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Title: Revealing priorities and power asymmetries in global health governance using twitter data

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Structured Abstract:

Objectives: Despite increases in global health actors and funding levels, health inequities persist. We empirically tested whether global health governance (GHG) operates under the Rational Actor Model (RAM) and characterized GHG power dynamics.

Design: We collected approximately 75,000 tweets of 20 key global health actors, between 2016 and 2020 using Twitter API. We generated priorities from tweets collected using a topic modeling algorithm. Priorities from tweets were compared with stated priorities from content analyses of policy documents and with revealed priorities from network analyses of development assistance for health (DAH) funding data. Comparing priorities derived from Twitter, policy documents, and DAH funding data, we are able to test if GHG operates under RAM and to characterize power dynamics in GHG.

Participants: 20 key global health actors were identified based on consensus of 3 peer-reviewed articles mapping global health networks. All tweets of global health actors were collected in three-month intervals from November 2016 to May 2020. Policy documents and DAH financial data for each actor were collected for the same time period.

Results: We find all 20 actors and the global health system collectively fulfill the 3 conditions of RAM based on stated and revealed priorities. We also find compulsory and institutional power asymmetries in GHG. Funding organizations have compulsory power over channels of DAH and implementing institutions they directly fund. Funding organizations also have transitive influence over implementing institutions receiving DAH funding.

Conclusions: GHG operates under RAM, the rational choice for all actors is to align their priorities with the priorities of wealthy funding organizations. Priorities of the entire global health system are determined by the priorities of wealthy funding organizations that have compulsory and institutional power over other actors. If health inequities are to be addressed, a reassessment of current global health governance is imperative.

Strengths and limitations of this study:

- This study utilizes an alternative methodology of using Twitter data in understanding global health governance and priority-setting.
- This study triangulates findings from multiple data sources to test the rational actor model and power asymmetries in global health governance.
- Because the scope of this study is from 2016 to 2020, the findings may not be fully representative of global health governance during the COVID-19 pandemic.
- Only the key 20 actors of the hundreds of global health actors today were included in the study.

INTRODUCTION

The turn of the 21st century introduced an unprecedented volume of new public and private actors in global health accompanied by stratospheric levels of funding.[1] While some argue that this multiplicity of new actors promotes cooperation, what persists is a politically fragmented network of actors with competing priorities and preferences.[2–4] Academics studying the complex network of global health actors have described it as a "congested" and "chaotic" network that causes inefficiencies in the practice and delivery of global health programs and aid.[5]

Inequities in global health have increasingly been attributed to the actions of transnational actors with varying degrees of power and divergent interests.[6] While more actors have entered global health with ostensible benevolent purposes, health inequities and inefficiencies in delivery still exist today. Fierce competition among donor priorities and requirements overwhelms the institutional capacities of recipient countries,[7,8] disrupts national health planning,[9] delays the delivery of aid,[10] and creates duplications and resource waste.[11,12]

Paradoxically, the increase in global health actors and funding has exacerbated inequities and inefficiencies in global health. Researchers have presented arguments explaining this paradox through the lens of economics, politics, and power.

The current global health governance (GHG) has been theorized as operating under the rational actor model (RAM) where "each actor has its own set of goals and objectives, and these actors take actions based on analysis of the costs and benefits of various available options."[13] Current GHG based on the RAM fails to "justify an obligation to help meet the health needs of others."[13]

The Lancet-University of Oslo Commission on Global Governance for Health (2014) argues that "power asymmetry and global social norms limit the range of choice and constrain action on health inequity."[6] The actions of powerful global actors in pursuit of their own interests "are not designed to harm health but can have negative side-effects that create health inequities."[6]

The explanations by the Commission on Global Governance for Health and the hypothesis that GHG operates under the RAM are conceptual ideas about the behaviors of global health actors founded on a collection of studies within specific nations, regions, or institutions. What is necessary is empirical evidence at the global level that can confirm, deny or recharacterize these characterizations of how global health currently operates. Empirical evidence at the global level eliminates doubts of how decisions are currently made in global health and can guide GHG towards addressing the world's inequities in health.

We aim to empirically test the following research questions at the global level: (1) does GHG operate under the RAM? and (2) how can we characterize power dynamics in GHG?

We hypothesize that GHG operates under RAM and that there are power asymmetries in GHG that limit the range of health priorities as presented by the Commission on Global Governance for Health. This study analyzed empirical evidence from Twitter,

funding data, and policy documents at the global level to test whether GHG operates under RAM and to characterize the power dynamics in GHG.

METHODS

We test if GHG operates under the RAM and characterize the power dynamics in GHG through the lens of global health priority-setting. All global health actors have certain preferences for health issues and act in alignment with these priorities.

Priorities can either be stated or revealed. Stated priorities are those preferences explicitly stated in a health actor's official documents or websites. For example, the first article in the constitution of the World Health Organization (WHO) states: "the objective of the [WHO] shall be the attainment by all peoples of the highest possible level of health."[14] The attainment of highest possible level of health by all is the WHO's stated priority. Revealed priorities are preferences that are gleaned from records of past behaviors and choices such as health funding allocations and accounts of actually implemented programs and policies. Revealed priorities may or may not be aligned with stated priorities. For example, the WHO has annual financial reports that break down how much each health area or issue is funded in proportion of their total budget. The most allocated health areas are the revealed priorities of the WHO.

We use evidence for both stated and revealed priorities from 2016 to 2020 to test both of our research questions.

Study Sample

In this study, we identified 20 key global health actors based on a consensus among three past studies that mapped the global health network using quantitative and qualitative methodologies.[4,15,16] As shown in Table 1, the key global health actors were categorized based on their nature of work in global health. Global health actors were either funding organizations, channels of developmental assistance for health (DAH) or implementing institutions. While most actors fall into more than one of these categories in practice, for the integrity of this analysis, organizations were limited to only one category based on the nature of their main line of work.

Table 1. Summary of Global Health Actors. Characteristics of the 20 global health actors analyzed in this study.

Nature of Work in Global Health	Organizational Category	Twitter Username	Global Health Actor
Channels of Developmental Assistance for Health	Global health initiative	gavi	Gavi, the Vaccine Alliance
		UNITAID	Unitaid
		GlobalFund	Global Fund to Fight AIDS, Tuberculosis and Malaria
	Multilateral Development Bank	WorldBank	World Bank
	United Nations System	WHO	World Health Organization
		UNAIDS	Joint United Nations Programme on HIV/AIDS (UNAIDS)
		UNFPA	United Nations Population Fund (UNFPA)
		UNICEF	United Nations Children's Fund (UNICEF)
Funding Organizations	National Government	USAID	United States Agency for International Development (USAID)
		DFID_UK	United Kingdom Department for International Development (UK DFID)

	Philanthropic Organization	gatesfoundation	Bill and Melinda Gates Foundation
Implementing Institutions	Global CSO/NGO	MSF	Doctors Without Borders (MSF)
		PATHtweets	PATH
		SavetheChildren	Save the Children
		Oxfam	Oxfam International
	United Nations System	FAO	Food and Agriculture Organization (FAO)
		UNDP	United Nations Development Programme (UNDP)
	National Government	CDCgov	Centers for Disease Control and Prevention (CDC)
		ECDC_EU	European Centre for Disease Prevention and Control (ECDC)
		NIH	National Institutes of Health (NIH)

Patient and public involvement

Patients and the public were not involved in the development of the research questions and outcome measures.

Data Sources

We analyze stated and revealed priorities of 20 key global health actors from three data sources – policy documents, DAH funding data, and tweets. As summarized in Table 2, stated priorities are obtained from a manual content analysis of policy documents, annual reports, and official websites of global health actors. Revealed priorities are derived using a network analysis and descriptive statistics of financial flows in DAH funding data. To obtain the revealed priorities of each global health actor, we use topic modeling in natural language processing (NLP) and a network analysis of the tweets of each global health actor. Further explanation of data collection from each source follows.

Table 2. Summary of Data Source, Collection, and Analysis. Description of how data is collected and analyzed in the study.

Data Source	Data Collection	Analysis	Type of Priorities Derived from Source
Policy Documents	Manual collection of annual reports, policy documents, and official communications from official websites of each global health actor	Manual content analysis	Stated
DAH Funding Data	Queried funding allocation data of each global health actor from the International Health Metrics and Evaluation (IHME) DAH Database	Descriptive statistics; network analysis	Revealed
Twitter Data	Collected all the tweets of each global health actor from November 2016 to May 2020 in three month intervals using the Twitter API	Natural language processing (topic modeling); network analysis	Revealed

Drawing stated priorities from policy documents

Available policy documents, annual reports, and relevant official communications from the websites of each global health actor within the timeframe of the study were collected. Documents not published between 2016 and 2020 were not collected. Manual content analysis was conducted to evaluate the available policy documents for each global health actor and identify their respective stated priorities.

The stated priorities drawn from these documents were commonly obtained from official statements that fall under the following headings: “strategic priorities,” “program priorities,” “strategic objectives,” “focus areas,” “strategic work areas,” “program focus,” “Strategy 20XX-20XX,” “strategic goals,” “priority areas,” among others. The first column of Supplementary Table 1 contains the stated priorities obtained from each actor.

Deriving revealed priorities from funding data

Data from the Institute for Health Metrics and Evaluation’s (IHME) Developmental Assistance for Health Database was collected for 2019.[17] The database includes approximately 800,000 transactions of financing for health programs and aid from funding organizations to channels of DAH and to implementing countries.

Descriptive statistics were conducted to determine the allocations of funding for each health area and geographic region for the 20 global health actors in 2019.

Network analysis was conducted to observe the funding relationships between global health actors. Gephi 0.9.2 was used in constructing and analyzing the network map. The network modelled in the study allows for a graphical visualization of the flows of global health funding in 2019. The network map was designed such that each global health actor is represented by a node and lines or “edges” indicate a flow of funding in global health. The Fruchterman-Reingold algorithm was used in modelling the network map. The algorithm “calculates the optimal layout so that nodes with less strength and less connections are placed further apart, and those with more and/or stronger connections are placed closer to each other.”[18] The thickness of edges represents the amount of funding transferred between actors. The modelled network map can be found and will be discussed in the findings section.

Twitter data

Using the Twitter API, we collected all the tweets of each global health actor by username from November 2016 to May 2020 in three month intervals. This means that all the tweets of each global health actor were collected for each day in the months of February, May, August, and November for each year. An interval of three months was decided for two reasons. First, a variation in the issues, topics, and themes that global health actors tweet can be observed in three month intervals. Initial small sample testing indicates that collecting all the tweets of every month for each actor yields redundancy in issues and topics observed. Redundancy is eliminated in three month intervals. Second, it also allows for efficient usage of the data request limits of the Twitter API. As Twitter limits the number of tweets one is able to collect from the Twitter API, this interval is an efficient way of collecting data for all 20 global health actors for the timeframe. A total of 74,241 tweets were collected from 2016 to 2020 for the 20 global health actors. Supplementary Tables 2 and 3 further describe the tweets collected.

Using Twitter as a data source plays an important role in analyzing GHG, examining whether it operates under the RAM, and characterizing power dynamics. In the academic area of communications studies, researchers suggest that there are two forms of utility that motivate actors to post content on Twitter. First, intrinsic utility assumes that a user receives inherent satisfaction from posting content on Twitter.[19] On its about page, Twitter positions “itself as a real-time information network powered

by people all around the world that lets you share and discover what's happening now…to millions across the globe." By this definition, global health actors acquire more intrinsic utility as their tweets reach a greater number of users. Second, image-related utility assumes that the perceptions of others,[20,21] and seeking status or prestige are strong motivators for posting content.[22,23] As global health actors operate best with high public approval, posting content on Twitter can improve public perception. Twitter is the ideal platform for global health actors to simultaneously share their work to a greater number of individuals and to improve their public perception. The utility received from using Twitter explains the social media's ubiquity among global health actors.

Because Twitter limits each post to 280 characters, the platform promotes short, frequent, and straightforward manners of communication. The tweets of global health actors are regular ways of communicating their work, preferences, and priorities to the public.[24–27] The tweets of global health actors act as an archive, a record of historical preferences, priorities, goals, and implemented programs.[28]

Obtaining priorities from Twitter data

NLP is a subfield in artificial intelligence, computer science, and linguistics at the intersection of the human language and computers. NLP is concerned about how to utilize computers to process and analyze large quantities of human language data. We use NLP in analyzing the tweets of the global health actors for two reasons. First, NLP allows for the efficient analysis of tens of thousands of rows of text data that could not be done manually.[29–31] Second, NLP allows for a technique called topic modeling where an algorithm generates lists of words that are frequently used together.[32–34] These lists of words can then be interpreted to identify specific themes, topics, or issues to identify the top 10 priorities of each global health actor from 2016 to 2020. The results of the topic modeling are then used in a network analysis that visualizes where each actor converges or diverges in global health priorities with other actors.

As seen in Table 3, ten topics were generated using the Latent Dirichlet Allocation (LDA) topic model for each global health actor's tweets to reveal their priorities from 2016 to 2020. LDA is a generative probabilistic modeling method where words in a corpus of text that are frequently used together are categorized into topics.[35] This follows the assumption that documents, or in this case Twitter profiles, can be broken down into multiple topics that are identified by certain combinations of words.

Table 3. Revealed Priorities from Twitter Topic Modeling. Ten revealed priorities of each of the 20 global health actors based on their tweets from 2016 to 2020. Priorities are alphabetically arranged. Red indicates Funding Organizations. Blue indicates Channels of DAH. Gray indicates Implementing Institution.

United States	United Kingdom	Gates Foundation	WHO	World Bank	UNAIDS	UNFPA	UNICEF	UNITAID	GAVI
Africa	Africa	Africa	Africa	Africa	Access	Africa	Africa	Access	Africa
Children	Agriculture	Breastfeeding	Breastfeeding	Agriculture	Africa	Child Marriage	Breastfeeding	Cancer	Cancer
Education	Children	Children	Children	Children	Discrimination	Children	Children	Children	Children
Food Security	Development	Education	Ebola	Climate Change	HIV/AIDS	Family Planning	Climate Change	Hepatitis	Cholera
HIV/AIDS	Ebola	HIV/AIDS	HIV/AIDS	Food Security	Human Rights	FGM	Ebola	HIV/AIDS	Ebola
Humanitarian Aid	Education	Malaria	Malaria	Humanitarian Aid	Innovation	Human Rights	Education	Malaria	Measles
Mothers	Food Security	Mothers	Measles	Poverty	Prevention	Humanitarian Aid	Human Rights	Testing	Pneumonia

South America	HIV/AIDS	Polio	Mothers	Sanitation	Testing	Nutrition	Online	Treatment	Polio
Water	Humanitarian Aid	Sanitation	Polio	Water	Treatment	Violence	Violence	Tuberculosis	Poverty
Women	Water	Women	Women	Women	Women	Women	Water	Vaccines	Vaccines
Global Fund	**CDC**	**EU CDC**	**NIH**	**FAO**	**UNDP**	**MSF**	**PATH**	**Save the Children**	**Oxfam**
Africa	Children	Ebola	Africa	Africa	Africa	Africa	Access	Africa	Africa
Children	Diarrhea	Hepatitis	Cancer	Agriculture	Children	Children	Africa	Children	Climate Change
Cholera	E. Coli	HIV/AIDS	Funding	Biodiversity	Climate Change	Cholera	Breastfeeding	Donations	Ebola
Ebola	Influenza	Influenza	Heart Disease	Climate Change	Education	Ebola	Cancer	Education	Food Security
HIV/AIDS	Measles	Measles	HIV/AIDS	Families	FGM	HIV/AIDS	Children	Food Security	Humanitarian Aid
Malaria	Prevention	Outbreaks	News	Farmers	Food Security	Humanitarian Aid	Ebola	Humanitarian Aid	Malaria
Pneumonia	Vaccines	Report	Rare Disease	Fisheries	HIV/AIDS	Refugees	Innovation	Pneumonia	Pneumonia
Polio	Water	Surveillance	Research	Food Security	Malaria	Treatment	Malaria	Refugees	Refugees
Tuberculosis	Women	Tuberculosis	Stress	Forests	Water	Tuberculosis	Pneumonia	Schools	Water
Women	Zika	West Nile	Veterans	Water	Women	Violence	Vaccines	Water	Women

Additionally, we model a network map from the priorities generated using the LDA topic model also using the Fruchterman-Reingold algorithm. This network map visualizes the similarities in priorities between the 20 actors. Data used for this network map can be found in Supplementary Table 4. This network map is compared with the network map generated using financial data from IHME in the findings section. This comparison between network maps can illustrate if priorities from tweets and from financial data are aligned.

Testing if GHG operates under the RAM

By combining evidence for stated and revealed priorities of 20 key global health actors, we can determine if GHG operates under the RAM.

The rational actor model (RAM) in international cooperation is categorized as the "linchpin of foreign policy decision making."[36] This approach is rooted in expected utility theory in microeconomics introduced by von Neumann and Morgenstern in the 1940s and subsequent theories of rationality.[37]

RAM is most useful in explanations of economic behavior if the three conditions of the rationality assumption are fulfilled.[36] First, it is assumed that an actor's goal is pre-determined before intentionally acting to achieve it.[36] Second, actors are assumed to "display consistent preferences as manifested in the ability to rank the preferences in transitive order."[36] Third, actors are assumed to maximize utility while choosing an alternative that provides the highest amount of net personal benefit.[36]

GHG operates under RAM if each of the 20 global health actors and the global health system collectively fulfill the three assumptions of pre-determined goal, rank order preferences, and benefit maximization.

To test the first assumption of pre-determined goal, we determine the stated priorities of each global health actor from policy documents. We test whether there exist explicit statements on goals and priorities and note what health areas or issues are the stated priorities of each global health actor.

To test the second assumption of consistent rank order preferences, we compare revealed priorities from DAH funding data and revealed priorities from tweets. From the DAH funding data, we can determine rank order preferences based on which health issues are allocated the most funding in 2019. From tweets, we can determine rank order preferences based on the top 10 topics each global health actor tweeted about from 2016 to 2020. If there is consistency in rank order preferences between the revealed priorities from DAH funding data and revealed priorities from tweets, then the second assumption is fulfilled.

To test the third assumption of benefit maximization, we compare the stated and revealed priorities from all three data sources. The priorities that are consistent across stated priorities from policy documents and revealed priorities from DAH funding data and from tweets are revealed to be the priority that the global health actor determines to be benefit maximizing.

We also test the three assumptions at the global health system level. Pre-determined goals are obtained from stated priorities from collective stated commitments to global health. Consistent rank order preferences are derived from the alignment between aggregated DAH funding allocations of all global health actors and the most common topics generated from tweets across all global health actors. The consistent preferences across stated and revealed priorities are inferred to be what the global health systems decides to be benefit maximizing.

If each global health actor fulfills the three assumptions, and if the global health system collectively fulfills the three assumptions, then GHG operates under the RAM.

Definitions and types of power

"Power is exercised everywhere in global health although its presence may be more apparent in some instances than others,"[38] one global health researcher notes. The power concept in global health does not stray far from Robert Dahl's (1957) definition in his seminal study where he describes "A has power over B to the extent that he can get B to do something B would not otherwise do."[39] Specifically, power can be categorized into four types introduced by Barnett and Duvall (2005), each manifesting in different manners in global health.[40] Supplementary Table 5 summarizes Barnett and Duvall's four types of power. First, compulsory power is defined as "direct control of one actor over the conditions of existence or the actions of another."[40] In global health, compulsory power can be seen in how donor countries dictate the conditions in low and middle-income countries (LMICs) through development aid.[41] Second, institutional power is "the control actors exercise indirectly over others through diffuse relations of interactions."[40] High-income countries control funding allocations for LMICs through institutional power via their contributions to the WHO and other multilateral organizations. Third, structural power refers to the "constitution of subjects' capacities in direct structural relation to one another."[40] The structural and historical disempowerment of indigenous populations have resulted in their disproportionate outcomes in health.[42,43] Fourth, "productive power works through diffuse constitutive relations to produce the situated social capacities of actors."[40] Research institutions funded by high-income countries direct what health issues are studied and addressed.[44]

Characterizing power dynamics in GHG

To characterize the power dynamics manifested in GHG, we analyze the interplay of stated and revealed priorities between funding organizations, channels of DAH, and implementing organizations. Particularly, we identify which global health actors have the most influence in setting global health priorities. The global health actors which have the most priorities aligned with the stated and revealed priorities of the global health system are determined to have the most influence and power in priority-setting.

FINDINGS

GHG operates under RAM

As seen in Supplementary Table 1, we find that each of the 20 key global health actors fulfills the three assumptions of the RAM. Each actor has a pre-determined goal stated in mission statements, strategic plans, multi-year strategies, and other policy documents. Each actor has consistent rank order preferences as observed in the alignment of order of preferences in DAH funding data and top identified topics from tweets. Consistent, top ranking preferences across policy documents, funding data, and tweets are the alternatives that maximize benefits for each global health actor based on their pre-determined goal.

As shown in the last row of Supplementary Table 1, we find that the global health system collectively fulfills the three assumptions of the RAM. The pre-determined goal of the global health system can be found in the WHO constitution and the 9 target areas for Sustainable Development Goal (SDG) 3 on good health and well-being. All 20 global health actors have stated commitments to the WHO mission and the SDGs. The alignment of DAH funding allocations and most common health issues from Twitter reveal that in terms of rank order, HIV/AIDS, child health, and maternal health are the top 3 priorities of the global health system collectively. To maximize benefits of the pre-determined goal of “health for all” and “SDG3: good health and well-being”, the global health system prioritizes HIV/AIDS, child health, and maternal health. Among all 9 stated targets in SDG3, only these three issues are prioritized. Effectively, the 6 other stated targets in SDG3 are deprioritized and underfunded by the global health system.

Since each global health actor and the global health system collectively fulfills the three assumptions, we find that GHG operates under the RAM. However, this does not imply cooperation of global health actors. This finding demonstrates the fact that each global health actor operates based on their rational self-interest and that the global health system operates based on the pursuit of only some of the stated priorities. Who determines which priorities are pursued by the global health system? The findings on power dynamics in GHG reveal the actors who determine global priorities.

Compulsory and institutional power asymmetries in GHG

As demonstrated in the following network maps, we find that there is compulsory and institutional power asymmetry in GHG.

Compulsory power asymmetry can be found in how funding organizations strongly influence channels of DAH and implementing institutions based on their relationship. Channels of DAH and implementing institutions rely on funding organizations for resources to continue operating. We find that the top priorities of the 3 funding

organizations in this study are also the priorities of channels of DAH and implementing institutions.

As seen in Figure 1, HIV/AIDS is 1st priority of United States Agency for International Development (USAID), 2nd priority of United Kingdom Department for International Development (UK-DFID), and 2nd priority of the Bill and Melinda Gates Foundation (BMGF) based on the alignment of stated and revealed priorities. HIV/AIDS is a priority of 4 of 8 channels of DAH and 4 of 9 implementing institutions based on its presence in policy documents, DAH funding, and tweets of each actor.

Figure 1 also demonstrates that maternal and child health is 2nd priority of USAID, 1st priority of UK-DFID, and 1st priority of BMGF based on the alignment stated and revealed priorities. Maternal and child health is a priority of 6 of 8 channels of DAH and 7 of 9 implementing institutions based on its presence in policy documents, DAH funding, and tweets of each actor.

Following the flow of the funding in Figure 2 and the similarities in tweets in Figure 1, we can see that institutional power asymmetry can be found in how funding organizations strongly influence implementing institutions through outsized influence of channels of DAH that allocate funding to these implementing institutions. As some implementing institutions do not get direct funding from funding organizations, but through channels of DAH, channels of DAH have direct control of funding of implementing institutions. Because wealthy funding organizations influence the priorities of channels of DAH, transitively, funders have power over implementing institutions. Implementing institutions in turn align their priorities with the priorities of channels of DAH, and transitively with the priorities of funding organizations.

Both network analyses of revealed priorities from DAH funding data and from tweets show how there is asymmetric levels of power held by the United States, United Kingdom, and the Gates Foundation in comparison to other actors. Figure 2 reveals how these three funding organizations are the largest funders for the work of the Global Fund, WHO, World Bank, US Foundations, UN organizations, and Gavi. The IHME DAH database reveals that 24% of all DAH funding was allocated to HIV/AIDS, 21% to child health, and 12% to maternal health – the three top priorities of funding organizations.[17][17] Only 14% was allocated to health system strengthening and 2% to non-communicable diseases.[17][17]

Figure 1 reveals how the most common topics generated across all global health actors include Africa, HIV/AIDS, child health, women health, and infectious diseases. These are the same health issues highly prioritized by the United States, United Kingdom, and Gates foundation. Comparing figures 1 and 2, we find that these three funding organizations have outsized influence in priority-setting. Funding organizations have outsized influence because of how much DAH funding these three organizations have provided in comparison to other funding organizations. We find that the programs implemented and issues prioritized from 2016 to 2020 as documented through the tweets of the actor revolve around the main priorities of funding organizations of HIV/AIDS, child health, maternal health, infectious disease, and Africa.

CONCLUSION

We find empirical evidence at the global level showing that GHG operates under the RAM. Additionally, we find that at the global level, there is asymmetric compulsory and institutional power held by funding organizations, allowing global health priorities to be set by funders that have the money to spend on global health. In the past years, these funders have been the United States, United Kingdom, and the Gates Foundation. The rational choice for all global health actors is to align their priorities with those of funding organizations in order to continue with their programs. The priorities of funders of HIV/AIDS, child health, and maternal health have been prioritized from 2016-2020. While global health has seen improvements in these three areas, other important health issues are deprioritized and underfunded, leading to a persistence in global health inequity. If “health for all” and the SDG3 targets are to be achieved, then there must be a reassessment of current GHG under the RAM.

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Competing interests: No author has competing interests to declare.

Ethics approval: The study did not have any human or animal participants. Additionally, the study did not require ethical approval as the Twitter data used were already in the public domain.

Data and materials availability: Under the "Content Redistribution" section of Twitter's Developer Agreement and Policy, "We restrict the redistribution of Twitter Content to third parties. If you provide Twitter Content to third parties, including downloadable datasets or via an API, you may only distribute Tweet IDs, Direct Message IDs, and/or User IDs." Because the data collected using the Twitter API does not allow for redistribution under the Twitter Developer Agreement and Policy, tweets cannot be made publicly available. Only Tweet ID’s and User ID’s are allowed to be redistributed according to the Twitter policy. Please email jenpr@upenn.edu if you wish to receive a copy of the Tweet ID’s and User ID’s of the data and/or the code used in the study. The IHME DAH Database can be found at http://ghdx.healthdata.org/record/ihme-data/development-assistance-health-database-1990-2019

REFERENCES

1 Ng NY, Ruger JP. Global Health Governance at a Crossroads. *Global health governance : the scholarly journal for the new health security paradigm* 2011;**3**.

2 Giaimo S. Interest Groups, Think Tanks, and Health Care Policy (1960s-Present). In: *Guide to U.S. Health and Health Care Policy*. Thousand Oaks CA: : SAGE Publications 2014. 375–92.

3 Spicer N, Agyepong I, Ottersen T, *et al.* 'It's far too complicated': why fragmentation persists in global health. *Globalization and Health* 2020;**16**. doi:10.1186/s12992-020-00592-1

4 Szlezák NA, Bloom BR, Jamison DT, *et al.* The Global Health System: Actors, Norms, and Expectations in Transition. *PLoS Medicine* 2010;**7**. doi:10.1371/journal.pmed.1000183

5 United Kingdom House of Lords. Chapter 3: International health: the institutional labyrinth. Select Committee on Intergovernmental Organisations First Report. 2008.

6 Ottersen OP, Dasgupta J, Blouin C, *et al.* The political origins of health inequity: Prospects for change. The Lancet. 2014;**383**. doi:10.1016/S0140-6736(13)62407-1

7 Walt G. Global cooperation in international public health. In: Merson M, Black R, Mills A, eds. *International Public Health*. Gaithersburg, Maryland: : Aspen Publishers 2001.

8 Mayhew SH, Walt G, Lush L, *et al.* Donor Agencies' Involvement in Reproductive Health: Saying One Thing and Doing Another? *International Journal of Health Services* 2005;**35**. doi:10.2190/K46B-RRXJ-95M4-JDQU

9 Burris S. Governance, Microgovernance and Health. *Temple Law Review* 2004;**77**:335–62.

10 Brooks A, Cutts FT, Walt G. Policy study of factors influencing the adoption of new and underutilized vaccines in developing countries. Washington D.C.: 1999.

