, friends and the community. We must honor those who have survived Ebola! We are all Ebola fighters!'

The fight is not over

'The Ebola outbreak is not over. We cannot relax our guard just because we are seeing signs of progress. We must continue to work together to defeat this disease until we get to zero.'

The results of the KAP survey further revealed that the large majority of the respondents (88%) received updates about Ebola via the radio³ – one of the most accessible media platforms in a country where almost half of the adult population is illiterate.⁷⁸ Because of the importance of radio in Sierra Leone, efforts were made to train Sierra Leonean journalists on essential facts about the virus,⁷⁹ supported by BBC Media Action and the CDC. Radio

stations were organized in networks and aligned their programming so that the same messages were amplified across the country. The customized programs ‘Kick Ebola Out Of Sierra Leone’ and ‘Kick Ebola Live’ reached national audiences through these networks.⁷⁹ Using the power of their medium, radio stations would host people from the community – from health workers and local leaders to Ebola survivors. It was made interactive by allowing listeners to call in with their questions and concerns.⁷⁹

Religious leaders similarly played an important communication role during the outbreak. In Sierra Leone, a country where 78% of the population is Muslim and 21% is Christian,⁸⁰ religion and religious leaders are ingrained in society.⁸¹ Religious leaders were engaged to develop faith-based messages, specifically to target unsafe burial practices that sparked further Ebola infections.^{82,83} Safe burials meant that deceased patients should be buried within 24 hours after death, and that burials should be carried out by trained teams wearing appropriate PPE.⁸³ In reality, many Ebola victims were often buried in unmarked graves, frequently with other bodies – a practice that was unacceptable to the public.⁸³ Furthermore, family members were not able to observe the burial and feared that the bodies were not handled appropriately.⁸⁴ It led to people burying their loved ones themselves, exposing them to the virus. Facing these obstacles, the safe and dignified burial protocols from the WHO and the GoSL that were developed in the second half of 2014, incorporated religious and cultural elements.^{85,86} Religious leaders were engaged and identified passages in the Quran and the Bible that highlighted the importance of safe burials in exceptional situations such as an Ebola outbreak.^{87,88} Furthermore, religious leaders were encouraged to give support to bereaved families and to give final prayers.⁸⁹ An analysis (currently in preprint) of a cross-sectional population-based KAP survey in December 2014 showed that people exposed to faith-based messages were significantly more accepting of safe burials.⁹⁰

In September 2014 and March 2015, house-to-house campaigns were initiated by the GoSL. During the three-day campaigns, households were visited by health workers to discuss Ebola and active case searching was intensified.⁹¹ There were many other community interventions over the course of the outbreak in Sierra Leone, most notably the engagement of traditional healers, who agreed to suspend their practices until the outbreak was over.^{92,93}

Engaging communities in the response was an important step in making people understand the reality of the outbreak and increasing people’s trust in response measures.^{76,94} In an evaluation of the lessons learned from the outbreak, Sierra Leone’s National Ebola Response Centre noted that the involvement of communities and local leaders helped to build trust and collaboration.⁹⁵ Furthermore, improved quality of care, seeing survivors, and hearing messages that were in line with reality all contributed towards accepting control measures.^{94,96} Taken together, community engagement and risk communication likely helped, together with the biomedical approach, to bring the outbreak to an end.^{45,97–99}

While Sierra Leone, Liberia and Guinea were the epicenters of the world’s largest Ebola outbreak in history, the virus spread to three other West African countries: Senegal, Mali and Nigeria.¹⁰ There were fears of a large outbreak in Nigeria when the virus was discovered in

the crowded urban areas of Lagos. However, intense outbreak measures such as contact tracing, isolation of patients and risk communication brought the outbreak quickly under control. A total of 19 laboratory confirmed cases and 8 deaths were recorded in Nigeria.¹⁰⁰ Outside of West Africa, various European countries treated Ebola patients on their soils.^{10,101} In the USA, 11 patients were treated, 4 of whom became ill after arrival in the country, and one of them died.¹⁰

An early community engagement success story

Text adapted from chapter 'Community responses to Ebola' in 'Ebola: How a people's science helped end an epidemic' by Paul Richards¹⁰²

The first cluster of Ebola cases in Sierra Leone started in the east of the country, in Kailahun, in the chiefdom of Jawei. The paramount chief of Jawei, Chief Musa Kallon, was a trained nurse and knew about the dangers of Ebola. Unfortunately, he was in Freetown for meetings on the day the first Ebola case was confirmed in his chiefdom. He tried warning his wife and daughter not to visit the patient – but he was too late. His wife was a childhood friend of the Ebola patient and she visited her in the health center. Shortly thereafter, Chief Kallon's wife became ill herself and died. Their daughter, taking care of her mother, was the next victim. Chief Kallon quickly instituted by-laws in his chiefdom to limit the spread of the virus, for instance by not allowing visitors to stay overnight and encouraging people to stay home. He created a task force to carry out contact tracing and safe burials – before any official guidelines about safe burials were created. As often as he could, he talked on the radio about the dangers of Ebola. The biggest hurdle he had to overcome was the persistent denial about Ebola. Many people believed Ebola was a political scam designed to reduce the number of voters in their area, which was supportive of the (at the time) political opposition. Chief Kallon was a friend of the president, and therefore suspected to be involved in the scam. But Chief Kallon persisted with his task force and together managed to convince the community about the reality of Ebola, breaking the transmission and bringing the outbreak to an end in his chiefdom. Cases and deaths started to decline before a major international response was mounted. It was a community-led response, which inspired community engagement in other heavily-hit parts of West Africa.

2.5 THE AFTERMATH

The West African Ebola outbreak was officially declared over on March 29, 2016 when the WHO lifted the PHEIC status.¹⁰ More than 28,600 cases were reported in the three most affected countries, with more than 11,000 deaths. Sierra Leone accounted for almost half of the Ebola cases, and almost 4,000 citizens reportedly lost their lives.⁴⁹ The health sector in Sierra Leone was heavily affected as well: 79 HCWs had died in the outbreak, corresponding to 7% of the total healthcare workforce.¹⁰³ Due to the severely reduced availability of health services for diseases other than Ebola, it is estimated that an additional 2,800 people in Sierra Leone died from malaria, HIV/AIDS and tuberculosis.¹⁰⁴ Education was disrupted and teenage pregnancies went up by at least 25%.¹⁰⁵ Aside from the enormous toll on health and the health system, the outbreak also had severe consequences for Sierra Leone's economy. In 2014, there was an estimated 10% loss in exports, and the production of staple crops fell by 12%.^{106,107} The price tag for external donors was hefty as well; the USA alone spent an estimated 3.3 billion USD on the West African outbreak response.¹⁰⁸

Those who survived an Ebola infection continued to face numerous challenges, both psychologically and physically. An unknown share of survivors reportedly suffered from post-Ebola syndrome, with complaints ranging from musculoskeletal pains, joint pain, headaches and visual problems to extreme fatigue, depression and decreased libido.^{109–113} Survivors also faced stigma when returning home, mostly because of community fears that survivors can still transmit Ebola.¹¹⁴ This fear and the related stigma was even higher when survivors suffered from post-Ebola syndrome.¹¹⁵ The finding that the virus can survive more than a year in semen further fueled fears.³⁷ A nationwide KAP survey conducted in August 2014 in Sierra Leone found that as many as 95% of the respondents held at least one stigmatizing belief or attitude about Ebola survivors, for instance that they would not accept a survivor back into their communities, or avoid buying vegetables from a shopkeeper who survived Ebola.³ These stigmatizing beliefs made that some survivors were evicted from their homes, were socially isolated and were abandoned and divorced by their partners.^{116–118} In a survey among 358 survivors in Sierra Leone, 83% reported signs of internalized stigma – having feelings of shame or guilt due to being an Ebola survivor.¹¹⁶

Over the course of the outbreak, the development of Ebola vaccines accelerated. Especially in Liberia, Guinea and Sierra Leone, various trials were conducted with thousands of participants to test the efficacy of newly developed vaccine candidates.^{119–123} In December 2019, the first Ebola vaccine (rVSV-ZEBOV) was officially approved by the U.S. Food and Drug Administration.^{124,125}

2.6 MORE EBOLA OUTBREAKS

Since the end of the West African Ebola outbreak, the virus has re-emerged three times, in different regions of the DRC. The outbreak that started in May 2018 in the Équateur province was brought under control relatively quickly, with the last cases reported in July 2018. A total of 54 people became infected, 33 of them died.^{126,127} At the time, the rVSV-ZEBOV vaccine

was not licensed yet, but was granted ‘compassionate use’ in the DRC and was administered to contacts of infected people and health workers. More than 3,000 people received the vaccine during the three months of the outbreak.¹²⁷

Unfortunately, there was not much time to celebrate the swift end of this outbreak. Just one month later, in August 2018, another unrelated outbreak was detected in the DRC – this time in the conflict-ridden province of North Kivu, where Ebola had never emerged before. The politically unstable and at times violent region proved to be a challenge of another order. Two thirds of respondents of a survey held in September 2018 indicated that they did not think the local authorities represented their interests.⁴ Another 25% did not believe Ebola was real, even when the outbreak had been going on for more than a month.⁴ The low trust was associated with a decreased likelihood of adopting protective behaviors.⁴ Violent attacks on ETUs continued to undermine the response and the outbreak spread to the neighboring provinces South Kivu and Ituri.^{128,129} Despite an effective vaccine, given to more than 300,000 people, it took almost 2 years to get the outbreak under control.¹³⁰ In 2020, another Ebola outbreak smoldered for almost six months in the DRC, this time in the Mbandaka area of the Équateur province.¹³¹ After 130 confirmed and probable cases, 55 deaths and a vaccine administered to more than 40,000 people, this outbreak was declared over in November 2020.¹³¹

More than anything, the ‘epidemic of suspicion’, as a health worker from Médecins sans Frontières called the North Kivu outbreak, shows how important it is that the at-risk population trusts the response efforts.¹²⁸ Even with more focus on risk communication and community engagement in the North Kivu outbreak and the use of an effective vaccine,¹³² trust and community empowerment do not seem to follow a step-by-step manual. There is still a lot to learn in this field.

3 MISINFORMATION

Despite risk communication guidelines and best practices, health emergencies such as disease outbreaks are often accompanied by a surge in misinformation, likely resulting from unmet information needs of the public.¹³³ In the North Kivu Ebola outbreak, misinformation was widespread, with sometimes deadly consequences. Together with distrust in authorities and international responders, it led to attacks on ETUs, killing and injuring HCWs.¹³⁴ During the international Zika outbreak in 2016, rumors went around that Zika was not the cause of microcephaly, but that a larvicide caused the disability.^{135,136} Similarly, blame was placed on vaccines distributed by the Brazilian government.^{136,137}

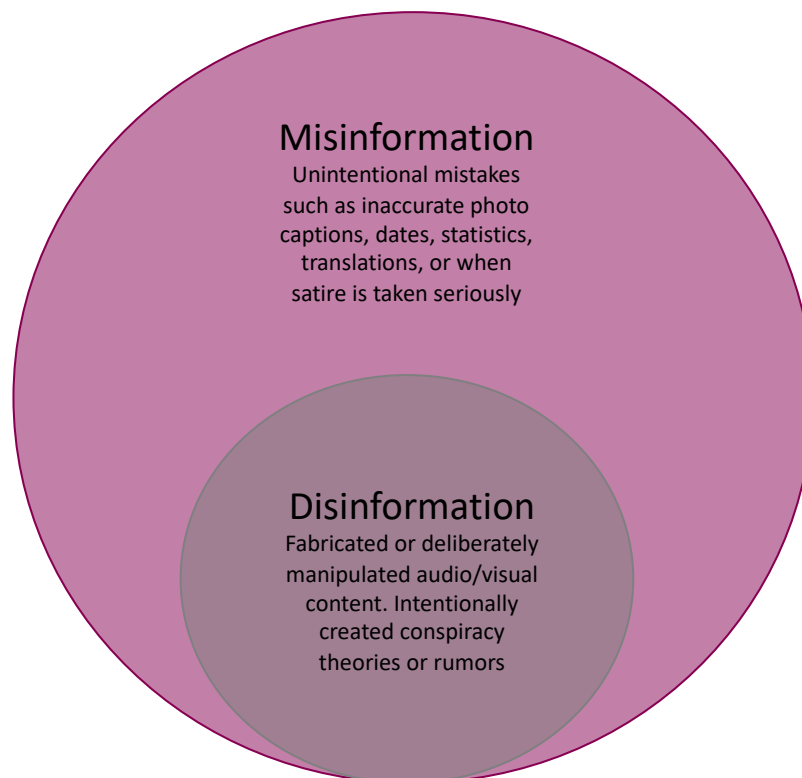


Figure 2: Definitions of Misinformation and Disinformation, modified from Derakshan & Wardle¹³⁹

What is misinformation?

Misinformation is defined as false information.¹³⁹ The difference between misinformation and disinformation lies in the intention to cause harm or to mislead with the incorrect information, see figure 2.^{139,140} In misinformation, there is no intention to cause harm or to mislead, while this intention is present in disinformation. Fabricated material, or intentionally created conspiracies are a form of disinformation. Wrong information can start as disinformation, for instance by somebody who created a conspiracy theory.¹⁴¹ This same information however, can also be classified as misinformation when it is shared by people who believe this is correct information. Because often the intention of spreading false information is not known, this thesis classifies all false information as misinformation.

Even as far back as the 1918 influenza pandemic, which took place towards the end of World War I, misinformation and downplaying the danger of the virus led to prioritizing military parades over public health in the USA.¹³⁸ Philadelphia's mayor Krusen felt it would undermine the spirit of war to cancel the largest parade in the history of the city because of a looming epidemic. He decided to let the festivities go ahead as planned. Just days later, hospitals were overflowing, and he had to admit that there was now widespread community transmission of the dreaded influenza virus.¹³⁸

Fast forward to 2020, the coronavirus pandemic. Not since the 1918 pandemic has the whole world been affected by a virus. SARS-CoV-2, the virus that causes the disease COVID-19, spread around the world in a matter of months. Border closures, societal lockdowns and social distancing have become the new normal in many parts of the world. Very different from the 1918 pandemic is the current media landscape, whereby online and social media bring us breaking news in a matter of seconds. Furthermore, thanks to social media, misinformation proliferates and spreads at a higher speed than the virus itself. Pointing to the overflow of information and misinformation around the coronavirus, the WHO has dubbed it an 'infodemic'.^{142,143} Misinformation has been around since mankind, but social media and the increased media fractionation have created echo chambers and information silos that can potentially amplify misinformation.¹⁴⁴⁻¹⁴⁶ An analysis of true and false information on Twitter found that false information spreads six times faster than correct information.¹⁴⁶ False information also spreads farther and more broadly than correct information.¹⁴⁶

Still, there are striking similarities between the 1918 pandemic and the coronavirus pandemic. In 1918, mayor Krusen allowed a super spreader event to take place, ignoring public health experts.¹³⁸ In 2020, the US president Donald Trump has consistently undermined the severity of the pandemic and called for states to reopen their economies - a stark increase in the number of COVID-19 cases followed in June and July 2020.¹⁴⁷

Not all misinformation poses direct harm to people, because not all misinformation influences important protective behaviors.^{148,149} For instance, during the West African Ebola outbreak, some people believed that witchcraft played a role in the spread of the virus.¹⁵⁰ Whereas this is from a biomedical point of view not true, the belief was harmless if people would still stop attending unsafe burials. Believing that injecting bleach will help prevent you from contracting COVID-19, as suggested by president Trump, clearly has a dangerous behavioral aspect. Before any efforts are made to counter misinformation, behavioral consequences of the misinformation should ideally be determined.

Vaccines and vaccination programs are known targets of misinformation, which in turn has influenced attitudes towards vaccination and health behaviors. The resulting vaccine hesitancy is a multifaceted, complex and growing problem on a global scale.¹⁵¹⁻¹⁵³ Hesitancy towards vaccines is not binary, but should be placed on a continuum, whereby some people receive all vaccinations despite concerns, others delay or refuse some vaccines. Highly vaccine hesitant people might refuse vaccination altogether.¹⁵⁴⁻¹⁵⁶ Misinformation has likely also contributed to the changed perceptions of risk around vaccines, whereby the risks of

adverse health outcomes associated with a disease are considered smaller than the risks associated with vaccination.¹⁵³ One of the most well-known examples of the impact of misinformation on vaccine uptake concerns the (non-existing) link between the measles vaccine and autism. This link was reported by Wakefield et al. in the *Lancet* in 1998, but the paper turned out to be based on fraudulent data and was fully retracted in 2010.¹⁵⁷

Unfortunately, very vocal, online anti-vaccination campaigners keep spreading this false information and urge parents not to have their children immunized. Despite countless studies proving that there is no link with autism,^{158–160} so-called ‘anti-vaxxers’ are not slowing down in their quest. The vaccine coverage in general is still high, but has declined slightly in several European countries and in the USA over the last years, leading to several measles outbreaks.^{161,162} HCWs are increasingly confronted by their patients with misinformation and often have difficulties in accurately and effectively communicating around vaccines.^{163–165} To add to the complexity, a systematic review of various interventions that aimed to target parental vaccine hesitancy found that the effect of information and education interventions was limited.¹⁶⁶ Finding ways to counter misinformation has never been more urgent.

