



The climate crisis and cholera: Integrating data and research to inform decision making

22nd February 2023: Technical workshop on research and surveillance needs

23rd February 2023: Open discussion forum with GTFCC partners



GLOBAL TASK FORCE ON
CHOLERA CONTROL

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Summary

On the 22nd-23rd February 2023, the Global Taskforce on Cholera Control (GTFCC) and the Wellcome Trust brought researchers, decision makers and public health implementers together through a virtual workshop to discuss cholera and climate.

The **objectives** included highlighting existing evidence and gaps on the interconnectedness between climate and cholera; identifying key climate and cholera research themes; and discussing challenges and opportunities that would enable the use of climate information to inform real-time decision-making for cholera prevention and control.

The discussion outlined the **complex relationship** between climate and cholera, identifying that opposite pattern can appear in different geographic locations. Climate is one driver of cholera, and can impact an outbreak through two main ways:

- Climate effects on cholera transmission, whether from an environmental reservoir into people (environmental spillover) or through human-to-human transmission via unsafe water, sanitation and hygiene (WASH).
- Climate disasters that increase the vulnerability of populations (for example, extreme flooding leaving more people with limited safe and effective access to WASH).

The recommendations from the meeting covered three main areas:

1. **Align research priorities with decision making:** the research should be led by the evidence gaps and needs for making decisions on cholera prevention and control
2. **Address challenges with data:** lack of transparency on data quality and inaccessible datasets hamper effective integration and use of climate data for informing cholera control planning,
3. **Answer key scientific knowledge gaps:** further research is needed to understand the relative contribution and pathways to disease impact of climate compared to other drivers of cholera (conflict, forced migration, and poverty – all mediated by unsafe and ineffective WASH), and within climate the relative contribution of different climatic events on a region-by-region basis.



Image credit: GTFCC

This event had representation with participants from the UK (approximately 30% of participants), USA (30%), Africa (30%) and South Asia (10%), and a range of expertise from infectious disease research, climate science, and public health decision making and implementation. However, this does not cover all geographies or knowledge gaps, so subsequent engagement should also include experts from Latin America, and other disciplines such as engineering and hydrology, for example.

This event was to initiate a discussion that this will lead to further conversations between climate and infectious diseases researchers, and public health decision makers and implementation teams. Next steps are to continue to work with these stakeholders (as well as others who we have not engaged with yet) to identify the priority themes that could be used to create a climate-focused annex to the Cholera Roadmap Research Agenda.

Introduction

On the 22nd-23rd February 2023, the Wellcome Trust and the Global Taskforce on Cholera Control (GTFCC) brought researchers, decision makers and public health implementers together through a virtual workshop to discuss cholera and climate.

The first day involved a technical workshop to identify key research themes as well as the challenges, gaps and opportunities in using climate information for cholera decision making. The second day was an open advocacy and communications forum, focusing on information-sharing and updates from countries and partners, and a call for stronger research and data on the connection between climate and cholera.

The meeting objectives were to:

- Examine the interconnectedness between climate and cholera, including the role of gradual climate changes and extreme climate events in driving recent outbreaks;
- Discuss the value of bringing climate and cholera surveillance data together
- Identify and discuss gaps and opportunities for improvement, for example how to operationalise the use of climate information to inform real-time cholera decision making
- Identify key climate and cholera research themes and potential research priorities, including connections with the Cholera Roadmap Research Agenda and the broader GTFCC strategy;
- Discuss methods for enabling greater collaboration between cholera stakeholders and climate scientists;
- Share perspectives on current advocacy efforts and brainstorm what is needed to integrate climate into future planning.



There are many public health factors that contribute to cholera outbreaks, most importantly the limited access to safe and effective WASH. Climate is one driver of cholera and is not sufficient to cause a cholera outbreak on its own, yet there are clear and complex interactions between the climate, weather and cholera that warrant further research. These interactions are context-dependent, often with opposite patterns appearing in different geographic locations.

The potential impact of climate on our ability to predict, prepare and respond to outbreaks has become clear over the last year. There is now an opportunity to coordinate within the cholera community by identifying the key climate-focused research gaps, building on the Cholera Roadmap Research Agenda which outlines the evidence required to understand how, when, and where to use tools to prevent and control cholera (WASH, OCV, surveillance, case management and community engagement).