11 Travis P, Bennett S, Haines A, *et al.* Overcoming health-systems constraints to achieve the Millennium Development Goals. *The Lancet* 2004;**364**. doi:10.1016/S0140-6736(04)16987-0

12 Hoffman SJ, Røttingen J-A. Dark sides of the proposed Framework Convention on Global Health's many virtues: A systematic review and critical analysis. *Health and Human Rights* 2013;**15**:117–34.

13 Ruger JP. Global health governance as shared health governance. *Journal of Epidemiology and Community Health* 2012;**66**. doi:10.1136/jech.2009.101097

14 CONSTITUTION of the World Health Organization. *Chronicle of the World Health Organization* 1947;**1**.

15 Frenk J, Moon S. Governance Challenges in Global Health. *New England Journal of Medicine* 2013;**368**. doi:10.1056/NEJMra1109339

16 Hoffman SJ, Cole CB. Defining the global health system and systematically mapping its network of actors. *Globalization and Health* 2018;**14**. doi:10.1186/s12992-018-0340-2

17 Institute for Health Metrics and Evaluation (IHME). Development Assistance for Health Database 1990-2019. *Institute for Health Metrics and Evaluation (IHME)* 2020.

18 Hevey D. Network analysis: A brief overview and tutorial. *Health Psychology and Behavioral Medicine* 2018;**6**. doi:10.1080/21642850.2018.1521283

19 Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist* 2000;**55**. doi:10.1037/0003-066X.55.1.68

20 Donelle L, Booth R. Health Tweets: An Exploration of Health Promotion on Twitter. *American Nurses Association* 2012;**17**.

21 Park H, Rodgers S, Stemmle J. Analyzing Health Organizations' Use of Twitter for Promoting Health Literacy. *Journal of Health Communication* 2013;**18**. doi:10.1080/10810730.2012.727956

22 Glazer A, Konrad K. A Signaling Explanation for Charity. *American Economic Review* 1996;**86**:1019–28.

23 Harbaugh W. The Prestige Motive for Making Charitable Transfers. *American Economic Review* 1998;**88**:227–82.

24 Fung IC-H, Jackson AM, Ahweyevu JO, *et al.* #Globalhealth Twitter Conversations on #Malaria, #HIV, #TB, #NCDS, and #NTDS: a Cross-Sectional Analysis. *Annals of Global Health* 2017;**83**. doi:10.1016/j.aogh.2017.09.006

25 Goff DA, Kullar R, Laxminarayan R, *et al.* Twitter to engage, educate, and advocate for global antibiotic stewardship and antimicrobial resistance. *The Lancet Infectious Diseases* 2019;**19**. doi:10.1016/S1473-3099(19)30058-1

26 Guidry JPD, Jin Y, Orr CA, *et al.* Ebola on Instagram and Twitter: How health organizations address the health crisis in their social media engagement. *Public Relations Review* 2017;**43**. doi:10.1016/j.pubrev.2017.04.009

27 Scanfeld D, Scanfeld V, Larson EL. Dissemination of health information through social networks: Twitter and antibiotics. *American Journal of Infection Control* 2010;**38**. doi:10.1016/j.ajic.2009.11.004

28 Zamora A. Making Room For Big Data: Web Scraping and an Affirmative Right to Access Publicly Available Information Online. *Journal of Business, Entrepreneurship & the Law* 2019;**12**:203–28.

29 Alvarez-Melis D, Saveski M. Topic Modeling in Twitter: Aggregating Tweets by Conversations. *Tenth International AAAI Conference on Web and Social Media* 2016.

30 Hong L, Davison BD. Empirical study of topic modeling in Twitter. In: *Proceedings of the First Workshop on Social Media Analytics - SOMA '10*. New York, New York, USA: : ACM Press 2010. doi:10.1145/1964858.1964870

31 Yang S-H, Kolcz A, Schlaikjer A, *et al.* Large-scale high-precision topic modeling on twitter. In: *Proceedings of the 20th ACM SIGKDD international conference on Knowledge discovery and data mining - KDD '14*. New York, New York, USA: : ACM Press 2014. doi:10.1145/2623330.2623336

32 Bakshi RK, Kaur N, Kaur R, *et al.* Opinion mining and sentiment analysis. *2016 3rd International Conference on Computing for Sustainable Global Development (INDIACom)* 2016;:452–5.

33 Pak A, Paroubek P. Twitter as a Corpus for Sentiment Analysis and Opinion Mining. *LREc* 2010;**10**:1320–6.

34 Saif H, He Y, Alani H. Semantic Sentiment Analysis of Twitter. 2012. doi:10.1007/978-3-642-35176-1_32

35 Blei DM, Ng AY, Jordan MI. Latent Dirichlet allocation. *Journal of Machine Learning Research* 2003;**3**. doi:10.1016/b978-0-12-411519-4.00006-9

36 Mintz A, DeRouen K. The Rational Actor Model. In: *Understanding Foreign Policy Decision Making*. Cambridge: : Cambridge University Press 2010. 57–68.

37 MacDonald PK. Useful Fiction or Miracle Maker: The Competing Epistemological Foundations of Rational Choice Theory. *American Political Science Review* 2003;**97**. doi:10.1017/S000305540300087X

38 Shiffman J. Knowledge, moral claims and the exercise of power in global health. *International Journal of Health Policy and Management* 2014;**3**. doi:10.15171/ijhpm.2014.120

39 Dahl RA. The concept of power. *Behavioral Science* 2007;**2**. doi:10.1002/bs.3830020303

40 Barnett M, Duvall R. Power in International Politics. *International Organization* 2005;**59**. doi:10.1017/S0020818305050010

41 Shawar YR, Ruger JP. The Politics of Global Health Inequalities: Approaches to Studying the Role of Power. In: McInnes C, Lee K, Youde J, eds. *The Oxford Handbook of Global Health Politics*. Oxford: 2020. 59–76.

42 Holmes SM. Structural Vulnerability and Hierarchies of Ethnicity and Citizenship on the Farm. *Medical Anthropology* 2011;**30**. doi:10.1080/01459740.2011.576728

43 Goldade K. “Health Is Hard Here” or “Health for All”? *Medical Anthropology Quarterly* 2009;**23**. doi:10.1111/j.1548-1387.2009.01074.x

44 Sridhar D. Who Sets the Global Health Research Agenda? The Challenge of Multi-Bi Financing. *PLoS Medicine* 2012;**9**. doi:10.1371/journal.pmed.1001312

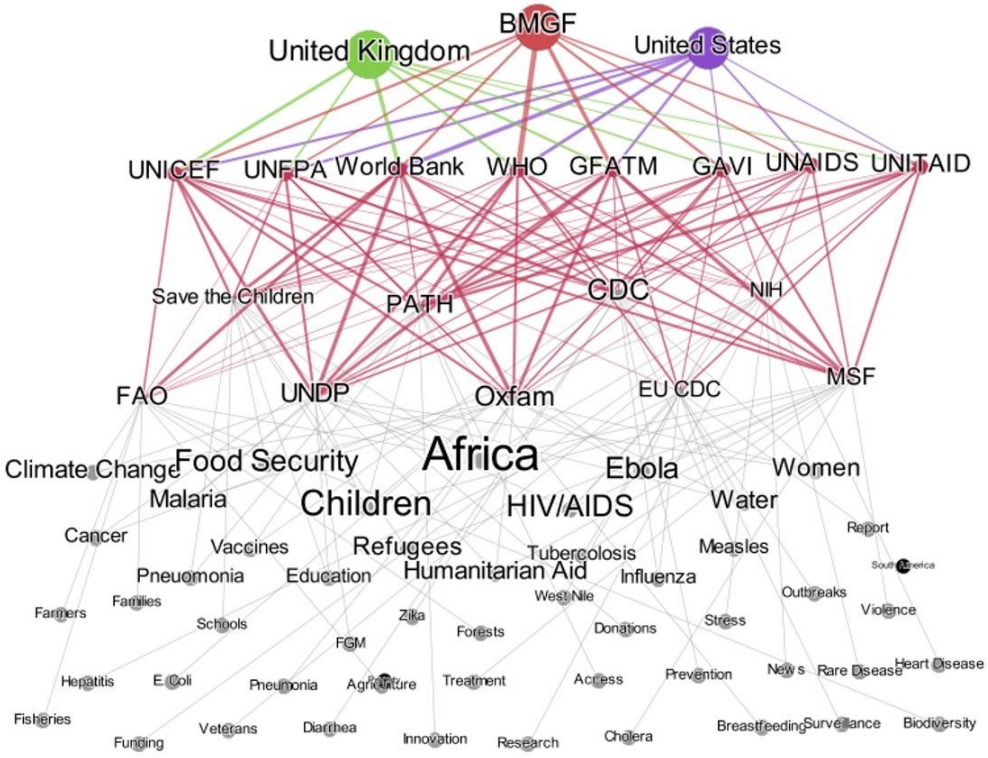

Figure 1. Network Analysis of Revealed Priorities from Tweets. Line thickness represents how many similar priorities one global health actor has with another. Font size of global health priorities represent the number of organizations have it as a priority. Data used found in Supplementary Table 4.

167x128mm (168 x 168 DPI)

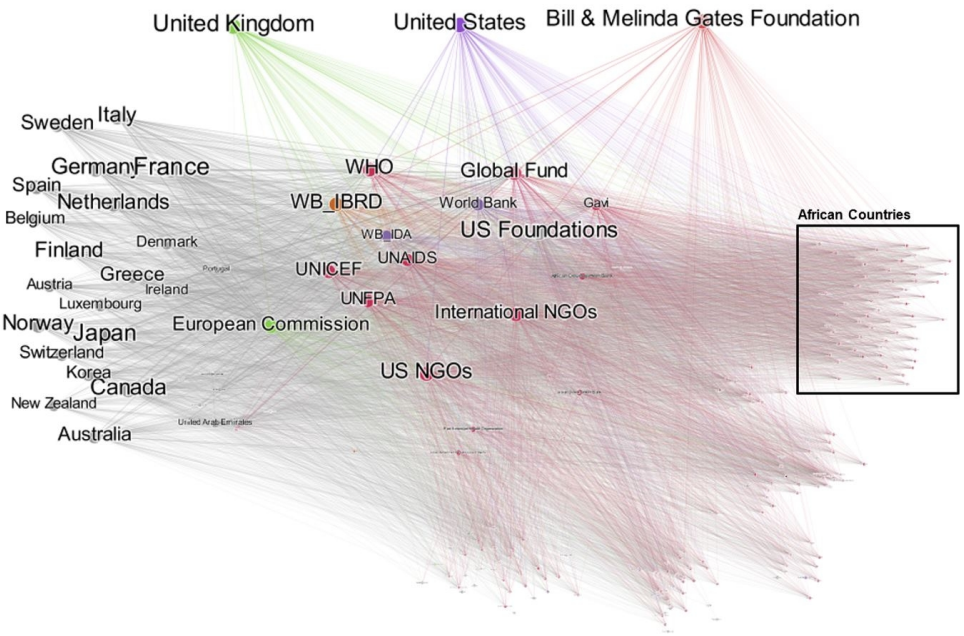

Figure 2. Network Analysis of Revealed Priorities from Funding for DAH (2019). Line thickness represents the amount of funding for health that was transferred between two actors. Font size represents the total amount of funding for health donated or received in 2019.

211x138mm (168 x 168 DPI)

Supplemental Material

Supplementary Table 1. Evidence and Testing RAM by Actor. Evidence for stated and revealed priorities and testing of RAM for each actor and the global health system as a whole. Light red indicates funding organization, blue indicates channel of DAH, yellow indicates implementing institution, and dark red indicates global health system as a whole.

	Evidence			Testing Assumptions of RAM			
	Stated Priorities from Policy Documents	**Revealed Priorities from DAH Data**	**Revealed Priorities from Tweets**	**Pre-determined goal?**	**Consistent preferences?**	**Utility maximizing?**	**Operates under RAM?**
USAID	"On behalf of the American people, we promote and demonstrate democratic values abroad, and advance a free, peaceful, and prosperous world. **In support of America's foreign policy**, the U.S. Agency for International Development leads the U.S. Government's international development and disaster assistance through partnerships and investments that save lives, reduce poverty, strengthen democratic governance, and help people emerge from humanitarian crises and progress beyond assistance." (2019 USAID Financial Report) "For over 50 years, USAID's global health programs have saved lives, protected people most vulnerable to disease, and promoted the stability of communities and nations, while advancing American security and prosperity. **America is safer and stronger when people can live healthy and productive lives and when nations around the world are self-reliant and resilient.**" (USAID Website) **Health Focus Area** (USAID Website) • Child and maternal death • HIV/AIDS • Malaria • Tuberculosis	Health Focus Area 49.0% of 2019 US DAH ($6.0 billion) supported **HIV/AIDS**; 7.0% ($862.5 million) supported **malaria**; 11.4% ($1.4 billion) was disbursed for **child health**, and 10.8% ($1.3 billion) went to **maternal health**. Region In 2017, the most recent year for which regional DAH estimates are available, the US directed much of its resources to **sub-Saharan Africa**, sending 50.5%, or $6.9 billion, of 2017 DAH. Channel The US provided 59.2% of its funding in 2019 through its own bilateral agencies, including the United States Agency for International Development (**USAID**), the President's Malaria Initiative (**PMI**), and **PEPFAR**. **UN agencies** received 6.2% of US DAH in 2019, or $761.4 million. **Gavi** received $307.0 million, up 9.0% from 2018, and the **Global Fund** received $636.5 million, down 25.8%. **NGOs** received 26.8% of US DAH in 2019, or $3.3 billion.	Topics from 2016-2020 tweets (no order) Africa Children Education Food Security HIV/AIDS Humanitarian Aid Mothers South America Water Women	National security National interests Global health focus: Child and maternal health, HIV/AIDS, malaria, tuberculosis	HIV/AIDS, child and maternal health, and Africa are consistent across DAH data and tweets	HIV/AIDS, child and maternal health are consistent across stated and revealed priorities. To maximize benefits for national security and interests, USAID prioritizes HIV/AIDS and child and maternal health in Africa.	Yes
UK DFID	"**We pursue our national interests and project the UK as a force for good in the world**. We promote the interests of British citizens, safeguard the UK's security, defend our values, reduce poverty and tackle global challenges with our international partners." (UK FCDO, formerly DFID website) "We are responsible for: 1. honouring the UK's international commitments and taking	Health Focus Area **Reproductive, maternal, newborn, and child health** was the focus of $1.4 billion (38.5%) of the UK's DAH in 2019, followed by **HIV/AIDS** with $553.9 million (15.8%). Region By GBD super-regions, the UK contributed $1.3 billion, or 37.3% of its 2017 DAH, to **sub-**	Topics from 2016-2020 tweets (no order) Africa Agriculture Children Development Ebola Education Food Security HIV/AIDS Humanitarian Aid Water	National interests National security Global peace, security, and governance; Crisis response and resilience; Global prosperity; Extreme poverty and helping most vulnerable; Value for money	Child and maternal health, HIV/AIDS, and Africa are consistent across DAH data and tweets.	Child and maternal health, HIV/AIDS, and Africa are consistent across stated and revealed priorities. To maximize benefits for national security and interests, UK DFID prioritizes child and maternal	Yes

	action to achieve the **United Nations' Global Goals** 2. making British aid more effective by improving transparency, openness and value for money 3. targeting British international development policy on economic growth and wealth creation **4.** improving the coherence and performance of British international development policy in **fragile and conflict-affected countries** 5. improving the lives of **girls and women** through better education and a greater choice on **family planning** 6. **preventing violence against girls and women** in the developing world 7. helping to prevent climate change and encouraging adaptation and low-carbon growth in developing countries Priorities • strengthening global peace, security and governance • **strengthening resilience and response to crisis** • promoting global prosperity • tackling extreme poverty and **helping the world's most vulnerable** • delivering value for money" (UK DFID About Page)	**Saharan Africa**; $301.0 million (8.7%) to South Asia; $163.9 million (4.7%) to Southeast Asia, East Asia, and Oceania; $237.9 million (6.9%) to North Africa and the Middle East; and $41.0 million (1.2%) to Central Europe, Eastern Europe, and Central Asia. Channel Of the UK's 2019 DAH, $990.3 million (28.2%) was channeled to **UK bilateral agencies**; $524.6 million (14.9%) to **UN agencies**; $306.4 million (8.7%) to **Gavi**; and $817.1 million (23.3%) to the **Global Fund**.				health and HIV/AIDS in Africa.	
BMGF	**"Strategic Investments.** We partner with entrepreneurs, companies, and other organizations to create incentives that **harness the power of private enterprise to create change for those who need it most**." (BMGF: how we work) **Global development.** "Our Global Development Division focuses on improving the delivery of **high-impact health**	Health Focus Area In 2019, the Gates Foundation directed $1.5 billion, or 38.3%, of its DAH to **reproductive, maternal, newborn, and child health**; $709.3 million, or 18.1%, to **HIV/AIDS**; $303.9 million, or 7.8% to **malaria**; $237.6 million, or 6.1%, to	Topics from 2016-2020 tweets (no order) Africa Breastfeeding Children Education HIV/AIDS Malaria Mothers Polio Sanitation Women	Strategic investments -- private enterprise solutions for most disadvantaged; High-impact health products and services to world's poorest Stated global development areas: Emergency	Child and maternal health, HIV/AIDS, malaria, and Africa are consistent across DAH data and tweets.	Child and maternal health, HIV/AIDS, malaria, and Africa are consistent across stated and revealed priorities. To maximize returns of their strategic	Yes

	products and services to the world's poorest communities and helps countries expand access to health coverage. **Areas**: Emergency Response, Family Planning ,Global Delivery Programs, Global Libraries, Maternal, Newborn & Child Health, Nutrition, Polio" (BMGF: our work) **Global health. "**Our Global Health Division aims to **reduce inequities in health** by developing new tools and strategies to reduce the **burden of infectious disease** and the **leading causes of child mortality** in developing countries. **Areas**: Discovery & Translational Sciences, Enteric and Diarrheal Diseases. HIV, Innovative Technology Solutions, Institute for Disease Modeling, Integrated Development, Malaria, Maternal, Newborn & Child Health, Discovery & Tools, Neglected Tropical Diseases, Pneumonia Tuberculosis, Vaccine Development and Surveillance**"** (BMGF: our work)	**tuberculosis**; $266.5 million, or 6.8%, to **health systems strengthening**; and $72.4 million, or 1.9%, to **non-communicable diseases**. Region In 2017, the Foundation provided 41% of its DAH to **global recipients** and programs and 18% to **sub- Saharan Africa.** Channel The Gates Foundation's 2019 DAH total of $3.9 billion was an increase of 9.9% from 2018. Of this, $2.5 billion or 64.0% was channeled through the Gates Foundation **directly to implementing institutions**. In 2019, $266.8 million (7%) in Gates Foundation DAH went to **UN agencies**, $256.9 million (7%) went to the **Global Fund**, and $406.1 million (10%) was directed to **Gavi**.		Response, Family Planning ,Global Delivery Programs, Global Libraries, Maternal, Newborn & Child Health, Nutrition, Polio Stated global health areas: Discovery & Translational Sciences, Enteric and Diarrheal Diseases. HIV, Innovative Technology Solutions, Institute for Disease Modeling, Integrated Development, Malaria, Maternal, Newborn & Child Health, Discovery & Tools, Neglected Tropical Diseases, Pneumonia Tuberculosis, Vaccine Development and Surveillance		investments, BMGF prioritizes child and maternal health, HIV/AIDS, and malaria in Africa.	
WHO	**"Health for all.** Ensuring universal health coverage without impoverishment is the foundation for achieving the health objectives of the Sustainable Development Goals – because when people are healthy, their families, communities and countries benefit. Our top priority must be to support national health authorities' efforts to strengthen all the building blocks of health systems and to enact policies aimed at ensuring health care is equitable and affordable for all. **Health emergencies.** In today's interconnected world, public health emergencies can affect anyone, anywhere – and the Ebola crisis in West Africa showed us the dangers of being unprepared. The development of resilient and robust global and local health systems capable of preventing, monitoring, detecting and responding to public health emergencies must therefore be a key priority, closely linked to our efforts to achieve universal health coverage. **Women, children and adolescents.** We cannot achieve the ambitious health and development targets in the Sustainable Development Goals unless we secure the health, dignity and rights of women, children and adolescents. Yet, in too many places, gender gaps, harmful cultural and social practices and gender-based violence are negatively impacting these individuals. Because of that,	Health Focus Area WHO provided $2.5 billion of DAH in 2019, down 1.2% from 2018. Of this, $630.7 million or 24.9% was disbursed to other **infectious diseases** and $1.0 billion or 39.8% to **health systems strengthening**. Region DAH data for the WHO in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Breastfeeding Children Ebola HIVA/AIDS Malaria Measles Mothers Polio Women	Universal health coverage, health systems strengthening, health equity, health emergencies, infectious diseases, maternal and child health, gender equity, climate and environmental impacts on health, improved WHO governance	Infectious diseases (ebola, HIV/AIDS, malaria, measles, polio) are consistent across DAH data and tweets.	Infectious diseases (ebola, HIV/AIDS, malaria, measles, polio) are consistent across stated and revealed priorities. To maximize the benefits of their pre-determined goal of health for all, WHO prioritizes on infectious diseases like Ebola, HIV/AIDS, malaria, measles, and polio.	Yes

	we must put the well-being of women, children and adolescents at the centre of global health and development. **The health impacts of climate and environmental change.** Climate and environmental change impact many aspects of life that are inextricably linked to health – food security, economic livelihoods, air safety and water and sanitation systems – and WHO estimates that 12.6 million people die each year as a result of living or working in an unhealthy environment. To address this, WHO has a key role to play advancing both mitigation and adaptation strategies for climate and environmental change, working in close partnership with other UN agencies and stakeholders. **A transformed WHO.** Building WHO into a more effective, transparent and accountable agency will require striking a balance between bold reform and stability of the organization. To meet the evolving needs and challenges of the 21st century and deliver game-changing, sustainable results, WHO will need to focus its work where it has the most value, broaden and intensify its engagement across stakeholders, attract more predictable, flexible financing, and work to identify and retain the best global talent." (WHO Priorities)						
World Bank	"The World Bank Group works in every major area of development. We provide a wide array of financial products and technical assistance, and we help countries share and apply innovative knowledge and solutions to the challenges they face. Three priorities guide our work with countries **to end poverty and boost prosperity for the poorest people.** Helping **create sustainable economic growth**, **investing in people** and **building resilience to shocks and threats** that can roll back decades of progress. **Themes** • Economic Policy • Environment and Resource Development • Finance • Human Development and Gender • Private Sector Development • Public Sector Management • Social Development and Protection • Urban and Rural Development" (World Bank Annual Report 2019)	Health Focus Area Focused on ending poverty in the world's poorest countries, the World Bank's International Development Association (IDA) disbursed $1.1 billion of DAH in 2019, down 33.9% from 2018. The International Bank for Reconstruction and Development (IBRD) is a global development cooperative owned by 189 countries. As "the world's largest development bank," the IBRD helps countries reduce poverty and extend the benefits of sustainable growth to all people. In 2019, the IBRD disbursed $11.1 billion of DAH, up 25.4% from 2018. Funds were targeted at **reproductive, maternal, newborn, and child health**; **vaccination programs**; **infectious diseases**; and **NCDs**. Region 27.6% of DAH disbursed by development banks	Topics from 2016-2020 tweets (no order) Africa Agriculture Children Climate change Food security Humanitarian aid Poverty Sanitation Water Women	End poverty and boost prosperity through sustainable economic growth, investing in people, and building resilience to shocks and threats; Maternal and child health, health emergencies, nutrition, infectious diseases, tobacco control, mental health	Child and maternal health and Africa are consistent across DAH data and tweets.	Child and maternal health are consistent across stated and revealed priorities. To maximize the benefits of their pre-determined goal of ending poverty and boosting prosperity for the poorest people, the World Bank prioritizes on child and maternal health issues in Africa.	Yes

	"World Bank Health Focus Areas: 1. **Women and children's health** 2. **Health emergencies** 3. **Nutrition** 4. **Infectious diseases** 5. **Tobacco control** 6. **Mental health"** (World Bank Health Focus Areas)	as group went to **sub-Saharan Africa** and 20.5% to North Africa and the Middle East.					
UNAIDS	**"Strategic leadership agenda** In the light of the need for change, this Strategy seeks to achieve a set of far-reaching and people-centred goals and targets that must be met by 2020 if we are to reach our 2030 ambition of ending the AIDS epidemic. The goals correspond to each of the three strategic directions, and include achieving by 2020: • Fewer than 500 000 people newly infected with HIV • Fewer than 500 000 people dying from AIDS-related causes • Elimination of HIV-related discrimination" (UNAIDS 2016-2021 Strategy)	Health Focus Area UNAIDS is leading the global effort to end **AIDS** as a public health threat by 2030. In addition, the agency is working toward its 2020 90-90-90 targets: for 90% of people living with HIV/AIDS to know their status; for 90% of those diagnosed with infections to receive antiretroviral treatments; and for 90% of patients receiving antiretroviral therapy to have viral suppression. In 2019, the agency disbursed $207.3 million, up 1.7% from 2018. The top five contributors to UNAIDS in 2019 were the US, Sweden, the Netherlands, the UK, and Norway. Region DAH data for UNAIDS in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Access Africa Discrimination HIV/AIDS Human Rights Innovation Prevention Testing Treatment Women	Ending the AIDS epidemic by 2030.	HIV/AIDS prevention, testing, and treatment is consistent across DAH data and tweets.	HIV/AIDS prevention, testing, and treatment are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of ending the AIDS epidemic by 2030, UNAIDS focuses on HIV/AIDS prevention, testing, and treatment.	Yes
UNFPA	"Our goal is to achieve **universal access to sexual and reproductive health, realize reproductive rights, and reduce maternal mortality** to accelerate progress on the agenda of the Programme of Action of the International Conference on Population and Development (ICPD), to **improve the lives of women, adolescents and youth,** enabled by population dynamics, human rights and gender equality. **Priority Areas** • Sexual and reproductive health services and reproductive rights • Adolescent and youth empowerment • Gender equality and women's empowerment • Population data for development" (UNFPA Strategic Plan)	Health Focus Area The United Nations Population Fund (UNFPA) is the United Nations' **sexual and reproductive health** agency. UNFPA's programs include the Maternal and Newborn Health Thematic Fund, focused on preventing maternal deaths through strategic interventions. Training midwives and ending fistula, a childbirth injury caused by prolonged obstructed labor, are also part of the **Maternal and Newborn Health Thematic Fund**. In 2019, UNFPA disbursed $1.1 billion in DAH, down 1.7% from 2018. Of this, UNFPA received $466.8 million, or 43.8%, from governments. In	Topics from 2016-2020 tweets (no order) Africa Child Marriage Children Family planning FGM Human Rights Humanitarian Aid Nutrition Violence Women	Universal access to sexual and reproductive health, reproductive rights, maternal mortality, child health	Sexual and reproductive health, and maternal and child health are consistent across DAH data and tweets.	HIV/AIDS prevention, testing, and treatment are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of ending the AIDS epidemic by 2030, UNAIDS focuses on HIV/AIDS prevention, testing, and treatment.	Yes