3.1 YOU’RE WRONG

In the context of epidemics, misinformation is especially likely to spread in the initial phases of an outbreak. The CERC guidelines therefore also highlight that misinformation should be actively targeted early on.^{59,60} In the fields of political science, psychology and climate science, there have been numerous scientific efforts to find effective ways to counter misinformation. Unfortunately, these efforts have had limited success and can sometimes even induce a so-called ‘backfire’ effect, whereby the belief in misinformation is inadvertently enhanced.¹⁴⁰

One of the very clear findings across all investigations in this field, is that simply saying ‘you’re wrong’ when you hear misinformation, is not likely to change people’s minds.^{167,168} This commonly happens because there is no replacement for the misinformation, leaving a gap in people’s understanding. When no alternative is given, what else should someone believe when he or she is told that the information is wrong? In absence of an alternative, people instead tend to keep relying on the misinformation.^{140,169} A clear example of this comes from a study whereby participants were asked to read a fictitious story about a fire in a warehouse, which alleged that the fire was caused by materials that were stored in a closet.¹⁷⁰ Participants were then told that the closet had actually been empty, but no alternative about the cause of the fire was provided. Despite remembering the correction of the misinformation, up to 95% of participants still relied on the misinformation. The authors of the study coined this the ‘continued influence effect’.¹⁷⁰ This effect is especially pronounced when no clear alternative or explanation is given.^{140,145,171}

3.2 DEBUNKING

Strategies to debunk (or counter) misinformation therefore usually rely on providing an alternative to the misinformation. Meta-analyses investigating the effect size of debunking

strategies found that factors such as the credibility of the source, explanations that are in line with people's existing worldviews and social norms, as well as repetition of the correct information all have the potential to enhance the chance of successful debunking.^{167,168}

Unfortunately, even when alternatives are provided, well-intentioned health messages can still backfire. In a survey experiment in the USA, aiming to test the effectiveness of messages to reduce misconceptions about the measles vaccine, parents were assigned to receive information, textual or visual, about the safety of the vaccine or the dangers of measles.¹⁷² Textual information reduced the belief in misinformation, but also decreased the self-reported intent to vaccinate.¹⁷² Furthermore, the images of children sick with measles actually increased the belief that the vaccine causes autism.¹⁷² A meta-analysis looking into these types of fear appeal messages concluded that they run a risk of backfiring, especially when they are not accompanied by messages to increase someone's self-efficacy.¹⁷³ Similar results have been reported in an online study aiming to counter misinformation about the measles vaccine, using debunking strategies such as 'myths vs facts' and 'visual correction', whereby participants saw a visualization of the risks of vaccines versus the risks of measles, as well as a 'fear correction', showing pictures of unvaccinated children that contracted measles.¹⁷⁴ None of the strategies reduced misconceptions or increased the intention to vaccinate compared to the control group. At the same time, the fear correction approach actually strengthened the belief that vaccines cause autism.¹⁷⁴ Fortunately, recent findings show that the backfire effect does not seem to happen as often as once feared.^{140,175}

But even when debunking efforts do not backfire, there are other hurdles. A trial among staff at autism centers in Australia aimed to decrease the support for non-evidence-based autism therapies, while at the same time enhancing support for proven therapies.¹⁷⁶ The study found that support for non-evidence-based therapies significantly decreased in the intervention group, whereas the support for proven therapies did not change. These effects were not sustained over time however, showing that more needs to be done to make the debunking effect stick over time.¹⁷⁶

To understand why debunking misinformation is so difficult, it is useful to look at mental models. When people are confronted with new information, they build a situational model around it – a representation of the information in the circumstances it was encountered.¹⁷⁷ This mental model is relatively flexible and can be adapted to new information, but only if the changes to the original model are not too large.¹⁷⁸ When the new information is too different to fit into the existing mental model, there is a conflict, or 'cognitive dissonance'.¹⁷⁹ Should you discard the old model and create a new one? Or stick to the old model and discard the new information? Unfortunately, we humans are often not very good at assimilating to the new information, so we are more likely to keep relying on the old information, even when clear alternatives to the misinformation are provided^{172,174,176} – another expression of the previously mentioned continued influence effect.¹⁸⁰

Another concern is that by debunking, attention is placed on the misinformation – which by itself can increase the familiarity with the misinformation and strengthen the belief in it.^{181,182}

Furthermore, by repeating the misinformation, it could also reach people who would otherwise not have heard of it, thus inadvertently spreading the misinformation.¹⁸³ An alternative method of debunking is therefore to not mention the misinformation at all and instead to only focus on the correct information.^{145,184} By consistently repeating the correct information, familiarity is increased, which is an important determinant of accepting the information as true.^{145,185,186}

To date, the large majority of published evidence comes from online survey experiments that investigate the effectiveness of debunking strategies on constructed misinformation – i.e. misinformation that participants have not been exposed to before the study.^{167,187–190} Few studies have looked into countering real-world health-related misinformation.^{172,174,176} Furthermore, evidence of the effectiveness of debunking real-world misinformation in low-income settings is lacking.

3.3 RATIONALE

Risk communication and community engagement interventions were incorporated in the response to the West African Ebola outbreak. However, the influence of these interventions on the public's knowledge, behaviors and risk perception have not been thoroughly investigated with empirical data. In infectious disease outbreaks, misinformation can quickly arise and spread, and potentially hamper response efforts. To date, the evidence on countering real-world misinformation around infectious diseases is lacking, especially in low-income settings. The studies in this thesis contribute to this knowledge gap by investigating the role of risk communication on the public's knowledge, behaviors and risk perception, as well as through understanding the perceived roles of Sierra Leonean journalists during the Ebola outbreak. Furthermore, the effectiveness of debunking strategies was tested on real-world infectious disease misinformation in Sierra Leone. Taken together, the findings of the studies can inform communication and debunking strategies in future infectious disease outbreaks.

4 AIMS

The overall aim is to determine the role of risk communication in the Ebola outbreak in Sierra Leone and to test the effectiveness of methods to debunk misinformation about infectious diseases.

4.1 SPECIFIC AIMS

The specific aims of the four sub-studies are:

- I. To determine the relation between exposure to different types of information sources and Ebola-specific knowledge and behavior
- II. To determine the relation between risk perception and exposure to different types of information sources, Ebola-specific knowledge and behavior
- III. To understand the perspectives and roles of journalists who reported during the Ebola outbreak
- IV. To test the effectiveness of two communication interventions in reducing the belief in misinformation about typhoid in Freetown

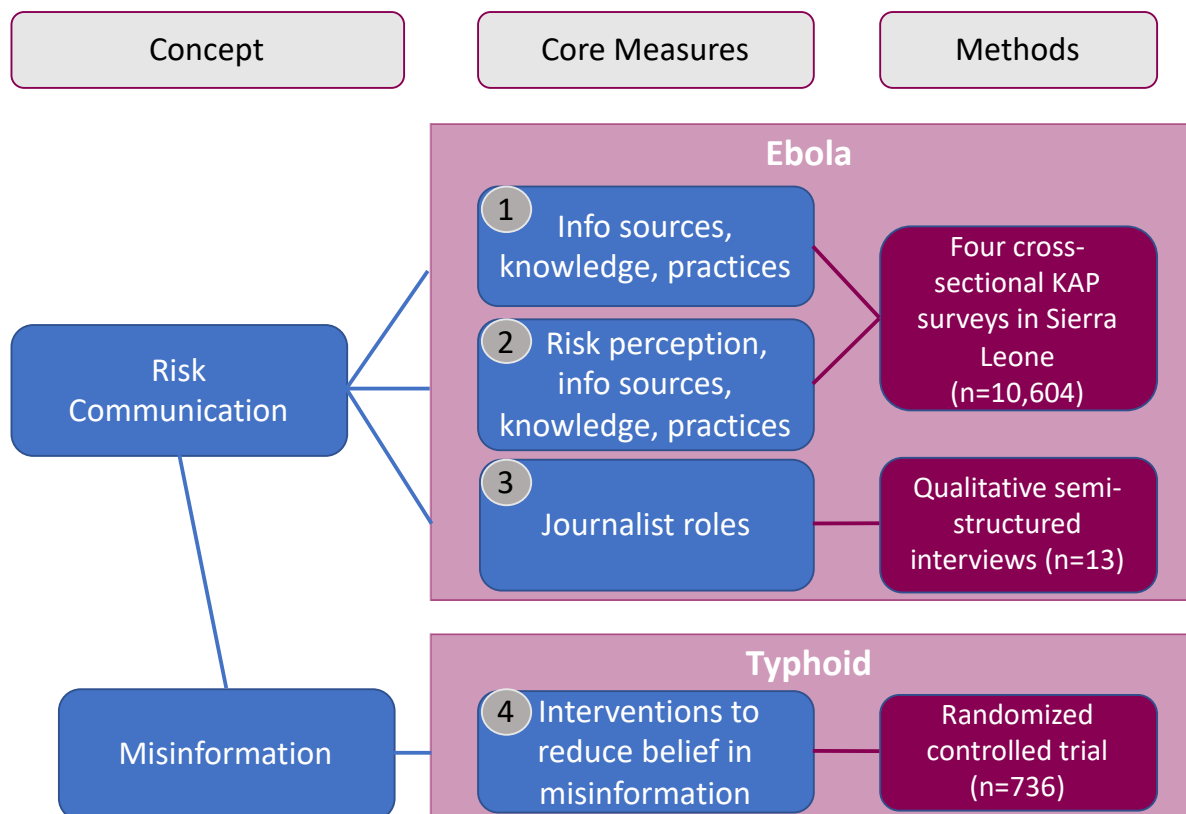


Figure 3: Overview of concepts, core measures and methods of the four studies

5 METHODS AND MATERIALS

Studies I and II were quantitative studies based on nationwide household KAP surveys, carried out during the Ebola outbreak in Sierra Leone. Study III was a qualitative study, based on semi-structured interviews with Sierra Leonean journalists who reported during the Ebola outbreak. Lastly, Study IV was a randomized controlled trial. The overall methods of the four studies are summarized in table 1.

Table 1. Methods of the four studies

Study	Population	Timeline	Design and sampling	Outcome measures	Data analysis
I	General public Sierra Leone	Aug 2014- July 2015	Four cross-sectional surveys (n=10,604), multi-stage cluster sampling	Ebola-specific knowledge and behaviors	Multilevel logistic regression modeling, mediation analysis
II	General public Sierra Leone	Aug 2014- Dec 2014	Three cross-sectional surveys (n=7,039), multi-stage cluster sampling	Risk perception, Ebola-specific knowledge, behaviors	Multilevel logistic regression modeling, mediation analysis
III	Sierra Leonean journalists	Feb-March 2016	Qualitative semi-structured interviews (n=13) using purposive sampling	Perspectives and roles of journalists	Thematic analysis
IV	Adult public with phone in Freetown	Oct 2019- Dec 2019	Randomized controlled trial (n=736), multi-stage cluster sampling	Belief that typhoid is caused by mosquitoes, belief that typhoid always co-occurs with malaria	Logistic regression models

5.1 STUDY SETTING

All studies took place in Sierra Leone, one of the countries with the lowest gross national incomes per capita in the world.¹⁹¹ When the Ebola outbreak started in 2014, the country was on the road of recovery after a devastating civil war ravaged the nation between 1991 and 2002.¹⁹² Around 70,000 people died during the war and 2.6 million people were displaced – accounting for more than half of the population of 4.3 million Sierra Leoneans at that time.^{193,194} During the war, life expectancy decreased from 42 years in 1990 to 34 years in 2000.¹⁹⁴ Since then, it has increased steadily and was around 54 years in 2018.¹⁹⁵ At the end

of the civil war, the total fertility rate was 6 and has since then dropped relatively quickly to 4.2 in 2018.¹⁹⁶ At the same time, child mortality decreased considerably, from around 260 to 110 per 1000 live births between 1990 and 2019.¹⁹⁷ As a result, the population of Sierra Leone still grows rather quickly – and currently stands at almost 8 million people.¹⁹³ It is estimated that more than half of the population (55%) does not have enough money to buy sufficient amounts of food.¹⁹⁸

Sierra Leone is divided into four regions (West, North, East and South), which are further divided into 14 districts, see figure 4. The capital, Freetown, home to around 1 million people, is situated in the coastal Western Area. English is the official language of Sierra Leone, but the most widely spoken language is Krio – one of the 23 languages in the country.¹⁹⁹ More than three quarters of Sierra Leoneans (78%) is Muslim, 21% is Christian.⁸⁰

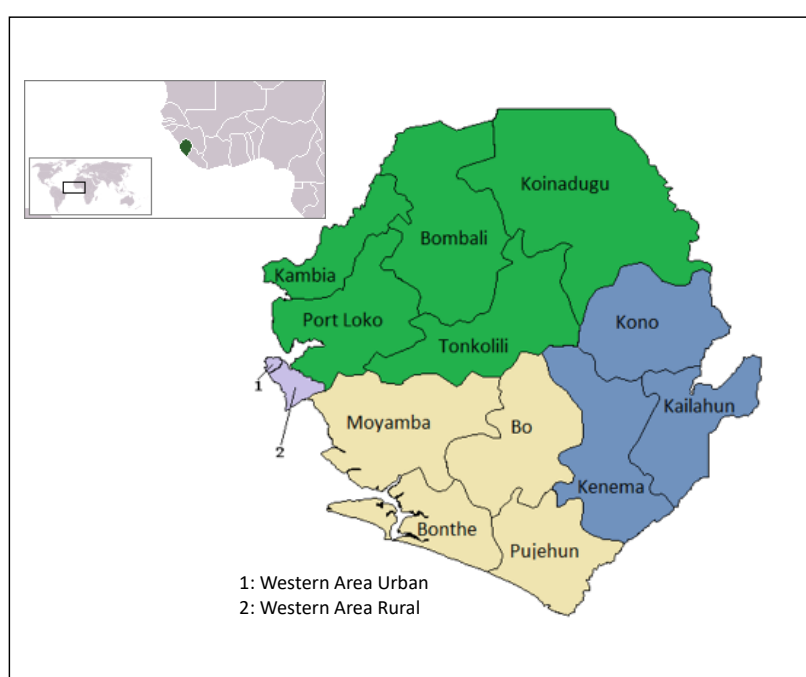


Figure 4. Map of Sierra Leone Regions and Districts²⁰⁰

Currently an estimated 43% of the adult population in Sierra Leone can read and write, but there is a large gender divide: 35% women are literate, compared to 52% of men.²⁰¹ The low levels of literacy play a role in how Sierra Leoneans use media: radio is the most used medium, accessed by 81% of the population.²⁰² There are many local and regional radio stations, but none of them have a nationwide reach. During the Ebola outbreak, the Independent Radio Network activated the network of radio stations they had set up to cover the 2007 elections. Using this network, the entire country could be reached.²⁰³ Internet access through computers or smartphones is still relatively low, but is rapidly increasing - 38% had access to internet in 2017. Large differences between rural and urban areas in terms of connectivity exist; around 65% of the urban population is estimated to have internet access, compared to less than 20% in rural areas.²⁰⁴ Only 13% of Sierra Leoneans had access to newspapers in 2015, and 45% could access TV.²⁰²

Sierra Leone used to be a media pioneer in West Africa, being the first country in the region to broadcast via radio and to publish newspapers.²⁰⁵ Unfortunately, the criminal libel law that was introduced in 1965 by the GoSL, was widely used to silence journalists.²⁰⁵ During the civil war, an estimated 70% of the media workforce fled the country.²⁰⁵ Even with the libel law still in place, the end of the civil war marked a comeback of many journalists and an expanding media landscape in the country. The law was finally repealed in July 2020.²⁰⁶ Reporters without Borders classified press freedom as ‘problematic’ in Sierra Leone in 2020 – it should be noted that this classification was made before the repeal of the libel law.²⁰⁷

The data underlying Studies I and II were collected at four times points of the Ebola outbreak: in August 2014, October 2014, December 2014 and July 2015.

The interviews for Study III were conducted in February and March 2016, a month after the last Ebola case was confirmed in the country. This qualitative study with Sierra Leonean journalists who reported during the Ebola outbreak was set in the Western Area - in urban Freetown and in Waterloo, a town about an hour drive from the capital.