Key recommendations

The discussions over the two days identified research challenges, gaps and opportunities for bringing climate and cholera information together in an appropriate way to inform decision-making. Three groups of recommendations were made: align with decision making, address data challenges, and answer scientific knowledge gaps.

1) Decision making

The underlying message throughout the event was that research questions should be led by what is needed to make decisions on cholera prevention and control. Evidence generated by research should enable the 'end-users' of climate and cholera information to make better informed and evidence-based public health and policy decisions.

Participants highlighted that climate information could be harnessed to:

- Refine hotspots to prioritise interventions
- Act as an early warning system to inform preparedness strategies
- To inform deployment of resources as part of longer-term prevention plans.

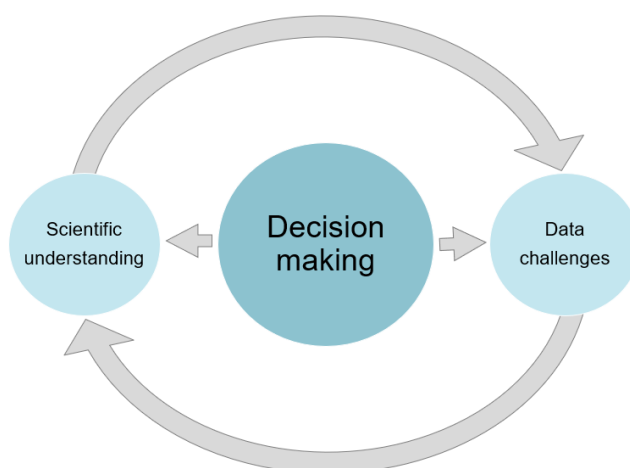
Key consideration: When using climate information for these three activities, it is important to ensure there are effective communication channels between researchers & decision makers to help them interpret & use data in an appropriate way.

2) Challenges with data

There are key opportunities for using climate data as part of cholera control decision-making, particularly as there is a wealth of historical climate data that could be investigated to identify past trends, whilst monitoring climate in real-time can develop more robust prediction models. However, to be useful for decision making, there is a pressing need to overcome barriers to collecting, accessing and integrating climate and cholera surveillance data. The main issues raised include:

- Both cholera surveillance and climate data can be of poor quality, non-existent or wrongly interpreted.
- Real-time, community-level datasets are often unavailable or not transparent to implementation teams
- Harmonising datasets can be complex, particularly given the diverse time and geographic scales covered by different climate datasets

Key consideration: In order to overcome these challenges, there needs to be a conscious effort to strengthen collaborations between cholera and climate experts in order to identify what data should be collected locally, nationally and globally in a way that enables climate and cholera data to be analysed together.



3) Scientific knowledge gaps

There is significant heterogeneity in how climate, weather, hydrology and seasonality affect cholera (some of which is exemplified below under 'The complex relationship between climate and cholera'). For example, some areas of Sub-Saharan Africa have seen increased cholera incidence rates during El Nino periods, whilst others have seen reductions during that same time. Cholera outbreaks have also been associated with both droughts and flooding, as well as with seasonal and extreme weather events. In many situations, climatic events amplify conditions already known to drive cholera outbreaks, predominantly limited access to safe and effective WASH.

The discussions identified three key priorities for coordinating the scientific community, highlighting that research needs to:

- Understand the relative contribution of climate and pathways to disease impact compared to other drivers (conflict, forced migration, and poverty – all mediated by unsafe and ineffective WASH), and within climate the relative contribution of different climatic events
- Define and use consistent metrics for assessing associations between cholera, climate, weather, seasonality, geographic areas and time periods. For example, metrics & measurements used in research should be:
 - a) using appropriate time periods (the impacts of climate change require multi-decade datasets, whilst the impacts of weather require data from a shorter time period),

- b) using consistent climate metrics (at the moment research varies with climate exposures measure through rainfall intensity, cumulative precipitation, time lag between weather etc)
 - c) using consistent cholera measures (confirmed cholera cases rather than suspected, incidence rate, reproductive number or the start of outbreaks)
- Prioritise regional-level research, identifying patterns that spanned across national borders and promote cross-border collaborations

Key consideration: the relevance on the climate research question depends on the social-ecological context, i.e. the social, cultural, economic, biological and environmental factors that drive transmission within a particular area. Also, prediction models need to be evidence-based and validated like any other tools used as part of control strategies (like diagnostics, vaccines etc.).