		2018, the US withheld funding from UNFPA for the third year in a row under the Kemp-Kasten amendment. Region DAH data for UNFPA in 2019 have unallocated or unspecified regions.					
UNICEF	**"Vision:** Realizing the rights of every child, especially the most disadvantaged. **Goal areas:** • Every child survives and thrives • Every child learns • Every child is protected from violence and exploitation • Every child lives in a safe and clean environment • Every child has an equitable chance in life" **(UNICEF Strategic Plan 2018-2021)**	Health Focus Area UNICEF provides long-term **humanitarian and development assistance to children and mothers**, with a specific focus on **nutrition, immunization, and HIV/AIDS**, as well as **emergency (i.e., pandemic) assistance**. UNICEF disbursed $2.6 billion in DAH in 2019, up 12.5% from 2018. Private philanthropies provided UNICEF with $519.3 million, or 19.8% of its funding in 2019, and the US contributed $316.9 million, or 12.1%. Region DAH data for UNICEF in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Breastfeeding Children Climate Change Ebola Education Human Rights Online Violence Water	Realizing the rights of every child, especially the most disadvantaged. Health related: child health, child mortality	Child and maternal health are consistent across DAH data and tweets.	Child and maternal health are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of realizing the rights of every child, UNICEF focuses on child and maternal health.	Yes
UNITAID	"Unitaid's Strategy for 2017-2021 is firmly grounded in its Constitution, which states that Unitaid aims to 'contribute to scale up access to treatment for **HIV/AIDS, malaria and tuberculosis** for the people in developing countries by **leveraging price reductions of quality drugs and diagnostics**, which currently are unaffordable for most developing countries, and to accelerate the pace at which they are made available.' Innovation, access, and scalability. They guide the design of unitaid's interventions, which • Promote innovation. Unitaid connects those who are developing innovations with people who need them the most. Innovation means both using existing commodities in new ways and developing new products and approaches. • Catalyze equitable access to better health products. Unitaid leverages its market expertise and its relationships with partners to design a portfolio of projects that will overcome barriers to access to	Health Focus Area In 2019, Unitaid disbursed $154.1 million in DAH, up 35.2% from 2018. Projects Unitaid has been working on include a net program to combat malaria and a program to distribute and promote HIV self-testing kits in Africa. US contributed $316.9 million, or 12.1%. Region DAH data for UNITAID in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Access Cancer Children Hepatitis HIV/AIDS Malaria Testing Treatment Tuberculosis Vaccines	Access to treatment of, affordability of drugs, and innovation in addressing HIV/AIDS, malaria, tuberculosis	Increasing access, testing, and treatment of HIV/AIDS, malaria, and tuberculosis are consistent across DAH data and tweets.	HIV/AIDS, malaria, and tuberculosis are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of scaling up treatment for HIV/AIDS, malaria, and tuberculosis in developing countries, UNITAID prioritizes HIV/AIDS, malaria, and tuberculosis.	Yes

	innovative health products • Create the right conditions for scale up, so better health products reach all people who need them. From conception through implementation, Unitaid works with partners to ensure that projects transition to scale." (Unitaid Strategy 2017-2021)						
Gavi	"Our 2016–2020 mission, to **save children's lives** and **protect people's health** by **increasing equitable use of vaccines in lower-income countries**, is guided by four strategic goals 1. Accelerate equitable uptake and coverage of vaccines. 2. Increase effectiveness and efficiency of immunisation delivery as an integrated part of strengthened health systems. 3. Improve sustainability of national immunisation programmes. 4. Shape markets for vaccines and other immunisation products. The current five-year strategy was approved by the Board in June 2014 – the full implementation of the strategy will see developing countries immunise 300 million children, saving 5–6 million lives in the long term. **Coverage and equity** are at the core of our current strategy. While we continue to support countries to introduce new vaccines, our focus is expanding to reach every child with these vaccines. With as many as 20 countries transitioning out of our financial support in this period, ensuring that programmes are sustainable in the long term is essential. " (Gavi Strategy 2016-2020)	Health Focus Area In 2019, Gavi channeled $1.8 billion in development assistance for health to **child health** (94.4% of Gavi funding) and non-communicable disease-related programs. Top sources of funding for Gavi in 2019 were the Bill & Melinda Gates Foundation, the United States, and the United Kingdom. Region In 2017, 52.6% of DAH disbursed by Gavi went to **sub-Saharan Africa** and 25.5% to South Asia. DAH data for Gavi in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Cancer Children Cholera Ebola Measles Pneumonia Polio Poverty Vaccines	Increasing overall coverage and equity in vaccinating children in lower-income countries.	Child health, vaccination, infectious diseases, and Africa are consistent across DAH data and tweets.	Child health, vaccination, infectious diseases, and Africa are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of "saving children's lives by increasing equitable use of vaccines in lower-income countries", Gavi prioritizes child health and vaccination of infectious diseases in Africa.	Yes
Global Fund	"The Global Fund Strategy 2017-2022: Investing to End Epidemics outlines our partnership's bold agenda for 2017-2022 based on an ambitious vision **to end the epidemics**. These four strategic objectives are at the core of the strategy: • Maximize impact against **HIV, TB**, and **Malaria** • Promote and protect **human rights** and **gender equality** • Mobilize increased resources • Build **resilient and sustainable systems for health**" (Global	Health Focus Area In 2019, the Global Fund channeled a total of $3.5 billion to programs worldwide. Leading sources of Global Fund contributions were the United States, the United Kingdom, and Japan. The UK provided $817.1 million or 23.3% to the Global Fund in 2019, more than any other contributor. The US contributed $636.5 million or 18.1%, Japan contributed $442.4 million or 12.6%, and Germany	Topics from 2016-2020 tweets (no order) Africa Children Cholera Ebola HIV/AIDS Malaria Pneumonia Polio Tuberculosis Women	To end HIV/AIDS, malaria, and tuberculosis epidemics	HIV/AIDS, malaria, tuberculosis, and Africa are consistent across DAH data and tweets.	HIV/AIDS, malaria, tuberculosis, and Africa are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of "ending the epidemics", the Global Fund prioritizes child health and vaccination of	Yes

	Fund Strategy 2017-2022)	contributed $396.7 million or 11.3%. 50.4% of funding were allocated to address **HIV/AIDS**, 31.7% to **Malaria**, and 17.8% to **Tuberculosis**. Region In 2019, 72.7% of DAH disbursed by the Global Fund went to **sub-Saharan Africa** and 10.5% to Southeast Asia, East Asia, and Oceania. DAH data for the Global Fund in 2019 have unallocated or unspecified regions.				infectious diseases in Africa.	

CDC	"CDC's Strategic Framework consists of five core capabilities that enable the agency's three strategic priorities, all united behind one mission: **protect America's safety, health, and security**. Our work is underscored by the agency's Pledge to the American People.
	Strategic Priorities
	• Securing global health and America's preparedness
	  • By stopping the spread of pandemic contagions, addressing public health terror threats, and protecting people from vector-borne diseases.
	• Eliminating disease
	  • By controlling vaccine-preventable disease, targeting Hepatitis C, and reducing the maternal mortality rate.
	• Ending epidemics
	  • Such as HIV, decreasing opioid overdoses, improving strategies and interventions to stem seasonal influenza, developing and deploying new answers for antibiotic resistance, and reducing new incidents of diabetes.
	Core Capabilities
	• World-class data and analytics
	• State-of-the-art laboratory capacity
		Health Focus Area
		Protecting Americans from Infectious Diseases at Home and Abroad ($3.0 billion)
		Preventing the Leading Causes of Disease, Disability, & Death ($2.0 billion)
		Protecting Americans from Natural Disasters, Terrorist Threats, Environmental & Occupational Hazards ($1.5 billion)
		Monitoring Health & Ensuring Laboratory Excellence ($496 million)
		Cross-cutting Support & PHHS Block Grant & Buildings & Facilities ($357 million)
		
		Region
		United States and global
			Topics from 2016-2020 tweets
			(no order)
			
			Children
			Diarrhea
			E. Coli
			Influenza
			Measles
			Prevention
			Vaccines
			Water
			Women
			Zika
				National security from infectious diseases
				
				Securing global health and national preparedness
					Protecting the USA from infectious diseases is consistent across DAH data and tweets.	HIV/AIDS, malaria, tuberculosis, and Africa are consistent across stated and revealed priorities.
						
						To maximize benefits of their pre-determined goal of "protecting America's safety, health, and security", the CDC prioritizes infectious disease protection in the US and globally.
							Yes

	• Elite public health expertise • Responding to outbreaks at their source • Global capacity and domestic preparedness" (CDC Strategic Framework)						
EU CDC	""ECDC is an EU agency aimed at **strengthening Europe's defences against infectious diseases**. The core functions cover a wide spectrum of activities: surveillance, epidemic intelligence, response, scientific advice, microbiology, preparedness, public health training, international relations, health communication, and the scientific journal Eurosurveillance. **Strategic Work Areas** • Providing evidence for effective and efficient decision-making: We support efficient public health decisionmaking by providing **timely, accurate and relevant information**. • Support the **strengthening of public health systems**: We strengthen European capacities and capabilities effectively prevent and control communicable diseases. • Supporting **response to threats**: We support effective health threats detection, assessment and control." (ECDC Annual Report 2019)	Health Focus Area All funding is spent on expenses for staff, buildings and equipment, and operations for surveillance, research, and response to infectious disease epidemics. Region European Union and global	Topics from 2016-2020 tweets (no order) Ebola Hepatitis HIV/AIDS Influenza Measles Outbreaks Report Surveillance Tuberculosis West Nile	European security from infectious disease	Infectious disease surveillance, reporting, and research are consistent across DAH data and tweets.	Infectious disease surveillance, reporting, and research are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of "strengthening Europe's defences against infectious diseases", the EU CDC prioritizes infectious disease surveillance, reporting, and research.	Yes
NIH	"NIH's mission is to seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability. The goals of the agency are: • to foster **fundamental creative discoveries**, **innovative research strategies**, and their applications as a basis for ultimately **protecting and improving health**; • to develop, maintain, and renew scientific human and physical resources that will **ensure the Nation's capability to prevent disease**; • to expand the knowledge base in medical and associated sciences in order to enhance the Nation's economic well-being and ensure a continued high return on the public	Health Focus Area In 2019, NIH had a $39.2B discretionary budget. 1. NCI (14.7%) – cancer 2. NIAID (14.1%) – allergy and infectious disease 3. NHLBI (8.9%) – heart, lung, and blood 4. NIA (7.9%) – instate on aging 5. NIGMS (7.3%) – general medical sciences Region United States (with some global research)	Topics from 2016-2020 tweets (no order) Africa Cancer Funding Heart Disease HIV/AIDS News Rare Disease Research Stress Veterans	National security through developing new knowledge in enhancing health and lengthening life.	Research on cancer, HIV/AIDS, heart disease, and rare diseases are consistent across DAH data and tweets.	Research on cancer, HIV/AIDS, heart disease, and rare diseases are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of seeking knowledge to enhance life and ensure the US's capability to prevent disease, the NIH prioritizes research on cancer, HIV/AIDS, heart disease, and rare diseases.	Yes

	investment in research; and • to exemplify and promote the highest level of scientific integrity, public accountability, and social responsibility in the conduct of science. In realizing these goals, the NIH provides leadership and direction to programs designed to improve the health of the Nation by conducting and supporting research: • in the **causes, diagnosis, prevention, and cure of human diseases**; • in the processes of human growth and development; • in the biological effects of environmental contaminants; • in the **understanding of mental, addictive and physical disorders**; and • in directing programs for the collection, dissemination, and exchange of information in medicine and health, including the development and support of medical libraries and the training of medical librarians and other health information specialists.						
FAO	"Today, member states face an increasing number of demands and challenges in agricultural development. To support them, FAO has identified five key priorities on which it is best placed to intervene. These priorities, or Strategic Objectives, represent our main areas of work to achieve our **vision of a world free from hunger and malnutrition, where food and agriculture help to improve the living standards of all**, especially the poorest, in an economically, socially and environmentally sustainable manner – contributing to the implementation of the 2030 Agenda for Sustainable Development. 1. **Help eliminate hunger, food insecurity, and malnutrition** 2. Make agriculture, forestry, and fisheries more productive and sustainable 3. Reduce rural poverty 4. Enable inclusive and efficient agricultural food systems 5. Increase the resilience of livelihoods to threats and crises" (FAO Strategic Objectives 2019)	Health Focus Area All received funding is spent on staffing and program expenses in addressing hunger, food insecurity, malnutrition, and improving resiliency of food systems. Region Funding data for FAO in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Agriculture Biodiversity Climate Change Families Farmers Fisheries Food Security Forests Water	Addressing hunger, food insecurity, and malnutrition through improving food and agricultural systems.	Food insecurity, malnutrition, and food systems are consistent across DAH data and tweets.	Food insecurity, malnutrition, and food systems are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of a world free from hunger and malnutrition, the FAO prioritizes eliminating hunger, food insecurity, and malnutrition	Yes
UNDP	"UNDP's Strategic Plan (2018-2021) has been designed to be	Tot/al budget allocation	Topics from 2016-2020 tweets	Poverty eradication,	HIV/AIDS, malaria, and	HIV/AIDS, malaria, and	Yes

	responsive to the wide diversity of the countries we serve. The diversity is reflected in three broad development contexts: • Eradicate poverty in all its forms and dimensions • Accelerate structural transformations • Build resilience to shocks and crises To respond to these issues, and better focus its resources and expertise to deliver on the 2030 Agenda, UNDP has identified a set of approaches that we call our Signature Solutions: • Keeping people out of POVERTY • GOVERNANCE for peaceful, just, and inclusive societies • Crisis prevention and increased RESILIENCE • ENVIRONMENT: nature-based solutions for development • Clean, affordable ENERGY • Women's empowerment and GENDER equality In all our activities, we encourage the **protection of human rights** and the **empowerment of women**, **minorities and the poorest and most vulnerable**." (UNDP About us) UNDP is the lead development agency in helping the achievement of the Sustainable Development Goals. **SDG 3: Ensure healthy lives and promote well-being for all at all ages.** (UNDP: SDGs)	$5.7 billion budget in 2019 By UNDP focus Eradicating poverty (43%), accelerate structural transformations (32%), build resilience to shocks and crises (11.5%), others (13.2%) By health focus area SDG3 was allotted $504M (9%) of total budget in 2019 –55% to HIV/AIDS, tuberculosis, and malaria (target 3.3), 26% to universal health coverage (target 3.8), 9% to child mortality (target 3.2) Region 23% of 2019 budget was allocated to Africa, 19% to Asia and the Pacific, 18% to Latin America and the Caribbean.	(no order) Africa Children Climate Change Education FGM Food Security HIV/AIDS Malaria Water Women	accelerate structural transformations, build resilience to shocks and crises SDG 3: Ensure healthy lives and promote well-being for all at all ages (includes: maternal mortality, child mortality, HIV/AIDS, tuberculosis, malaria, infectious diseases, mental health, substance abuse, road traffic accidents, sexual and reproductive health, universal health coverage, deaths from environmental pollution)	child and maternal health are consistent across DAH data and tweets.	child and maternal health are consistent across stated and revealed preferences. To maximize benefits of their pre-determined global health goal of ensuring healthy lives and promoting well-being for all, the UNDP prioritizes HIV/AIDS, malaria, and child and maternal health.	
MSF	"Médecins Sans Frontières brings **medical humanitarian assistance** to victims of **conflict**, **natural disasters**, **epidemics** or **healthcare exclusion**" (MSF About Us) "Program Priorities • Outpatient consultations • Birth assistance (including C-section) • Cholera treatment • Inpatient care • Vaccinations against measles • Malaria treatment • Sexual violence • Meningitis treatment • Inpatient feeding programs for malnourished children • TB treatment • HIV ART treatment • Mental health services • Distribution of relief goods" (International Activity Report 2019)	Health Focus Area "81% of our financial resources are allocated to fulfilling our social mission: 65% to our humanitarian programmes, 12% to support our projects and programmes, and 4% to awareness-raising, the Access Campaign, and the Drugs for Neglected Diseases initiative (DNDi). The rest is spent on general management and fundraising costs. We also maintain reserves that allow us to respond immediately to a crisis without having to wait for an appeal." Funding is allocated mostly to outpatient consultations, malaria treatment, and birth assistance Region	Topics from 2016-2020 tweets (no order) Africa Children Cholera Ebola HIV/AIDS Humanitarian Aid Refugees Treatment Tuberculosis Violence	Medical humanitarian assistance to victims of conflict, natural disasters, epidemics, or healthcare exclusion.	Humanitarian aid, HIV/AIDS, infectious diseases, and child health are consistent across DAH data and tweets.	Humanitarian aid, HIV/AIDS, infectious diseases, and child health are consistent across stated and revealed preferences. To maximize benefits of their pre-determined goal of bringing medical humanitarian assistance to victims of crises, MSF prioritizes humanitarian aid, HIV/AIDS, infectious diseases, and child health.	Yes

		Funding data for MSF in 2019 have unallocated or unspecified regions.					
PATH	"At PATH, we are a global team of innovators working to **accelerate health equity** so all people and communities can thrive. We advise and partner with public institutions, businesses, grassroots groups, and investors to solve the world's most pressing health challenges." (PATH About Us) "2019 Achievements • Controlling and eliminating **malaria** • Differentiating services for **HIV** patients • Reimagining **primary health care** • Creating **innovative devices** and diagnostics • Maximizing impact through **policy** • Advancing **essential medicines** • Reducing the cost of **sanitation** and cleaning • Expanding access to **contraception**" (PATH Annual Report 2019)	Health Focus Area Of the $303 million 2019 budget, 48% was allocated to global health programs, 37% to essential medicines, 11% to technology and innovation, 3.5% to other. Region Funding data for PATH in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Access Africa Breastfeeding Cancer Children Ebola Innovation Malaria Pneumonia Vaccines	Accelerating health equity Areas: Malaria, HIV/AIDS, primary health care, health innovations, health policy, essential medicines, sanitation, contraceptives	Malaria, vaccines, and innovations are consistent across DAH data and tweets.	Malaria, vaccines, and innovations are consistent across stated and revealed preferences. To maximize benefits of their pre-determined goal of "accelerating health equity", PATH prioritizes malaria, vaccines, and health innovations.	Yes
Save the Children	"For 100 years, we've been giving **children** in the U.S. and around the world a **healthy start in life**, the **opportunity to learn** and **protection from harm**. When crisis strikes, we are always among the first to respond and the last to leave. We do whatever it takes to save children, transforming their lives and the future we share." (Save the Children About Us) Focus Areas • Health and Nutrition • Education • Hunger and Livelihoods • Public Policy and Advocacy • HIV/AIDS • Child Protection and Rights Governance (Save the Children Annual Report 2019)	Health Focus Area In 2019, Save the Children had a budget of $836 million. • Health & Nutrition (38%) • Education (19%) • Hunger & Livelihoods (13%) • Public Policy & Advocacy (11%) • HIV/AIDS (7%) • Child Protection & Rights Governance (4%) • Other (8%) Region Funding data for Save the Children in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Children Donations Education Food Security Humanitarian Aid Pneumonia Refugees Schools Water	Health related: "giving children a healthy start", "protection from harm"	Child health, nutrition, and food security are consistent across DAH data and tweets.	Child health, nutrition, and food security are consistent across stated and revealed priorities. To maximize benefits of their pre-determined global health goals of "giving children a healthy start and protection from harm", Save the Children prioritizes child health, nutrition, and food security.	Yes
Oxfam	"Oxfam is a global organization working to **end the injustice of poverty**. We help people **build better futures for themselves**, **hold the powerful accountable**, and **save lives in disasters**." (About Oxfam) "Across Yemen, Puerto Rico, Bangladesh, Syria, Central America, and Mozambique, among many other places, our work is delivering tangible, measurable impact: providing lifesaving aid, partnering with local organizations to achieve long-term solutions, and using	Health Focus Area Of the $88 million 2019 budget, 36% was allocated to emergency response and preparedness, 28% to overcoming poverty, 28% to social justice campaigns, 8% to public education. Region Of the budget spent on emergency response and preparedness, 40% was allocated to Africa, 24% to Latin	Topics from 2016-2020 tweets (no order) Africa Climate Change Ebola Food Security Humanitarian Aid Malaria Pneumonia Refugees Water Women	Health related: "help people build better futures for themselves," "save lives in disasters"	Emergency response (humanitarian aid, Ebola, food security, and infectious disease) is consistent across DAH data and tweets.	Emergency response (humanitarian aid, Ebola, food security, and infectious disease) is consistent across stated and revealed preferences. To maximize benefits of their pre-determined global health goals of "helping	Yes

	our strong policy voice to advocate for change. **Program Services** • Saving Lives: Emergency Response and Preparedness • Programs to overcome poverty • Campaigning for social justice • Public education" (Oxfam Annual Report 2019)	America and the Caribbean, and 13% to Asia and the Pacific				people build better futures for themselves" and "saving lives in disasters", Oxfam prioritizes emergency response, humanitarian aid, Ebola, food security, and infectious diseases.	
Global health system	**WHO constitution (1948)**: "Health for All" and the right to the highest attainable standard of health. **Declaration of Alma-Ata (1978)**: universal access to primary health care. **MDGs (2000):** reduce child mortality (4), improve maternal health (5), combat HIV/AIDS and other diseases (6) **SDGs (2015) [Relevant to study's time period]:** good health and well-being (3) • By 2030, reduce the global **maternal mortality** ratio to less than 70 per 100,000 live births (3.1) • By 2030, end **preventable deaths of newborns and children** under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births (3.2) • By 2030, end the epidemics of **AIDS, tuberculosis, malaria** and **neglected tropical diseases** and combat **hepatitis,** water-borne diseases and other **communicable diseases** (3.3) • By 2030, reduce by one third premature mortality from **non-communicable diseases** through prevention and treatment and promote **mental health and well-being** (3.4) • Strengthen the prevention and treatment of **substance abuse**, including narcotic drug abuse and harmful use of alcohol (3.5) • By 2020, halve the number of global deaths and injuries from **road traffic accidents** (3.6) • By 2030, ensure universal access to	Health Focus Areas Of the $41 billion DAH transferred across all global health actors in 2019, 24% was allocated to **HIV/AIDS**, 21% to **newborn and child health**, 14% to **health system strengthening**, 12% to **reproductive and maternal health**, 6% to other infectious diseases, 6% to malaria, 4% to tuberculosis, and 2% to non-communicable diseases. Region Funding data in 2019 have unallocated or unspecified regions. In 2017, 33% of all DAH funding was allocated to **sub-Saharan Africa**, 5% to Southeast Asia, 5% to South Asia, 4% to North Africa and the Middle East, 3% to Latin America and the Caribbean, 2% to Europe and Central Asia, 15% globally, and 32% unallocated.	Most common topics from 2016-2020 across 20 key actors (number in parenthesis indicates count of actors that had the topic as a priority from 2016-2020 tweets) 1. Africa (17), 2. Children (15), 3. HIV/AIDS (11), 4. Women (10), 5. Ebola (9), 6. Water (9), 7. Food security (7), 8. Humanitarian aid (7), 9. Malaria (7), 10. Education (6), 11. Climate change (5), 12. Pneumonia (5), 13. Breastfeeding (4), 14. Cancer (4), 15. Measles (4), 16. Polio (4), 17. Tuberculosis (4), 18. Vaccines (4), 19. Access (3), 20. Agriculture (3), 21. Cholera (3), 22. Human Rights (3), 23. Mothers (3), 24. Refugees (3), 25. Treatment (3), 26. Violence (3), 27. FGM (2), 28. Hepatitis (2), 29. Influenza (2), 30. Innovation (2), 31. Poverty (2), 32. Prevention (2), 33. Sanitation (2), 34. Testing (2)	Health for all and the right to highest attainable standard of health. 9 important target areas under SDG 3.	HIV/AIDS, child and maternal health, and infectious diseases are consistent across DAH data and tweets.	HIV/AIDS, child and maternal health, and infectious diseases are consistent across stated and revealed priorities. To maximize benefits of the pre-determined goal of "health for all" and "SDG3: good health and well-being", the global health system prioritizes 3 of the 9 target areas of SDG 3: HIV/AIDS, child and maternal health, and infectious diseases. **Note:** These benefit-maximizing priorities are the same top priorities of the three funding organizations.	Yes

	sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes (3.7) • Achieve **universal health coverage**, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all (3.8) • By 2030, substantially reduce the number of **deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination** (3.9)						

Supplementary Table 2. Breakdown of Collected Tweets by Actor and Month. Total tweets and average tweets per month for each of the 20 global health actors.

Global Health Actor	Total Tweets	Average Tweets per Month
World Health Organization	10,827	722
Oxfam International	5,694	380
Doctors Without Borders (MSF)	5,553	370
UN Children's Fund (UNICEF)	5,395	360
World Bank	5,365	358
UN Development Programme (UNDP)	4,912	327
UN Population Fund (UNFPA)	3,908	261
UK Department of International Development	3,823	255
Centers for Disease Control and Prevention (CDC)	3,701	247
United States Agency for International Development (USAID)	3,604	240
Food and Agriculture Organization (FAO)	3,263	218
Save the Children	3,121	208
Gavi, the Vaccine Alliance	2,739	183
National Institutes of Health (NIH)	2,664	178
Joint UN Programme on HIV/AIDS (UNAIDS)	2,214	148
PATH	1,954	130
Global Fund	1,727	115
European Centre for Disease Prevention and Control (ECDC)	1,311	87
Gates Foundation	1,249	83
Unitaid	1,217	81
Total	**74,241**	**4,949**

Supplementary Table 3. Breakdown of Collected Tweets by Year and Month Tweets per month and per year for all the tweets collected.

	Tweets per Month	Tweets per Year
2016		5,973
November	5,973	
2017		21,193
February	4,474	
May	5,582	
August	5,103	
November	6,034	
2018		18,562
February	4,145	
May	4,965	
August	4,205	
November	5,247	
2019		17,884
February	4,500	
May	4,886	
August	3,987	
November	4,511	
2020		10,629
February	4,446	
May	6,183	
Total	**74,241**	**74,241**

Supplementary Table 4. Priority Similarity Matrix Scores are generated by comparing the list of 10 health priorities of actor A with that of actor B and the number of matching priorities is counted. Topic similarity scores range from 0-10.

	USA	UK	BMGF	WHO	World Bank	UNAIDS	UNFPA	UNICEF	UNITAID	GAVI	Oxfam	Global Fund	CDC	EU CDC	NIH	FAO	UNDP	MSF	PATH	Save the Children
USA		7	6	5	6	3	4	4	2	2	5	4	3	1	2	3	7	4	2	6
UK	7		4	4	6	2	3	5	2	3	5	4	2	2	2	4	6	5	3	6
BMGF	6	4		8	4	3	3	4	3	3	3	6	2	1	2	1	6	3	4	3
WHO	5	4	8		3	3	3	4	3	5	4	7	3	3	2	1	5	4	5	2
World Bank	6	6	4	3		2	4	4	1	3	6	3	3	0	1	5	6	3	2	5
UNAIDS	3	2	3	3	2		3	2	4	1	2	3	2	1	2	1	3	3	3	1
UNFPA	4	3	3	3	4	3		4	1	2	3	3	2	0	1	1	4	4	2	3
UNICEF	4	5	4	4	4	2	4		1	3	4	3	2	1	1	3	5	4	4	4
UNITAID	2	2	3	3	1	4	1	1		3	1	4	2	3	2	0	3	4	5	1
GAVI	2	3	3	5	3	1	2	3	3		3	6	3	2	2	1	2	4	5	2
Oxfam	5	5	3	4	6	2	3	4	1	3		5	2	1	1	4	6	4	3	5
Global Fund	4	4	6	7	3	3	3	3	4	6	5		2	3	2	1	5	6	4	2
CDC	3	2	2	3	3	2	2	2	2	3	2	2		2	0	1	3	1	2	2
EU CDC	1	2	1	3	0	1	0	1	3	2	1	3	2		1	0	1	3	1	0
NIH	2	2	2	2	1	2	1	1	2	2	1	2	0	1		1	2	2	2	1
FAO	3	4	1	1	5	1	1	3	0	1	4	1	1	0	1		4	1	1	3
UNDP	7	6	6	5	6	3	4	5	3	2	6	5	3	1	2	4		3	3	5
MSF	4	5	3	4	3	3	4	4	4	4	4	6	1	3	2	1	3		3	4
PATH	2	3	4	5	2	3	2	4	5	5	3	4	2	1	2	1	3	3		3
Save the Children	6	6	3	2	5	1	3	4	1	2	5	2	2	0	1	3	5	4	3	

Supplementary Table 5. Types of Power. A summary of the four types of power as presented by Barnett and Duvall (2005) with examples in global health.

Power Type	Relational specificity	Power works through…	Definition according to Barnett & Duvall (2005)	Global Health Example
Compulsory Power	Direct	Interactions of specific actors	"Direct control of one actor over the conditions of existence or the actions of another." (p. 48)	Donor countries dictate the conditions in low and middle-income countries (LMICs) through dictating requirements in development aid.
Institutional Power	Diffuse	Interactions of specific actors	"Control actors exercise indirectly over others through diffuse relations of interactions." (p. 43)	High-income countries control funding allocations for LMICs through institutional power via their contributions to the WHO and other multilateral organizations.
Structural Power	Direct	Social relations of constitution	"Constitution of subjects' capacities in direct structural relation to one another." (p. 43)	The structural and historical disempowerment of indigenous populations have resulted in their disproportionate outcomes in health.
Productive Power	Diffuse	Social relations of constitution	"Power [that] works through diffuse constitutive relations to produce the situated social capacities of actors." (p. 48)	High-income countries direct what research institutions prioritize and study, and ultimately determine what health issues are addressed.

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Title: Examining power dynamics in global health governance using topic modeling and network analysis

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Structured Abstract:

Objectives: Despite increases in global health actors and funding levels, health inequities persist. We empirically tested whether global health governance (GHG) operates under the Rational Actor Model (RAM) and characterized GHG power dynamics.