The randomized controlled trial for Study IV was carried out in the fall of 2019 and took place in Freetown, among adults who had a smartphone with WhatsApp.

5.2 DESIGN AND DATA COLLECTION

5.2.1 Study I and II: The KAP surveys

Four nationwide, cross-sectional KAP surveys were conducted during the Ebola outbreak in Sierra Leone, in August 2014, October 2014, December 2014 and July 2015, see figure 5. The first survey took place during the exponential phase of the outbreak, and covered 9 out of the 14 districts in Sierra Leone - representing the districts with the highest Ebola transmission. Surveys two and three were administered one month before and after the national peak of the outbreak, respectively. The fourth survey took place during the long end tail of the outbreak, with relatively few cases nationwide. Surveys two to four covered all 14 districts of Sierra Leone. For all surveys, multistage cluster sampling was used, whereby the 2004 Sierra Leone Population and Housing Census List of Enumeration Areas²⁰⁸ was used as the sampling frame for the random selection of enumeration areas in the districts. Within the selected enumeration areas, households were selected through the random walk method - a form of systematic random sampling. In the selected households two interviews were carried out: one with the head of the household (usually a man) and the second with either a young person (aged 15-24 years) or a woman. The surveys comprised questions on knowledge (both correct knowledge and misconceptions around Ebola), attitudes (e.g. stigmatizing attitudes towards Ebola survivors) and behaviors (e.g. self-reported behaviors around Ebola prevention). The Sierra Leonean NGO FOCUS1000 was in charge of the data collection and training of the enumerators and received technical support from the CDC and UNICEF. The initial questionnaire was in English, which was translated during the training to local languages. The first survey was done on paper, but the subsequent surveys were carried out on tablets using Open Data Kit (ODK) software. The average response rate of the four

surveys was 98%. For Study I, data from all four surveys were pooled and analyzed. For Study II only surveys one to three were included, as the fourth survey did not include questions on risk perception – the main outcome of Study II. Study I and II were reported according to the guidelines for Strengthening the Reporting of Observational Studies.²⁰⁹

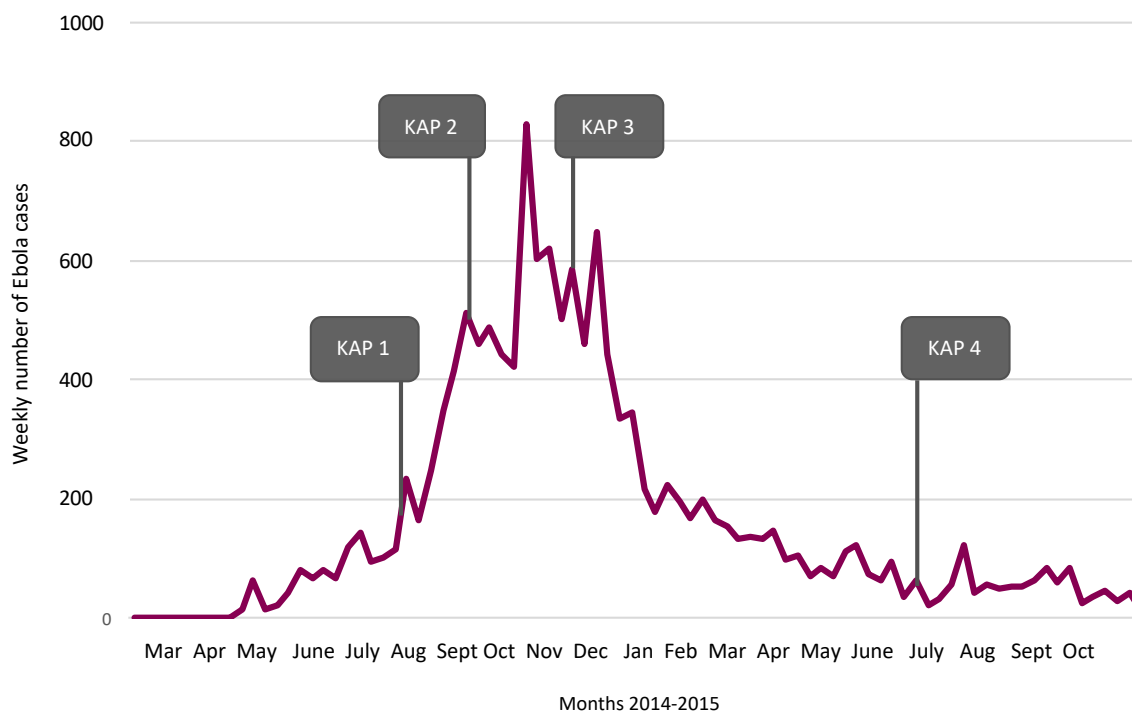


Figure 5. Timeline of the KAP surveys during the Ebola outbreak in Sierra Leone

5.2.2 Study III: The qualitative study

For this qualitative study, journalists were interviewed who reported during the Ebola outbreak in Sierra Leone. The previously mentioned NGO FOCUS1000 in Freetown assisted in the purposive sampling of the interview candidates, using their wide network of media professionals in the country. Journalists were eligible when they were currently working for a news outlet and had experience reporting during the Ebola outbreak. A total of 13 journalists were interviewed in 12 interviews. The majority of the participants was male and worked for radio, which reflected the media landscape of Sierra Leone, see table 2. 10 of the interviewees were based in Freetown, the other three were based in Waterloo. Three journalists (all in Freetown) were involved in the organization of training sessions around Ebola for journalists and in message creation during the outbreak. The other 10 journalists were recipients of the training and disseminated the messages further. All semi-structured interviews were conducted in English and were held in the journalists’ radio studios or newsrooms. The interview guide was informed by the results from Study I, showing that exposure to various information sources, such as radio, was associated with knowledge, misconceptions and behaviors. The guide contained questions about journalists’ experiences

during the outbreak, the information sources they accessed, as well as questions on knowledge and behaviors around Ebola.

Four extra interviews were held with other Ebola stakeholders to contextualize the interviews with the journalists. Stakeholders included a representative from the Ministry of Health and Sanitation in Sierra Leone, a Sierra Leonean media expert, a representative from an international NGO and an international health expert deployed to the Ministry of Health in Liberia. The study was reported following the guidelines from the Consolidated Criteria for Reporting Qualitative Research.²¹⁰

Table 2. Demographics of the journalists

Demographic	Sample
Location	10 in Freetown 3 in Waterloo
Age in years (mean, range)	37 (29-49)
Sex	10 men 3 women
Education	4 high school 9 university
Medium	11 radio 1 newspaper 1 online news site
Ebola training access	3 direct access to training and trainers themselves 10 receiving training

5.2.3 Study IV: The randomized controlled trial

The Contagious Misinformation Trial was designed as a prospective, three-arm randomized controlled trial that took place in Freetown in 2019, aiming to counter prevalent misinformation about typhoid. In Sierra Leone, typhoid is commonly referred to as ‘typhoid-malaria’ – whereby many people think typhoid is caused by mosquitoes and that typhoid and malaria always co-occur.²¹¹ During pilot studies in Freetown, people explained ‘typhoid-malaria’ in different ways. For instance, that a malaria infection weakens the immune system, after which a typhoid infection would occur. Or people would say ‘typhoid and malaria walk on the same road’ and ‘typhoid and malaria are friends’. Like malaria, typhoid is characterized by fever. Unlike malaria, typhoid is caused by a bacterial infection, which is commonly transmitted through the fecal-oral route, often via contaminated water and food. Malaria, caused by parasite-infected mosquitoes, is much more common in Sierra Leone than typhoid. Incidence studies of malaria and typhoid from Sierra Leone are lacking, but modelled estimates suggest that there were an estimated 3 million malaria cases and around 13,000 typhoid cases in 2017.²¹² Even though these numbers are modelled, it demonstrates the magnitude of the difference between malaria and typhoid incidence in Sierra Leone.

The gold standard to diagnose typhoid is through blood culture. In Sierra Leone however, there is currently only one hospital that has the facilities to do this, but limited resources constrain the actual use of it.²¹³ Typhoid diagnoses are therefore commonly made using the Widal test – a test with low sensitivity, specificity and positive predictive value.²¹⁴ Furthermore, the test reportedly cross-reacts with malaria antigens, increasing the likelihood of false positive results in malaria endemic areas.²¹⁵ Studies that compare typhoid and malaria diagnoses through different tests, show that the Widal test consistently overestimates the number of typhoid and malaria co-infections.^{216–218} For instance, a study in Northern India found that 8.5% of the 800 febrile patients tested positive for both malaria and typhoid when typhoid was diagnosed with the Widal test. When typhoid was diagnosed through culture, malaria and typhoid co-infection was found to be as low as 1.6%.²¹⁶ A study in Cameroon found that of 200 patients with fever, 17% had concurrent malaria and typhoid when diagnosed through blood culture. However, when using the Widal test, as many as 48% of these patients were shown to have both typhoid and malaria.²¹⁷ Another study in Nigeria found that out of 33 confirmed malaria patients, 42% also had typhoid according to the Widal test, compared to 6% when diagnosed through blood culture.²¹⁸ It can be deduced that in Sierra Leone, with its reliance on the Widal test, typhoid is overdiagnosed. Patients also frequently hear in health centers that they have ‘typhoid-malaria’, likely often without diagnostic tests.²¹⁹ This diagnosis also implies that antibiotics are commonly prescribed, in addition to antimalarials.²²⁰ The unnecessary usage of antibiotics likely contributes to antibiotic resistance and treatment failures.²²¹ While data for Sierra Leone is lacking, studies in other West African countries show that multi-drug resistant typhoid is on the rise.²²²

The Contagious Misinformation Trial aimed to counter the belief in typhoid-related misinformation, using audio dramas. Participants were randomized into three groups: two intervention groups or the control group. The two intervention groups received audio dramas of four episodes on WhatsApp about typhoid – every week on Mondays the next episode was sent. The interventions differed in that Intervention Group A received dramas that explicitly discussed the misinformation (Group A was called ‘Plausible Alternative’) (see figure 6), while Intervention Group B received audio dramas that only discussed the correct information about typhoid (the ‘Avoiding Misinformation’ group). Every episode had one core message, see table 3. The audio dramas were co-created with the Sierra Leonean well-known actor’s group the Freetong Players and FOCUS1000, both trusted organizations that are grounded in the communities. All dramas were recorded in Krio and produced to incorporate the Sierra Leonean understanding and culture around typhoid and malaria. The correct(ive) information about typhoid was given by actors playing nurses and physicians in the dramas. The QR code gives access to the audio dramas, as well as their English transcripts. At the start of each episode, the Freetong Players identified themselves,



together with FOCUS1000 and Karolinska Institutet. The control group received two audio messages about breast feeding.

Table 3. Core message per episode for the two intervention groups

Episode	Group A: Plausible Alternative	Group B: Avoiding Misinformation
1: Disease	People think there is a disease called ‘typhoid-malaria’, but these are actually two different diseases	You can get typhoid by itself, without having other diseases
2: Cause	Typhoid is not caused by mosquitoes, but by contaminated water and food	Typhoid is caused by contaminated water and food
3: Prevention	People think that sleeping under a bed net helps to prevent typhoid, but actually drinking treated water and cooking food properly are the best ways to avoid getting typhoid	Prevent yourself from getting typhoid by cooking your food properly and drinking treated water only
4: Repetition	Repetition of core messages of episodes 1-3	Repetition of core messages of episodes 1-3

The study was powered to be able to detect a 15% reduction in the belief in typhoid-misinformation. Based on pilot studies in Freetown, it was estimated that around 50% of the population believed in misinformation about typhoid. This led to an estimated sample size of around 250 participants in each study arm, taking into account attrition and intra-cluster correlation.²²³ A three-day training for 12 enumerators and three supervisors was conducted twice – one time before the recruitment and baseline survey and the second time before the follow-up survey. During the training, the recruitment and survey questions were practiced. The survey was in English and translated by a certified translator to Krio.

Freetown comprises 64 administrative sections, 21 of which were selected using weighted random sampling, with weights proportionate to the population of the section. The three teams of four enumerators and one supervisor visited one section per day and administered the survey using ODK on tablets. In each section, an enumerator would recruit nine new participants who fit the inclusion criteria:

- Living in Freetown
- Aged 18 years or older
- Fluent in Krio
- In possession of a phone with WhatsApp
- No hearing impairment

The data collection team started in the approximate middle of the section and used the random walk method, with a skip interval of 15 households. The supervisors of the data collection teams were asked to, apart from supervising, recruit participants who did not have WhatsApp. Because smartphone users in Freetown might be wealthier and more highly educated than the general adult population of the city, we also recruited an additional 60

participants who did not have WhatsApp, but were in possession of a phone. These participants were called every week to listen to the audio dramas over the phone. This also allowed testing whether the interventions worked with a different mode of administration. Participants with WhatsApp were randomized 1:1:1 to one of the intervention groups or control group, see figure 6. Participants without WhatsApp were randomized 1:1 to one of the intervention groups.

The enumerators were not supposed to say anything about misinformation when recruiting the participants, instead they called the study ‘Info Na Pawa’ (‘Information Is Power’ in Krio) and said the study aimed to understand people’s knowledge about diseases. Along with each new episode, participants received 10,000 Leones (around 1 USD) data credit to ensure they could download the episode. Study IV was reported in accordance with the Consolidated Standards for Reporting Trials²²⁴ and was pre-registered on ClinicalTrials.gov (NCT04112680).

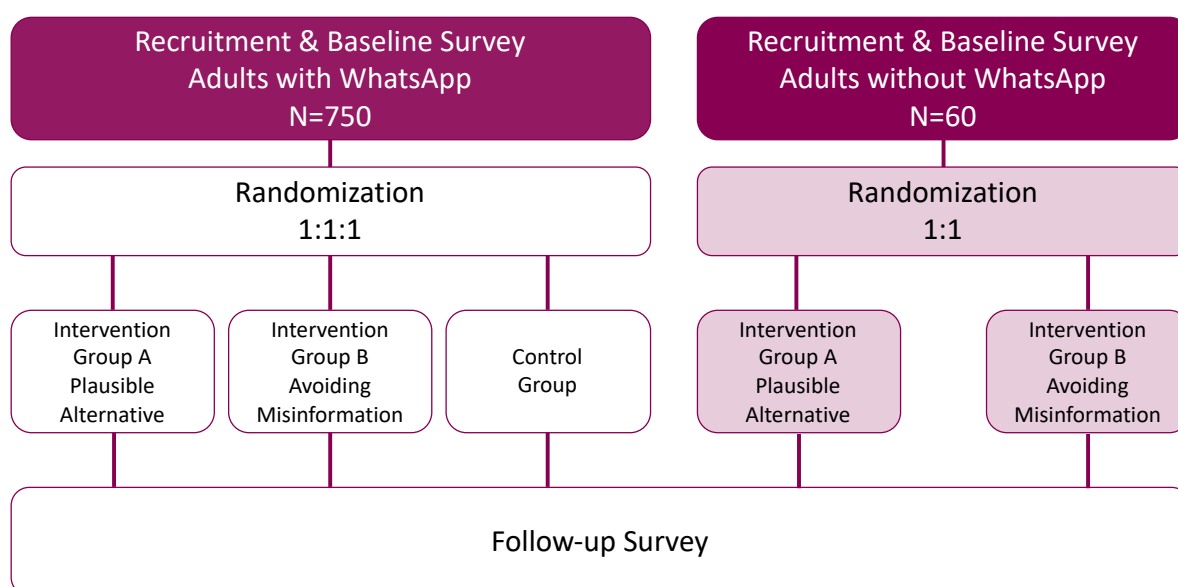


Figure 6. Overview of the Contagious Misinformation Trial

5.3 DATA ANALYSIS

5.3.1 Study I: Risk communication

For Study I, the data from all four KAP surveys were pooled and composite variables were created for exposure to information sources, knowledge and practices. For exposure to information sources, the question ‘*Through what means/ways did you learn about Ebola?*’ was used. This was an open question in the survey; the enumerator ticked the boxes that corresponded to the answers of the respondents – more than one alternative could be ticked. Five categories were created, reflecting the media landscape in Sierra Leone.²⁰²

- Electronic media (radio and TV)
- Print media (newspapers, brochures, other print material)
- New media (mobile phones, text messages, internet)
- Government (house visits by health workers, Ministry of Health and Sanitation)
- Community (religious leaders, traditional leaders, megaphone public announcements, community meetings, friends and family)

To make these categories mutually exclusive, those exposed to a source were compared to those who were not exposed to that source. To measure dose-response associations, a variable was created counting how many sources a respondent was exposed to, ranging between 0 and 5. Composite variable for knowledge and misconceptions were created based on two open-ended and five close-ended questions, see table 4.