*Salma collects water from a tubewale to reduce outbreaks of waterborne diseases like cholera, typhoid and diarrhoea in Jamalpur, Bangladesh.
Image Credit: Mushfiqul Alam/NurPhoto via Getty Images*

Discussion themes

The complex relationship between climate & cholera: Exemplars from Africa & South Asia

The first part of discussions on day 1 outlined some of the current evidence on the associations between cholera and climate. Global genomic and epidemiological evidence suggests that there are two paradigms of cholera transmission: one driven by environmental spillover, the other driven by human-human transmission (and these paradigms are not mutually exclusive). Whilst environmental transmission is an important driver of cholera in some locations, these studies suggest that human-to-human transmission is more likely to be responsible for the spread of the serogroup responsible for the 7th cholera pandemic (7PET *V. cholerae*) and therefore the driver of the majority of current cholera outbreaks.

A high concentration of research conducted to date has focused on the Bay of Bengal, although evidence in sub-Saharan Africa (mainly at the ecological level) is being increasingly generated, as demonstrated by. Cholera is endemic in South Asia, with consistent seasonal patterns which are exacerbated by climatic factors. These patterns differ between coastal and inland regions within a country, as well as differing across countries within South Asia. For example, in Bangladesh cholera patterns in Dhaka and Matlab are characterized by an initial peak in the dry season in spring and a second peak after the wet season in autumn. This contrasts with Southern coastal areas that see a single spring peak, and northern inland areas which see a single autumn peak. Other countries have different patterns: Iran has a higher incidence of cholera when there is less precipitation. Importantly, increasingly severe climatic events have led to more vulnerable populations as abnormal monsoon rainfalls have led to overflowing drains, widespread flooding, and contaminated drinking water all of which supports *V. cholerae* transmission.

Over the two days, we also heard about the impact of climate on cholera within countries in Africa, particularly in Kenya, Nigeria and the Democratic Republic of Congo. In Kenya, the largest outbreaks since the 1980s have coincided with the El Niño South Oscillation and La Niña climatic cycles. The 2021 outbreak followed flooding across Kenya, whilst severe droughts have contributed to a significant outbreak in 2022-23. In these situations, climate was one of numerous drivers

of cholera as the droughts led to water shortages that were amplified by poor WASH infrastructure in urban and informal settlements and, increased population movement into Kenya from neighboring countries (and subsequently with more people living in slums characterized by overcrowding, poor housing, open drainage systems, and poor WASH infrastructure). It may also be relevant to explore the persistence of multi-drug resistant *V. cholerae* in relation to environmental reservoirs and changing environmental conditions.

Similarly in Nigeria, major flooding events in 2012 and 2022 had greater impacts in areas already known to be cholera hotspots, and cholera outbreaks have previously occurred mostly during the rainy season. In the DRC, there are different patterns sub-nationally with some cholera hotspots having more outbreaks during the dry season, with others during the wet season, meaning they require a context-specific, multi-sectoral response that brings in cholera surveillance, weather forecasting, and land use teams in order to inform preventative OCV campaigns.

Operationalising climate information in public health

Over both days of the event, the public health, non-governmental implementation, policy, and advocacy representatives from gave their perspectives on the possibilities of using climate data to inform decision-making for cholera control and what is needed to enable this in a robust and appropriate way.

There is potential to use climate information to indicate when an outbreak is likely to occur, thus helping implementing teams take a predictive and preventative approach rather than solely a reactionary and responsive one. Currently, research and data are not aligned with operational activities, and most cholera data is kept within confidential networks during outbreaks. There is therefore a need to agree standards that allow implementation partners to use “good enough” data direct from ongoing investigations to inform operations before waiting for research studies to be published, as well as conduct implementation and operational research to identify how to ensure climate and cholera information can be used most appropriately. Also, challenges arise when bringing global or national climate data to the community and aligning it with cholera surveillance programmes.

It was repeatedly said that climate information could be useful for identifying communities to prioritise interventions, like OCV campaigns and WASH activities, particularly if early warning systems could enable community-level actions before a declaration of an official outbreak. Existing systems and tools that are used for surveillance should also be adapted to incorporate climate information as part of standard processes.