Design: We collected approximately 75,000 tweets of 20 key global health actors, between 2016 and 2020 using Twitter API. We generated priorities from tweets collected using a topic modeling algorithm. Priorities from tweets were compared with stated priorities from content analyses of policy documents and with revealed priorities from network analyses of development assistance for health (DAH) funding data. Comparing priorities derived from Twitter, policy documents, and DAH funding data, we are able to test if GHG operates under RAM and to characterize power dynamics in GHG.

Participants: 20 key global health actors were identified based on consensus of 3 peer-reviewed articles mapping global health networks. All tweets of global health actors were collected in three-month intervals from November 2016 to May 2020. Policy documents and DAH financial data for each actor were collected for the same time period.

Results: We find all 20 actors and the global health system collectively fulfill the 3 conditions of RAM based on stated and revealed priorities. We also find compulsory and institutional power asymmetries in GHG. Funding organizations have compulsory power over channels of DAH and implementing institutions they directly fund. Funding organizations also have transitive influence over implementing institutions receiving DAH funding.

Conclusions: GHG operates under RAM, the rational choice for all actors is to align their priorities with the priorities of wealthy funding organizations. Priorities of the entire global health system are determined by the priorities of wealthy funding organizations that have compulsory and institutional power over other actors. If health inequities are to be addressed, a reassessment of current global health governance is imperative.

Strengths and limitations of this study:

- This study utilizes an alternative methodology of using Twitter data in understanding global health governance and priority-setting.
- This study triangulates findings from multiple data sources to test the rational actor model and to characterize power asymmetries in global health governance.
- Because the scope of this study is from 2016 to 2020, the findings may not be fully representative of global health governance during the COVID-19 pandemic.
- Only the key 20 actors of the hundreds of global health actors today were included in the study.

INTRODUCTION

The turn of the 21st century introduced an unprecedented volume of new public and private actors in global health accompanied by stratospheric levels of funding.[1] While some argue that this multiplicity of new actors promotes cooperation, what persists is a politically fragmented network of actors with competing priorities and preferences.[2–4] Academics studying the complex network of global health actors have described it as a "congested" and "chaotic" network that causes inefficiencies in the practice and delivery of global health programs and aid.[5]

Inequities in global health have increasingly been attributed to the actions of transnational actors with varying degrees of power and divergent interests.[6] While more actors have entered global health with ostensible benevolent purposes, health inequities and inefficiencies in delivery still exist today. Fierce competition among donor priorities and requirements overwhelms the institutional capacities of recipient countries,[7,8] disrupts national health planning,[9] delays the delivery of aid,[10] and creates duplications and resource waste.[11,12] Paradoxically, despite the exponential increases in global health actors and funding, preventable global health inequities have persisted. Some argue that, to an extent, the multiplicity and fragmentation of global health actors contribute to the persistence of inequities and inefficiencies in global health.

Researchers have presented at least two arguments attempting to understand this paradox through the lens of economics, politics, and power. First, global health governance (GHG) has been theorized as operating under the rational actor model (RAM) where "each actor has its own set of goals and objectives, and these actors take actions based on analysis of the costs and benefits of various available options."[13] With each actor acting on their own set of explicit goals in the form of mission statements, bylaws, and other founding documents, and implicit goals revealed from past decisions and behaviors, prioritization in GHG is not based on a shared ethical commitment to a common global health goal co-created by various health actors but is based on the aggregation of individual explicit and implicit objectives. GHG based on the RAM fails to "justify an obligation to help meet the health needs of others" and may have contributed to the persistence of global health inequities.[13]

Second, the Lancet-University of Oslo Commission on Global Governance for Health (2014) argues that "power asymmetry and global social norms limit the range of choice and constrain action on health inequity."[6] The actions of powerful global health actors in pursuit of their own interests "are not designed to harm health but can have negative side-effects" that may have contributed to the persistence of inequities.[6] The lack of power of global health beneficiaries and smaller health actors, and the outsized wielded power of large global health funders may also have contributed to the slow rate of reduction in global health inequities.

The argument that GHG operates under the RAM and the Commission on Global Governance for Health's argument about power asymmetry are mainly theoretical ideas about the behaviors of global health actors founded on a collection of studies within specific nations, regions, or institutions. What is necessary is empirical evidence at the global level that can confirm, deny or recharacterize these characterizations of how

global health currently operates. Empirical evidence at the global level eliminates doubts of how decisions are currently made in global health and can guide GHG towards addressing the world's inequities in health.

We aim to empirically test the following research questions at the global level: (1) does GHG operate under the RAM? and (2) how can we characterize power dynamics in GHG?

We hypothesize that GHG operates under RAM and that there are power asymmetries in GHG that limit the range of health priorities. We analyzed empirical evidence from Twitter, funding data, and policy documents at the global level to test whether GHG operates under RAM and to characterize the power dynamics in GHG.

METHODS

We test if GHG operates under the RAM and characterize the power dynamics in GHG through the lens of global health priority-setting. All global health actors have certain preferences for health issues and act in alignment with these priorities.

Priorities can either be stated or revealed. Stated priorities are those preferences explicitly stated in a health actor's founding documents, websites, and annual reports. The mission statements and the health areas each actor explicitly mention in their official documents and websites are stated priorities. Revealed priorities are preferences that are gleaned from records of past behaviors and choices. Past health funding allocations and accounts of actually implemented programs and policies are revealed priorities. Revealed priorities may or may not be aligned with stated priorities.

We use evidence for both stated and revealed priorities from 2016 to 2020 to test both of our research questions.

Study Sample

We identified 20 key global health actors based on a consensus among three past studies that mapped the global health network using quantitative and qualitative methodologies.[4,14,15] As shown in Table 1, the key global health actors were categorized based on their nature of work in global health. Global health actors were either funding organizations, channels of developmental assistance for health (DAH) or implementing institutions. While most actors fall into more than one of these categories in practice, for the integrity of this analysis, organizations were limited to only one category based on the nature of their main line of work.

Table 1. Summary of Global Health Actors. Characteristics of the 20 global health actors analyzed in this study.

Nature of Work in Global Health	Organizational Category	Twitter Username	Global Health Actor	Number of Twitter Followers (as of October 2021)
Channels of Developmental Assistance for Health	Global health initiative	gavi	Gavi, the Vaccine Alliance	153,000
		UNITAID	Unitaid	17,200
		GlobalFund	Global Fund to Fight AIDS, Tuberculosis and Malaria	240,100
	Multilateral Development Bank	WorldBank	World Bank	3,500,000
	United Nations System	WHO	World Health Organization	10,000,000

		UNAIDS	Joint United Nations Programme on HIV/AIDS (UNAIDS)	286,800
		UNFPA	United Nations Population Fund (UNFPA)	260,800
		UNICEF	United Nations Children's Fund (UNICEF)	8,900,000
Funding Organizations	National Government	USAID	United States Agency for International Development (USAID)	843,200
		DFID_UK*	United Kingdom Department for International Development (UK DFID)*	1,000,000
	Philanthropic Organization	gatesfoundation	Bill and Melinda Gates Foundation	2,100,000
Implementing Institutions	Global CSO/NGO	MSF	Doctors Without Borders (MSF)	165,100
		PATHtweets	PATH	59,500
		SavetheChildren	Save the Children	2,700,000
		Oxfam	Oxfam International	836,300
	United Nations System	FAO	Food and Agriculture Organization (FAO)	469,600
		UNDP	United Nations Development Programme (UNDP)	1,600,000
	National Government	CDCgov	Centers for Disease Control and Prevention (CDC)	4,300,000
		ECDC_EU	European Centre for Disease Prevention and Control (ECDC)	90,600
		NIH	National Institutes of Health (NIH)	1,400,000

* UK DFID is now the Foreign, Commonwealth, and Development Office. During the time of the analysis, the UK's agency for aid was known as DFID.

Patient and public involvement

Patients and the public were not involved in the development of the research questions and outcome measures.

Data Sources

We analyze stated and revealed priorities of 20 key global health actors from three data sources – policy documents, DAH funding data, and tweets. Table 2 summarizes each data source, how they were collected, how they were analyzed, and what types of priorities can be derived.

Table 2. Summary of Data Source, Collection, and Analysis. Description of how data is collected and analyzed in the study.

Data Source	Data Collection	Analysis	Type of Priorities Derived from Source
Policy Documents	Manual collection of annual reports, policy documents, and official communications from official websites of each global health actor	Manual content analysis	Stated
DAH Funding Data	Queried funding allocation data of each global health actor from the International Health Metrics and Evaluation (IHME) DAH Database	Descriptive statistics; network analysis	Revealed
Twitter Data	Collected all the tweets of each global health actor from November 2016 to May 2020	Natural language processing (topic modeling); network analysis	Revealed

	in three month intervals using the Twitter API		

Drawing stated priorities from policy documents

Stated priorities are obtained from a manual content analysis of policy documents, annual reports, and official websites of global health actors.

Available policy documents, annual reports, and relevant official communications from the websites of each global health actor within the timeframe of the study were collected. Documents not published between 2016 and 2020 were not collected. Manual content analysis was conducted to evaluate the available policy documents for each global health actor and identify their respective stated priorities.

The stated priorities drawn from these documents were commonly obtained from official statements that fall under the following headings: “strategic priorities,” “program priorities,” “strategic objectives,” “focus areas,” “strategic work areas,” “program focus,” “Strategy 20XX-20XX,” “strategic goals,” “priority areas,” among others. The first column of Supplementary Table 1 contains the stated priorities obtained from each actor.

Deriving revealed priorities from funding data

Revealed priorities are derived using a network analysis and descriptive statistics of financial flows in DAH funding data. To obtain the revealed priorities of each global health actor, we use topic modeling in natural language processing (NLP) and a network analysis of the tweets for each global health actor. Further explanation of data collection from each source follows.

Data from the Institute for Health Metrics and Evaluation’s (IHME) Developmental Assistance for Health Database was collected for 2019.[16] The database includes approximately 800,000 transactions of financing for health programs and aid from funding organizations to channels of DAH and to implementing countries.

Descriptive statistics were conducted to determine the allocations of funding for each health area and geographic region for the 20 global health actors in 2019.

Network analysis is an analytic method that has proved to be useful in understanding relational dynamics across actors in global and public health.[17,18] Network analysis was conducted to observe the funding relationships between global health actors. Gephi 0.9.2 was used in constructing and analyzing the network map. The network modelled in the study allows for a graphical visualization of the flows of global health funding in 2019. The network map was designed such that each global health actor is represented by a node and lines or “edges” indicate a flow of funding in global health. The Fruchterman-Reingold algorithm was used in modelling the network map. The algorithm “calculates the optimal layout so that nodes with less strength and less connections are placed further apart, and those with more and/or stronger connections are placed closer to each other.”[19] The thickness of edges represents the amount of funding transferred between actors. The modelled network map can be found and will be discussed in the findings section.

Twitter data

Using the Twitter API, we collected all the tweets of each global health actor by username from November 2016 to May 2020 in three month intervals. This means that all the tweets of each global health actor were collected for each day in the months of February, May, August, and November for each year. An interval of three months was decided for two reasons. First, a variation in the issues, topics, and themes that global health actors tweet can be observed in three month intervals. Initial small sample testing indicates that collecting all the tweets of every month for each actor yields redundancy in issues and topics observed. Redundancy is eliminated in three month intervals. Second, it also allows for efficient usage of the data request limits of the Twitter API. As Twitter limits the number of tweets one is able to collect from the Twitter API, this interval is an efficient way of collecting data for all 20 global health actors for the timeframe. A total of 74,241 tweets were collected from 2016 to 2020 for the 20 global health actors. Supplementary Tables 2 and 3 further describe the tweets collected.

Using Twitter as a data source plays an important role in analyzing GHG, examining whether it operates under the RAM, and characterizing power dynamics. In the academic area of communications studies, researchers suggest that there are two forms of utility that motivate actors to post content on Twitter. First, intrinsic utility assumes that a user receives inherent satisfaction from posting content on Twitter.[20] While global health actors do not necessarily receive the same “inherent satisfaction” as individual Twitter users, global health actors acquire more intrinsic utility as their communications reach a greater number of users. Second, image-related utility assumes that the perceptions of others,[21,22] and seeking status or prestige are strong motivators for posting content.[23,24] As global health actors operate best with high public approval, posting content on Twitter can improve public perception. Twitter is the ideal platform for global health actors to simultaneously share their work to a greater number of individuals and to improve their public perception. The utility received from using Twitter explains the social media’s ubiquity among global health actors.

Because Twitter limits each post to 280 characters, the platform promotes short, frequent, and straightforward manners of communication. The tweets of global health actors are regular ways of communicating their work, preferences, and priorities to the public.[25–28] The tweets of global health actors act as an archive, a record of historical preferences, priorities, goals, and implemented programs.[29]

While tweets can represent both stated and revealed priorities, for this study, we use tweets to represent revealed priorities. Since this study analyzes tweets in aggregation, our findings reveal the top themes discussed by each actor from 2016-2020. Because we do not analyze each tweet at an individual level, tweets are considered revealed priorities and not stated priorities.

Obtaining revealed priorities from Twitter data

NLP is a subfield in artificial intelligence, computer science, and linguistics at the intersection of the human language and computers. NLP is concerned about how to utilize computers to process and analyze large quantities of human language data. We use NLP in analyzing the tweets of the global health actors for two reasons. First, NLP allows for the efficient analysis of tens of thousands of rows of text data that could not be done manually.[30–32] Second, NLP allows for a technique called topic modeling

where an algorithm generates lists of words that are frequently used together.[33–35] These lists of words can then be interpreted to identify specific themes, topics, or issues to identify the top 10 priorities of each global health actor from 2016 to 2020. The results of the topic modeling are then used in a network analysis that visualizes where each actor converges or diverges in global health priorities with other actors.

As seen in Table 3, ten topics were generated using the Latent Dirichlet Allocation (LDA) topic model for each global health actor's tweets to reveal their priorities from 2016 to 2020. LDA is a generative probabilistic modeling method where words in a corpus of text that are frequently used together are categorized into topics.[36] This follows the assumption that documents, or in this case Twitter profiles, can be broken down into multiple topics that are identified by certain combinations of words.

Table 3. Revealed Priorities from Twitter Topic Modeling. Ten revealed priorities of each of the 20 global health actors based on their tweets from 2016 to 2020. Priorities are alphabetically arranged. Red indicates Funding Organizations. Blue indicates Channels of DAH. Gray indicates Implementing Institution.

United States	United Kingdom	Gates Foundation	WHO	World Bank	UNAIDS	UNFPA	UNICEF	UNITAID	GAVI
Africa	Africa	Africa	Africa	Africa	Access	Africa	Africa	Access	Africa
Children	Agriculture	Breastfeeding	Breastfeeding	Agriculture	Africa	Child Marriage	Breastfeeding	Cancer	Cancer
Education	Children	Children	Children	Children	Discrimination	Children	Children	Children	Children
Food Security	Development	Education	Ebola	Climate Change	HIV/AIDS	Family Planning	Climate Change	Hepatitis	Cholera
HIV/AIDS	Ebola	HIV/AIDS	HIV/AIDS	Food Security	Human Rights	FGM	Ebola	HIV/AIDS	Ebola
Humanitarian Aid	Education	Malaria	Malaria	Humanitarian Aid	Innovation	Human Rights	Education	Malaria	Measles
Mothers	Food Security	Mothers	Measles	Poverty	Prevention	Humanitarian Aid	Human Rights	Testing	Pneumonia
South America	HIV/AIDS	Polio	Mothers	Sanitation	Testing	Nutrition	Online	Treatment	Polio
Water	Humanitarian Aid	Sanitation	Polio	Water	Treatment	Violence	Violence	Tuberculosis	Poverty
Women	Water	Women	Women	Women	Women	Women	Water	Vaccines	Vaccines
Global Fund	**CDC**	**EU CDC**	**NIH**	**FAO**	**UNDP**	**MSF**	**PATH**	**Save the Children**	**Oxfam**
Africa	Children	Ebola	Africa	Africa	Africa	Africa	Access	Africa	Africa
Children	Diarrhea	Hepatitis	Cancer	Agriculture	Children	Children	Africa	Children	Climate Change
Cholera	E. Coli	HIV/AIDS	Funding	Biodiversity	Climate Change	Cholera	Breastfeeding	Donations	Ebola
Ebola	Influenza	Influenza	Heart Disease	Climate Change	Education	Ebola	Cancer	Education	Food Security
HIV/AIDS	Measles	Measles	HIV/AIDS	Families	FGM	HIV/AIDS	Children	Food Security	Humanitarian Aid
Malaria	Prevention	Outbreaks	News	Farmers	Food Security	Humanitarian Aid	Ebola	Humanitarian Aid	Malaria
Pneumonia	Vaccines	Report	Rare Disease	Fisheries	HIV/AIDS	Refugees	Innovation	Pneumonia	Pneumonia
Polio	Water	Surveillance	Research	Food Security	Malaria	Treatment	Malaria	Refugees	Refugees
Tuberculosis	Women	Tuberculosis	Stress	Forests	Water	Tuberculosis	Pneumonia	Schools	Water
Women	Zika	West Nile	Veterans	Water	Women	Violence	Vaccines	Water	Women

Additionally, we model a network map from the priorities generated using the LDA topic model also using the Fruchterman-Reingold algorithm. This network map visualizes the similarities in priorities between the 20 actors. Data used for this network map can be found in Supplementary Table 4. This network map is compared with the network map generated using financial data from IHME in the findings section. This comparison between network maps can illustrate if priorities from tweets and from financial data are aligned.

Testing if GHG operates under the RAM

By combining evidence for stated and revealed priorities of 20 key global health actors, we can determine if GHG operates under the RAM.

The rational actor model (RAM) in international cooperation is categorized as the "linchpin of foreign policy decision making."[37] This approach is rooted in expected utility theory in microeconomics introduced by von Neumann and Morgenstern in the 1940s and subsequent theories of rationality.[38]

RAM is most useful in explanations of economic behavior if the three conditions of the rationality assumption are fulfilled.[37] First, it is assumed that an actor's goal is pre-determined before intentionally acting to achieve it.[37] Second, actors are assumed to "display consistent preferences as manifested in the ability to rank the preferences in transitive order."[37] Third, actors are assumed to maximize utility while choosing an alternative that provides the highest amount of net personal benefit.[37]

"Rational" in this case does not simply mean a dispassionate calculation of costs and benefits. In the case of global health actors, acting rationally means weighing both economic and political factors, and acting according to the three assumptions of RAM.

GHG operates under RAM if each of the 20 global health actors and the global health system collectively fulfill the three assumptions of pre-determined goal, rank order preferences, and benefit maximization.

To test the first assumption of pre-determined goal, we determine the stated priorities of each global health actor from policy documents. We test whether there exist explicit statements on goals and priorities and note what health areas or issues are the stated priorities of each global health actor.

To test the second assumption of consistent rank order preferences, we compare revealed priorities from DAH funding data and revealed priorities from tweets. From the DAH funding data, we can determine rank order preferences based on which health issues are allocated the most funding in 2019. From tweets, we can determine rank order preferences based on the top 10 topics each global health actor tweeted about from 2016 to 2020. If there is consistency in rank order preferences between the revealed priorities from DAH funding data and revealed priorities from tweets, then the second assumption is fulfilled.

To test the third assumption of benefit maximization, we compare the stated and revealed priorities from all three data sources. The priorities that are consistent across stated priorities from policy documents and revealed priorities from DAH funding data and from tweets are revealed to be the priority that the global health actor determines to be benefit maximizing. An alignment of a preference across the three different sources can lead us to believe with high probability that it is the actor's benefit maximizing preference.

We also test the three assumptions at the global health system level. Pre-determined goals are obtained from stated priorities from collective stated commitments to global health based on Sustainable Development Goal 3 (SDG-3) of "good health and well-being" as all 20 of the actors in this study have stated commitments to this goal. Consistent rank order preferences are derived from the alignment between aggregated

DAH funding allocations of all global health actors and the most common topics generated from tweets across all global health actors. The consistent preferences across stated and revealed priorities are inferred to be what the global health systems decides to be benefit maximizing.

If each global health actor fulfills the three assumptions, and if the global health system collectively fulfills the three assumptions, then GHG operates under the RAM.

Characterizing power dynamics in GHG

We use the following typology of power when characterizing power dynamics in GHG. "Power is exercised everywhere in global health although its presence may be more apparent in some instances than others,"[39] one global health researcher notes. The power concept in global health does not stray far from Robert Dahl's (1957) definition in his seminal study where he describes "A has power over B to the extent that he can get B to do something B would not otherwise do."[40] Specifically, one way to categorize power is through the four types introduced by Barnett and Duvall (2005), each manifesting in different manners in global health.[41] Supplementary Table 5 summarizes Barnett and Duvall's four types of power. First, compulsory power is defined as "direct control of one actor over the conditions of existence or the actions of another."[41] In global health, compulsory power can be seen in how donor countries dictate the conditions in low and middle-income countries (LMICs) through development aid.[42] Second, institutional power is "the control actors exercise indirectly over others through diffuse relations of interactions."[41] High-income countries control funding allocations for LMICs through institutional power via their contributions to the WHO and other multilateral organizations. Third, structural power refers to the "constitution of subjects' capacities in direct structural relation to one another."[41] The structural and historical disempowerment of indigenous populations have resulted in their disproportionate outcomes in health.[43,44] Fourth, "productive power works through diffuse constitutive relations to produce the situated social capacities of actors."[40] Research institutions funded by high-income countries direct what health issues are studied and addressed.[45]

To characterize the power dynamics manifested in GHG, we analyze the interplay of stated and revealed priorities between funding organizations, channels of DAH, and implementing organizations. Particularly, we identify which global health actors have the most influence in setting global health priorities. The global health actors which have the most priorities aligned with the stated and revealed priorities of the global health system are determined to have the most influence and power in priority-setting.

DISCUSSION

GHG operates under RAM

As seen in Supplementary Table 1, we find that each of the 20 key global health actors fulfills the three assumptions of the RAM. Each actor has a pre-determined goal stated in mission statements, strategic plans, multi-year strategies, and other policy documents. Each actor has consistent rank order preferences as observed in the

alignment of order of preferences in DAH funding data and top identified topics from tweets. Consistent, top-ranking preferences across policy documents, funding data, and tweets are the alternatives that maximize benefits for each global health actor based on their pre-determined goal.

As an example, USAID's pre-determined goal is protecting national security through the providing aid the health areas of child and maternal health, HIV/AIDS, malaria, and tuberculosis as stated on their official website.[46] In 2019, 49% of aid from USAID support HIV/AIDS, 22% supported child and maternal health, and 7% to malaria.[47] The topic modelling for USAID's tweets shows that HIV/ADIS, child and maternal health, and malaria are the top themes tweeted about by the organization from 2016-2020 (See Supplementary Table 1). USAID behaves under the RAM since their revealed priorities from past funding behavior and from tweets align with their pre-determined goal.

As shown in the last row of Supplementary Table 1, we find that the global health system collectively fulfills the three assumptions of the RAM. The pre-determined goal of the global health system can be found in the WHO constitution and the 9 target areas for Sustainable Development Goal (SDG) 3 on good health and well-being. All 20 global health actors have stated commitments to the WHO mission and the SDGs. The alignment of DAH funding allocations and most common health issues from Twitter reveal that in terms of rank order, HIV/AIDS, child health, and maternal health are the top 3 priorities of the global health system collectively. To maximize benefits of the pre-determined goal of "health for all" and "SDG3: good health and well-being", the global health system prioritizes HIV/AIDS, child health, and maternal health. Among all 9 stated targets in SDG3, only these three issues are prioritized. Effectively, the 6 other stated targets in SDG3 are deprioritized and underfunded by the global health system.

Since each global health actor and the global health system collectively fulfills the three assumptions, we find that GHG operates under the RAM. However, this does not imply cooperation of global health actors. This finding demonstrates the fact that each global health actor operates based on their rational self-interest and that the global health system operates based on the pursuit of only some of the stated priorities. Who determines which priorities are pursued by the global health system? The findings on power dynamics in GHG reveal the actors who determine global priorities.

Compulsory and institutional power asymmetries in GHG

As demonstrated in the following network maps, we find that there is compulsory and institutional power asymmetry in GHG.

Compulsory power asymmetry can be found in how funding organizations strongly influence channels of DAH and implementing institutions based on their relationship. Channels of DAH and implementing institutions rely on funding organizations for resources to continue operating. We find that the top priorities of the 3 funding organizations in this study are also the priorities of channels of DAH and implementing institutions.

As seen in Figure 1, HIV/AIDS is 1st priority of United States Agency for International Development (USAID), 2nd priority of United Kingdom Department for International Development (UK-DFID), and 2nd priority of the Bill and Melinda Gates Foundation

(BMGF) based on the alignment of stated and revealed priorities. HIV/AIDS is a priority of 4 of 8 channels of DAH and 4 of 9 implementing institutions based on its presence in policy documents, DAH funding, and tweets of each actor.

Figure 1 also demonstrates that maternal and child health is 2nd priority of USAID, 1st priority of UK-DFID, and 1st priority of BMGF based on the alignment stated and revealed priorities. Maternal and child health is a priority of 6 of 8 channels of DAH and 7 of 9 implementing institutions based on its presence in policy documents, DAH funding, and tweets of each actor.

Following the flow of the funding in Figure 2 and the similarities in tweets in Figure 1, we can see that institutional power asymmetry can be found in how funding organizations strongly influence implementing institutions through outsized influence of channels of DAH that allocate funding to these implementing institutions. As some implementing institutions do not get direct funding from funding organizations, but through channels of DAH, channels of DAH have direct control of funding of implementing institutions. Because wealthy funding organizations influence the priorities of channels of DAH, transitively, funders have power over implementing institutions. Implementing institutions in turn align their priorities with the priorities of channels of DAH, and transitively with the priorities of funding organizations.

Both network analyses of revealed priorities from DAH funding data and from tweets show how there is asymmetric levels of power held by the United States, United Kingdom, and the Gates Foundation in comparison to other actors. Figure 2 reveals how these three funding organizations are the largest funders for the work of the Global Fund, WHO, World Bank, US Foundations, UN organizations, and Gavi. The IHME DAH database reveals that 24% of all DAH funding was allocated to HIV/AIDS, 21% to child health, and 12% to maternal health – the three top priorities of funding organizations.[16] Only 14% was allocated to health system strengthening and 2% to non-communicable diseases.[16]

Figure 1 reveals how the most common topics generated across all global health actors include Africa, HIV/AIDS, child health, women health, and infectious diseases. These are the same health issues highly prioritized by the United States, United Kingdom, and Gates Foundation. Comparing figures 1 and 2, we find that these three funding organizations have outsized influence in priority-setting. Funding organizations have outsized influence because of how much DAH funding these three organizations have provided in comparison to other funding organizations. We find that the programs implemented and issues prioritized from 2016 to 2020 as documented through the tweets of the actor revolve around the main priorities of funding organizations of HIV/AIDS, child health, maternal health, infectious disease, and Africa. This outsized influence of global health funders limits the range of funded programs and policies that effectively reduce health inequities, especially making it difficult for smaller implementers to fund local programs and policies that do not neatly align with the priorities of major funders.

Limitations

It is necessary to acknowledge the three limitations of this study. First, we assume stated priorities match what is specified in organizational documents. It may be the case

that some organizations communicate priorities differently from what is written in their foundational documents. Moreover, what is fundable may not necessarily be what is most important. Second, we assume that health funding is indeed spent on what it is ostensibly spent on when deriving revealed preferences from past health funding data, although may not be the case. Third, our scope is limited to examining 20 global health actors from 2016 to 2020. There is a multiplicity of non-health actors and processes that likely influence overall health outcomes of populations. Studying the stated and revealed priorities of non-health actors and processes such as foreign relations between nations and the influence of the private sector on health can improve the characterization of current GHG.

CONCLUSION

We find empirical evidence at the global level showing that GHG operates under the RAM. Additionally, we find that at the global level, there is asymmetric compulsory and institutional power held by funding organizations, allowing global health priorities to be set by funders that have the money to spend on global health. In the past years, these funders have been the United States, United Kingdom, and the Gates Foundation. As shown by the triangulated evidence, the rational choice for all global health actors is to align their priorities with those of funding organizations in order to continue with their programs. These findings are in alignment with current literature discussing how "philantrocapitalists" and large funders having an outsized influence on global health agenda setting even without necessarily having an ethical framework for decision-making.[48,49]

Our paper complements the current research on agenda-setting in global health. Jeremy Shiffman's (2016) discussion of how agenda-setting is not purely a rational deliberation of evidence but the convergence of problems, solutions, and political developments.[50] This study attempts to deepen the understanding of the manifestation and influence of power in agenda-setting through the lens of stated and revealed priorities.