Table 4. Overview of knowledge questions in the KAP surveys

Knowledge Questions	Correct answers	Incorrect answers
What causes Ebola?	Virus Bats/monkeys/chimpanzees	God or higher power Witchcraft Evildoing/sin Curse
What happens if someone suspected of Ebola goes to the hospital?	They will take care of him/her (rehydrate, give medicine, monitor status)	They won't be able to do anything They will definitely cure Ebola They will find a way to kill the patient <u>Extra in surveys 2-4:</u> They will be turned away
Can I prevent myself from getting Ebola by avoiding funeral/burial rituals that require handling the body of someone who died from Ebola?	Yes	No
If a person has Ebola, does he/she have a higher chance of survival if he/she goes immediately to a health facility?	Yes	No
If a person with Ebola goes immediately to a health facility, will he/she reduce the chance of spreading it to family or people living with him/her?	Yes	No
Do you believe that traditional healers can treat Ebola successfully?	No	Yes
Do you believe that spiritual healers can treat Ebola successfully?	No	Yes
Maximum score	Survey 1-4: 8	Survey 1: 12 Survey 2-4: 13
Cut-off for dichotomization	Survey 1-4: 0-6/7-8	Survey 1-4: 0/≥1

Because from the second survey an extra answering alternative was added to reflect the on-the-ground situation, the maximum number of correct or incorrect answers differed for the misconceptions score: in survey one a respondent could score a maximum of 12 wrong answers, and in survey two to four a maximum of 13. A similar approach was taken for risk and protective behavior, where two open-ended questions were used, see table 5. All scores were dichotomized based on the mean.

Table 5. Overview of behavior questions in the KAP surveys

Behavior questions	Correct answers	Incorrect answers
In what ways have you changed your behavior or took actions to avoid being infected with Ebola?	I wash my hands with soap and water I clean my hands with other disinfectants I try to avoid crowded places I wear gloves I try to avoid physical contact with people I suspect may have Ebola <u>Extra in survey 2-4:</u> I do not participate in burials that involve handling the dead body I use a condom when having sex with an Ebola survivor	I wash my hands with just water I drink Bittercola I drink a lot of water/juices I drink traditional herbs I take antibiotics <u>Extra in survey 2-4:</u> I wash myself with salt and hot water
What would you do if you suspect someone in your family has Ebola?	Avoid all physical contact and bodily fluids of that person Call the hospital/Ebola phone line	Nothing Help care for them at home Check temperature by touching the body Take to the hospital <u>Extra in survey 2-4:</u> Hide them
Maximum score	Survey 1: 7 Survey 2-4: 9	Survey 1: 9 Survey 2-4: 11
Cut-off for dichotomization	Survey 1: 0-2/3-7 Survey 2-4: 0-3/4-9	Survey 1-4: 0≥1

The associations between the various information sources and knowledge, misconceptions, protective behavior and risk behavior were analyzed using multilevel modeling, see figure 7. In an infectious disease outbreak, there is an inherent high correlation between cases over time and place. Multilevel modeling provides a way to account for this.²²⁵ To do so, clusters were created based on survey (i.e. time) and district, with a total of 51 clusters. Within the multilevel models, associations were estimated with crude and adjusted odds ratios (AORs) and their 95% confidence intervals (CI). The models were adjusted for age (15-20, 21-35, 36-49, 50+ years), gender (male/female), education (no education, primary education, secondary and above), religion (Islam/Christianity) and region (North, East, South, West).

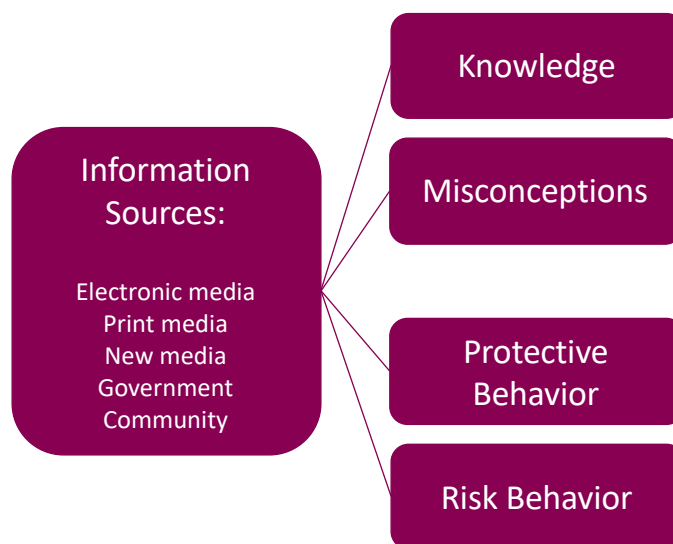


Figure 7. Analysis plan of Study I

Various studies have found that increased knowledge does not necessarily translate into the desired behaviors, also known as the ‘knowledge-behavior gap’.^{62–65} To test whether knowledge played a mediating role on the associations between exposure to information sources and protective behavior, mediation analyses were conducted using the mediated effect model.²²⁶ The same approach was used to test the mediating role of misconceptions on risk behavior. The β coefficients for A and B (see figure 8) were obtained from the adjusted multilevel models. They were subsequently multiplied and Standard Errors (SEs) were calculated. The Chi² distribution with 1 degree of freedom was used to determine the statistical significance of the mediated effects. For all analyses, alpha was set to 0.05 for statistical significance and SPSS 22 (Armonk, NY, USA) was used for the analysis.

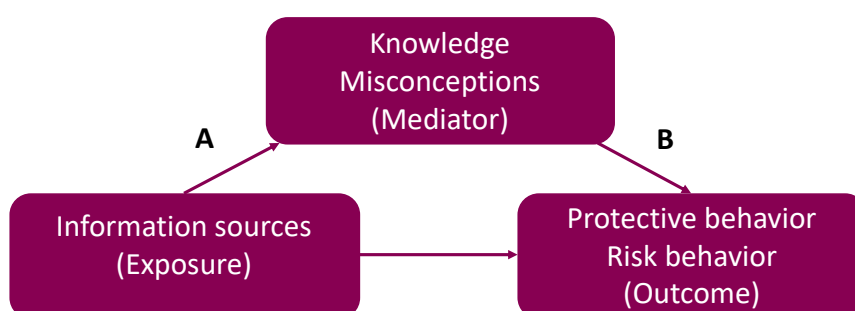


Figure 8. Mediation analysis Study I

5.3.2 Study II: Risk perception

To understand the role of risk perception and its associations with information sources, knowledge and practices, the first three KAP surveys were pooled for Study II. Risk perception was captured in the surveys with the questions: ‘*What level of risk do you think you have in getting Ebola in the next 6 months?*’ with the answering alternatives: ‘no risk, small risk, moderate risk or great risk’. The answers were dichotomized into ‘no risk

perception’ and ‘some level of risk perception’. The composite variables for exposure to information sources, knowledge and misconceptions were created as explained under Study I. Furthermore, three specific protective behaviors were analyzed that played a role in the transmission of Ebola:

- Washing hands with soap and water
- Avoiding physical contact with people suspected to have Ebola
- Avoiding burials/funerals that involve contact with the corpse

For the same reasons as explained under Study I, multilevel modelling was used to analyze the data, adjusting for gender (male/female), age (15-20, 21-35, 36-49, 50+ years), education (no education, primary education, secondary and above), religion (Islam/Christianity) and region (North, East, South, West). Multilevel models were estimated based on 167 sampling clusters. Associations between information sources, knowledge, misconceptions, behavior and risk perception were tested, see figure 9.

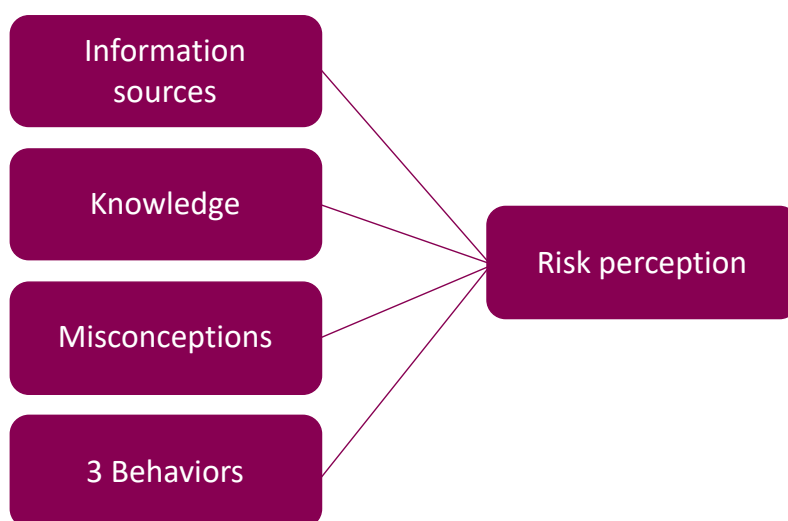


Figure 9. Analysis plan of Study II

Furthermore, mediation analyses were carried out to test whether knowledge, misconceptions and the three behaviors had a mediating effect on the associations between exposure to information sources and risk perception. Similar to Study I, the mediated effect model was used, whereby the β coefficients for A and B (see figure 10) were obtained from the fully adjusted models and multiplied.²²⁶ The statistical significance of the mediated effect was determined through the Chi2 distribution with 1 degree of freedom. StataMP 15 was used for all analyses, with an alpha set to 0.05 for statistical significance.

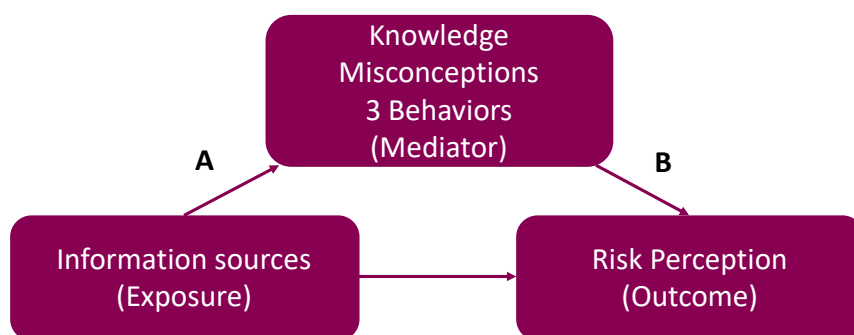


Figure 10. Mediation analysis Study II

5.3.3 Study III: Journalist roles

All interviews were transcribed verbatim. The analysis (carried out in NVivo) was an iterative process; going back to the literature for deeper understanding of emerging topics and using the newly acquired knowledge for further interpretation of the data. Comparing and contrasting between journalists (for instance between rural and urban journalists, or between journalists with various levels of access to Ebola training) helped to make the analysis more latent. Peer examinations²²⁷ were carried out with a Sierra Leonean peer with an academic public health background, who worked and lived through the Ebola outbreak in Sierra Leone. Using his experiences, he provided feedback on the emerging themes.

The analysis phase was inspired by, but not limited to, agenda-setting theory as described by McCombs^{72,73,228} and journalists roles as described in other emergency settings.^{229–232} In the agenda-setting theory it is proposed that mass media often sets the agenda, determining what people get to see and hear. The theory also describes four behaviors journalists commonly adopt, which should be regarded as a continuum: professional detachment, targeted involvement, boosterism and proactive agenda-setting.²²⁸ For the first three behaviors, agenda-setting is regarded to be a passive by-product of reporting. In the last behavior (proactive agenda-setting), the journalist actively seeks to set the public's agenda.²²⁸ Previously described journalist roles include the various roles German journalists took on during E. coli outbreak in the country in 2011. Among others, journalists were public advocates, catalysts and public safety officials (informing people about the public health risks for instance).²²⁹ The earthquake in Japan in 2011 similarly showed that journalists who normally considered themselves to be watchdogs temporarily turned into public mobilizers.^{230,231} Journalists who experienced Typhoon Haiyan in the Philippines in 2013 reportedly felt they were victims, leaders and community members, as well journalists.²³²

5.3.4 Study IV: Contagious Misinformation Trial

The Contagious Misinformation Trial had two primary outcomes:
To reduce the belief that:

1. Typhoid is caused by mosquitoes
2. Typhoid co-occurs with malaria

These outcomes were measured in the baseline and in the follow-up survey with the following questions: ‘*Can a person get typhoid from mosquitoes?*’ and ‘*Can you get typhoid without getting malaria?*’. The primary outcomes were analyzed with an intention-to-treat analysis, which excluded the participants who were lost to follow-up. Logistic regression models, both crude and adjusted, were controlled for the baseline value. The adjusted models included sociodemographic covariates: age (18-30, 31-49, 50+ years), gender (male/female), education (no formal, primary, secondary, post-secondary), religion (Islam/Christianity), and monthly income in Leones (0-300.000, 300.000-1.00.000, >1.000.000). Both intervention groups were compared to the control group as well as to each other.

The two intervention groups with participants who did not have WhatsApp were similarly analyzed using an intention-to-treat analysis, comparing the intervention groups to the control group of the WhatsApp participants and to each other.

To test whether the interventions unintentionally made people who held the correct belief at baseline believe the misinformation (i.e. whether the interventions seeded misinformation), logistic regression models were limited to people who held the correct beliefs at baseline. Similar to the intention-to-treat analysis, the intervention groups were compared to the control group and directly compared to each other. An exploratory analysis was conducted of two self-reported behaviors around typhoid prevention: an incorrect one (sleeping under a bed net) and a correct one (drinking treated water). This was based on the question whether participants were currently taking action to avoid typhoid infection in both the baseline and the follow-up survey. Those answering ‘yes’ to that question, received an open-ended question, asking them to list their actions. Enumerators would tick the corresponding answers on the tablet. Both behavioral outcomes were analyzed with logistic regression models, comparing the intervention groups to the control group and to each other. StataMP 15 was used for the analysis. To account for multiple hypothesis testing, a Bonferroni adjustment was applied, with an alpha set to 0.025 for statistical significance.

5.4 REFLECTIONS ON MY ROLE

I had different roles in the four studies. The data that was needed for Study I and II was collected while I was studying to get a Master’s degree in Public Health Epidemiology at KI. The team at FOCUS1000 conceptualized and carried out the data collection for the surveys. I was very lucky that they agreed to share some of the data with me and my supervisors to be analyzed for my Master’s thesis in the beginning of 2016.

I was also very lucky that the late professor Hans Rosling paid for my trip to visit FOCUS1000 in Freetown in 2016, so that I had a chance to understand the context of the data instead of analyzing the data from a distant laptop in the darkness of Sweden. Plus, I could do the data collection for a qualitative study around Sierra Leonean journalists (Study III). Staying in Freetown and working at the FOCUS1000 office was an eye-opener. As a Sierra Leonean organization, FOCUS1000 had a wide network in the entire country and enjoyed the trust of many ordinary Sierra Leoneans. I learned a lot about the difficulties of collecting data during an active outbreak; the logistics, the ethics, the speed at which it needed to happen and the trade-offs that needed to be made. Doing the interviews with the journalists provided input not only for Study III, but also gave a qualitative perspective on the results that emerged from Study I. Study III was a great learning experience in setting up a qualitative study, from conceptualizing and conducting qualitative interviews to the analysis and manuscript writing. Developing a study design is one thing, implementing and carrying out the study is something else. The process from rough ideas on paper to the actual interviews and data analysis gave me valuable insights into how many decisions you need to make along the way.

Getting to know my colleagues at FOCUS1000 meant days filled with laughter and (sometimes awkward) cultural differences. I think to them I was a sweaty, hot-headed stranger who gave them lots to laugh at – from incidents involving yelling about corrupted visa fees at someone who turned out to be the head of immigration, to getting laughed at for being afraid of a rat running around the office. Together with my favorite FOCUS1000 driver and friend Sam, I spent hours driving (and getting stuck in traffic) to the interviews for Study III. Listening to Sam's stories about the Ebola outbreak, but also his memories of the civil war gave me a much deeper understanding of Sierra Leonean culture. And he was almost like a therapist when the lack of electricity and the increasing temperatures started boiling my blood again - rationalizing and explaining why things were the way they were.