Finally, research teams should work closely with public health to communicate research outputs, particularly to ensure the uncertainty and limitations in data and models are understood by the teams who will be using them to make decisions. If

decision-making teams, such as those in Ministries of Health or in non-governmental organisations, are unaware of the limitations of these models, they risk relying too heavily on predictions without accounting for uncertainty, assumptions and the underlying data source and quality. Effective communication of climate and disease models should aim to balance this with a need to act in a preventative manner and take appropriate risks. Therefore, models need to be sufficiently validated and accompanied by clear communication with results conveyed to decision makers in a way that bypasses the need and time to interpret complex datasets.

Conclusion and next steps

This event highlighted that climate is one of many drivers of cholera, and on its own is not sufficient to cause an outbreak. The lack of access to safe and effective water, sanitation and hygiene (WASH) is the primary driver for cholera outbreaks, and these situations are made worse during more extreme climatic and weather events. However, there is a complex relationship between cholera and climate that is dependent on socio-ecological contexts, and knowledge and data in this field could be harnessed to help predict, prevent and prepare for cholera outbreaks. The event was to initiate a discussion that this will lead to further conversations between researchers, decision makers and implementation teams. Next steps are to identify the top priority themes that could be used to create a climate-focused annex to the Cholera Roadmap Research Agenda.

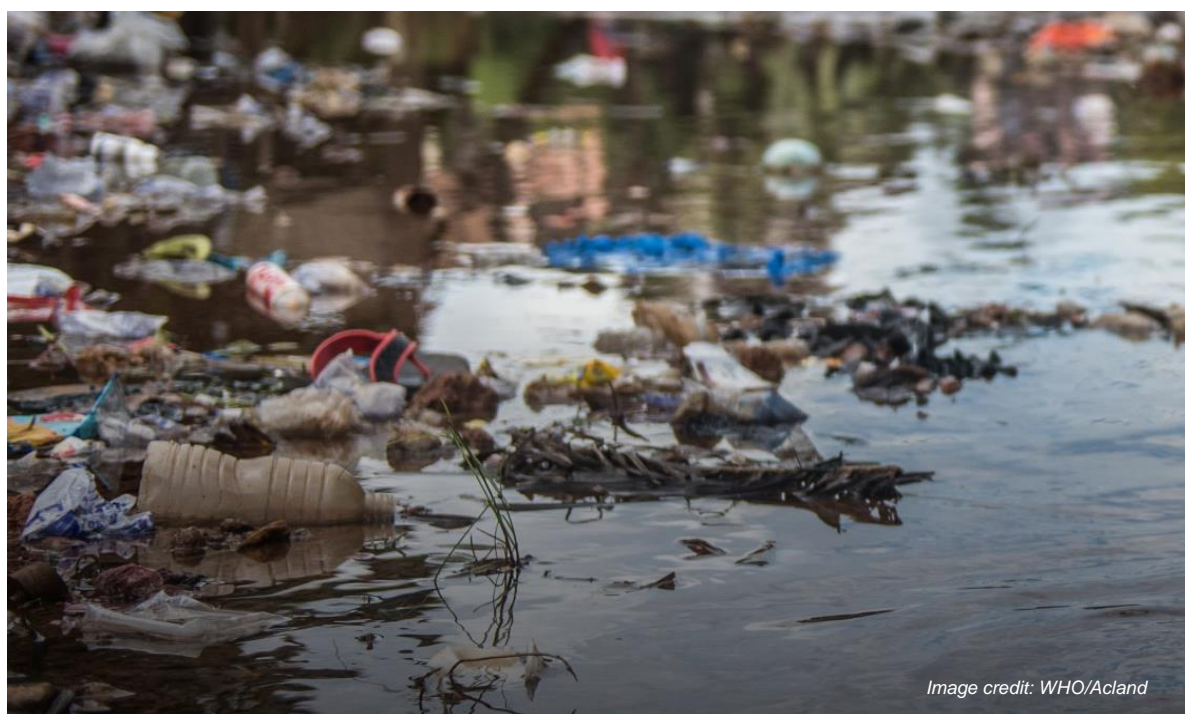


Image credit: WHO/Acland