The priorities of funders of HIV/AIDS, child health, and maternal health have been prioritized from 2016-2020. While global health has seen improvements in these three areas, the existence of significant and severe preventable health inequalities demonstrates that this funding architecture does not necessarily promote equity and justice in global health. Additionally, other core health issues such as horizontal health system improvements do not appear to be prioritized that may have led to the persistence of global health inequity. We have empirical evidence supporting the arguments that current GHG operates under the RAM, and existing power asymmetries limit the range of choice for health policies and programs that aim to reduce inequities. If "health for all" and the SDG3 targets are to be achieved, then there must be a reassessment of current GHG under the RAM.

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Competing interests: No author has competing interests to declare.

Ethics approval: The study did not have any human or animal participants. Additionally, the study did not require ethical approval as the Twitter data used were already in the public domain.

Data and materials availability: Under the "Content Redistribution" section of Twitter's Developer Agreement and Policy, "We restrict the redistribution of Twitter Content to third parties. If you provide Twitter Content to third parties, including downloadable datasets or via an API, you may only distribute Tweet IDs, Direct Message IDs, and/or User IDs." Because the data collected using the Twitter API does not allow for redistribution under the Twitter Developer Agreement and Policy, tweets cannot be made publicly available. Only Tweet ID's and User ID's are allowed to be redistributed according to the Twitter policy. Please email jenpr@upenn.edu if you wish to receive a copy of the Tweet ID's and User ID's of the data and/or the code used in the study. The IHME DAH Database can be found at http://ghdx.healthdata.org/record/ihme-data/development-assistance-health-database-1990-2019

FIGURE LEGENDS

Figure 1. Network Analysis of Revealed Priorities from Tweets. Line thickness represents how many similar priorities one global health actor has with another. Font size of global health priorities represent the number of organizations have it as a priority. Data used found in Supplementary Table 4.

Figure 2. Network Analysis of Revealed Priorities from Funding for DAH (2019). Line thickness represents the amount of funding for health that was transferred between two actors. Font size represents the total amount of funding for health donated or received in 2019.

REFERENCES

1 Ng NY, Ruger JP. Global Health Governance at a Crossroads. *Global health governance : the scholarly journal for the new health security paradigm* 2011;**3**.

2 Giaimo S. Interest Groups, Think Tanks, and Health Care Policy (1960s-Present). In: *Guide to U.S. Health and Health Care Policy*. Thousand Oaks CA: : SAGE Publications 2014. 375–92.

3 Spicer N, Agyepong I, Ottersen T, *et al.* 'It's far too complicated': why fragmentation persists in global health. *Globalization and Health* 2020;**16**. doi:10.1186/s12992-020-00592-1

4 Szlezák NA, Bloom BR, Jamison DT, *et al.* The Global Health System: Actors, Norms, and Expectations in Transition. *PLoS Medicine* 2010;**7**. doi:10.1371/journal.pmed.1000183

5 United Kingdom House of Lords. Chapter 3: International health: the institutional labyrinth. Select Committee on Intergovernmental Organisations First Report. 2008.

6 Ottersen OP, Dasgupta J, Blouin C, *et al.* The political origins of health inequity: Prospects for change. The Lancet. 2014;**383**. doi:10.1016/S0140-6736(13)62407-1

7 Walt G. Global cooperation in international public health. In: Merson M, Black R, Mills A, eds. *International Public Health*. Gaithersburg, Maryland: : Aspen Publishers 2001.

8 Mayhew SH, Walt G, Lush L, *et al.* Donor Agencies' Involvement in Reproductive Health: Saying One Thing and Doing Another? *International Journal of Health Services* 2005;**35**. doi:10.2190/K46B-RRXJ-95M4-JDQU

9 Burris S. Governance, Microgovernance and Health. *Temple Law Review* 2004;**77**:335–62.

10 Brooks A, Cutts FT, Walt G. Policy study of factors influencing the adoption of new and underutilized vaccines in developing countries. Washington D.C.: 1999.

11 Travis P, Bennett S, Haines A, *et al.* Overcoming health-systems constraints to achieve the Millennium Development Goals. *The Lancet* 2004;**364**. doi:10.1016/S0140-6736(04)16987-0

12 Hoffman SJ, Røttingen J-A. Dark sides of the proposed Framework Convention on Global Health's many virtues: A systematic review and critical analysis. *Health and Human Rights* 2013;**15**:117–34.

13 Ruger JP. Global health governance as shared health governance. *Journal of Epidemiology and Community Health* 2012;**66**. doi:10.1136/jech.2009.101097

14 Frenk J, Moon S. Governance Challenges in Global Health. *New England Journal of Medicine* 2013;**368**. doi:10.1056/NEJMra1109339

15 Hoffman SJ, Cole CB. Defining the global health system and systematically mapping its network of actors. *Globalization and Health* 2018;**14**. doi:10.1186/s12992-018-0340-2

16 Institute for Health Metrics and Evaluation (IHME). Development Assistance for Health Database 1990-2019. *Institute for Health Metrics and Evaluation (IHME)* 2020.

17 Lopreite M, Puliga M, Riccaboni M, *et al.* A social network analysis of the organizations focusing on tuberculosis, malaria and pneumonia. *Social Science and Medicine* 2021;**278**. doi:10.1016/j.socscimed.2021.113940

18 Quissell K, Berlan D, Shiffman J, *et al.* Explaining global network emergence and nonemergence: Comparing the processes of network formation for tuberculosis and pneumonia. *Public Administration and Development* 2018;**38**. doi:10.1002/pad.1836

19 Hevey D. Network analysis: A brief overview and tutorial. *Health Psychology and Behavioral Medicine* 2018;**6**. doi:10.1080/21642850.2018.1521283

20 Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist* 2000;**55**. doi:10.1037/0003-066X.55.1.68

21 Donelle L, Booth R. Health Tweets: An Exploration of Health Promotion on Twitter. *American Nurses Association* 2012;**17**.

22 Park H, Rodgers S, Stemmle J. Analyzing Health Organizations' Use of Twitter for Promoting Health Literacy. *Journal of Health Communication* 2013;**18**. doi:10.1080/10810730.2012.727956

23 Glazer A, Konrad K. A Signaling Explanation for Charity. *American Economic Review* 1996;**86**:1019–28.

24 Harbaugh W. The Prestige Motive for Making Charitable Transfers. *American Economic Review* 1998;**88**:227–82.

25 Fung IC-H, Jackson AM, Ahweyevu JO, *et al.* #Globalhealth Twitter Conversations on #Malaria, #HIV, #TB, #NCDS, and #NTDS: a Cross-Sectional Analysis. *Annals of Global Health* 2017;**83**. doi:10.1016/j.aogh.2017.09.006

26 Goff DA, Kullar R, Laxminarayan R, *et al.* Twitter to engage, educate, and advocate for global antibiotic stewardship and antimicrobial resistance. *The Lancet Infectious Diseases* 2019;**19**. doi:10.1016/S1473-3099(19)30058-1

27 Guidry JPD, Jin Y, Orr CA, *et al.* Ebola on Instagram and Twitter: How health organizations address the health crisis in their social media engagement. *Public Relations Review* 2017;**43**. doi:10.1016/j.pubrev.2017.04.009

28 Scanfeld D, Scanfeld V, Larson EL. Dissemination of health information through social networks: Twitter and antibiotics. *American Journal of Infection Control* 2010;**38**. doi:10.1016/j.ajic.2009.11.004

29 Zamora A. Making Room For Big Data: Web Scraping and an Affirmative Right to Access Publicly Available Information Online. *Journal of Business, Entrepreneurship & the Law* 2019;**12**:203–28.

30 Alvarez-Melis D, Saveski M. Topic Modeling in Twitter: Aggregating Tweets by Conversations. *Tenth International AAAI Conference on Web and Social Media* 2016.

31 Hong L, Davison BD. Empirical study of topic modeling in Twitter. In: *Proceedings of the First Workshop on Social Media Analytics - SOMA '10*. New York, New York, USA: : ACM Press 2010. doi:10.1145/1964858.1964870

32 Yang S-H, Kolcz A, Schlaikjer A, *et al.* Large-scale high-precision topic modeling on twitter. In: *Proceedings of the 20th ACM SIGKDD international conference on Knowledge discovery and data mining - KDD '14*. New York, New York, USA: : ACM Press 2014. doi:10.1145/2623330.2623336

33 Bakshi RK, Kaur N, Kaur R, *et al.* Opinion mining and sentiment analysis. *2016 3rd International Conference on Computing for Sustainable Global Development (INDIACom)* 2016;:452–5.

34 Pak A, Paroubek P. Twitter as a Corpus for Sentiment Analysis and Opinion Mining. *LREc* 2010;**10**:1320–6.

35 Saif H, He Y, Alani H. Semantic Sentiment Analysis of Twitter. 2012. doi:10.1007/978-3-642-35176-1_32

36 Blei DM, Ng AY, Jordan MI. Latent Dirichlet allocation. *Journal of Machine Learning Research* 2003;**3**. doi:10.1016/b978-0-12-411519-4.00006-9

37 Mintz A, DeRouen K. The Rational Actor Model. In: *Understanding Foreign Policy Decision Making*. Cambridge: : Cambridge University Press 2010. 57–68.

38 MacDonald PK. Useful Fiction or Miracle Maker: The Competing Epistemological Foundations of Rational Choice Theory. *American Political Science Review* 2003;**97**. doi:10.1017/S000305540300087X

39 Shiffman J. Knowledge, moral claims and the exercise of power in global health. *International Journal of Health Policy and Management* 2014;**3**. doi:10.15171/ijhpm.2014.120

40 Dahl RA. The concept of power. *Behavioral Science* 2007;**2**. doi:10.1002/bs.3830020303

41 Barnett M, Duvall R. Power in International Politics. *International Organization* 2005;**59**. doi:10.1017/S0020818305050010

42 Shawar YR, Ruger JP. The Politics of Global Health Inequalities: Approaches to Studying the Role of Power. In: McInnes C, Lee K, Youde J, eds. *The Oxford Handbook of Global Health Politics*. Oxford: 2020. 59–76.

43 Holmes SM. Structural Vulnerability and Hierarchies of Ethnicity and Citizenship on the Farm. *Medical Anthropology* 2011;**30**. doi:10.1080/01459740.2011.576728

44 Goldade K. "Health Is Hard Here" or "Health for All"? *Medical Anthropology Quarterly* 2009;**23**. doi:10.1111/j.1548-1387.2009.01074.x

45 Sridhar D. Who Sets the Global Health Research Agenda? The Challenge of Multi-Bi Financing. *PLoS Medicine* 2012;**9**. doi:10.1371/journal.pmed.1001312

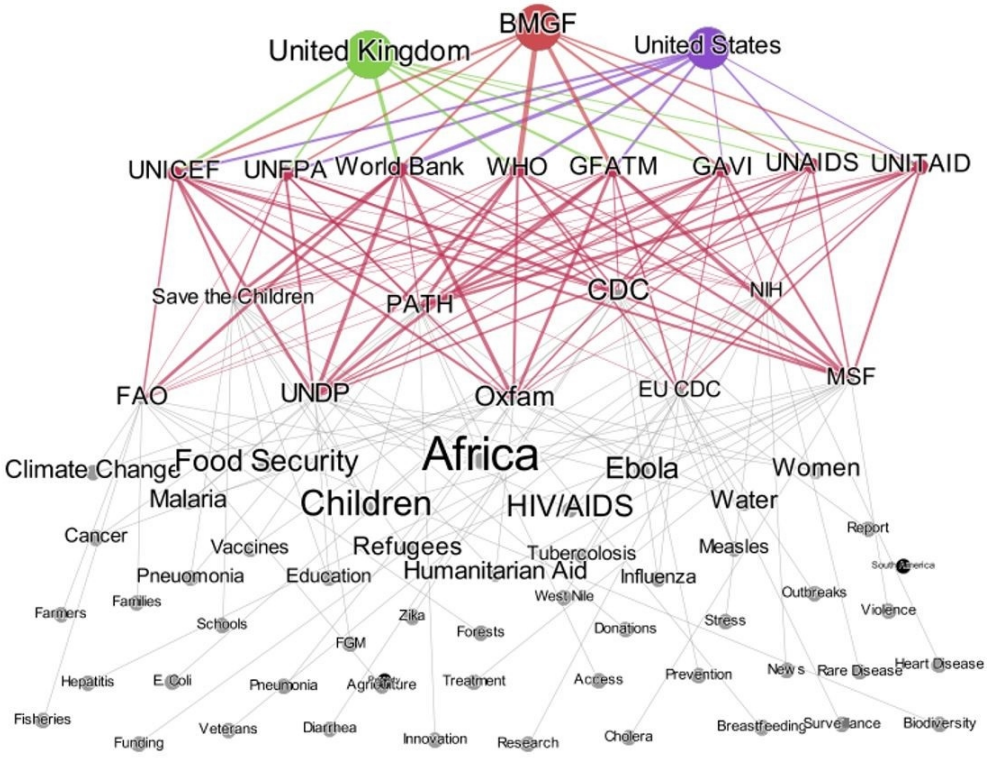
46 Usaid.gov. 2021. Global Health. [online] Available at: <https://www.usaid.gov/global-health> [Accessed 1 November 2021].

47 Usaid.gov. 2021. Health Areas. [online] Available at: <https://www.usaid.gov/global-health/health-areas> [Accessed 1 November 2021].

48 Birn A-E. Philanthrocapitalism Past and Present: The Rockefeller Foundation, the Gates Foundation and the Setting(s) of the International/Global Health Agenda. *Hypothesis* 2014;**12**.

49 McGoey L. Philanthrocapitalism and its critics. *Poetics* 2012;**40**. doi:10.1016/j.poetic.2012.02.006

50 Shiffman J. Agenda Setting in Public Health Policy. In: *International Encyclopedia of Public Health*. 2016. doi:10.1016/B978-0-12-803678-5.00007-2



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167x128mm (168 x 168 DPI)

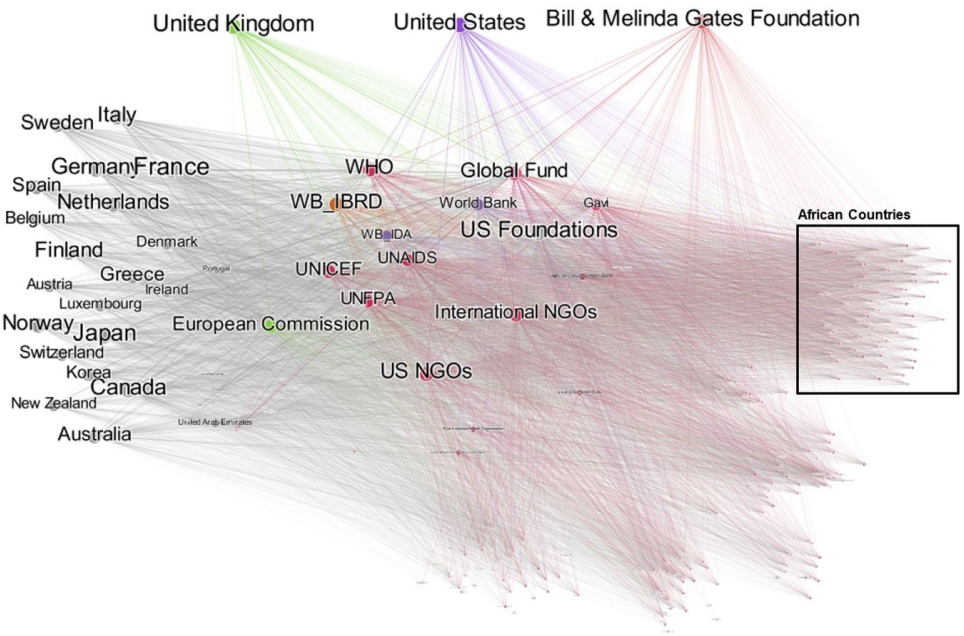


Figure 2. Network Analysis of Revealed Priorities from Funding for DAH (2019). Line thickness represents the amount of funding for health that was transferred between two actors. Font size represents the total amount of funding for health donated or received in 2019.

211x138mm (168 x 168 DPI)

Supplemental Material

Supplementary Table 1. Evidence and Testing RAM by Actor. Evidence for stated and revealed priorities and testing of RAM for each actor and the global health system as a whole. Light red indicates funding organization, blue indicates channel of DAH, yellow indicates implementing institution, and dark red indicates global health system as a whole.

	Evidence			Testing Assumptions of RAM			
	Stated Priorities from Policy Documents	**Revealed Priorities from DAH Data**	**Revealed Priorities from Tweets**	**Pre-determined goal?**	**Consistent preferences?**	**Utility maximizing?**	**Operates under RAM?**
USAID	"On behalf of the American people, we promote and demonstrate democratic values abroad, and advance a free, peaceful, and prosperous world. **In support of America's foreign policy**, the U.S. Agency for International Development leads the U.S. Government's international development and disaster assistance through partnerships and investments that save lives, reduce poverty, strengthen democratic governance, and help people emerge from humanitarian crises and progress beyond assistance." (2019 USAID Financial Report) "For over 50 years, USAID's global health programs have saved lives, protected people most vulnerable to disease, and promoted the stability of communities and nations, while advancing American security and prosperity. **America is safer and stronger when people can live healthy and productive lives and when nations around the world are self-reliant and resilient.**" (USAID Website) **Health Focus Area** (USAID Website) • Child and maternal death • HIV/AIDS • Malaria • Tuberculosis	Health Focus Area 49.0% of 2019 US DAH ($6.0 billion) supported **HIV/AIDS**; 7.0% ($862.5 million) supported **malaria**; 11.4% ($1.4 billion) was disbursed for **child health**, and 10.8% ($1.3 billion) went to **maternal health**. Region In 2017, the most recent year for which regional DAH estimates are available, the US directed much of its resources to **sub-Saharan Africa**, sending 50.5%, or $6.9 billion, of 2017 DAH. Channel The US provided 59.2% of its funding in 2019 through its own bilateral agencies, including the United States Agency for International Development (**USAID**), the President's Malaria Initiative (**PMI**), and **PEPFAR**. **UN agencies** received 6.2% of US DAH in 2019, or $761.4 million. **Gavi** received $307.0 million, up 9.0% from 2018, and the **Global Fund** received $636.5 million, down 25.8%. **NGOs** received 26.8% of US DAH in 2019, or $3.3 billion.	Topics from 2016-2020 tweets (no order) Africa Children Education Food Security HIV/AIDS Humanitarian Aid Mothers South America Water Women	National security National interests Global health focus: Child and maternal health, HIV/AIDS, malaria, tuberculosis	HIV/AIDS, child and maternal health, and Africa are consistent across DAH data and tweets	HIV/AIDS, child and maternal health are consistent across stated and revealed priorities. To maximize benefits for national security and interests, USAID prioritizes HIV/AIDS and child and maternal health in Africa.	Yes
UK DFID	"**We pursue our national interests and project the UK as a force for good in the world**. We promote the interests of British citizens, safeguard the UK's security, defend our values, reduce poverty and tackle global challenges with our international partners." (UK FCDO, formerly DFID website) "We are responsible for: 1. honouring the UK's international commitments and taking	Health Focus Area **Reproductive, maternal, newborn, and child health** was the focus of $1.4 billion (38.5%) of the UK's DAH in 2019, followed by **HIV/AIDS** with $553.9 million (15.8%). Region By GBD super-regions, the UK contributed $1.3 billion, or 37.3% of its 2017 DAH, to **sub-**	Topics from 2016-2020 tweets (no order) Africa Agriculture Children Development Ebola Education Food Security HIV/AIDS Humanitarian Aid Water	National interests National security Global peace, security, and governance; Crisis response and resilience; Global prosperity; Extreme poverty and helping most vulnerable; Value for money	Child and maternal health, HIV/AIDS, and Africa are consistent across DAH data and tweets.	Child and maternal health, HIV/AIDS, and Africa are consistent across stated and revealed priorities. To maximize benefits for national security and interests, UK DFID prioritizes child and maternal	Yes

	action to achieve the **United Nations' Global Goals** 2. making British aid more effective by improving transparency, openness and value for money 3. targeting British international development policy on economic growth and wealth creation **4.** improving the coherence and performance of British international development policy in **fragile and conflict-affected countries** 5. improving the lives of **girls and women** through better education and a greater choice on **family planning** 6. **preventing violence against girls and women** in the developing world 7. helping to prevent climate change and encouraging adaptation and low-carbon growth in developing countries Priorities • strengthening global peace, security and governance • **strengthening resilience and response to crisis** • promoting global prosperity • tackling extreme poverty and **helping the world's most vulnerable** • delivering value for money" (UK DFID About Page)	**Saharan Africa**; $301.0 million (8.7%) to South Asia; $163.9 million (4.7%) to Southeast Asia, East Asia, and Oceania; $237.9 million (6.9%) to North Africa and the Middle East; and $41.0 million (1.2%) to Central Europe, Eastern Europe, and Central Asia. Channel Of the UK's 2019 DAH, $990.3 million (28.2%) was channeled to **UK bilateral agencies**; $524.6 million (14.9%) to **UN agencies**; $306.4 million (8.7%) to **Gavi**; and $817.1 million (23.3%) to the **Global Fund**.					health and HIV/AIDS in Africa.	
BMGF	**"Strategic Investments.** We partner with entrepreneurs, companies, and other organizations to create incentives that **harness the power of private enterprise to create change for those who need it most**." (BMGF: how we work) **Global development.** "Our Global Development Division focuses on improving the delivery of **high-impact health**	Health Focus Area In 2019, the Gates Foundation directed $1.5 billion, or 38.3%, of its DAH to **reproductive, maternal, newborn, and child health**; $709.3 million, or 18.1%, to **HIV/AIDS**; $303.9 million, or 7.8% to **malaria**; $237.6 million, or 6.1%, to	Topics from 2016-2020 tweets (no order) Africa Breastfeeding Children Education HIV/AIDS Malaria Mothers Polio Sanitation Women	Strategic investments -- private enterprise solutions for most disadvantaged; High-impact health products and services to world's poorest Stated global development areas: Emergency	Child and maternal health, HIV/AIDS, malaria, and Africa are consistent across DAH data and tweets.	Child and maternal health, HIV/AIDS, malaria, and Africa are consistent across stated and revealed priorities. To maximize returns of their strategic	Yes

	products and services to the world's poorest communities and helps countries expand access to health coverage. **Areas**: Emergency Response, Family Planning ,Global Delivery Programs, Global Libraries, Maternal, Newborn & Child Health, Nutrition, Polio" (BMGF: our work) **Global health. "**Our Global Health Division aims to **reduce inequities in health** by developing new tools and strategies to reduce the **burden of infectious disease** and the **leading causes of child mortality** in developing countries. **Areas**: Discovery & Translational Sciences, Enteric and Diarrheal Diseases. HIV, Innovative Technology Solutions, Institute for Disease Modeling, Integrated Development, Malaria, Maternal, Newborn & Child Health, Discovery & Tools, Neglected Tropical Diseases, Pneumonia Tuberculosis, Vaccine Development and Surveillance**"** (BMGF: our work)	**tuberculosis**; $266.5 million, or 6.8%, to **health systems strengthening**; and $72.4 million, or 1.9%, to **non-communicable diseases**. Region In 2017, the Foundation provided 41% of its DAH to **global recipients** and programs and 18% to **sub- Saharan Africa.** Channel The Gates Foundation's 2019 DAH total of $3.9 billion was an increase of 9.9% from 2018. Of this, $2.5 billion or 64.0% was channeled through the Gates Foundation **directly to implementing institutions**. In 2019, $266.8 million (7%) in Gates Foundation DAH went to **UN agencies**, $256.9 million (7%) went to the **Global Fund**, and $406.1 million (10%) was directed to **Gavi**.		Response, Family Planning ,Global Delivery Programs, Global Libraries, Maternal, Newborn & Child Health, Nutrition, Polio Stated global health areas: Discovery & Translational Sciences, Enteric and Diarrheal Diseases. HIV, Innovative Technology Solutions, Institute for Disease Modeling, Integrated Development, Malaria, Maternal, Newborn & Child Health, Discovery & Tools, Neglected Tropical Diseases, Pneumonia Tuberculosis, Vaccine Development and Surveillance		investments, BMGF prioritizes child and maternal health, HIV/AIDS, and malaria in Africa.	
WHO	**"Health for all.** Ensuring universal health coverage without impoverishment is the foundation for achieving the health objectives of the Sustainable Development Goals – because when people are healthy, their families, communities and countries benefit. Our top priority must be to support national health authorities' efforts to strengthen all the building blocks of health systems and to enact policies aimed at ensuring health care is equitable and affordable for all. **Health emergencies.** In today's interconnected world, public health emergencies can affect anyone, anywhere – and the Ebola crisis in West Africa showed us the dangers of being unprepared. The development of resilient and robust global and local health systems capable of preventing, monitoring, detecting and responding to public health emergencies must therefore be a key priority, closely linked to our efforts to achieve universal health coverage. **Women, children and adolescents.** We cannot achieve the ambitious health and development targets in the Sustainable Development Goals unless we secure the health, dignity and rights of women, children and adolescents. Yet, in too many places, gender gaps, harmful cultural and social practices and gender-based violence are negatively impacting these individuals. Because of that,	Health Focus Area WHO provided $2.5 billion of DAH in 2019, down 1.2% from 2018. Of this, $630.7 million or 24.9% was disbursed to other **infectious diseases** and $1.0 billion or 39.8% to **health systems strengthening**. Region DAH data for the WHO in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Breastfeeding Children Ebola HIVA/AIDS Malaria Measles Mothers Polio Women	Universal health coverage, health systems strengthening, health equity, health emergencies, infectious diseases, maternal and child health, gender equity, climate and environmental impacts on health, improved WHO governance	Infectious diseases (ebola, HIV/AIDS, malaria, measles, polio) are consistent across DAH data and tweets.	Infectious diseases (ebola, HIV/AIDS, malaria, measles, polio) are consistent across stated and revealed priorities. To maximize the benefits of their pre-determined goal of health for all, WHO prioritizes on infectious diseases like Ebola, HIV/AIDS, malaria, measles, and polio.	Yes

	we must put the well-being of women, children and adolescents at the centre of global health and development. **The health impacts of climate and environmental change.** Climate and environmental change impact many aspects of life that are inextricably linked to health – food security, economic livelihoods, air safety and water and sanitation systems – and WHO estimates that 12.6 million people die each year as a result of living or working in an unhealthy environment. To address this, WHO has a key role to play advancing both mitigation and adaptation strategies for climate and environmental change, working in close partnership with other UN agencies and stakeholders. **A transformed WHO.** Building WHO into a more effective, transparent and accountable agency will require striking a balance between bold reform and stability of the organization. To meet the evolving needs and challenges of the 21st century and deliver game-changing, sustainable results, WHO will need to focus its work where it has the most value, broaden and intensify its engagement across stakeholders, attract more predictable, flexible financing, and work to identify and retain the best global talent." (WHO Priorities)						
World Bank	"The World Bank Group works in every major area of development. We provide a wide array of financial products and technical assistance, and we help countries share and apply innovative knowledge and solutions to the challenges they face. Three priorities guide our work with countries **to end poverty and boost prosperity for the poorest people.** Helping **create sustainable economic growth**, **investing in people** and **building resilience to shocks and threats** that can roll back decades of progress. **Themes** • Economic Policy • Environment and Resource Development • Finance • Human Development and Gender • Private Sector Development • Public Sector Management • Social Development and Protection • Urban and Rural Development" (World Bank Annual Report 2019)	Health Focus Area Focused on ending poverty in the world's poorest countries, the World Bank's International Development Association (IDA) disbursed $1.1 billion of DAH in 2019, down 33.9% from 2018. The International Bank for Reconstruction and Development (IBRD) is a global development cooperative owned by 189 countries. As "the world's largest development bank," the IBRD helps countries reduce poverty and extend the benefits of sustainable growth to all people. In 2019, the IBRD disbursed $11.1 billion of DAH, up 25.4% from 2018. Funds were targeted at **reproductive, maternal, newborn, and child health**; **vaccination programs**; **infectious diseases**; and **NCDs**. Region 27.6% of DAH disbursed by development banks	Topics from 2016-2020 tweets (no order) Africa Agriculture Children Climate change Food security Humanitarian aid Poverty Sanitation Water Women	End poverty and boost prosperity through sustainable economic growth, investing in people, and building resilience to shocks and threats; Maternal and child health, health emergencies, nutrition, infectious diseases, tobacco control, mental health	Child and maternal health and Africa are consistent across DAH data and tweets.	Child and maternal health are consistent across stated and revealed priorities. To maximize the benefits of their pre-determined goal of ending poverty and boosting prosperity for the poorest people, the World Bank prioritizes on child and maternal health issues in Africa.	Yes