That first trip to Freetown created a bond between FOCUS1000 and KI that deepened as my PhD progressed and culminated in Study IV – when I could experience quantitative data collection first hand, working closely together with FOCUS1000. The entire year of 2019 revolved around the Contagious Misinformation Trial; early trips that year to Freetown involved lots of discussions about what kind of misinformation was prevalent in Sierra Leone. Together with Sam, I spent hours on markets talking to people about their beliefs around various diseases. FOCUS1000 called in the heads of their network of religious leaders, who gave their perspectives on which diseases people likely had misinformed ideas. It was not until I had heard people mention 'typhoid-malaria' a few times that I realized that this was something strange. Digging deeper, there turned about to be many narratives around 'typhoid-malaria', and almost everybody we spoke to had heard about it. I thoroughly enjoyed doing this detective work, talking to so many people from all walks of life in Sierra Leone; from religious leaders, to medical doctors, to market women, to traditional healers (who kept referring to me as 'Madam White Lady' and offered to bathe me in protective blood). FOCUS1000 played an instrumental gatekeeping role in all of this, guiding me and bringing me in touch with people. Without mentioning FOCUS1000 when I introduced

myself, I would never have been able to get access to so many people. This became abundantly clear when I was with Sam in the slum area of Kroo Bay one day, to do further pilot testing. You can't simply stroll around markets and ask people questions, or wander around slums and talk to people. Protocol demands that you first talk to the head of the market/slum to get their permission. When Sam and I located the head of Kroo Bay, I tried introducing myself, but he immediately started yelling at me. 'You white people come here, want to do your so-called 'research', you make promises to us that things will change. But they never do! And you white people just leave!' I was a bit taken aback by his tone and his aggression, but could only admit that he was quite right. Too often researchers and NGOs collect data to never be seen again. While I was stuttering a half-baked apology, Sam intervened. 'Sir, this lady is with us, FOCUS1000.' He showed the head of Kroo Bay his ID badge. In less than a second the face and posture of the man changed completely. 'Ah you are with FOCUS1000? Why didn't you say so? Of course you are welcome here! You can do the first interview with me!' His anger had completely disappeared. He joined us for the next three hours while we walked around Kroo Bay and talked to its residents. FOCUS1000 also put me in touch with the Freetong Players, the actor's group with whom we co-created the audio dramas for the intervention. Workshops with 12 outgoing actors, staff of FOCUS1000 and a bewildered Helena (my main supervisor) and me led to many lively discussions (putting it mildly) and ended in long photo sessions with everybody involved. Together with the Head of Research of FOCUS1000, mister Paul Sengeh, we developed a sampling and data collection plan. Planning every detail of the recruitment and data collection was an enormous challenge, but gave me invaluable experience – and a whole new appreciation for data. Helena and I made a list of everything that could go wrong, and plans for how to mitigate these problems.

Of course, when the data collection actually started, almost none of the things we listed went wrong. Instead a whole range of other problems popped up. Data collection tablets that were not charged on the morning they should have gone out. Enumerators who took a creative turn in the recruitment of participants. The sheer reality of recruitment and data collection in a slum, or in the hills of Freetown. Dirty rivers and fences had to be crossed sometimes to be able to find the next suitable household, all the while keeping an eye on a map to ensure you were still in the designated section. As part of quality assurance measures, I drove around with Sam to bring surprise visits to the enumerators, checking whether they gave the correct information to participants and asked the questions according to how we practiced them. When the interventions started, we had problems with sending the data credit incentives. The company that was supposed to do it conveniently 'forgot' to send credit to many participants, and could never work in a transparent way. This left us in the dark about who had received credit and who was right to complain to never have received anything. From week 3, we took the control, demanded our prepaid credit back and hired three enumerators to manually, phone number by phone number, send the data credit to our 700+ participants. The follow-up survey posed a whole range of new logistical problems: instead of following a skip interval, we now had to find our participants back. This actually went better than expected – we

reached 91% of them. Attending some of the follow-up interviews was quite the experience: some people came fully prepared with all the documents we gave them during recruitment, telling stories that they had gathered community meetings to talk about typhoid-malaria (fantastic of course, despite us asking to not share any information until after the follow-up survey). Others complained that they never received the dramas or the credit, that their phones had broken, or that WhatsApp had expired. Planning and supervising data collection in a low-income setting was both the most stressful and the most enriching experience of my PhD journey.

6 ETHICAL CONSIDERATIONS

The KAP surveys that formed the basis of Studies I and II were administered during an active outbreak. The research team in Sierra Leone faced several ethical dilemmas while collecting the data. The results of the KAP surveys aimed to provide the response to the outbreak with an up-to-date nationwide overview of knowledge and behavior of the general public. This meant that it was vital to include people who were at that moment potentially at high risk of contracting Ebola; families of sick people for instance. It was decided that these people, despite the risk they may pose, should not be excluded from the data collection, so that true insights into the knowledge and behaviors of the public could be obtained.

The results of the KAP surveys revealed that misconceptions and risky behaviors were not uncommon. Whereas in essence, it is not the job of a research team to educate their respondents on the rights and wrongs of different aspects of Ebola, it was decided to give all participants a brochure with information about Ebola after the interview. They were also given the chance to ask the enumerators questions about the virus. Enumerators were trained to answer these questions. In case they could not answer a question, they referred the participants to the Ebola hotline. In an outbreak setting, ethical implications should be extra carefully considered, so that data collection can be done in the best and most neutral way possible, while ensuring the principle of justice by including all eligible people – also those at-risk. Enumerators themselves could also have been considered to be at-risk during their work. They were extensively trained on all aspects of the virus and were instructed to not make bodily contacts, shake hands or enter the homes of participants.

As I came into the project after the data collection of the KAP surveys had finished, I did not actively have to make the many inherently difficult decisions the research team in Sierra Leone was facing. In talks with FOCUS1000 employees in Freetown, I learned a lot about the ethical implications of research in an outbreak setting in a low-income country. For instance, methods such as verbal consent had to be employed so that people with low literacy could also be included in the study - adhering to the principle of justice. Trade-offs in the rigor of study designs and the need to ensure fair access to interventions and potentially life-saving information, meant that observational studies were preferred, despite the fact that experimental studies would provide more rigorous evidence.

The data collection about the Ebola outbreak that I was involved in, was for Study III: the qualitative study with Sierra Leonean journalists. Ethical issues I had considered for that study were regarding the potential impact the interviews could have on journalists by bringing back painful memories of the outbreak. Furthermore, as Sierra Leone does not enjoy entire freedom of press in practice, I was careful to make sure that the transcripts of the interviews could not be traced back to individual journalists. From the start of the analysis, names and affiliations were removed.

In Study IV, I organized and supervised the data collection for the Contagious Misinformation Trial in Freetown, together with FOCUS1000. An important ethical

consideration for the trial revolved around the topic of misinformation. As the trial aimed to counter misinformation, we wanted to start with misinformed beliefs that were prevalent among the general public in Sierra Leone. Because the first studies were about Ebola, a natural extension would be to continue with that topic – trying to counter misinformation about Ebola. However, as pilot studies in Freetown made clear, Ebola is still a very sensitive topic in Sierra Leone. Merely talking or asking people questions about it, might incite the belief that Ebola is back. Many Sierra Leoneans fear that the virus will present itself again sooner or later. Our collaborators at FOCUS1000 strongly advised against using Ebola as a topic for the trial. Instead, we found that there is a lot of misinformation about another infectious disease: typhoid. The risk of doing harm with this topic (e.g. in the form of inciting rumors) was deemed to be very low.

The trial itself was not expected to pose harm to participants. It did not involve invasive procedures and people were only asked to listen to audio messages on WhatsApp. Every episode of the audio dramas contained correct information. All participants were extensively briefed on what it meant to participate in the trial and were not further enrolled before informed consent was obtained. Participants received contact information of the team members of the trial, as well as the phone number of the trial hotline, so that any concerns they had could be addressed. Participants were not told that the aim of the trial was to counter misinformation. Doing so could have potentially biased our results. Instead, the name of the trial in Krio was translated to ‘Info Na Pawa’ (meaning: Information is Power), highlighting that good information is important for people’s health. After completion of the follow-up survey, all participants received an information sheet, explaining in detail the actual aim of the study, and countering the misinformation around typhoid. This information was read out loud to illiterate participants. All participants were encouraged to ask any questions they had about typhoid; enumerators were trained to answer them. Naturally, all collected data was anonymized, kept safe on servers that were compliant with the EU’s General Data Protection Regulations and only made available to team members involved in the data analysis of the trial.

Ethical permission was obtained for all studies, both in Sweden at the Swedish Ethical Review Authority in Stockholm and in Sierra Leone at the Sierra Leone Ethics and Scientific Review Committee.

7 RESULTS

7.1 STUDY I: INFORMATION SOURCES, KNOWLEDGE AND BEHAVIORS

Pooling the four KAP surveys resulted in a sample size of 10,604 respondents. Due to missing data, 95 respondents (0.9%) were excluded, bringing the sample size for the study to 10,509. The sample had an even distribution between men (49%) and women (51%) and 67% of the sample was affiliated with Islam. Almost half (48%) of the respondents had attained secondary education or higher. Information about Ebola was most commonly received through electronic media (i.e. radio and TV) (94%) and community sources such as religious or traditional leaders (60%). A majority (73%) of the respondents had heard Ebola messages through at least 2 different information sources.

7.1.1 Information sources, knowledge and protective behavior

Being exposed to any kind of information source was significantly associated with increased Ebola-specific knowledge, see figure 11. The strongest association was found for electronic media (Adjusted Odds Ratio (AOR) 1.75, 95% Confidence Interval (CI) 1.46-2.09). There were similar associations between exposure to information sources and protective behavior, whereby new media showed the strongest association (AOR 2.15, 95% CI 1.87-2.48).

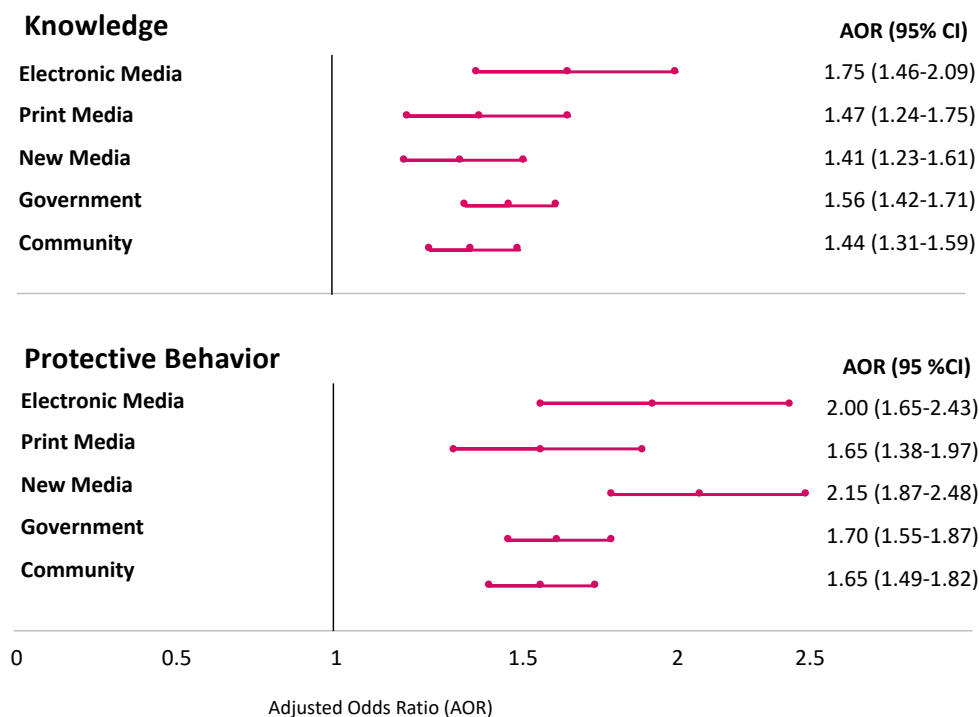


Figure 11. Associations between exposure to information sources and knowledge, protective behavior

7.1.2 Information sources, misconceptions and risk behavior

Unfortunately, there was another side of the coin: all information sources apart from print media were also associated with Ebola-specific misconceptions, but with lower point estimates, see figure 12. Being exposed to electronic and print media was not associated with risk behaviors around Ebola. New media, government and community sources however, did have a significant association with risk behavior.

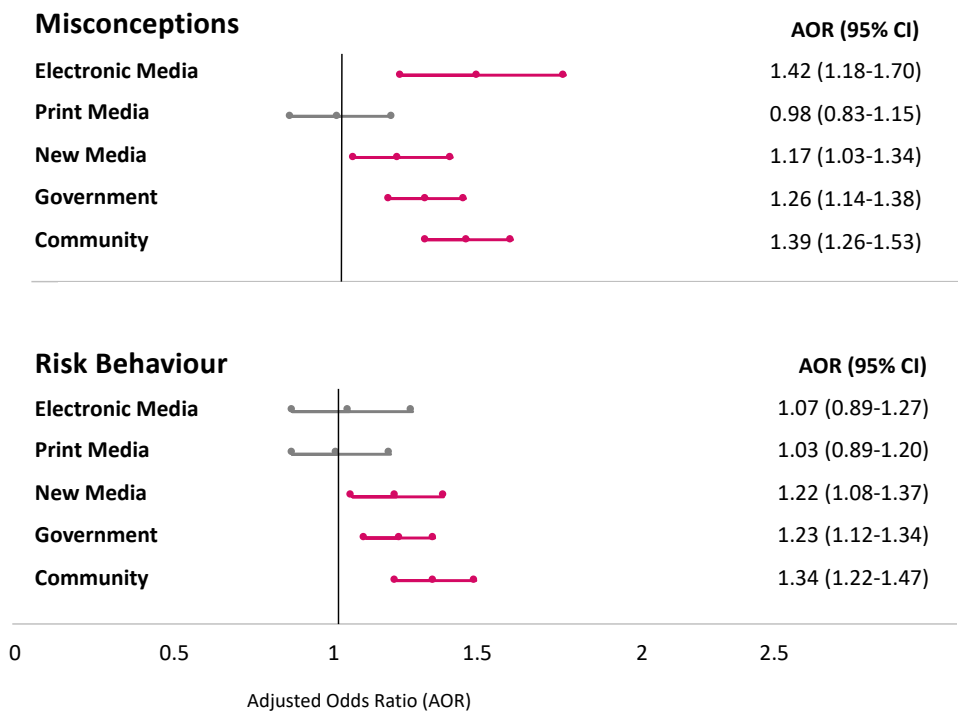


Figure 12. Associations between exposure to information sources and misconceptions, risk behavior

7.1.3 Clear dose-response associations

For all four outcomes (knowledge, misconceptions, protective and risk behavior), point estimates increased with exposure to more information sources, compared to being exposed to none or just one information source, see table 6. Protective behavior had the strongest dose-response association, whereby exposure to 4-5 sources resulted in an AOR of 6.77 (95% CI 5.53-8.28).

Table 6. Dose-response associations between information sources, knowledge, misconceptions, protective and risk behavior

	Knowledge	Protective behavior	Misconceptions	Risk behavior
Number of exposures	Adjusted OR [†] (95% CI)	Adjusted OR [‡] (95% CI)	Adjusted OR [†] (95% CI)	Adjusted OR [‡] (95% CI)
0-1 source	Reference	Reference	Reference	Reference
2 sources	1.37 (1.23-1.53)*	1.38 (1.23-1.54)*	1.07 (0.95-1.19)	1.18 (1.06-1.32)*
3 sources	2.09 (1.86-2.35)*	2.78 (2.46-3.14)*	1.67 (1.47-1.88)*	1.57 (1.40-1.77)*
4-5 sources	3.83 (3.17-4.61)*	6.77 (5.53-8.28)*	1.86 (1.56-2.22)*	1.87 (1.59-2.18)*

*p-value <0.05

[†]Adjusted for region, sex, age, religion, educational level, level of outbreak, all information sources

[‡]Adjusted for all of the above, plus knowledge and misconceptions

OR = Odds Ratio, CI = Confidence Interval

7.1.4 Knowledge and misconceptions as mediators

The mediation analyses showed that knowledge played a mediating role on the associations between exposure to all tested information sources and protective behavior, see table 7. A similar trend could be seen in the mediation analyses for misconceptions and risk behavior, whereby misconceptions played a mediating role on risk behavior for all information sources, apart from print media.

Table 7. Mediation analyses between knowledge and protective behavior, misconceptions and risk behavior

Information sources	Knowledge	Misconceptions
	Beta AB (SE)	Beta AB (SE)
Electronic media	0.369 (0.066)*	0.140 (0.040)*
Print media	0.256 (0.061)*	-0.009 (0.034)
New media	0.226 (0.048)*	0.063 (0.028)*
Government	0.294 (0.038)*	0.091 (0.022)*
Community	0.242 (0.037)*	0.132 (0.025)*

*p-value<0.05 based on Chi2 test with 1df

SE = Standard Error

7.2 STUDY II: RISK PERCEPTION AND RISK COMMUNICATION

The three pooled KAP surveys (KAP 1-3, see figure 5) yielded a sample size of 7,039 respondents. Demographic characteristics are in line with the four KAP surveys described in section 7.1. In the first KAP survey, 59% of respondents indicated that they perceived some level of risk of contracting Ebola in the next six months. This went down to 43% in both the second and third survey. Compared to survey one, this was a significant decrease (survey two AOR 0.40 95% CI 0.25-0.64, survey three AOR 0.37 95% CI 0.25-0.56).

7.2.1 Risk perception and information sources

From the five information sources tested, new media and community sources were significantly associated with increased risk perception (new media AOR 1.53 95% CI 1.21-1.93; community AOR 1.28 95% CI 1.07-1.53), see figure 13. Print media had a borderline significant association with increased risk perception (AOR 1.24 95% CI 1.00-1.54).

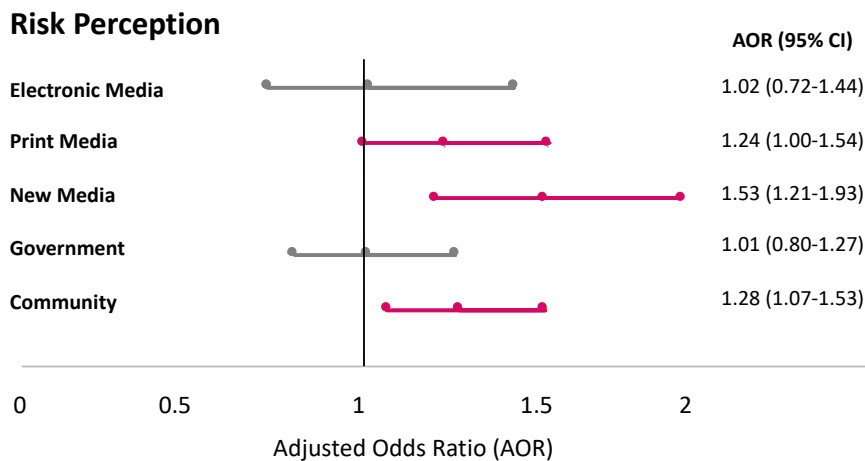


Figure 13. Associations between exposure to information sources and risk perception

7.2.2 Risk perception, knowledge and behaviors

Having appropriate Ebola-specific knowledge was significantly associated with increased risk perception (AOR 1.42 95% CI 1.15-1.75), see figure 14. Having misconceptions around Ebola however, was associated with decreased risk perception (AOR 0.67 95% CI 0.55-0.82). Regarding the specific Ebola behaviors, hand washing was associated with increased perception of risk (AOR 1.40 95% CI 1.13-1.74). Avoiding burials on the other hand, was associated with a decreased perception of risk (AOR 0.77 95% CI 0.62-0.96), while avoiding physical contact was not associated with risk perception (AOR 1.08 95% CI 0.91-1.29).

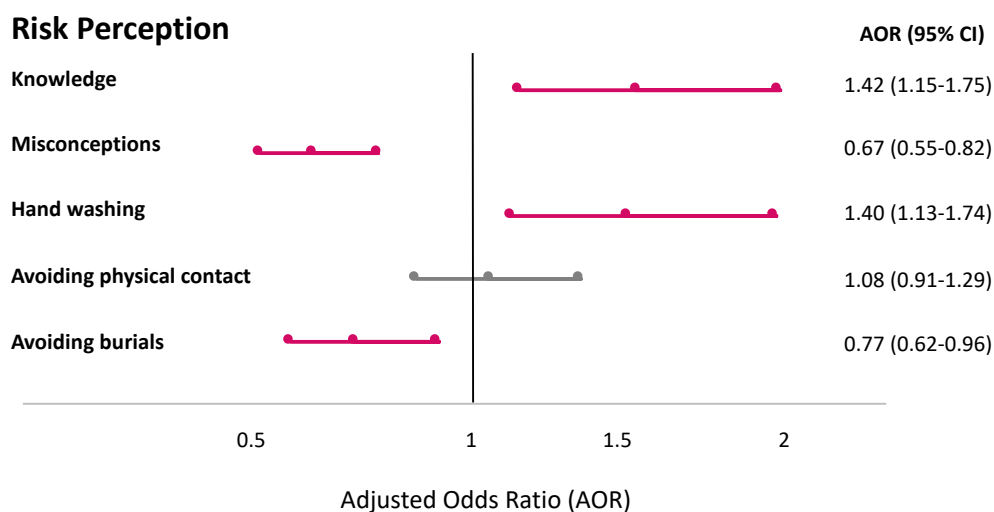


Figure 14. Associations between knowledge, misconceptions, behaviors and risk perception

7.2.3 Knowledge, misconceptions, behaviors as mediators

Knowledge and misconceptions played a mediating role on the associations between exposure to all information sources (apart from electronic media) and risk perception, see table 8. While avoiding physical contact was not directly associated to risk perception, this behavior was a mediator for all information sources, apart from electronic media. Practicing frequent hand washing was a mediator only for government and community sources, avoiding unsafe burials for new media, government and community sources.

Table 8. Mediation analyses between knowledge, misconceptions, behaviors and risk perception

Information source	Knowledge	Misconceptions	Hand washing	Avoiding physical contact	Avoiding unsafe burials
	Beta AB (SE)	Beta AB (SE)	Beta AB (SE)	Beta AB (SE)	Beta AB (SE)
Electronic media	0.230 (0.082)	-0.033 (0.060)	0.121 (0.066)	0.041 (0.049)	-0.144 (0.082)
Print media	0.076 (0.044)*	-0.022 (0.051)*	0.082 (0.059)	0.032 (0.037)*	-0.156 (0.076)
New media	0.120 (0.055)*	-0.059 (0.050)*	0.106 (0.059)	0.036 (0.041)*	-0.076 (0.042)*
Government	0.136 (0.053)*	-0.087 (0.045)*	0.096 (0.047)*	0.029 (0.033)*	-0.057 (0.037)*
Community	0.107 (0.045)*	-0.069 (0.044)*	0.111 (0.045)*	0.020 (0.023)*	-0.110 (0.054)*

*p-value <0.05 based on Chi2 test with 1df
SE = Standard Error

7.3 STUDY III: ROLES OF SIERRA LEONEAN JOURNALISTS

Four main themes around journalist roles were identified in the data, which are summarized in figure 15. The themes have a chronological order, as this is how the journalists reflected on their experiences reporting during the Ebola outbreak in Sierra Leone.

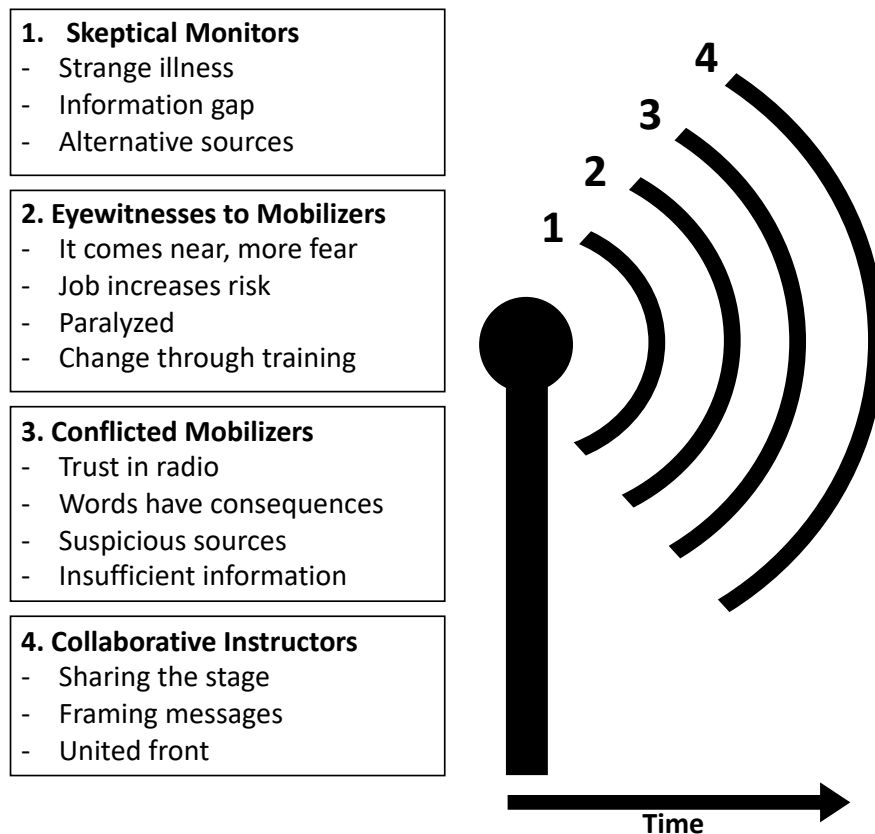


Figure 15. Themes and categories

7.3.1 Skeptical monitors

The journalists explained that during the first months of the Ebola outbreak, there was a lot of confusion about the existence of the outbreak, because the first cases were confined to the Eastern Province of the country – away from Freetown and an area where the (at that time) political opposition had a stronghold. Journalists did not take the outbreak seriously in the beginning:

‘...A strange illness had arrived, it transferred to contacts and it is killing people fast. But then, we didn’t take it seriously. Because it was confined to a far part of the country. The attitude was ‘it’s not my business’, to some extent that was also the attitude of the government.’ (Journalist 6)

Many different explanations about the outbreak emerged:

‘There was this perception among people that Ebola was a political tool, meant to wipe out the population of people where it all started.’ (Journalist 10)

Journalists said that it was hard to get official information about the outbreak:

‘Some of the major challenges we had here, was how to get to them [Ministry of Health and Sanitation]. Just to explain the Ebola thing. It took time. We had to go to other communities to interview health experts, asking them questions, asking to give information.’ (Journalist 3)

7.3.2 Eyewitnesses and victims to educators and public mobilizers

Apart from being reporters, the journalists in the study were also members of the public, citizens who experienced an outbreak up close. Most of the journalists lost friends or family members to Ebola. It terrified the journalists:

‘Initially we were so scared, even of recording. We thought, what if the person was talking and the saliva just came on your hand?... How do we hold the microphone?’ (Journalist 4)

The journalists still perceived a lack of official information about the outbreak, especially those working outside of Freetown. Some journalists in Freetown managed to get health experts to come explain the outbreak and the disease to their staff:

‘At one point, the CDC organized a media orientation for journalists to educate us on what Ebola was all about. The signs and symptoms of Ebola, what you need to do, what are the best practices for us to stop transmission of the disease.’ (Journalist 12)

Journalists said that the training reduced their fear and gave them practical tips on how to minimize their risks while reporting.

‘Once we had that knowledge, we had the power to feel the fear, but to confront the enemy anyways.’ (Journalist 4)

7.3.3 Conflicted mobilizers

The journalists said that the information from the Ebola training made their reporting about the outbreak more in line with official sources. As the journalists in this study perceived themselves to be highly trusted by their communities, several of them felt that reporting in line with messages from the government made their audiences suspicious about their motives:

‘Some people said, you guys are talking too much, that means that the government gives you a lot of money, that’s why you are talking.’ (Journalist 1)

A further complication of their reporting was that some of their messages raised more questions than they could answer:

‘We educated the people a lot, but the information that we passed at that time was not that enough. Sometimes it was contradictory. Because you tell people don’t come near the sick, but who is going to take care of the sick?’ (Journalist 1)

7.3.4 Collaborative instructors

Journalists said that as the outbreak continued, they became partners of the response. They started sharing their stage with health experts, local leaders and other trusted voices in their communities.

'People [journalists] host swabbers [those who take samples from corpses to determine the cause of death], burial team members, doctors, nurses at ETUs, traditional healers and leaders. Healers talking to other healers and ask them to stop their practices for a while. Religious leaders asking people not to touch dead bodies until swabbers had come and confirmed it was negative. Through that medium, each category of people had been targeted.' (Journalist 11)

Journalists also reflected that the nature of their jobs changed during the outbreak; from independent reporters to collaborative instructors:

'Before Ebola, our editorial policy was just to give views and information. We don't tell people what to do. We give our views and information and allow people to make their own decisions. When Ebola came, we realized it should be a different type of information dissemination. In fact, it was communication and not information. And by communication it means telling people what to do and what not to do.' (Journalist 6)

7.4 STUDY IV: CONTAGIOUS MISINFORMATION TRIAL

A total of 736 participants with WhatsApp were included at baseline and randomized to one of the three groups. With 68 participants lost to follow-up (see figure 16), the completion rate was 91%. At baseline, 94% of the participants had heard of the term ‘typhoid-malaria’. Belief in typhoid misinformation was prevalent at baseline, 51% of the participants believed that mosquitoes cause typhoid, and 59% believed that typhoid and malaria always co-occur. There was no significant difference between the randomized groups at baseline. Among the 60 participants with no WhatsApp, 62% believed in the mosquito cause and 75% believed that typhoid and malaria co-occur.

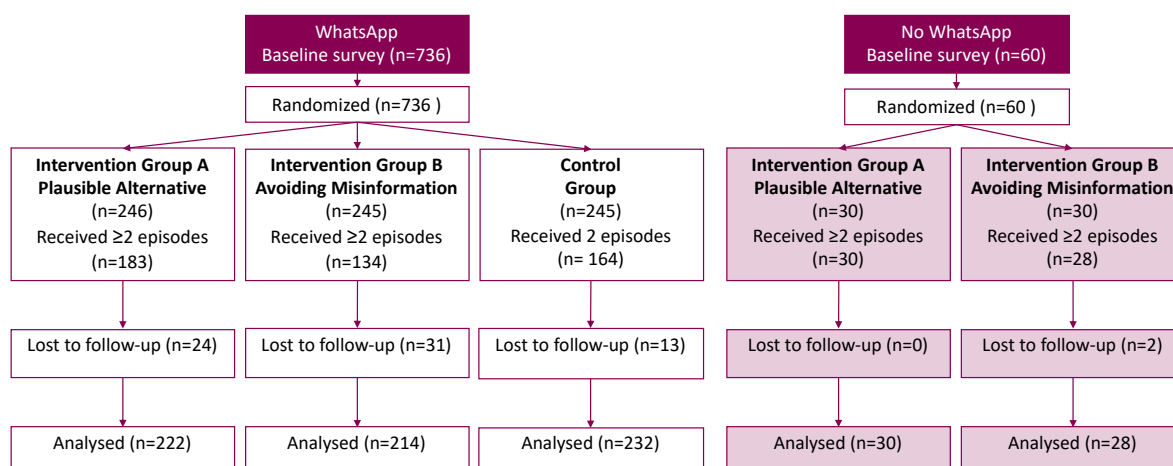


Figure 16. Flowchart of the Contagious Misinformation Trial

7.4.1 Intention-to-treat analysis

The intention-to-treat analysis of the WhatsApp participants showed that the belief in typhoid misinformation was reduced in both intervention groups compared to the control group, see table 9. Due to the Bonferroni adjustment, Group B was borderline significant on the mosquito-outcome (p-value: 0.029). A direct comparison between the two intervention groups showed that Group A (Plausible Alternative) had a greater reduction than Group B (Avoiding Misinformation) on both outcomes.

7.4.2 No misinformation seeded

The interventions did not unintentionally seed misinformation among the participants who held the correct beliefs at baseline (table 9). On both outcomes, participants in Group A were less likely to believe the misinformation at follow-up compared to the control (mosquito outcome AOR 0.25 95% CI 0.15-0.81, malaria outcome AOR 0.39 95% CI 0.18-0.82). There was no difference between Group B and the control group, or between the two intervention groups.