	"World Bank Health Focus Areas: 1. **Women and children's health** 2. **Health emergencies** 3. **Nutrition** 4. **Infectious diseases** 5. **Tobacco control** 6. **Mental health"** (World Bank Health Focus Areas)	as group went to **sub-Saharan Africa** and 20.5% to North Africa and the Middle East.					
UNAIDS	**"Strategic leadership agenda** In the light of the need for change, this Strategy seeks to achieve a set of far-reaching and people-centred goals and targets that must be met by 2020 if we are to reach our 2030 ambition of ending the AIDS epidemic. The goals correspond to each of the three strategic directions, and include achieving by 2020: • Fewer than 500 000 people newly infected with HIV • Fewer than 500 000 people dying from AIDS-related causes • Elimination of HIV-related discrimination" (UNAIDS 2016-2021 Strategy)	Health Focus Area UNAIDS is leading the global effort to end **AIDS** as a public health threat by 2030. In addition, the agency is working toward its 2020 90-90-90 targets: for 90% of people living with HIV/AIDS to know their status; for 90% of those diagnosed with infections to receive antiretroviral treatments; and for 90% of patients receiving antiretroviral therapy to have viral suppression. In 2019, the agency disbursed $207.3 million, up 1.7% from 2018. The top five contributors to UNAIDS in 2019 were the US, Sweden, the Netherlands, the UK, and Norway. Region DAH data for UNAIDS in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Access Africa Discrimination HIV/AIDS Human Rights Innovation Prevention Testing Treatment Women	Ending the AIDS epidemic by 2030.	HIV/AIDS prevention, testing, and treatment is consistent across DAH data and tweets.	HIV/AIDS prevention, testing, and treatment are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of ending the AIDS epidemic by 2030, UNAIDS focuses on HIV/AIDS prevention, testing, and treatment.	Yes
UNFPA	"Our goal is to achieve **universal access to sexual and reproductive health, realize reproductive rights, and reduce maternal mortality** to accelerate progress on the agenda of the Programme of Action of the International Conference on Population and Development (ICPD), to **improve the lives of women, adolescents and youth,** enabled by population dynamics, human rights and gender equality. **Priority Areas** • Sexual and reproductive health services and reproductive rights • Adolescent and youth empowerment • Gender equality and women's empowerment • Population data for development" (UNFPA Strategic Plan)	Health Focus Area The United Nations Population Fund (UNFPA) is the United Nations' **sexual and reproductive health** agency. UNFPA's programs include the Maternal and Newborn Health Thematic Fund, focused on preventing maternal deaths through strategic interventions. Training midwives and ending fistula, a childbirth injury caused by prolonged obstructed labor, are also part of the **Maternal and Newborn Health Thematic Fund**. In 2019, UNFPA disbursed $1.1 billion in DAH, down 1.7% from 2018. Of this, UNFPA received $466.8 million, or 43.8%, from governments. In	Topics from 2016-2020 tweets (no order) Africa Child Marriage Children Family planning FGM Human Rights Humanitarian Aid Nutrition Violence Women	Universal access to sexual and reproductive health, reproductive rights, maternal mortality, child health	Sexual and reproductive health, and maternal and child health are consistent across DAH data and tweets.	HIV/AIDS prevention, testing, and treatment are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of ending the AIDS epidemic by 2030, UNAIDS focuses on HIV/AIDS prevention, testing, and treatment.	Yes

		2018, the US withheld funding from UNFPA for the third year in a row under the Kemp-Kasten amendment. Region DAH data for UNFPA in 2019 have unallocated or unspecified regions.					
UNICEF	**"Vision:** Realizing the rights of every child, especially the most disadvantaged. **Goal areas:** • Every child survives and thrives • Every child learns • Every child is protected from violence and exploitation • Every child lives in a safe and clean environment • Every child has an equitable chance in life" **(UNICEF Strategic Plan 2018-2021)**	Health Focus Area UNICEF provides long-term **humanitarian and development assistance to children and mothers**, with a specific focus on **nutrition, immunization, and HIV/AIDS**, as well as **emergency (i.e., pandemic) assistance**. UNICEF disbursed $2.6 billion in DAH in 2019, up 12.5% from 2018. Private philanthropies provided UNICEF with $519.3 million, or 19.8% of its funding in 2019, and the US contributed $316.9 million, or 12.1%. Region DAH data for UNICEF in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Breastfeeding Children Climate Change Ebola Education Human Rights Online Violence Water	Realizing the rights of every child, especially the most disadvantaged. Health related: child health, child mortality	Child and maternal health are consistent across DAH data and tweets.	Child and maternal health are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of realizing the rights of every child, UNICEF focuses on child and maternal health.	Yes
UNITAID	"Unitaid's Strategy for 2017-2021 is firmly grounded in its Constitution, which states that Unitaid aims to 'contribute to scale up access to treatment for **HIV/AIDS, malaria and tuberculosis** for the people in developing countries by **leveraging price reductions of quality drugs and diagnostics**, which currently are unaffordable for most developing countries, and to accelerate the pace at which they are made available.' Innovation, access, and scalability. They guide the design of unitaid's interventions, which • Promote innovation. Unitaid connects those who are developing innovations with people who need them the most. Innovation means both using existing commodities in new ways and developing new products and approaches. • Catalyze equitable access to better health products. Unitaid leverages its market expertise and its relationships with partners to design a portfolio of projects that will overcome barriers to access to	Health Focus Area In 2019, Unitaid disbursed $154.1 million in DAH, up 35.2% from 2018. Projects Unitaid has been working on include a net program to combat malaria and a program to distribute and promote HIV self-testing kits in Africa. US contributed $316.9 million, or 12.1%. Region DAH data for UNITAID in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Access Cancer Children Hepatitis HIV/AIDS Malaria Testing Treatment Tuberculosis Vaccines	Access to treatment of, affordability of drugs, and innovation in addressing HIV/AIDS, malaria, tuberculosis	Increasing access, testing, and treatment of HIV/AIDS, malaria, and tuberculosis are consistent across DAH data and tweets.	HIV/AIDS, malaria, and tuberculosis are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of scaling up treatment for HIV/AIDS, malaria, and tuberculosis in developing countries, UNITAID prioritizes HIV/AIDS, malaria, and tuberculosis.	Yes

	innovative health products • Create the right conditions for scale up, so better health products reach all people who need them. From conception through implementation, Unitaid works with partners to ensure that projects transition to scale." (Unitaid Strategy 2017-2021)						
Gavi	"Our 2016–2020 mission, to **save children's lives** and **protect people's health** by **increasing equitable use of vaccines in lower-income countries**, is guided by four strategic goals 1. Accelerate equitable uptake and coverage of vaccines. 2. Increase effectiveness and efficiency of immunisation delivery as an integrated part of strengthened health systems. 3. Improve sustainability of national immunisation programmes. 4. Shape markets for vaccines and other immunisation products. The current five-year strategy was approved by the Board in June 2014 – the full implementation of the strategy will see developing countries immunise 300 million children, saving 5–6 million lives in the long term. **Coverage and equity** are at the core of our current strategy. While we continue to support countries to introduce new vaccines, our focus is expanding to reach every child with these vaccines. With as many as 20 countries transitioning out of our financial support in this period, ensuring that programmes are sustainable in the long term is essential. " (Gavi Strategy 2016-2020)	Health Focus Area In 2019, Gavi channeled $1.8 billion in development assistance for health to **child health** (94.4% of Gavi funding) and non-communicable disease-related programs. Top sources of funding for Gavi in 2019 were the Bill & Melinda Gates Foundation, the United States, and the United Kingdom. Region In 2017, 52.6% of DAH disbursed by Gavi went to **sub-Saharan Africa** and 25.5% to South Asia. DAH data for Gavi in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Cancer Children Cholera Ebola Measles Pneumonia Polio Poverty Vaccines	Increasing overall coverage and equity in vaccinating children in lower-income countries.	Child health, vaccination, infectious diseases, and Africa are consistent across DAH data and tweets.	Child health, vaccination, infectious diseases, and Africa are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of "saving children's lives by increasing equitable use of vaccines in lower-income countries", Gavi prioritizes child health and vaccination of infectious diseases in Africa.	Yes
Global Fund	"The Global Fund Strategy 2017-2022: Investing to End Epidemics outlines our partnership's bold agenda for 2017-2022 based on an ambitious vision **to end the epidemics**. These four strategic objectives are at the core of the strategy: • Maximize impact against **HIV, TB**, and **Malaria** • Promote and protect **human rights** and **gender equality** • Mobilize increased resources • Build **resilient and sustainable systems for health**" (Global	Health Focus Area In 2019, the Global Fund channeled a total of $3.5 billion to programs worldwide. Leading sources of Global Fund contributions were the United States, the United Kingdom, and Japan. The UK provided $817.1 million or 23.3% to the Global Fund in 2019, more than any other contributor. The US contributed $636.5 million or 18.1%, Japan contributed $442.4 million or 12.6%, and Germany	Topics from 2016-2020 tweets (no order) Africa Children Cholera Ebola HIV/AIDS Malaria Pneumonia Polio Tuberculosis Women	To end HIV/AIDS, malaria, and tuberculosis epidemics	HIV/AIDS, malaria, tuberculosis, and Africa are consistent across DAH data and tweets.	HIV/AIDS, malaria, tuberculosis, and Africa are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of "ending the epidemics", the Global Fund prioritizes child health and vaccination of	Yes

	Fund Strategy 2017-2022)	contributed $396.7 million or 11.3%. 50.4% of funding were allocated to address **HIV/AIDS**, 31.7% to **Malaria**, and 17.8% to **Tuberculosis**. Region In 2019, 72.7% of DAH disbursed by the Global Fund went to **sub-Saharan Africa** and 10.5% to Southeast Asia, East Asia, and Oceania. DAH data for the Global Fund in 2019 have unallocated or unspecified regions.				infectious diseases in Africa.	

CDC	"CDC's Strategic Framework consists of five core capabilities that enable the agency's three strategic priorities, all united behind one mission: **protect America's safety, health, and security**. Our work is underscored by the agency's Pledge to the American People.
	Strategic Priorities
	• Securing global health and America's preparedness
	  • By stopping the spread of pandemic contagions, addressing public health terror threats, and protecting people from vector-borne diseases.
	• Eliminating disease
	  • By controlling vaccine-preventable disease, targeting Hepatitis C, and reducing the maternal mortality rate.
	• Ending epidemics
	  • Such as HIV, decreasing opioid overdoses, improving strategies and interventions to stem seasonal influenza, developing and deploying new answers for antibiotic resistance, and reducing new incidents of diabetes.
	Core Capabilities
	• World-class data and analytics
	• State-of-the-art laboratory capacity
		Health Focus Area
		Protecting Americans from Infectious Diseases at Home and Abroad ($3.0 billion)
		Preventing the Leading Causes of Disease, Disability, & Death ($2.0 billion)
		Protecting Americans from Natural Disasters, Terrorist Threats, Environmental & Occupational Hazards ($1.5 billion)
		Monitoring Health & Ensuring Laboratory Excellence ($496 million)
		Cross-cutting Support & PHHS Block Grant & Buildings & Facilities ($357 million)
		
		Region
		United States and global
			Topics from 2016-2020 tweets
			(no order)
			
			Children
			Diarrhea
			E. Coli
			Influenza
			Measles
			Prevention
			Vaccines
			Water
			Women
			Zika
				National security from infectious diseases
				
				Securing global health and national preparedness
					Protecting the USA from infectious diseases is consistent across DAH data and tweets.	HIV/AIDS, malaria, tuberculosis, and Africa are consistent across stated and revealed priorities.
						
						To maximize benefits of their pre-determined goal of "protecting America's safety, health, and security", the CDC prioritizes infectious disease protection in the US and globally.
							Yes

	• Elite public health expertise • Responding to outbreaks at their source • Global capacity and domestic preparedness" (CDC Strategic Framework)						
EU CDC	""ECDC is an EU agency aimed at **strengthening Europe's defences against infectious diseases**. The core functions cover a wide spectrum of activities: surveillance, epidemic intelligence, response, scientific advice, microbiology, preparedness, public health training, international relations, health communication, and the scientific journal Eurosurveillance. **Strategic Work Areas** • Providing evidence for effective and efficient decision-making: We support efficient public health decisionmaking by providing **timely, accurate and relevant information**. • Support the **strengthening of public health systems**: We strengthen European capacities and capabilities effectively prevent and control communicable diseases. • Supporting **response to threats**: We support effective health threats detection, assessment and control." (ECDC Annual Report 2019)	Health Focus Area All funding is spent on expenses for staff, buildings and equipment, and operations for surveillance, research, and response to infectious disease epidemics. Region European Union and global	Topics from 2016-2020 tweets (no order) Ebola Hepatitis HIV/AIDS Influenza Measles Outbreaks Report Surveillance Tuberculosis West Nile	European security from infectious disease	Infectious disease surveillance, reporting, and research are consistent across DAH data and tweets.	Infectious disease surveillance, reporting, and research are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of "strengthening Europe's defences against infectious diseases", the EU CDC prioritizes infectious disease surveillance, reporting, and research.	Yes
NIH	"NIH's mission is to seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability. The goals of the agency are: • to foster **fundamental creative discoveries**, **innovative research strategies**, and their applications as a basis for ultimately **protecting and improving health**; • to develop, maintain, and renew scientific human and physical resources that will **ensure the Nation's capability to prevent disease**; • to expand the knowledge base in medical and associated sciences in order to enhance the Nation's economic well-being and ensure a continued high return on the public	Health Focus Area In 2019, NIH had a $39.2B discretionary budget. 1. NCI (14.7%) – cancer 2. NIAID (14.1%) – allergy and infectious disease 3. NHLBI (8.9%) – heart, lung, and blood 4. NIA (7.9%) – instate on aging 5. NIGMS (7.3%) – general medical sciences Region United States (with some global research)	Topics from 2016-2020 tweets (no order) Africa Cancer Funding Heart Disease HIV/AIDS News Rare Disease Research Stress Veterans	National security through developing new knowledge in enhancing health and lengthening life.	Research on cancer, HIV/AIDS, heart disease, and rare diseases are consistent across DAH data and tweets.	Research on cancer, HIV/AIDS, heart disease, and rare diseases are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of seeking knowledge to enhance life and ensure the US's capability to prevent disease, the NIH prioritizes research on cancer, HIV/AIDS, heart disease, and rare diseases.	Yes

	investment in research; and • to exemplify and promote the highest level of scientific integrity, public accountability, and social responsibility in the conduct of science. In realizing these goals, the NIH provides leadership and direction to programs designed to improve the health of the Nation by conducting and supporting research: • in the **causes, diagnosis, prevention, and cure of human diseases**; • in the processes of human growth and development; • in the biological effects of environmental contaminants; • in the **understanding of mental, addictive and physical disorders**; and • in directing programs for the collection, dissemination, and exchange of information in medicine and health, including the development and support of medical libraries and the training of medical librarians and other health information specialists.						
FAO	"Today, member states face an increasing number of demands and challenges in agricultural development. To support them, FAO has identified five key priorities on which it is best placed to intervene. These priorities, or Strategic Objectives, represent our main areas of work to achieve our **vision of a world free from hunger and malnutrition, where food and agriculture help to improve the living standards of all**, especially the poorest, in an economically, socially and environmentally sustainable manner – contributing to the implementation of the 2030 Agenda for Sustainable Development. 1. **Help eliminate hunger, food insecurity, and malnutrition** 2. Make agriculture, forestry, and fisheries more productive and sustainable 3. Reduce rural poverty 4. Enable inclusive and efficient agricultural food systems 5. Increase the resilience of livelihoods to threats and crises" (FAO Strategic Objectives 2019)	Health Focus Area All received funding is spent on staffing and program expenses in addressing hunger, food insecurity, malnutrition, and improving resiliency of food systems. Region Funding data for FAO in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Agriculture Biodiversity Climate Change Families Farmers Fisheries Food Security Forests Water	Addressing hunger, food insecurity, and malnutrition through improving food and agricultural systems.	Food insecurity, malnutrition, and food systems are consistent across DAH data and tweets.	Food insecurity, malnutrition, and food systems are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of a world free from hunger and malnutrition, the FAO prioritizes eliminating hunger, food insecurity, and malnutrition	Yes
UNDP	"UNDP's Strategic Plan (2018-2021) has been designed to be	Tot/al budget allocation	Topics from 2016-2020 tweets	Poverty eradication,	HIV/AIDS, malaria, and	HIV/AIDS, malaria, and	Yes

	responsive to the wide diversity of the countries we serve. The diversity is reflected in three broad development contexts: • Eradicate poverty in all its forms and dimensions • Accelerate structural transformations • Build resilience to shocks and crises To respond to these issues, and better focus its resources and expertise to deliver on the 2030 Agenda, UNDP has identified a set of approaches that we call our Signature Solutions: • Keeping people out of POVERTY • GOVERNANCE for peaceful, just, and inclusive societies • Crisis prevention and increased RESILIENCE • ENVIRONMENT: nature-based solutions for development • Clean, affordable ENERGY • Women's empowerment and GENDER equality In all our activities, we encourage the **protection of human rights** and the **empowerment of women**, **minorities and the poorest and most vulnerable**." (UNDP About us) UNDP is the lead development agency in helping the achievement of the Sustainable Development Goals. **SDG 3: Ensure healthy lives and promote well-being for all at all ages.** (UNDP: SDGs)	$5.7 billion budget in 2019 By UNDP focus Eradicating poverty (43%), accelerate structural transformations (32%), build resilience to shocks and crises (11.5%), others (13.2%) By health focus area SDG3 was allotted $504M (9%) of total budget in 2019 –55% to HIV/AIDS, tuberculosis, and malaria (target 3.3), 26% to universal health coverage (target 3.8), 9% to child mortality (target 3.2) Region 23% of 2019 budget was allocated to Africa, 19% to Asia and the Pacific, 18% to Latin America and the Caribbean.	(no order) Africa Children Climate Change Education FGM Food Security HIV/AIDS Malaria Water Women	accelerate structural transformations, build resilience to shocks and crises SDG 3: Ensure healthy lives and promote well-being for all at all ages (includes: maternal mortality, child mortality, HIV/AIDS, tuberculosis, malaria, infectious diseases, mental health, substance abuse, road traffic accidents, sexual and reproductive health, universal health coverage, deaths from environmental pollution)	child and maternal health are consistent across DAH data and tweets.	child and maternal health are consistent across stated and revealed preferences. To maximize benefits of their pre-determined global health goal of ensuring healthy lives and promoting well-being for all, the UNDP prioritizes HIV/AIDS, malaria, and child and maternal health.	
MSF	"Médecins Sans Frontières brings **medical humanitarian assistance** to victims of **conflict**, **natural disasters**, **epidemics** or **healthcare exclusion**" (MSF About Us) "Program Priorities • Outpatient consultations • Birth assistance (including C-section) • Cholera treatment • Inpatient care • Vaccinations against measles • Malaria treatment • Sexual violence • Meningitis treatment • Inpatient feeding programs for malnourished children • TB treatment • HIV ART treatment • Mental health services • Distribution of relief goods" (International Activity Report 2019)	Health Focus Area "81% of our financial resources are allocated to fulfilling our social mission: 65% to our humanitarian programmes, 12% to support our projects and programmes, and 4% to awareness-raising, the Access Campaign, and the Drugs for Neglected Diseases initiative (DNDi). The rest is spent on general management and fundraising costs. We also maintain reserves that allow us to respond immediately to a crisis without having to wait for an appeal." Funding is allocated mostly to outpatient consultations, malaria treatment, and birth assistance Region	Topics from 2016-2020 tweets (no order) Africa Children Cholera Ebola HIV/AIDS Humanitarian Aid Refugees Treatment Tuberculosis Violence	Medical humanitarian assistance to victims of conflict, natural disasters, epidemics, or healthcare exclusion.	Humanitarian aid, HIV/AIDS, infectious diseases, and child health are consistent across DAH data and tweets.	Humanitarian aid, HIV/AIDS, infectious diseases, and child health are consistent across stated and revealed preferences. To maximize benefits of their pre-determined goal of bringing medical humanitarian assistance to victims of crises, MSF prioritizes humanitarian aid, HIV/AIDS, infectious diseases, and child health.	Yes

		Funding data for MSF in 2019 have unallocated or unspecified regions.					
PATH	"At PATH, we are a global team of innovators working to **accelerate health equity** so all people and communities can thrive. We advise and partner with public institutions, businesses, grassroots groups, and investors to solve the world's most pressing health challenges." (PATH About Us) "2019 Achievements • Controlling and eliminating **malaria** • Differentiating services for **HIV** patients • Reimagining **primary health care** • Creating **innovative devices** and diagnostics • Maximizing impact through **policy** • Advancing **essential medicines** • Reducing the cost of **sanitation** and cleaning • Expanding access to **contraception**" (PATH Annual Report 2019)	Health Focus Area Of the $303 million 2019 budget, 48% was allocated to global health programs, 37% to essential medicines, 11% to technology and innovation, 3.5% to other. Region Funding data for PATH in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Access Africa Breastfeeding Cancer Children Ebola Innovation Malaria Pneumonia Vaccines	Accelerating health equity Areas: Malaria, HIV/AIDS, primary health care, health innovations, health policy, essential medicines, sanitation, contraceptives	Malaria, vaccines, and innovations are consistent across DAH data and tweets.	Malaria, vaccines, and innovations are consistent across stated and revealed preferences. To maximize benefits of their pre-determined goal of "accelerating health equity", PATH prioritizes malaria, vaccines, and health innovations.	Yes
Save the Children	"For 100 years, we've been giving **children** in the U.S. and around the world a **healthy start in life**, the **opportunity to learn** and **protection from harm**. When crisis strikes, we are always among the first to respond and the last to leave. We do whatever it takes to save children, transforming their lives and the future we share." (Save the Children About Us) Focus Areas • Health and Nutrition • Education • Hunger and Livelihoods • Public Policy and Advocacy • HIV/AIDS • Child Protection and Rights Governance (Save the Children Annual Report 2019)	Health Focus Area In 2019, Save the Children had a budget of $836 million. • Health & Nutrition (38%) • Education (19%) • Hunger & Livelihoods (13%) • Public Policy & Advocacy (11%) • HIV/AIDS (7%) • Child Protection & Rights Governance (4%) • Other (8%) Region Funding data for Save the Children in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Children Donations Education Food Security Humanitarian Aid Pneumonia Refugees Schools Water	Health related: "giving children a healthy start", "protection from harm"	Child health, nutrition, and food security are consistent across DAH data and tweets.	Child health, nutrition, and food security are consistent across stated and revealed priorities. To maximize benefits of their pre-determined global health goals of "giving children a healthy start and protection from harm", Save the Children prioritizes child health, nutrition, and food security.	Yes
Oxfam	"Oxfam is a global organization working to **end the injustice of poverty**. We help people **build better futures for themselves**, **hold the powerful accountable**, and **save lives in disasters**." (About Oxfam) "Across Yemen, Puerto Rico, Bangladesh, Syria, Central America, and Mozambique, among many other places, our work is delivering tangible, measurable impact: providing lifesaving aid, partnering with local organizations to achieve long-term solutions, and using	Health Focus Area Of the $88 million 2019 budget, 36% was allocated to emergency response and preparedness, 28% to overcoming poverty, 28% to social justice campaigns, 8% to public education. Region Of the budget spent on emergency response and preparedness, 40% was allocated to Africa, 24% to Latin	Topics from 2016-2020 tweets (no order) Africa Climate Change Ebola Food Security Humanitarian Aid Malaria Pneumonia Refugees Water Women	Health related: "help people build better futures for themselves," "save lives in disasters"	Emergency response (humanitarian aid, Ebola, food security, and infectious disease) is consistent across DAH data and tweets.	Emergency response (humanitarian aid, Ebola, food security, and infectious disease) is consistent across stated and revealed preferences. To maximize benefits of their pre-determined global health goals of "helping	Yes

	our strong policy voice to advocate for change. **Program Services** • Saving Lives: Emergency Response and Preparedness • Programs to overcome poverty • Campaigning for social justice • Public education" (Oxfam Annual Report 2019)	America and the Caribbean, and 13% to Asia and the Pacific				people build better futures for themselves" and "saving lives in disasters", Oxfam prioritizes emergency response, humanitarian aid, Ebola, food security, and infectious diseases.	
Global health system	**WHO constitution (1948)**: "Health for All" and the right to the highest attainable standard of health. **Declaration of Alma-Ata (1978)**: universal access to primary health care. **MDGs (2000):** reduce child mortality (4), improve maternal health (5), combat HIV/AIDS and other diseases (6) **SDGs (2015) [Relevant to study's time period]:** good health and well-being (3) • By 2030, reduce the global **maternal mortality** ratio to less than 70 per 100,000 live births (3.1) • By 2030, end **preventable deaths of newborns and children** under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births (3.2) • By 2030, end the epidemics of **AIDS, tuberculosis, malaria** and **neglected tropical diseases** and combat **hepatitis,** water-borne diseases and other **communicable diseases** (3.3) • By 2030, reduce by one third premature mortality from **non-communicable diseases** through prevention and treatment and promote **mental health and well-being** (3.4) • Strengthen the prevention and treatment of **substance abuse**, including narcotic drug abuse and harmful use of alcohol (3.5) • By 2020, halve the number of global deaths and injuries from **road traffic accidents** (3.6) • By 2030, ensure universal access to	Health Focus Areas Of the $41 billion DAH transferred across all global health actors in 2019, 24% was allocated to **HIV/AIDS**, 21% to **newborn and child health**, 14% to **health system strengthening**, 12% to **reproductive and maternal health**, 6% to other infectious diseases, 6% to malaria, 4% to tuberculosis, and 2% to non-communicable diseases. Region Funding data in 2019 have unallocated or unspecified regions. In 2017, 33% of all DAH funding was allocated to **sub-Saharan Africa**, 5% to Southeast Asia, 5% to South Asia, 4% to North Africa and the Middle East, 3% to Latin America and the Caribbean, 2% to Europe and Central Asia, 15% globally, and 32% unallocated.	Most common topics from 2016-2020 across 20 key actors (number in parenthesis indicates count of actors that had the topic as a priority from 2016-2020 tweets) 1. Africa (17), 2. Children (15), 3. HIV/AIDS (11), 4. Women (10), 5. Ebola (9), 6. Water (9), 7. Food security (7), 8. Humanitarian aid (7), 9. Malaria (7), 10. Education (6), 11. Climate change (5), 12. Pneumonia (5), 13. Breastfeeding (4), 14. Cancer (4), 15. Measles (4), 16. Polio (4), 17. Tuberculosis (4), 18. Vaccines (4), 19. Access (3), 20. Agriculture (3), 21. Cholera (3), 22. Human Rights (3), 23. Mothers (3), 24. Refugees (3), 25. Treatment (3), 26. Violence (3), 27. FGM (2), 28. Hepatitis (2), 29. Influenza (2), 30. Innovation (2), 31. Poverty (2), 32. Prevention (2), 33. Sanitation (2), 34. Testing (2)	Health for all and the right to highest attainable standard of health. 9 important target areas under SDG 3.	HIV/AIDS, child and maternal health, and infectious diseases are consistent across DAH data and tweets.	HIV/AIDS, child and maternal health, and infectious diseases are consistent across stated and revealed priorities. To maximize benefits of the pre-determined goal of "health for all" and "SDG3: good health and well-being", the global health system prioritizes 3 of the 9 target areas of SDG 3: HIV/AIDS, child and maternal health, and infectious diseases. **Note:** These benefit-maximizing priorities are the same top priorities of the three funding organizations.	Yes

	• **sexual and reproductive health-care services**, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes (3.7) • Achieve **universal health coverage**, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all (3.8) • By 2030, substantially reduce the number of **deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination** (3.9)						

Supplementary Table 2. Breakdown of Collected Tweets by Actor and Month. Total tweets and average tweets per month for each of the 20 global health actors.

Global Health Actor	Total Tweets	Average Tweets per Month
World Health Organization	10,827	722
Oxfam International	5,694	380
Doctors Without Borders (MSF)	5,553	370
UN Children's Fund (UNICEF)	5,395	360
World Bank	5,365	358
UN Development Programme (UNDP)	4,912	327
UN Population Fund (UNFPA)	3,908	261
UK Department of International Development	3,823	255
Centers for Disease Control and Prevention (CDC)	3,701	247
United States Agency for International Development (USAID)	3,604	240
Food and Agriculture Organization (FAO)	3,263	218
Save the Children	3,121	208
Gavi, the Vaccine Alliance	2,739	183
National Institutes of Health (NIH)	2,664	178
Joint UN Programme on HIV/AIDS (UNAIDS)	2,214	148
PATH	1,954	130
Global Fund	1,727	115
European Centre for Disease Prevention and Control (ECDC)	1,311	87
Gates Foundation	1,249	83
Unitaid	1,217	81
Total	**74,241**	**4,949**

Supplementary Table 3. Breakdown of Collected Tweets by Year and Month Tweets per month and per year for all the tweets collected.

	Tweets per Month	Tweets per Year
2016		5,973
November	5,973	
2017		21,193
February	4,474	
May	5,582	
August	5,103	
November	6,034	
2018		18,562
February	4,145	
May	4,965	
August	4,205	
November	5,247	
2019		17,884
February	4,500	
May	4,886	
August	3,987	
November	4,511	
2020		10,629
February	4,446	
May	6,183	
Total	**74,241**	**74,241**

Supplementary Table 4. Priority Similarity Matrix Scores are generated by comparing the list of 10 health priorities of actor A with that of actor B and the number of matching priorities is counted. Topic similarity scores range from 0-10.

	USA	UK	BMGF	WHO	World Bank	UNAIDS	UNFPA	UNICEF	UNITAID	GAVI	Oxfam	Global Fund	CDC	EU CDC	NIH	FAO	UNDP	MSF	PATH	Save the Children
USA		7	6	5	6	3	4	4	2	2	5	4	3	1	2	3	7	4	2	6
UK	7		4	4	6	2	3	5	2	3	5	4	2	2	2	4	6	5	3	6
BMGF	6	4		8	4	3	3	4	3	3	3	6	2	1	2	1	6	3	4	3
WHO	5	4	8		3	3	3	4	3	5	4	7	3	3	2	1	5	4	5	2
World Bank	6	6	4	3		2	4	4	1	3	6	3	3	0	1	5	6	3	2	5
UNAIDS	3	2	3	3	2		3	2	4	1	2	3	2	1	2	1	3	3	3	1
UNFPA	4	3	3	3	4	3		4	1	2	3	3	2	0	1	1	4	4	2	3
UNICEF	4	5	4	4	4	2	4		1	3	4	3	2	1	1	3	5	4	4	4
UNITAID	2	2	3	3	1	4	1	1		3	1	4	2	3	2	0	3	4	5	1
GAVI	2	3	3	5	3	1	2	3	3		3	6	3	2	2	1	2	4	5	2
Oxfam	5	5	3	4	6	2	3	4	1	3		5	2	1	1	4	6	4	3	5
Global Fund	4	4	6	7	3	3	3	3	4	6	5		2	3	2	1	5	6	4	2
CDC	3	2	2	3	3	2	2	2	2	3	2	2		2	0	1	3	1	2	2
EU CDC	1	2	1	3	0	1	0	1	3	2	1	3	2		1	0	1	3	1	0
NIH	2	2	2	2	1	2	1	1	2	2	1	2	0	1		1	2	2	2	1
FAO	3	4	1	1	5	1	1	3	0	1	4	1	1	0	1		4	1	1	3
UNDP	7	6	6	5	6	3	4	5	3	2	6	5	3	1	2	4		3	3	5
MSF	4	5	3	4	3	3	4	4	4	4	4	6	1	3	2	1	3		3	4
PATH	2	3	4	5	2	3	2	4	5	5	3	4	2	1	2	1	3	3		3
Save the Children	6	6	3	2	5	1	3	4	1	2	5	2	2	0	1	3	5	4	3	

Supplementary Table 5. Types of Power. A summary of the four types of power as presented by Barnett and Duvall (2005) with examples in global health.

Power Type	Relational specificity	Power works through…	Definition according to Barnett & Duvall (2005)	Global Health Example
Compulsory Power	Direct	Interactions of specific actors	"Direct control of one actor over the conditions of existence or the actions of another." (p. 48)	Donor countries dictate the conditions in low and middle-income countries (LMICs) through dictating requirements in development aid.
Institutional Power	Diffuse	Interactions of specific actors	"Control actors exercise indirectly over others through diffuse relations of interactions." (p. 43)	High-income countries control funding allocations for LMICs through institutional power via their contributions to the WHO and other multilateral organizations.
Structural Power	Direct	Social relations of constitution	"Constitution of subjects' capacities in direct structural relation to one another." (p. 43)	The structural and historical disempowerment of indigenous populations have resulted in their disproportionate outcomes in health.
Productive Power	Diffuse	Social relations of constitution	"Power [that] works through diffuse constitutive relations to produce the situated social capacities of actors." (p. 48)	High-income countries direct what research institutions prioritize and study, and ultimately determine what health issues are addressed.

SUPPLEMENTARY MATERIALS

Materials and Methods

Rationale for choosing the 20 global health actors

1. Hoffman & Cole (2018), Frenk & Moon (2013), and Szlezak et al. (2010) were the basis for the 20 global health actors in this study.[4, 15, 16]
    a. Hoffman & Cole (2018) used the related search function in Google in order to systematically map global health actors – 20 global health actors were identified as most important based on their methodology and was validated by 9 identified global health experts.
    b. Frenk & Moon (2013) identifies 9 primary types of actors in global health with 24 examples in their study on pluralism and other challenges in global health.
    c. Zlezak et al. (2010) describes their 8 identified types of actors in global health as a partnership in their article that argues for the norms and roles of each actor in the transition of global health.
2. The identified global health actors across the 3 studies were compared, and the 20 actors that were identified most important by all 3 studies were chosen.

Collection of tweets

1. Twitter is one of the social media platforms where global health actors actively and consistently share their work, research, and news to the general global public.
2. Using the Twitter Application Programming Interface (API), tweets from of the 20 global health actors were collected from November 2016 to May 2020 in three month intervals.
    a. All the tweets of each of the 20 global health actors were collected for the following 15 months:
        i. 2016: November
        ii. 2017: February, May, August, November
        iii. 2018: February, May, August, November
        iv. 2019: February, May, August, November
        v. 2020: February, May
    b. November 2019 is the identified beginning of the COVID-19 outbreak.
    c. This scope allows an analysis of tweets of global health actors 3 years leading up to the COVID-19 outbreak and 6-months into the pandemic.
3. Three month intervals were chosen with the assumption that a variance in the issues, topics, and themes that global health actors tweet can be seen in three month intervals while allowing for efficient usage of the request limit from the Twitter API.

Topic modelling

1. Topic Modeling was conducted to identify the 10 most tweeted global health issues/topics by each actor in each of the 15 months in the study.

2. The 10 most tweeted global health issues/topics were used to describe the set of issues/problems a specific global health actor prioritizes in a given month.
3. Latent Dirichlet Allocation (LDA) was used in topic modeling.
4. Topic modeling answers the questions:
    a. "What are the most prioritized issues among the identified global health actors from 2016 to 2020?"
    b. "When did global health actors have pandemic preparedness as a priority in the three years leading up to the COVID-19 pandemic?"
    c. "What are the trends in prioritization of global health issues between and among different types of global health actors?

FAQs about how LDA was used in this study

- What did the authors do with tweets that mentioned both "breastfeeding" and "mothers"? Do the authors believe that the revealed priorities of an organization that references both breastfeeding and mothers are substantively different than those of an organization that just references breastfeeding, and so on?
    - For context, LDA topic modeling is a form of "unsupervised machine learning" where the data used is "unlabeled." This means that when we ran the algorithm, we did not define what statements will be categorized as "breastfeeding" and what will be categorized as "mothers." We also did not define what words would fall under any other topics that were generated by the model. The only input from us is was how many topics we want the LDA algorithm to categorize the corpus of text. In our analysis, we generated 10 topics for each of the 20 actors. The LDA algorithm generates topics based on a generative probabilistic model that assumes each topic is a mixture over an underlying set of words, and each corpus of text is a mixture of sets of topic probabilities. In a nutshell, the algorithm analyzes all the words in all the tweets of a specific actor. It then generates probabilities of each unique word appearing with other words in a certain tweet or sentence. Topics are then generated by the model based on these sets of probabilities.
- Some topics are quite general (e.g., "Poverty", "Treatment", "News"), while others are more specific ("Fisheries", "Hepatitis", "Veterans"). In cases where one topic could be subsumed by another (e.g., "Schools" could be subsumed by "Education"), how did the authors disaggregate these?
    - We did not have any input in categorizing any of the topics generated. The topics generated are based on the words and language used by each respective actor in their tweets. The algorithm uses the words/language used by the actor in their tweets to generate topics. We did not make any other edits to the topics after they were generated.

Code for collecting tweets

```
# CREDENTIALS
import yaml

config = dict(
    search_tweets_api = dict(
        account_type = 'premium',
        endpoint = 'https://api.twitter.com/1.1/tweets/search/fullarchive/datacollection.json',
```

```
        consumer_key = 'xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx',
        consumer_secret = 'xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx'
    )
)

with open('twitter_keys_fullarchive.yaml', 'w') as config_file:
    yaml.dump(config, config_file, default_flow_style=False)

# LOAD CREDENTIALS
from searchtweets import load_credentials

premium_search_args = load_credentials("twitter_keys_fullarchive.yaml",
                                       yaml_key="search_tweets_api",
                                       env_overwrite=False)
print(premium_search_args)

# QUERY RULE SET UP
from searchtweets import gen_rule_payload

rule = gen_rule_payload("from:username",
                        results_per_call=500,
                        from_date="2020-02-01",
                        to_date="2020-03-01"
                       )

# WRITE TO JSONL config_file
import json

with open('tweets_feb_2020.jsonl', 'a', encoding='utf-8') as f:
    n = 0
    for tweet in rs.stream():
        n += 1
        if n % 10 == 0:
            print('{0}: {1}'.format(str(n), tweet['created_at']))
        json.dump(tweet, f)
        f.write('\n')
print('done')

# REPEAT FOR OTHER USERS AND MONTHS
```

Code for topic modelling

```
# Importing modules

import pandas as pd

# Read data into tweets_df
tweets_df = pd.read_csv('tweets_nov2016-may2020.csv')

# Print head
tweets.head()

# Remove the columns
tweets_df = tweets_df[["username","user_id","created_at","tweet"]]

# Print out the first rows of tweets_df
tweets_df.head()

# Create dataframe for each month in analysis
tweets_feb = tweets.loc[tweets.created_at.str.contains("Feb")]
tweets_feb_17 = tweets_feb.loc[tweets_feb.created_at.str.contains("2017")]
tweets_feb_18 = tweets_feb.loc[tweets_feb.created_at.str.contains("2018")]
tweets_feb_19 = tweets_feb.loc[tweets_feb.created_at.str.contains("2019")]
tweets_feb_20 = tweets_feb.loc[tweets_feb.created_at.str.contains("2020")]

tweets_may = tweets.loc[tweets.created_at.str.contains("May")]
tweets_may_17 = tweets_may.loc[tweets_may.created_at.str.contains("2017")]
tweets_may_18 = tweets_may.loc[tweets_may.created_at.str.contains("2018")]
tweets_may_19 = tweets_may.loc[tweets_may.created_at.str.contains("2019")]
tweets_may_20 = tweets_may.loc[tweets_may.created_at.str.contains("2020")]

tweets_aug = tweets.loc[tweets.created_at.str.contains("Aug")]
tweets_aug_17 = tweets_aug.loc[tweets_aug.created_at.str.contains("2017")]
tweets_aug_18 = tweets_aug.loc[tweets_aug.created_at.str.contains("2018")]
tweets_aug_19 = tweets_aug.loc[tweets_aug.created_at.str.contains("2019")]
```

```
tweets_nov = tweets.loc[tweets.created_at.str.contains("Nov")]
tweets_nov_16 = tweets_nov.loc[tweets_nov.created_at.str.contains("2016")]
tweets_nov_17 = tweets_nov.loc[tweets_nov.created_at.str.contains("2017")]
tweets_nov_18 = tweets_nov.loc[tweets_nov.created_at.str.contains("2018")]
tweets_nov_19 = tweets_nov.loc[tweets_nov.created_at.str.contains("2019")]

# Helper function
def plot_10_most_common_words(count_data, count_vectorizer):
    import matplotlib.pyplot as plt
    words = count_vectorizer.get_feature_names()
    total_counts = np.zeros(len(words))
    for t in count_data:
        total_counts+=t.toarray()[0]

    count_dict = (zip(words, total_counts))
    count_dict = sorted(count_dict, key=lambda x:x[1], reverse=True)[1:23]
    words = [w[0] for w in count_dict]
    counts = [w[1] for w in count_dict]
    x_pos = np.arange(len(words))

    plt.figure(2, figsize=(15, 2))
    plt.subplot(title=f'10 Most Common Words')
    sns.set_context("notebook", font_scale=1.25, rc={"lines.linewidth": 2.5})
    sns.barplot(x_pos, counts, palette='husl')
    plt.xticks(x_pos, words, rotation=90)
    plt.xlabel('words')
    plt.ylabel('counts')
    plt.show()

# Import Libraries
from sklearn.feature_extraction.text import CountVectorizer
import numpy as np

import matplotlib.pyplot as plt
import seaborn as sns

import re
import string

# Identify top 10 keywords, issues, topics of each actor for a given month
tweets = tweets_nov_16[tweets_nov_16["username"] == username]
tweets = tweets_df[tweets_df['username'].isin(username)]
printable = set(string.printable)
tweets['paper_text_processed'] = tweets['tweet'].map(lambda x: re.sub('[,\.!?]', '', x))
tweets['paper_text_processed'] = tweets['tweet'].map(lambda x: x.encode('ascii','ignore'))
exclusionList = ['amp','https','RT','people','know','living','new','2018','latest','use', 'week',
                 'ECDC_EU','thank','Thank','DYK','USAID','today','world','million','country',
                'foreignoffice','UK','billgates','melindagates','2019','des','33', 'DFID',
                '000','day','like','year','old','live','UNITAID','PATHtweets','PATH','para',
                'WorldBank','LIVE','WHOAFRO','WHOWPRO','WHOSEARO','WHOEMRO','GlobalFund','WHO_Europe','la'
                ]
exclusions = '|'.join(exclusionList)
tweets['paper_text_processed'] = tweets['tweet'].map(lambda x: re.sub(exclusions, '', x))
tweets['paper_text_processed'] = tweets['paper_text_processed'].map(lambda x: x.lower())
tweets['paper_text_processed'].head()
sns.set_style('whitegrid')
%matplotlib inline
count_vectorizer = CountVectorizer(stop_words='english')
count_data = count_vectorizer.fit_transform(tweets['paper_text_processed'])
import warnings
warnings.simplefilter("ignore")
plot_10_most_common_words(count_data, count_vectorizer)

# LDA Topic Modeling
import warnings
warnings.simplefilter("ignore", DeprecationWarning)
# Load the LDA model from sk-learn
from sklearn.decomposition import LatentDirichletAllocation as LDA

# Helper function
def print_topics(model, count_vectorizer, n_top_words):
    words = count_vectorizer.get_feature_names()
    for topic_idx, topic in enumerate(model.components_):
        print("\nTopic #%d:" % topic_idx)
        print(" ".join([words[i]
                        for i in topic.argsort()[:-n_top_words - 1:-1]]))

# Tweak the two parameters below
number_topics = 5
```

```
number_words = 10
# Create and fit the LDA model
lda = LDA(n_components=number_topics, n_jobs=-1)
lda.fit(count_data)
# Print the topics found by the LDA model
print("Topics found via LDA:")
print_topics(lda, count_vectorizer, number_words)
```

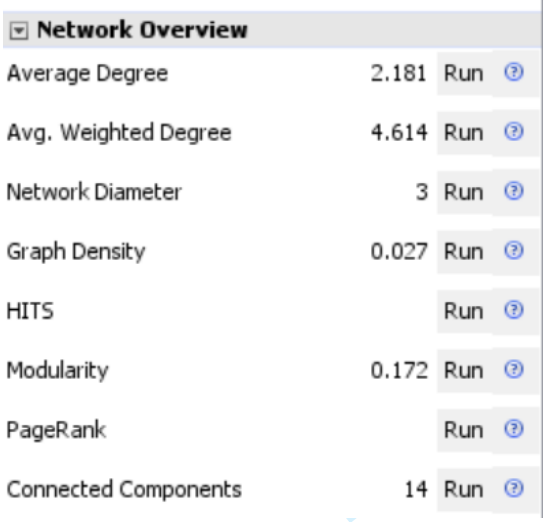
How network maps were analyzed

- **What is network analysis?** Network analysis is an analytic method that has proved to be useful in understanding relational dynamics across actors in global and public health. (Lopreite et al. 2021 and Quisell et al. 2018).
- **Why use network analysis for the study?** Network analysis was conducted to observe the funding relationships between global health actors.
- **What tool was used?** Gephi 0.9.2 was used in constructing and analyzing the network map.
- **How was the network map designed?**
    - The network modelled in the study allows for a graphical visualization of the flows of global health funding in 2019.
    - The network map was designed such that each global health actor is represented by a node and lines or “edges” indicate a flow of funding in global health.
    - The Fruchterman-Reingold algorithm was used in modelling the network map.
        - The algorithm “calculates the optimal layout so that nodes with less strength and less connections are placed further apart, and those with more and/or stronger connections are placed closer to each other.”[18]
        - The thickness of edges represents the amount of funding transferred between actors.
        - The modelled network map can be found and will be discussed in the findings section.

DAH funding data network analysis summary statistics

Network Overview		
Average Degree	25.403	Run
Avg. Weighted Degree	254.124	Run
Network Diameter	4	Run
Graph Density	0.113	Run
HITS		Run
Modularity	0.093	Run
PageRank		Run
Connected Components	1	Run

Twitter data network analysis summary statistics



Network Overview		
Average Degree	2.181	Run
Avg. Weighted Degree	4.614	Run
Network Diameter	3	Run
Graph Density	0.027	Run
HITS		Run
Modularity	0.172	Run
PageRank		Run
Connected Components	14	Run

DAH funding data network analysis statistics report

Label	indegree	outdegree	Degree	weighted indegree	weighted outdegree	Weighted Degree	Eccentricity	closnesscentrality	harmonicclosnesscentrality	betweenesscentrality	modularity_class	strongcompnum
African Development Bank	25	57	82	1149	1149	2298	1	1.00	1.00	54.18	1	57
Asian Development Bank	26	48	74	723	723	1446	3	0.42	0.53	52.20	0	160
United Arab Emirates	1	79	80	79	79	158	1	1.00	1.00	7.28	2	161
Australia	1	151	152	137	1021	1158	2	0.85	0.91	0.00	2	175
Austria	1	128	129	112	1083	1195	2	0.76	0.85	0.00	0	179
Belgium	1	140	141	123	1278	1401	2	0.80	0.87	0.00	0	181
Canada	1	163	164	146	1564	1710	2	0.89	0.94	0.00	2	183
Switzerland	1	138	139	124	866	990	2	0.82	0.89	0.00	2	184
China	39	12	51	251	380	631	2	0.52	0.53	661.00	1	160
Germany	1	165	166	147	1476	1623	2	0.90	0.94	0.00	0	185
Denmark	1	131	132	115	1229	1344	2	0.77	0.85	0.00	0	186
Spain	1	152	153	134	1498	1632	2	0.84	0.91	0.00	0	188
Finland	1	160	161	144	1210	1354	2	0.88	0.93	0.00	0	189
France	1	172	173	154	1466	1620	2	0.92	0.96	0.00	0	192
United Kingdom	1	168	169	150	1552	1702	2	0.91	0.95	0.00	0	193
Greece	1	148	149	133	1031	1164	2	0.83	0.90	0.00	0	194
Ireland	1	120	121	104	1081	1185	2	0.74	0.82	0.00	2	195
Italy	1	160	161	143	1433	1576	2	0.88	0.93	0.00	0	196
Japan	1	169	170	155	1111	1266	2	0.94	0.97	0.00	2	198
Korea	1	138	139	125	876	1001	2	0.82	0.89	0.00	2	199
Luxembourg	1	130	131	114	1124	1238	2	0.77	0.85	0.00	2	200

Netherlands	1	158	159	142	1380	1522	2	0.87	0.93	0.00	0	201
Norway	1	157	158	138	1221	1359	2	0.86	0.92	0.00	2	203
New Zealand	1	129	130	118	633	751	2	0.78	0.86	0.00	3	204
Portugal	1	73	74	57	885	942	3	0.62	0.69	0.00	0	205
Sweden	1	155	156	139	1464	1603	2	0.86	0.92	0.00	0	206
United States	1	165	166	150	1390	1540	2	0.92	0.96	0.00	2	207
Bill & Melinda Gates Foundation	1	162	163	146	1280	1426	2	0.89	0.94	0.00	1	208
Coalition for Epidemic Preparedness Innovations	10	1	11	10	10	20	1	1.00	1.00	0.23	1	163
European Commission	15	148	163	2184	2184	4368	3	0.83	0.92	53.93	0	178
European Economic Area	3	7	10	17	17	34	1	1.00	1.00	8.85	2	202
Gavi	28	118	146	2024	2024	4048	3	0.65	0.81	110.05	1	160
Global Fund	29	155	184	4119	4119	8238	3	0.91	0.96	336.01	2	160
Inter-American Development Bank	15	34	49	269	269	538	1	1.00	1.00	49.50	2	119
International NGOs	27	151	178	2323	2323	4646	3	0.86	0.94	198.03	2	171
US NGOs	27	158	185	442	442	884	3	0.90	0.95	306.65	1	174
Pan American Health Organization	23	44	67	318	318	636	3	0.41	0.52	28.46	2	162
UNAIDS	30	133	163	612	612	1224	3	0.73	0.87	198.05	1	160
UNFPA	30	141	171	1630	1630	3260	3	0.79	0.90	226.79	0	160
UNICEF	30	146	176	1913	1913	3826	3	0.83	0.92	250.51	1	160
UNITAID	9	2	11	14	14	28	1	1.00	1.00	0.28	1	187
US Foundations	1	164	165	164	164	328	3	0.92	0.96	23.90	1	210
World Bank	21	129	150	1134	1134	2268	3	0.71	0.85	32.25	0	176
WB_IBRD	20	153	173	1369	1369	2738	3	0.84	0.93	247.82	0	169
WB_IDA	27	117	144	2596	2596	5192	3	0.64	0.81	163.51	3	160
WHO	29	154	183	2476	2476	4952	3	0.90	0.95	314.53	0	160
Corporate Donations	0	2	2	0	2	2	4	0.48	0.49	0.00	1	211
Debt Repayments	0	2	2	0	173	173	4	0.47	0.48	0.00	3	212
Non-OECD DAC Countries	0	17	17	0	710	710	2	0.52	0.55	0.00	2	213
Other	0	11	11	0	285	285	3	0.52	0.53	0.00	2	214
Other OECD DAC Countries	0	8	8	0	220	220	3	0.51	0.52	0.00	2	215
Private Other	0	14	14	0	941	941	3	0.52	0.54	0.00	1	216
Unallocable	0	4	4	0	4	4	4	0.46	0.49	0.00	1	217
Afghanistan	40	0	40	275	0	275	0	0.00	0.00	0.00	0	134
Albania	34	0	34	190	0	190	0	0.00	0.00	0.00	3	122
Algeria	36	0	36	138	0	138	0	0.00	0.00	0.00	2	3
Angola	39	0	39	279	0	279	0	0.00	0.00	0.00	1	21
Anguilla	3	0	3	3	0	3	0	0.00	0.00	0.00	2	170
Antigua and Barbuda	19	0	19	65	0	65	0	0.00	0.00	0.00	2	87
Argentina	34	0	34	118	0	118	0	0.00	0.00	0.00	2	113
Armenia	36	0	36	218	0	218	0	0.00	0.00	0.00	3	75
Azerbaijan	36	0	36	199	0	199	0	0.00	0.00	0.00	3	74
Bahrain	1	0	1	1	0	1	0	0.00	0.00	0.00	0	190
Bangladesh	39	0	39	271	0	271	0	0.00	0.00	0.00	0	135
Barbados	6	0	6	47	0	47	0	0.00	0.00	0.00	2	107

Belarus	30	0	30	119	0	119	0	0.00	0.00	0.00	2	144
Belize	33	0	33	119	0	119	0	0.00	0.00	0.00	2	94
Benin	39	0	39	273	0	273	0	0.00	0.00	0.00	1	43
Bhutan	34	0	34	163	0	163	0	0.00	0.00	0.00	3	70
Bolivia	38	0	38	180	0	180	0	0.00	0.00	0.00	2	108
Bosnia and Herzegovina	35	0	35	182	0	182	0	0.00	0.00	0.00	3	121
Botswana	39	0	39	210	0	210	0	0.00	0.00	0.00	0	18
Brazil	37	0	37	131	0	131	0	0.00	0.00	0.00	2	117
Bulgaria	5	0	5	34	0	34	0	0.00	0.00	0.00	2	156
Burkina Faso	39	0	39	280	0	280	0	0.00	0.00	0.00	1	50
Burundi	39	0	39	264	0	264	0	0.00	0.00	0.00	1	19
Cambodia	37	0	37	266	0	266	0	0.00	0.00	0.00	0	130
Cameroon	39	0	39	277	0	277	0	0.00	0.00	0.00	1	37
Cape Verde	24	0	24	117	0	117	0	0.00	0.00	0.00	3	12
Central African Republic	39	0	39	259	0	259	0	0.00	0.00	0.00	1	14
Chad	39	0	39	266	0	266	0	0.00	0.00	0.00	1	29
Chile	34	0	34	112	0	112	0	0.00	0.00	0.00	2	102
Christmas Island	1	0	1	1	0	1	0	0.00	0.00	0.00	1	209
Colombia	36	0	36	126	0	126	0	0.00	0.00	0.00	2	118
Comoros	39	0	39	223	0	223	0	0.00	0.00	0.00	3	5
Congo	39	0	39	249	0	249	0	0.00	0.00	0.00	1	7
Cook Islands	9	0	9	49	0	49	0	0.00	0.00	0.00	2	149
Costa Rica	35	0	35	131	0	131	0	0.00	0.00	0.00	2	97
Cote d'Ivoire	39	0	39	276	0	276	0	0.00	0.00	0.00	1	20
Croatia	22	0	22	61	0	61	0	0.00	0.00	0.00	2	153
Cuba	36	0	36	166	0	166	0	0.00	0.00	0.00	2	92
Czech Republic	2	0	2	2	0	2	0	0.00	0.00	0.00	1	173
Democratic Republic of the Congo	37	0	37	199	0	199	0	0.00	0.00	0.00	1	46
Djibouti	39	0	39	247	0	247	0	0.00	0.00	0.00	1	25
Dominica	26	0	26	83	0	83	0	0.00	0.00	0.00	2	89
Dominican Republic	37	0	37	159	0	159	0	0.00	0.00	0.00	2	112
Ecuador	37	0	37	128	0	128	0	0.00	0.00	0.00	2	106
Egypt	39	0	39	254	0	254	0	0.00	0.00	0.00	1	35
El Salvador	37	0	37	161	0	161	0	0.00	0.00	0.00	2	100
Equatorial Guinea	38	0	38	197	0	197	0	0.00	0.00	0.00	3	51
Eritrea	39	0	39	255	0	255	0	0.00	0.00	0.00	1	16
Estonia	5	0	5	31	0	31	0	0.00	0.00	0.00	2	154
Ethiopia	39	0	39	288	0	288	0	0.00	0.00	0.00	1	41
Federated States of Micronesia	24	0	24	64	0	64	0	0.00	0.00	0.00	2	64
Fiji	26	0	26	81	0	81	0	0.00	0.00	0.00	2	139
Gabon	38	0	38	210	0	210	0	0.00	0.00	0.00	0	47
Georgia	36	0	36	245	0	245	0	0.00	0.00	0.00	3	81
Ghana	39	0	39	284	0	284	0	0.00	0.00	0.00	1	40
Global	43	0	43	260	0	260	0	0.00	0.00	0.00	1	6