Table 9. Results of intention-to-treat, seeding misinformation, behavioral and non-WhatsApp analyses

	Adjusted* OR (95% CI)	P-value	Adjusted* OR (95% CI)	P-value
Intention-to-treat				
Typhoid comes from mosquitoes				
Group A	0.29 (0.18-0.47)	0.000	0.46 (0.28-0.76)	0.002
Group B	0.61 (0.39-0.95)	0.029	Reference	-
Control group	Reference	-	-	-
Typhoid and malaria co-occur				
Group A	0.29 (0.19-0.45)	0.000	0.51 (0.33-0.81)	0.004
Group B	0.55 (0.36-0.83)	0.004	Reference	-
Control group	Reference	-	-	-
Seeding Misinformation				
Typhoid comes from mosquitoes				
Group A	0.35 (0.15-0.81)	0.014	0.41 (0.16-1.05)	0.064
Group B	0.70 (0.33-1.51)	0.369	Reference	-
Control group	Reference	-	-	-
Typhoid and malaria co-occur				
Group A	0.39 (0.18-0.82)	0.014	0.72 (0.33-1.58)	0.413
Group B	0.58 (0.29-1.16)	0.123	Reference	-
Control group	Reference	-	-	-
Behaviors				
Sleeping under a bed net				
Group A	0.43 (0.24-0.78)	0.005	0.66 (0.35-1.27)	0.213
Group B	0.64 (0.36-1.12)	0.118	Reference	-
Control group	Reference	-	-	-
Drinking treated water				
Group A	2.78 (1.67-4.64)	0.000	1.57 (0.92-2.68)	0.100
Group B	1.77 (1.08-2.91)	0.023	Reference	-
Control group	Reference	-	-	-
Non-WhatsApp				
Typhoid comes from mosquitoes				
Group A	0.20 (0.07-0.52)	0.001	1.57 (0.33-7.36)	0.569
Group B	0.21 (0.07-0.64)	0.006	Reference	-
Control group	Reference	-	-	-
Typhoid and malaria co-occur				
Group A	0.13 (0.05-0.35)	0.000	0.55 (0.10-2.90)	0.480
Group B	0.26 (0.10-0.70)	0.008	Reference	-
Control group	Reference	-	-	-

*Adjusted for: sex, education, religion, income, age
OR = Odds Ratio, CI = Confidence Interval

7.4.3 Typhoid behaviors

Participants in Group A were less likely than the control group to report that they prevented typhoid infection by sleeping under a bed net (AOR 0.43 95% CI 0.24-0.78). There was no difference on this behavior between Group B and the control group. Participants in both intervention groups were significantly more likely to drink treated water to avoid typhoid infection (Group A AOR 2.78 95% CI 1.67-4.64, Group B AOR 1.77 95% CI 1.08-2.91). There was no difference between the two intervention groups on either of these outcomes.

7.4.4 Participants without WhatsApp

Among the participants who did not have WhatsApp, the belief in misinformation was reduced in both intervention groups compared to the control group (table 9), on both the belief that typhoid is caused by mosquitoes (Group A: AOR 0.20, 95% CI 0.07-0.52, Group B: AOR 0.21, 95% CI 0.07-0.64) and the belief typhoid and malaria co-occur (Group A: AOR 0.13, 95 % CI 0.05-0.35, Group B: AOR 0.26, 95% CI 0.10-0.70). There was no difference between Group A and Group B.

'We need to learn from earlier mistakes. The denial syndrome was a big problem. We need to learn how to get politics out of Ebola, or similar national emergency responses. People need to understand that some problems affect us all, and are bigger than tribe or party.' (p. 129 in 233)

These words were spoken by Chief Kallon, from Kailahun, who helped bring Ebola to an end in his district (see text box in section 2.4). Replace 'Ebola' in this quote with 'COVID-19' and it perfectly reflects the first 10 months of the coronavirus pandemic. Many lessons were learned during the West African Ebola outbreak. It's time we put these lessons into practice.

8 DISCUSSION

8.1 MAIN FINDINGS

Results from the analyses of the four KAP surveys, carried out at four time points of the Ebola outbreak in Sierra Leone, showed that exposure to information sources was associated with increased Ebola-specific knowledge and protective behavior. At the same time, exposure to all information sources, apart from print and electronic media, was also associated with Ebola-specific misconceptions and risk behavior. There was a strong dose response association; the more information sources one was exposed to, the higher the odds to exhibit appropriate knowledge, protective behavior, misconceptions and risk behavior. Knowledge and misconceptions played a mediating role on the associations between exposure to information sources and protective and risk behavior. The pooled analyses of the first three KAP surveys showed that exposure to new media (i.e. mobile phones, internet) and community sources (i.e. religious/traditional leaders) was associated with increased risk perception. While having appropriate knowledge about Ebola was associated with increased risk perception, Ebola-specific misconceptions were associated with lower perceptions of risk. Specific behaviors around Ebola showed a mixed picture in terms of their association with risk perception – increased frequency of hand washing was associated with increased risk perception, but avoiding burials was linked to decreased risk perception. Knowledge, misconceptions and behaviors played a mediating role on the associations between most information sources and risk perception.

Sierra Leonean journalists adopted various roles over the course of the Ebola outbreak. What started with skepticism about the existence of an outbreak in the beginning, changed into fears for the virus, which also impacted their work as journalists. Being educated about the virus empowered them and made them step away from their professional detachment as journalists to become instructors.

Results from the Contagious Misinformation Trial showed that the belief in typhoid-related misinformation was significantly reduced in both intervention groups compared to the control group. Furthermore, explicitly mentioning the misinformation and then providing an alternative (i.e. Intervention Group A) reduced the belief in misinformation more than focusing on the correct information only (i.e. Intervention Group B).

8.1.1 Information sources, knowledge and behaviors

The findings from Study I might appear slightly counterintuitive in that exposure to information sources was associated to knowledge and protective behaviors as well as to misconceptions and risk behaviors. This can be partially explained by the contradicting messages that were sent during the Ebola outbreak.²⁸ Moreover, various explanations and theories around Ebola can co-exist in communities. A cross-sectional survey carried out during the Ebola outbreak in Guinea, found that while 83% of the respondents indicated that a virus caused Ebola, 36% also believed that higher powers played a role in causing the outbreak.²³⁴ Exposure to electronic media (which was mostly radio), showed strong

associations with knowledge and protective behavior, but also with misconceptions. Communication through radio was not unidirectional during the outbreak; listeners were encouraged to call in with their questions and community leaders and experts were invited for interviews on radio. The strong associations could therefore be a result of various sources coming together in radio.

8.1.2 Risk perception

Results from Study II showed that only exposure to new media and community sources were associated with increased perception of Ebola risk. Compared to the other information sources in the study, these sources share the characteristic that they are more interactive; recipients of the information can express concerns and pose questions.^{45,235} Especially community leaders are commonly regarded as highly trusted sources of information.⁴⁴

While a heightened perception of risk is regarded to be a key determinant of behavior change by the WHO,⁵³ the observed associations in Study II between risk perception and the various Ebola-specific behaviors do not seem to follow that logic. Previous studies have also reported ambiguous results when looking at risk perception and behavior change.^{236–238} An explanation for this might lie in the nature of the data: cross-sectional surveys might not show an accurate picture of the interplay between risk perception and behavior. In the ‘risk reappraisal hypothesis’, Brewer et al. argue that time is an important and overlooked variable in risk perception and behavior change.²³⁹ People might adopt protective behaviors facing a certain risk and in turn feel less at risk, precisely because they have changed their behavior.²³⁹ The negative association between avoiding traditional burials and risk perception could therefore be an indication that those who avoided burials felt at less risk for Ebola because they avoided these high risk events. Similarly, the finding that hand washing was associated with increased Ebola risk perception could come from people feeling at risk and therefore feeling more inclined to wash their hands. Temporal data is needed to further test the risk reappraisal hypothesis. While the KAP surveys were collected at different time points, they should still be regarded as cross-sectional data.

8.1.3 Journalist roles

As Sierra Leonean journalists experienced and reported on the Ebola outbreak in their country, their roles shifted. Interestingly, they side-stepped their professional detachment as journalists when they turned into instructors – something that has not been observed among journalists reporting in other disaster settings.^{229,230,240,241} While many factors can influence how journalists react in emergency situations,^{68,232,242–244} one of the reasons that Sierra Leonean journalists stepped away from their detachment might lie in the fact that they were also personally affected by the outbreak. Many of the study participants lost family members or friends to Ebola, and all of them saw the emergency play out in front of their eyes. This might have increased their perceived need to inform their fellow citizens about the dangers of Ebola. The lack of understanding about the disease in the first months of the outbreak had a

paralyzing effect on the journalists. Acquiring knowledge through training was a turning point – it empowered them to carry out their jobs again.

8.1.4 Contagious misinformation

Results from the randomized controlled trial showed that both interventions significantly reduced the belief in typhoid-related misinformation, compared to the control group. Intervention Group A (Plausible Alternative) generally showed stronger reductions than Intervention Group B (Avoiding Misinformation). A similar trend could be seen in the analyses of the two self-reported behaviors (i.e. sleeping under a bed net and drinking treated water). It can be speculated that one of the reasons for this difference might lie in the dramatic elements of the audio dramas in Group A. Because these episodes explicitly mentioned the misinformation and then debunked them, there was more conflict and debate. This may have increased the ‘stickiness’ of the content.²⁴⁵ However, the misinformation itself also proved to be sticky: despite significant reductions in the belief in misinformation in the intervention groups, the belief was not completely eradicated in either group. This finding can likely be explained by the continued influence effect of misinformation, whereby despite credible corrections, there was (to some extent) a continued reliance on the misinformation.^{167,168,170} A recent meta-analysis of 32 studies found that the influence of previous misinformation never seems to be entirely eliminated.²⁴⁶

An often-debated topic in debunking misinformation is the unintended backfire effect, whereby debunking efforts can enhance people’s believe in the misinformation.¹⁷² While this trial did not specifically study a backfire effect, results show that the interventions did not unintentionally seed misinformation among those who held the correct beliefs at baseline. The finding that the self-reported wrong behavior (i.e. sleeping under a bed net to avoid typhoid infection) was significantly reduced in Group A, but not in Group B, could be explained by the fact that this was explicitly mentioned in the audio dramas for Group A (while at the same time highlighting that sleeping under a bed net should be done to prevent malaria). As it was wrong information, there was no mentioning of bed nets in the dramas for Group B.

WhatsApp has been utilized for health promotion in various settings, but this has so far been fairly limited in low- and middle-income countries.^{247–249} The Contagious Misinformation Trial showed that using WhatsApp to deliver debunking messages in a low-income setting is feasible, bearing in mind that the recipients of these messages might not be representative of the general population. Further studies should be carried out to determine the scalability of interventions using WhatsApp.

8.2 THEORETICAL CONTEXT

Various health communication and behavior change theories can help to contextualize and ground the findings of the four studies.²⁵⁰ Theories have inherent limitations in that they are highly simplified explanations of human behavior and generally assume that people are rather rational beings. Facing a deadly infectious disease outbreak understandably elicits strong

emotions, which likely influence rational thinking and acting. With that drawback in mind, some theories help to explain the findings of the four studies.

8.2.1 Health Behavior Model

The HBM focuses on the individual level of health beliefs and behaviors.²⁵⁰ It poses that the perceived susceptibility to a disease, the perceived severity of a disease, the perceived costs and benefits of taking action, cues to action and the perceived self-efficacy of the individual all influence people's decisions to engage in certain health practices.^{66,250} The results from Study I show that exposure to information sources was associated with knowledge and misconceptions – likely influencing the perceived susceptibility to and severity of Ebola. Similarly, exposure to information sources likely influenced the self-reported protective and risk behaviors through the perceived cost and benefits of taking action. While the actual content of various risk communication messages was not analyzed, the available messaging guidelines show that messages generally included cues to action.⁷⁷ All these factors may help to explain the public's behaviors during the Ebola outbreak.

The Sierra Leonean journalists interviewed for Study III shared their experiences on the individual level and on a community level. Their lived experiences on an individual level, being citizens and journalists during an unprecedented health emergency, likely influenced their views of the severity of Ebola and their own perceived susceptibility to getting infected, as well as the actions they did or did not take.

The perceived susceptibility to and severity of Ebola is also closely linked to the concept of risk perception. Study II showed that having appropriate knowledge about Ebola was associated with increased risk perception, having misconceptions with decreased risk perception – well in line with the HBM. However, the mixed results regarding the protective behaviors, as well as the finding that only the more interactive information sources were associated with increased risk perception, indicate that the HBM might not be sufficient to contextualize the findings. A broader approach could give different insights.

8.2.2 Social Cognitive Theory

The Social Cognitive Theory (SCT) might help to explain some of the results further.^{250–252} This theory takes a broader perspective, and poses that personal factors and characteristics, environmental factors and behavior all influence each other. Communication in general should be placed in this broader context, acknowledging that the interactions between individual, community and societal levels are complex and difficult to disentangle.^{252,253}

The mixed results in Study II around the Ebola-specific behaviors can be explained using SCT, as well as through the risk reappraisal theory, as described in section 8.1.2.²³⁹ Especially in an outbreak situation, circumstances can change quickly, influencing knowledge, misconceptions and practices. Lower risk perceptions might therefore not be a sign of a lack of knowledge, but of having adopted enough protective practices to not feel at immediate risk of contracting the disease anymore. The finding that the more interactive

sources of communication (i.e. new media and community sources) were associated with increased risk perception also point to the interplay between individual and community levels as outlined in the SCT.

An important element of SCT is the so-called ‘observational learning’, whereby behaviors are learned and practiced by seeing them in others, especially in role models. The information sources studied in Study I and II likely enjoyed varying levels of trust and had some characteristics of role models to the general public. The journalists in Study III were also trusted sources in their communities and might have been role models to some degree themselves. The journalists experienced first-hand that words they said on air, or stated by guests they invited to their studios, had consequences in their communities. One journalist described an incident whereby a studio guest started a rumor on the radio, after which a hospital in the area was attacked and vandalized. When journalists turned more into instructors later in the outbreak, they had to balance two other aspects of SCT: self-efficacy and expectations. As they explained, you can encourage people to call the Ebola hotline (increasing self-efficacy), but if in reality there are no hospital beds or ambulances available, it can hamper the public’s expectations and potentially undermine trust in the source of the information as well as in the response efforts in general.

8.2.3 Agenda-setting theory

Agenda-setting theory can help to further contextualize the various roles of the Sierra Leonean journalists in Study III.^{72,73,228} The media can never report about everything; there is always a selection process at play. The topics that the media chooses to focus on, are made more salient to the public. It has been shown that there is a strong correlation between what the media reports on and the importance the public assigns to that topic.⁷² This process of setting the agenda can be a passive byproduct of reporting; for instance, on topics that have inherent news value (e.g. upcoming elections).²²⁸ In their role as skeptical monitors in the first phase of the Ebola outbreak, agenda-setting was rather passive for the Sierra Leonean journalists. When they turned into public mobilizers later in the outbreak, agenda-setting was done proactively. In the final phase, as instructors, the journalists actually went beyond that – the Ebola outbreak was already the most salient topic. Instead, the focus turned to second-level agenda-setting (i.e. framing the news) – with messages including elements of behavior change communication instead.^{254,255}

8.2.4 Debunking

Trying to debunk misinformation is about changing someone’s mental model around a topic. It is not simply about learning new information, it is about re-learning information and updating or creating a new mental model. The HBM and SCT both mention the role communication can play in correcting misinformation. Study IV made use of trusted sources in the audio dramas, facilitating observational learning as outlined in the SCT. The audio dramas were created with an ecological perspective in mind, so that the content reflected how people normally encounter and handle ‘typhoid-malaria’. Debunking misinformation and

with that, re-learning information, poses challenges, as numerous studies have shown. Ideally one would like to study whether debunking has an effect on actual behavior, not just self-reported behavior. As the SCT shows, support on community and societal level, as well as in the physical environment are likely needed to be able to make debunking efforts have a behavioral impact. In the case of Study IV, an added layer of difficulty is that people often hear about ‘typhoid-malaria’ from credible sources such as doctors and nurses in health centers. To be able to make debunking efforts have a lasting effect on knowledge and behavior, an ecological perspective would therefore imply implementing and evaluating interventions on all levels; from doctors and nurses, to the availability of better diagnostic tests, to empowering individuals to question a typhoid-malaria diagnosis and more restrictions on the availability of antibiotics.

8.3 METHODOLOGICAL CONSIDERATIONS

8.3.1 Study design and data collection

Various study designs were used for the four studies. Study I and Study II were retrospective quantitative analyses of three (Study II) or four KAP surveys (Study I). Study III was a qualitative interview study, and Study IV a randomized controlled trial. These study designs all come with their own strengths and limitations.

The KAP surveys underlying Study I and Study II were cross-sectional surveys, carried out at different time points of the Ebola outbreak in Sierra Leone. Apart from the first survey, which was done in nine out of the 14 districts of Sierra Leone, surveys two to four were nationwide and included all districts. All surveys had relatively large sample sizes. Being able to adjust for potential confounders, and applying multilevel modeling, made for robust analyses. The respondents of the surveys were different in each survey round, so individual changes in knowledge and behavior could not be measured. For ethical reasons, respondents received an Ebola information sheet after completing the survey. A learning effect would therefore distort the results if the same respondents would be followed-up again in the next surveys. Whereas the surveys were carried out at different time points, they should be still considered as cross-sectional surveys with their inherent limitations. With cross-sectional data, there is always a risk of reverse causality, so significant associations should be regarded as just that: associations. Even though temporality cannot be established with this type of data, the mediation analyses performed in Study I and II assume that the exposure happened before the mediator and the outcome. Ebola was a new disease in Sierra Leone, it can therefore be assumed that knowledge about the disease was low at the start of the outbreak, and most information came from the information sources included in Study I and II. So, at least on paper, both exposure and mediator most likely occurred before the outcome. It should also be noted that all behaviors that were asked about in the surveys were self-reported and might therefore not directly reflect how people behaved in real life.²⁵⁶

Study III was a qualitative interview study, aiming to understand the roles and experiences of Sierra Leonean journalists who reported during the outbreak. A qualitative study provides in-

depth insights that can give further meaning to a phenomenon, which is hard to obtain using quantitative methods. The role of the interviewer is important in qualitative studies; the level of established rapport with the interviewee can influence how the conversation flows and how interviewees answer the questions.²⁵⁷ As I carried out the interviews, my background in journalism was both a curse and a blessing. Being trained as a journalist was a blessing in that it might have been easier for me to establish rapport with the interviewees. Whereas I had no experience reporting in a health emergency, I understood the basic demands of their jobs. It might also have been a curse in that as a journalist, I was trained to hunt for the quotes, the soundbites and repeatedly asking the question ‘why?’. As a qualitative interviewer, you should let your interviewee be free to tell his or her story, with a limited amount of probing. I had to learn to restrain myself from asking the ‘why?’ question that was always on the tip of my tongue. Determining whether the sample size of a qualitative study is large enough, can be done by evaluating of the information power of the sample.²⁵⁸ According to this method, various dimension can impact the information power, such as the aim of the study, the specificity of the sample, the use of established theory, the quality of dialogue and the analysis strategy. While information power is not meant to give a conclusive sample size, studies that have a narrow aim, have a highly specific sample, use established theory, have strong dialogues and use case rather than cross-case analysis are considered to have more information power, and therefore smaller sample sizes can be sufficient.²⁵⁸ Applying this to Study III, one can argue that there was an underrepresentation of journalists from rural areas in the sample, which limited further cross-case analysis. Apart from one interview, the dialogues were rich. The overall information power of Study III was deemed to be sufficient.

The randomized controlled trial that formed the basis for Study IV is a strong study design, which lends itself to examine cause-effect relationships between the tested interventions and the measured outcome.²⁵⁹ The main focus of the trial was on participants who were in possession of a phone with WhatsApp installed. This method could be criticized, as it might represent a population that is wealthier and potentially more educated than the average adult population of Sierra Leone. The participants of the trial indeed had a higher educational attainment compared to the general population of Western Area (6% of trial participants did not have any formal education versus 19% of the general population of Western Area).⁷⁸ To ensure that participants of different demographic backgrounds could be included, as well as to test whether the interventions worked with a different method of administration, 60 participants without WhatsApp were recruited. Just like in Studies I and II, the analyzed behaviors were self-reported, and thus might not reflect actual behavior.²⁵⁶ A major strength of the trial was that it aimed to counter prevalent real-world misinformation about health in a community setting.

8.3.2 Social desirability bias

The tendency to answer according to what is perceived to be socially desirable by the respondent can lead to social desirability bias. During the Ebola outbreak, health promotion and risk communication messages tried to raise awareness about the disease and informed the

public about protective practices. Knowing the messages of the official (inter)national response might have influenced the respondents of the KAP surveys to respond according to what they thought the enumerators wanted to hear as opposed to what they actually knew and practiced. The level of knowledge and protective behaviors of the public would then be overestimated, while the level of misconceptions and risk behaviors would be underestimated. To counter this potential bias, enumerators ensured respondents at the start of the survey that there were no repercussions to their answers, that their answers were anonymous and encouraged them to answer the questions truthfully. Furthermore, behavioral questions were asked in an open way, so that respondents were not triggered to a certain response. Despite these measures, social desirability might still have played a role in all KAP surveys – especially the ones that were done later in the outbreak when the general public had been exposed to risk communication messages longer.

Social desirability bias may have also played a role during the interviews for Study III. As I, a white woman from Europe, conducted all the interviews, the journalists I spoke to may have had a certain idea in mind of how I would interpret the interviews and tell me their stories from that perspective. This could for instance be noticed in that the interviewees were not very strong in self-reflection and all ascribed great importance to the role of journalists during the Ebola outbreak. The four extra interviews that were carried out with other stakeholders and the peer examinations during the data analysis allowed for further contextualization.

The tendency to answer socially desirable was of less concern for the Contagious Misinformation Trial. While almost all respondents had heard of ‘typhoid-malaria’, there had not been any large information campaigns targeting typhoid recently. It was therefore harder for participants to know what the socially desirable answer to some of the questions would be, which likely increased the chances of them answering honestly. Just as with the KAP surveys, the enumerators encouraged all participants to answer according to their beliefs and practices and ensured them that their answers would be treated anonymously.

8.3.3 Instruments and validation

Validation of data collection instruments is especially important in quantitative studies, as the (mis)use of instruments can greatly influence the results. The KAP surveys were not psychometrically validated before being deployed. This was due to the ongoing, unprecedented health emergency, which required fast data collection. However, all questionnaires were pilot tested before being used. The items in the KAP surveys were also used for KAP studies in neighboring Liberia and Guinea during the Ebola outbreak, which supports their usefulness to some extent. Methods to rapidly psychometrically validate newly developed (or adapted) survey items would be very useful in emergency settings.

Similarly, the baseline and follow-up questionnaires developed and used for Study IV were not psychometrically validated, mainly due to constraints in resources. The instruments were adapted and inspired by the KAP surveys in Studies I and II, as well as KAP surveys used specifically for typhoid. Extensive pilot testing in Freetown helped to improve the

instruments. The two questions that were used for the primary outcomes (*‘Can a person get typhoid from mosquitoes?’* and *‘Can you get typhoid without getting malaria?’*) were yes/no questions - useful to get clear-cut answers. However, a Likert-type scale might have given more information regarding how certain participants were about their answers and to what extent the interventions moved their answers on the scale.

8.3.4 Generalizability

To determine the generalizability of the studies, one needs to look at the external validity of each study.²⁶⁰ The data for the KAP surveys underlying Studies I and II were generated using probability sampling, which should, in theory, give the general public equal chances to be included. Apart from the first KAP survey, in which nine out of 14 districts were sampled, surveys two till four included all districts of the country. The survey samples largely reflected the general population of Sierra Leone aged 15 years and older.²⁶¹ It can therefore be said that, with some caveats, the results from Studies I and II were generalizable to the general adult population of Sierra Leone.

The aim of Study III was to obtain a deeper understanding of the roles and experiences of Sierra Leonean journalists. As the journalists in the study were important and trusted gatekeepers of information, the results could be transferable to other low-income settings with reliance on local radio stations and help in planning risk communication strategies in health emergencies.

Randomized controlled trials typically have high internal validity, but might suffer from lower external validity as the set-up does often not properly reflect reality.^{262,263} Pragmatic randomized controlled trials have higher external validity, since they are implemented in community settings, with interventions that could continue in absence of the research team.^{263–265} The Contagious Misinformation Trial could be seen as a hybrid between a classic RCT and a pragmatic RCT, with strict control (e.g. sending the audio dramas and checking who received them), but taking place in a community setting. The generalizability of the trial might therefore be higher than a classic RCT, especially considering that probability sampling was used to recruit the participants. Contrary to many other studies that have aimed to counter constructed misinformation among undergraduate students or through online survey experiments,^{140,167} the Contagious Misinformation Trial targeted real-life misinformation in a community setting, giving the results a higher external validity. However, the exact contents of the audio dramas are not generalizable outside of Sierra Leone as they were tailor-made to reflect the worldviews and experiences with typhoid and malaria in the country. The building blocks of the audio dramas (i.e. stories that are in line with worldviews, delivered by credible sources, repetition of the core messages), do have external validity – it would be interesting to test those in different settings and across different communication channels.

8.4 IMPLICATIONS

8.4.1 Risk communication should be a central pillar

The four studies in this thesis have shed a light on the role of risk communication and misinformation in infectious disease outbreaks – especially looking at the 2014-2016 Ebola outbreak in Sierra Leone. Results from the quantitative and qualitative studies in Sierra Leone showed that information sources have an important role to play in an outbreak. This role can go in various directions; from increased knowledge and protective behavior to increased misconceptions and risk behavior. The interviews in Study III showed the importance of keeping local journalists well-informed, as well as engaging them in the response to an emergency. Results from the risk perception study (Study II) indicated that risk perception is a complex phenomenon that is difficult to measure with cross-sectional studies. As time passes and outbreak situations change, the change in knowledge and behavior will likely have influenced the perceived risk of contracting a disease. Messages during an outbreak need to be continuously updated and be aligned with the real situation on the ground. Just like the ‘Ebola has no cure’ message was communicated for too long in Sierra Leone, the message to call the Ebola hotline when someone was sick was less effective when there were long waiting times for ambulances.²⁶ The level and role of trust in various information sources and its influence on changing knowledge, attitudes and practices was not measured in the studies, but it would be important to do so in future health emergencies. *Distrust* has been shown to hamper the response, both in the West African Ebola outbreak and in the North Kivu Ebola outbreak in 2018-2019.^{4,266} As perceived trust in information sources can change over time, it should ideally be evaluated continuously in a health emergency. For instance, Ebola survivors faced stigmatizing attitudes in the first months of the outbreak.³ While some stigma persisted, a qualitative study among community members in Sierra Leone showed that later in the outbreak, Ebola survivors were regarded as highly trusted sources on outbreak-related information.²⁶⁷ Factors such as timeliness, completeness and clarification of the information can influence the perceived trust.²⁶⁸ Taken together, risk communication and community engagement should be one of the core pillars in outbreak response – not an afterthought.^{44,269} Or, as has been suggested in the wake of the COVID-19 pandemic, effective risk communication should be considered a social determinant of health, alongside classic social determinants such as access to health care and education.²⁷⁰

8.4.2 Test, trace, isolate and communicate

Applying these findings and implications to the current coronavirus pandemic, one can see clear parallels. While commentators in high income countries wondered why it was so hard for Sierra Leoneans to avoid touching their loved ones during a burial ritual,²⁷¹ simple practices such as keeping physical distance or wearing a face mask have become polarized and politicized topics in many places around the world in the current pandemic.^{272,273} Effective risk communication has been hampered by widespread misinformation, distrust in organizations like the WHO and – as the pandemic continues – fatigue of public health measures.^{1,274,275} Furthermore, risk communication in the form of a dialogue with affected

communities have largely been lacking.²⁶⁹ Again, the focus is mostly on the biomedical part of the response, with slogans like ‘Test, Trace and Isolate’.²⁷⁶ Much more fitting would be ‘Test, Trace, Isolate and Communicate’.

While circumstances were very different, risk communication and community engagement lessons from West Africa can be translated to countries on other income levels as well. Dialogue and more engagement (which will also enhance a sense of ownership of the response⁴⁵) can be achieved through, for instance, social media campaigns and online Question and Answer sessions. Through events, such as (online) townhalls, communities can be encouraged to co-create long-term sustainable public health measures. The government in the United Kingdom actively worked with social media influencers to promote and increase testing for COVID-19 among adolescents.²⁷⁷ These types of community-led ‘bottom-up approaches’ have been shown to have played an important role in the West African Ebola outbreak,^{278–280} but are overlooked and underused in the current pandemic.

8.4.3 Battling an infodemic

The results of the Contagious Misinformation Trial hold lessons for the rampant coronavirus misinformation pandemic, also dubbed the ‘infodemic’. As results of the trial have shown, real-life misinformation can be debunked. However, given the sheer amount of misinformation circulating, and the fact that misinformation often travels farther and faster than correct information,¹⁴⁶ decisions need to be made as to what kind of misinformation should be prioritized. On top of the list should be misinformation with important behavioral implications.¹⁴⁸ The building blocks of the interventions created for Study IV could be used to craft targeted debunking interventions in the current pandemic.

But before interventions are created, it is important to get a deeper understanding of the reasons why the misinformation is spreading. Rumors and misinformation are often based on real concerns and are a way of trying to make sense of what is happening.^{3,4,281} Vaccination programs are no strangers to widespread misinformation.²⁸¹ While it is easy to dismiss people holding the misinformed beliefs as ‘vaccine hesitant’, their concerns are often based on valid questions, but also on deep-rooted distrust in vaccines and the health system.^{282–284} They should be listened to and their concerns should be taken seriously.²⁸¹ Doing so enables the creation of much more targeted debunking interventions. Just like with risk communication as outlined in section 8.4.2, engaging with communities and co-creating debunking interventions will enhance ownership and increase the chances of successfully countering misinformation.

Debunking misinformation that is already spreading, is one way of battling the infodemic. Another method of addressing misinformation has a clear analogy with vaccines: the inoculation method. Similar to a vaccine, this implies being exposed to a weakened form of the (expected) misinformation and explaining why an argument is flawed from the outset.²⁸⁵ ‘Cognitive antibodies’ should protect a person from believing subsequent misinformation.²⁸⁵ It usually also involves an explicit warning that misinformation can be expected. Studies

evaluating a game based on this theory show promising results, but are prone to various serious limitations.^{285–289} For instance, study participants were self-selected and knew that the goal of the game was to learn to resist misinformation.²⁸⁷ Effects of the inoculation seem to be short-lived.^{290,291} Still, inoculation (or ‘prebunking’) is potentially an interesting method that should be evaluated with more rigorous methods, which will also help to understand to what extent the cognitive antibodies work when exposed to misinformation on very different topics.

Methodological issues are not limited to the inoculation method. As explained before, the large majority of studies that looked into debunking have relied on online survey experiments or on small samples of undergraduate students.^{140,167} Most studies used constructed misinformation, to which the study participants were not exposed before.^{167,170,187–190} Study IV addressed these limitations by debunking real-life misinformation in a community setting. However, there are limitations that affect all debunking studies: the lack of measuring behavioral outcomes.²⁹² Instead, as a proxy, many studies (including Study IV) ask questions on self-reported (intentional) behavior. Whereas this might be an indicator of real-life practices, self-reported behavior is not the same as actual behavior and is often prone to social desirability bias.²⁵⁶ Creative solutions should be found and reliable methods to measure actual behavior should be developed to address this major shortcoming.

To summarize, instead of focusing on de- or prebunking one piece of misinformation and measuring whether it had an effect on the belief in the misinformation, there are steps before and after that should be taken. The step before includes taking a holistic approach to the misinformation. This means creating an understanding of the reasons and concerns that underlie the misinformation, as well as understanding the social interactions and networks, and the levels of trust in various actors. This will help in creating dialogue and engagement and in finding ways to actually reach the people who hold the misinformed beliefs. The step after debunking means measuring actual behavior and studying whether the debunking efforts had an effect on it.

In an ever-evolving pandemic where misinformation travels at lightning speed, this holistic approach might seem unrealistic. Enormous resources are needed to be able to address even a fraction of the widely circulating misinformation. Still, it is likely to be worth it. Because while misinformation has side-effects such as the erosion of trust in (health) authorities,¹⁴⁸ serious efforts to debunk misinformation through engaging with communities can have the benefit of restoring some of that trust, which can have a larger ripple effect on other protective health behaviors and health service utilization.

9 CONCLUSIONS

Being exposed to various information sources over the course of the 2014-2016 Ebola outbreak in Sierra Leone was associated with increased knowledge and protective behavior, but also with misconceptions and risk behavior. The more information sources one was exposed to, the stronger these associations. It shows the need to have clear, transparent, and contextualized information available during the entire course of an epidemic. Being exposed to sources that are trusted and allow for dialogue (such as community sources and new media), was associated with an increased perception of risk of getting Ebola. The mixed findings regarding risk perception and various protective behaviors likely point to the complex interplay between behavior and risk perception – whereby adopting a behavior has an effect on how the risk of disease is perceived. However, the cross-sectional nature of the data does not allow for clear-cut conclusions. Temporal data is needed to establish this theory further.

As trusted sources in their communities, Sierra Leonean journalists had an important role to play during the epidemic. However, in the first months of the outbreak, their work was undermined by a lack of forthcoming official information and a lack of knowledge about Ebola. The empowerment they felt after receiving training on the topic and the roles they took on as mobilizers and instructors, shows that local journalists can be vital partners in outbreak response. Their platforms should be leveraged in health emergencies to disseminate risk communication messages, not only by journalists, but also by trusted community members.

Misinformation about Ebola was widespread during the outbreak in West Africa, and is similarly pervasive in the current coronavirus pandemic. The Contagious Misinformation Trial showed that prevalent beliefs in infectious disease misinformation can be successfully targeted and debunked. Whereas the audio drama interventions used in the trial were highly specific to the Sierra Leonean context, the elements (delivered by trusted sources, repeated exposure, and in line with existing worldviews) could be tested in other settings as well. A strategy which actively engages with the misinformation is likely to be more successful in debunking than merely focusing on the correct information.

Taken together, the studies in this thesis show that risk communication and misinformation management should be key pillars in health emergency response and preparedness and need to be rooted in communities.

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