Grenada	30	0	30	85	0	85	0	0.00	0.00	0.00	2	90
Guatemala	37	0	37	170	0	170	0	0.00	0.00	0.00	2	115
Guinea	39	0	39	270	0	270	0	0.00	0.00	0.00	1	31
Guinea-Bissau	39	0	39	259	0	259	0	0.00	0.00	0.00	1	30
Guyana	34	0	34	156	0	156	0	0.00	0.00	0.00	2	98
Haiti	38	0	38	234	0	234	0	0.00	0.00	0.00	2	111
Honduras	38	0	38	186	0	186	0	0.00	0.00	0.00	2	109
Hungary	3	0	3	3	0	3	0	0.00	0.00	0.00	1	166
India	39	0	39	274	0	274	0	0.00	0.00	0.00	0	136
Indonesia	39	0	39	265	0	265	0	0.00	0.00	0.00	0	132
Iran	36	0	36	142	0	142	0	0.00	0.00	0.00	2	73
Iraq	37	0	37	195	0	195	0	0.00	0.00	0.00	0	76
Jamaica	36	0	36	143	0	143	0	0.00	0.00	0.00	2	103
Jordan	37	0	37	198	0	198	0	0.00	0.00	0.00	0	80
Kazakhstan	37	0	37	212	0	212	0	0.00	0.00	0.00	3	78
Kenya	39	0	39	285	0	285	0	0.00	0.00	0.00	1	48
Kiribati	28	0	28	98	0	98	0	0.00	0.00	0.00	2	58
Kosovo	32	0	32	142	0	142	0	0.00	0.00	0.00	3	143
Kyrgyzstan	36	0	36	225	0	225	0	0.00	0.00	0.00	3	77
Laos	37	0	37	258	0	258	0	0.00	0.00	0.00	0	127
Latvia	5	0	5	7	0	7	0	0.00	0.00	0.00	1	157
Lebanon	38	0	38	162	0	162	0	0.00	0.00	0.00	0	68
Lesotho	39	0	39	253	0	253	0	0.00	0.00	0.00	1	22
Liberia	39	0	39	269	0	269	0	0.00	0.00	0.00	1	33
Libya	33	0	33	123	0	123	0	0.00	0.00	0.00	0	2
Lithuania	5	0	5	7	0	7	0	0.00	0.00	0.00	1	158
Macedonia	30	0	30	131	0	131	0	0.00	0.00	0.00	2	145
Madagascar	39	0	39	276	0	276	0	0.00	0.00	0.00	1	38
Malawi	39	0	39	277	0	277	0	0.00	0.00	0.00	1	44
Malaysia	31	0	31	132	0	132	0	0.00	0.00	0.00	0	140
Maldives	32	0	32	110	0	110	0	0.00	0.00	0.00	3	66
Mali	40	0	40	282	0	282	0	0.00	0.00	0.00	1	45
Malta	1	0	1	1	0	1	0	0.00	0.00	0.00	0	180
Marshall Islands	21	0	21	76	0	76	0	0.00	0.00	0.00	0	138
Mauritania	39	0	39	259	0	259	0	0.00	0.00	0.00	1	34
Mauritius	33	0	33	112	0	112	0	0.00	0.00	0.00	2	0
Mayotte	1	0	1	1	0	1	0	0.00	0.00	0.00	0	191
Mexico	37	0	37	161	0	161	0	0.00	0.00	0.00	2	114
Moldova	33	0	33	185	0	185	0	0.00	0.00	0.00	3	125
Mongolia	37	0	37	213	0	213	0	0.00	0.00	0.00	0	124
Montenegro	31	0	31	137	0	137	0	0.00	0.00	0.00	3	142
Montserrat	25	0	25	72	0	72	0	0.00	0.00	0.00	2	91
Morocco	39	0	39	218	0	218	0	0.00	0.00	0.00	1	55
Mozambique	39	0	39	288	0	288	0	0.00	0.00	0.00	1	36

Myanmar	37	0	37	258	0	258	0	0.00	0.00	0.00	0	131
Namibia	39	0	39	222	0	222	0	0.00	0.00	0.00	1	17
Nauru	19	0	19	52	0	52	0	0.00	0.00	0.00	2	59
Nepal	39	0	39	265	0	265	0	0.00	0.00	0.00	0	86
Netherlands Antilles	2	0	2	12	0	12	0	0.00	0.00	0.00	0	177
Nicaragua	37	0	37	201	0	201	0	0.00	0.00	0.00	2	110
Niger	39	0	39	276	0	276	0	0.00	0.00	0.00	1	42
Nigeria	39	0	39	287	0	287	0	0.00	0.00	0.00	1	52
Niue	18	0	18	64	0	64	0	0.00	0.00	0.00	2	63
North Korea	32	0	32	127	0	127	0	0.00	0.00	0.00	2	72
Northern Mariana Islands	2	0	2	2	0	2	0	0.00	0.00	0.00	2	197
Oman	5	0	5	5	0	5	0	0.00	0.00	0.00	1	164
Pakistan	39	0	39	273	0	273	0	0.00	0.00	0.00	0	137
Palau	18	0	18	50	0	50	0	0.00	0.00	0.00	2	62
Palestine	34	0	34	125	0	125	0	0.00	0.00	0.00	2	151
Panama	35	0	35	142	0	142	0	0.00	0.00	0.00	2	105
Papua New Guinea	32	0	32	138	0	138	0	0.00	0.00	0.00	0	128
Paraguay	36	0	36	116	0	116	0	0.00	0.00	0.00	2	95
Peru	37	0	37	131	0	131	0	0.00	0.00	0.00	2	104
Philippines	39	0	39	248	0	248	0	0.00	0.00	0.00	0	120
Poland	4	0	4	6	0	6	0	0.00	0.00	0.00	1	168
Romania	5	0	5	34	0	34	0	0.00	0.00	0.00	2	155
Russia	8	0	8	36	0	36	0	0.00	0.00	0.00	2	147
Rwanda	39	0	39	276	0	276	0	0.00	0.00	0.00	1	27
Saint Helena	33	0	33	130	0	130	0	0.00	0.00	0.00	0	10
Saint Kitts and Nevis	8	0	8	47	0	47	0	0.00	0.00	0.00	2	152
Saint Lucia	33	0	33	107	0	107	0	0.00	0.00	0.00	2	93
Saint Vincent and the Grenadines	32	0	32	95	0	95	0	0.00	0.00	0.00	2	88
Samoa	26	0	26	106	0	106	0	0.00	0.00	0.00	3	65
Sao Tome and Principe	38	0	38	230	0	230	0	0.00	0.00	0.00	3	4
Saudi Arabia	5	0	5	5	0	5	0	0.00	0.00	0.00	1	172
Senegal	39	0	39	283	0	283	0	0.00	0.00	0.00	1	39
Serbia	35	0	35	167	0	167	0	0.00	0.00	0.00	2	146
Seychelles	33	0	33	97	0	97	0	0.00	0.00	0.00	2	1
Sierra Leone	39	0	39	270	0	270	0	0.00	0.00	0.00	1	49
Slovakia	2	0	2	2	0	2	0	0.00	0.00	0.00	1	165
Slovenia	8	0	8	8	0	8	0	0.00	0.00	0.00	0	159
Solomon Islands	26	0	26	128	0	128	0	0.00	0.00	0.00	3	82
Somalia	39	0	39	252	0	252	0	0.00	0.00	0.00	1	15
South Africa	39	0	39	260	0	260	0	0.00	0.00	0.00	0	24
South Korea	7	0	7	7	0	7	0	0.00	0.00	0.00	0	167
South Sudan	39	0	39	245	0	245	0	0.00	0.00	0.00	1	13
Sri Lanka	37	0	37	231	0	231	0	0.00	0.00	0.00	0	126
Sudan	39	0	39	272	0	272	0	0.00	0.00	0.00	1	26

Suriname	34	0	34	107	0	107	0	0.00	0.00	0.00	2	96
Swaziland	38	0	38	201	0	201	0	0.00	0.00	0.00	0	11
Syria	38	0	38	195	0	195	0	0.00	0.00	0.00	0	67
Tajikistan	37	0	37	248	0	248	0	0.00	0.00	0.00	0	83
Tanzania	39	0	39	285	0	285	0	0.00	0.00	0.00	1	53
Thailand	38	0	38	193	0	193	0	0.00	0.00	0.00	0	85
The Gambia	39	0	39	248	0	248	0	0.00	0.00	0.00	1	28
Timor-Leste	37	0	37	231	0	231	0	0.00	0.00	0.00	0	79
Togo	39	0	39	255	0	255	0	0.00	0.00	0.00	1	9
Tokelau	13	0	13	18	0	18	0	0.00	0.00	0.00	2	148
Tonga	23	0	23	99	0	99	0	0.00	0.00	0.00	3	60
Trinidad and Tobago	11	0	11	52	0	52	0	0.00	0.00	0.00	2	116
Tunisia	37	0	37	172	0	172	0	0.00	0.00	0.00	2	8
Turkey	29	0	29	142	0	142	0	0.00	0.00	0.00	0	141
Turkmenistan	36	0	36	158	0	158	0	0.00	0.00	0.00	3	69
Turks and Caicos Islands	2	0	2	2	0	2	0	0.00	0.00	0.00	2	182
Tuvalu	21	0	21	93	0	93	0	0.00	0.00	0.00	3	61
Uganda	39	0	39	286	0	286	0	0.00	0.00	0.00	1	54
Ukraine	32	0	32	181	0	181	0	0.00	0.00	0.00	0	123
Unallocated/Unspecified	45	0	45	357	0	357	0	0.00	0.00	0.00	1	56
Uruguay	31	0	31	78	0	78	0	0.00	0.00	0.00	2	101
Uzbekistan	35	0	35	253	0	253	0	0.00	0.00	0.00	0	129
Vanuatu	25	0	25	76	0	76	0	0.00	0.00	0.00	2	71
Venezuela	34	0	34	106	0	106	0	0.00	0.00	0.00	2	99
Vietnam	39	0	39	270	0	270	0	0.00	0.00	0.00	0	133
Wallis and Futuna Islands	18	0	18	27	0	27	0	0.00	0.00	0.00	0	150
Yemen	37	0	37	249	0	249	0	0.00	0.00	0.00	3	84
Zambia	39	0	39	283	0	283	0	0.00	0.00	0.00	1	32
Zimbabwe	39	0	39	275	0	275	0	0.00	0.00	0.00	1	23

Twitter network analysis statistics report

Label	indegree	outdegree	Degree	weighted indegree	weighted outdegree	Weighted Degree	Eccentricity	closnesscentrality	harmonicclosnesscentrality	betweenesscentrality	modularity_class	strongcompnum
United States	0	8	8	0	30	30	3	0.38	0.44	0.00	0	67
United Kingdom	0	8	8	0	29	29	3	0.38	0.44	0.00	1	68
BMGF	0	8	8	0	35	35	3	0.38	0.44	0.00	0	69
WHO	3	9	12	17	29	46	2	0.54	0.58	23.50	0	66
World Bank	3	8	11	16	31	47	2	0.54	0.58	19.65	1	65
UNAIDS	3	9	12	8	18	26	2	0.54	0.58	23.50	0	64

UNFPA	3	8	11	10	20	30	2	0.54	0.58	19.65	1	63
UNICEF	3	9	12	13	28	41	2	0.54	0.58	23.50	1	62
UNITAID	3	8	11	7	21	28	2	0.54	0.58	20.21	4	61
GAVI	3	9	12	9	24	33	2	0.54	0.58	23.50	4	60
GFATM	3	9	12	14	30	44	2	0.54	0.58	23.50	3	59
Oxfam	8	10	18	28	10	38	1	1.00	1.00	40.64	1	58
CDC	8	10	18	19	10	29	1	1.00	1.00	72.46	2	56
EU CDC	6	10	16	13	10	23	1	1.00	1.00	62.06	3	51
NIH	8	10	18	13	10	23	1	1.00	1.00	87.07	4	43
FAO	7	9	16	13	9	22	1	1.00	1.00	67.06	1	35
UNDP	8	10	18	33	10	43	1	1.00	1.00	41.00	1	28
MSF	8	10	18	32	10	42	1	1.00	1.00	56.78	3	23
PATH	8	10	18	30	10	40	1	1.00	1.00	59.94	4	17
Save the Children	8	9	17	20	9	29	1	1.00	1.00	46.99	1	9
Access	1	0	1	1	0	1	0	0.00	0.00	0.00	4	16
Africa	7	0	7	7	0	7	0	0.00	0.00	0.00	1	8
Agriculture	1	0	1	1	0	1	0	0.00	0.00	0.00	1	34
Biodiversity	1	0	1	1	0	1	0	0.00	0.00	0.00	1	33
Breastfeeding	1	0	1	1	0	1	0	0.00	0.00	0.00	4	15
Cancer	2	0	2	2	0	2	0	0.00	0.00	0.00	4	14
Child Marriage	0	0	0	0	0	0	0	0.00	0.00	0.00	5	70
Children	5	0	5	5	0	5	0	0.00	0.00	0.00	1	7
Cholera	1	0	1	1	0	1	0	0.00	0.00	0.00	3	22
Climate Change	3	0	3	3	0	3	0	0.00	0.00	0.00	1	27
Development	0	0	0	0	0	0	0	0.00	0.00	0.00	6	71
Diarrhea	1	0	1	1	0	1	0	0.00	0.00	0.00	2	55
Discrimination	0	0	0	0	0	0	0	0.00	0.00	0.00	7	72
Donations	1	0	1	1	0	1	0	0.00	0.00	0.00	1	6
E. Coli	1	0	1	1	0	1	0	0.00	0.00	0.00	2	54
Ebola	4	0	4	4	0	4	0	0.00	0.00	0.00	3	13
Education	2	0	2	2	0	2	0	0.00	0.00	0.00	1	5
FGM	1	0	1	1	0	1	0	0.00	0.00	0.00	1	26
Families	1	0	1	1	0	1	0	0.00	0.00	0.00	1	32
Family Planning	0	0	0	0	0	0	0	0.00	0.00	0.00	8	73
Farmers	1	0	1	1	0	1	0	0.00	0.00	0.00	1	31
Fisheries	1	0	1	1	0	1	0	0.00	0.00	0.00	1	30
Food Security	4	0	4	4	0	4	0	0.00	0.00	0.00	1	4
Forests	1	0	1	1	0	1	0	0.00	0.00	0.00	1	29
Funding	1	0	1	1	0	1	0	0.00	0.00	0.00	4	42
HIV/AIDS	4	0	4	4	0	4	0	0.00	0.00	0.00	1	21
Heart Disease	1	0	1	1	0	1	0	0.00	0.00	0.00	4	41
Hepatitis	1	0	1	1	0	1	0	0.00	0.00	0.00	3	50
Human Rights	0	0	0	0	0	0	0	0.00	0.00	0.00	9	74

Humanitarian Aid	3	0	3	3	0	3	0	0.00	0.00	0.00	3	3
Influenza	2	0	2	2	0	2	0	0.00	0.00	0.00	2	49
Innovation	1	0	1	1	0	1	0	0.00	0.00	0.00	4	12
Malaria	3	0	3	3	0	3	0	0.00	0.00	0.00	1	11
Measles	2	0	2	2	0	2	0	0.00	0.00	0.00	3	48
Mothers	0	0	0	0	0	0	0	0.00	0.00	0.00	10	75
News	1	0	1	1	0	1	0	0.00	0.00	0.00	4	40
Nutrition	0	0	0	0	0	0	0	0.00	0.00	0.00	11	76
Online	0	0	0	0	0	0	0	0.00	0.00	0.00	12	77
Outbreaks	1	0	1	1	0	1	0	0.00	0.00	0.00	3	47
Pneumonia	1	0	1	1	0	1	0	0.00	0.00	0.00	1	57
Pneuomonia	2	0	2	2	0	2	0	0.00	0.00	0.00	1	2
Polio	0	0	0	0	0	0	0	0.00	0.00	0.00	13	78
Poverty	0	0	0	0	0	0	0	0.00	0.00	0.00	14	79
Prevention	1	0	1	1	0	1	0	0.00	0.00	0.00	2	53
Rare Disease	1	0	1	1	0	1	0	0.00	0.00	0.00	4	39
Refugees	3	0	3	3	0	3	0	0.00	0.00	0.00	3	1
Report	1	0	1	1	0	1	0	0.00	0.00	0.00	3	46
Research	1	0	1	1	0	1	0	0.00	0.00	0.00	4	38
Sanitation	0	0	0	0	0	0	0	0.00	0.00	0.00	15	80
Schools	1	0	1	1	0	1	0	0.00	0.00	0.00	1	0
South America	0	0	0	0	0	0	0	0.00	0.00	0.00	16	81
Stress	1	0	1	1	0	1	0	0.00	0.00	0.00	4	37
Surveillance	1	0	1	1	0	1	0	0.00	0.00	0.00	3	45
Testing	0	0	0	0	0	0	0	0.00	0.00	0.00	17	82
Treatment	1	0	1	1	0	1	0	0.00	0.00	0.00	3	20
Tubercolosis	2	0	2	2	0	2	0	0.00	0.00	0.00	3	19
Vaccines	2	0	2	2	0	2	0	0.00	0.00	0.00	2	10
Veterans	1	0	1	1	0	1	0	0.00	0.00	0.00	4	36
Violence	1	0	1	1	0	1	0	0.00	0.00	0.00	3	18
Water	3	0	3	3	0	3	0	0.00	0.00	0.00	2	25
West Nile	1	0	1	1	0	1	0	0.00	0.00	0.00	3	44
Women	3	0	3	3	0	3	0	0.00	0.00	0.00	2	24
Zika	1	0	1	1	0	1	0	0.00	0.00	0.00	2	52

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Title: Examining power dynamics in global health governance using topic modeling and network analysis of twitter data

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Structured Abstract:

Objectives: Despite increases in global health actors and funding levels, health inequities persist. We empirically tested whether global health governance (GHG) operates under the Rational Actor Model (RAM) and characterized GHG power dynamics.

Design: We collected approximately 75,000 tweets of 20 key global health actors, between 2016 and 2020 using Twitter API. We generated priorities from tweets collected using topic modeling. Priorities from tweets were compared with stated priorities from content analyses of policy documents and with revealed priorities from network analyses of development assistance for health funding data. Comparing priorities derived from Twitter, policy documents, and funding data, we can test if GHG operates under RAM and characterize power dynamics in GHG.

Participants: 20 global health actors were identified based on a consensus of 3 peer-reviewed articles mapping global health networks. All tweets of each actor were collected in three-month intervals from November 2016 to May 2020. Policy documents and DAH financial data for each actor were collected for the same period.

Results: We find all 20 actors and the global health system collectively fulfill the 3 conditions of RAM based on stated and revealed priorities. We also find compulsory and institutional power asymmetries in GHG. Funding organizations have compulsory power over channels of DAH and implementing institutions they directly fund. Funding organizations also have transitive influence over implementing institutions receiving DAH funding.

Conclusions: We find that there is a correlation between the priorities of large funders and the priorities of health actors. This correlation in conjunction with GHG operating under the RAM and the asymmetric power held by funders raises issues. GHG under the RAM grants large funders majority of the power to determine global health priorities, and ultimately influencing outcomes while implementing organizations, especially those that work closest with populations, have little to no influence in priority-setting.

Strengths and limitations of this study:

- This study utilizes an alternative methodology of using Twitter data in understanding global health governance and priority-setting.
- This study triangulates findings from multiple data sources to test the rational actor model and to characterize power asymmetries in global health governance.
- Because the scope of this study is from 2016 to 2020, the findings may not be fully representative of global health governance during the COVID-19 pandemic.
- Only the key 20 actors of the hundreds of global health actors today were included in the study.

INTRODUCTION

The turn of the 21st century introduced an unprecedented volume of new public and private actors in global health accompanied by stratospheric levels of funding.[1] While some argue that this multiplicity of new actors promotes cooperation, what persists is a politically fragmented network of actors with competing priorities and preferences.[2–4] Academics studying the complex network of global health actors have described it as a "congested" and "chaotic" network that causes inefficiencies in the practice and delivery of global health programs and aid.[5]

Inequities in global health have increasingly been attributed to the actions of transnational actors with varying degrees of power and divergent interests.[6] While more actors have entered global health with ostensible benevolent purposes, health inequities and inefficiencies in delivery still exist today. Fierce competition among donor priorities and requirements overwhelms the institutional capacities of recipient countries,[7,8] disrupts national health planning,[9] delays the delivery of aid,[10] and creates duplications and resource waste.[11,12] Paradoxically, despite the exponential increases in global health actors and funding, preventable global health inequities have persisted.

Researchers have presented at least two arguments attempting to understand this paradox through the lens of economics, politics, and power. First, global health governance (GHG) has been theorized as operating under the rational actor model (RAM) where "each actor has its own set of goals and objectives, and these actors take actions based on analysis of the costs and benefits of various available options."[13] Under RAM, each actor acts on their own set of explicit and implicit goals. Explicit goals come in the form of mission statements, bylaws, and other founding documents. Implicit goals are priorities revealed from past decisions and behaviors. It is theorized that under RAM, prioritization in GHG is based on the aggregation of individual explicit and implicit objectives.

Second, the Lancet-University of Oslo Commission on Global Governance for Health (2014) argues that "power asymmetry and global social norms limit the range of choice and constrain action on health inequity."[6] The actions of powerful global health actors in pursuit of their own interests "are not designed to harm health but can have negative side-effects" that may have contributed to the persistence of inequities.[6] The lack of power of global health beneficiaries and smaller health actors, and the outsized wielded power of large global health funders may also have contributed to the slow rate of reduction in global health inequities.

The argument that GHG operates under the RAM and the Commission on Global Governance for Health's argument about power asymmetry are mainly theoretical ideas about the behaviors of global health actors founded on a collection of studies within specific nations, regions, or institutions. What is necessary is empirical evidence at the global level that can confirm, deny or recharacterize these characterizations of how global health currently operates. Empirical evidence at the global level eliminates doubts of how decisions are currently made in global health and can guide GHG towards addressing the world's inequities in health.

We aim to empirically test the following research questions at the global level: (1) does GHG operate under the RAM? and (2) how can we characterize power dynamics in GHG?

We hypothesize that GHG operates under RAM and that there are power asymmetries in GHG that limit the range of health priorities. We analyzed empirical evidence from Twitter, funding data, and policy documents at the global level to test whether GHG operates under RAM and to characterize the power dynamics in GHG.

METHODS

We test if GHG operates under the RAM and characterize the power dynamics in GHG through the lens of global health priority-setting. All global health actors have certain preferences for health issues and act in alignment with these priorities.

Priorities can either be stated or revealed. Stated priorities are those preferences explicitly stated in a health actor's founding documents, websites, and annual reports. The mission statements and the health areas each actor explicitly mention in their official documents and websites are stated priorities. Revealed priorities are preferences that are gleaned from records of past behaviors and choices. Past health funding allocations and accounts of implemented programs and policies are revealed priorities. Revealed priorities may or may not be aligned with stated priorities.

We use evidence for both stated and revealed priorities from 2016 to 2020 to test our research questions.

Study Sample

We identified 20 key global health actors based on a consensus among three past studies that mapped the global health network using quantitative and qualitative methodologies.[4,14,15] As shown in Table 1, the key global health actors were categorized based on their nature of work in global health. Global health actors were either funding organizations, channels of developmental assistance for health (DAH) or implementing institutions. While most actors fall into multiple categories in practice, for the integrity of this analysis, organizations were limited to only one category based on the nature of their main line of work.

Table 1. Summary of Global Health Actors. Characteristics of the 20 global health actors analyzed in this study.

Nature of Work in Global Health	Organizational Category	Twitter Username	Global Health Actor	Number of Twitter Followers (as of October 2021)
Channels of Developmental Assistance for Health	Global health initiative	gavi	Gavi, the Vaccine Alliance	153,000
		UNITAID	Unitaid	17,200
		GlobalFund	Global Fund to Fight AIDS, Tuberculosis and Malaria	240,100
	Multilateral Development Bank	WorldBank	World Bank	3,500,000
	United Nations System	WHO	World Health Organization	10,000,000
		UNAIDS	Joint United Nations Programme on HIV/AIDS (UNAIDS)	286,800
		UNFPA	United Nations Population Fund (UNFPA)	260,800
		UNICEF	United Nations Children's Fund (UNICEF)	8,900,000

Funding Organizations	National Government	USAID	United States Agency for International Development (USAID)	843,200
		DFID_UK*	United Kingdom Department for International Development (UK DFID)*	1,000,000
	Philanthropic Organization	gatesfoundation	Bill and Melinda Gates Foundation	2,100,000
Implementing Institutions	Global CSO/NGO	MSF	Doctors Without Borders (MSF)	165,100
		PATHtweets	PATH	59,500
		SavetheChildren	Save the Children	2,700,000
		Oxfam	Oxfam International	836,300
	United Nations System	FAO	Food and Agriculture Organization (FAO)	469,600
		UNDP	United Nations Development Programme (UNDP)	1,600,000
	National Government	CDCgov	Centers for Disease Control and Prevention (CDC)	4,300,000
		ECDC_EU	European Centre for Disease Prevention and Control (ECDC)	90,600
		NIH	National Institutes of Health (NIH)	1,400,000

* UK DFID is now the Foreign, Commonwealth, and Development Office. During the time of the analysis, the UK's agency for aid was known as DFID.

Patient and public involvement

Patients and the public were not involved in the development of the research questions and outcome measures.

Data Sources

We analyze stated and revealed priorities of 20 key global health actors from three data sources – policy documents, DAH funding data, and tweets. Table 2 summarizes each data source, how they were collected, how they were analyzed, and what types of priorities can be derived.

Table 2. Summary of Data Source, Collection, and Analysis. Description of how data is collected and analyzed in the study.

Data Source	Data Collection	Analysis	Type of Priorities Derived from Source
Policy Documents	Manual collection of annual reports, policy documents, and official communications from official websites of each global health actor	Manual content analysis	Stated
DAH Funding Data	Queried funding allocation data of each global health actor from the International Health Metrics and Evaluation (IHME) DAH Database	Descriptive statistics; network analysis	Revealed
Twitter Data	Collected all the tweets of each global health actor from November 2016 to May 2020 in three month intervals using the Twitter API	Natural language processing (topic modeling); network analysis	Revealed

Drawing stated priorities from policy documents

Stated priorities are obtained from a manual content analysis of policy documents, annual reports, and official websites of global health actors.

Available policy documents, annual reports, and relevant official communications from the websites of each global health actor between 2016 and 2020 were collected. Manual content analysis was conducted to evaluate the available policy documents for each global health actor and identify their respective stated priorities.

The stated priorities drawn from these documents were commonly obtained from official statements that fall under the following headings: “strategic priorities,” “program priorities,” “strategic objectives,” “focus areas,” “strategic work areas,” “program focus,” “Strategy 20XX-20XX,” “strategic goals,” “priority areas,” among others. Supplementary Table 1 contains the stated priorities obtained from each actor.

Deriving revealed priorities from funding data

The first of two ways we derive revealed priorities is by using a network analysis and descriptive statistics of financial flows in DAH funding data.

Data from the Institute for Health Metrics and Evaluation’s (IHME) Developmental Assistance for Health Database was collected for 2019.[16] The database includes approximately 800,000 transactions of health financing from funding organizations to channels of DAH and to implementing countries.

Descriptive statistics were conducted to determine the allocations of funding for each health area and geographic region for the 20 global health actors in 2019.

Network analysis is an analytic method that has proved to be useful in understanding relational dynamics across actors in global and public health.[17,18] Network analysis was conducted to observe the funding relationships between global health actors. Gephi 0.9.2 was used in constructing and analyzing the network map. The network modelled in the study allows for a visualization of the flows of global health funding in 2019. In the network map, nodes represent global health actors and lines or “edges” indicate a flow of funding in global health. The Fruchterman-Reingold algorithm was used in modelling the network map. The algorithm “calculates the optimal layout so that nodes with less strength and less connections are placed further apart, and those with more and/or stronger connections are placed closer to each other.”[19] The thickness of edges represents the amount of funding transferred between actors. The modelled network is discussed in the findings section.

Twitter data

The second way we derive revealed priorities is by using topic modeling in natural language processing (NLP) and conducting a network analysis of the global health actors’ tweets.

Using the Twitter API, we collected all the tweets of each global health actor by username from November 2016 to May 2020 in three-month intervals. This means that all the tweets of each global health actor were collected for each day in the months of February, May, August, and November for each year. An interval of three months was decided for two reasons. First, a variation in the issues, topics, and themes that global health actors’ tweet can be observed in three-month intervals. Initial small sample testing indicates that collecting all the tweets of every month for each actor yields redundancy in issues and topics observed. Redundancy is eliminated in three-month intervals. Second, it also allows for efficient usage of the data request limits of the

Twitter API. As Twitter limits the number of tweets one can collect from the Twitter API, this interval is an efficient way of collecting data for the timeframe. A total of 74,241 tweets were collected from 2016 to 2020 for the 20 global health actors. Supplementary Tables 2 and 3 describe the tweets collected.

Using Twitter as a data source plays an important role in analyzing GHG. In the academic area of communications studies, researchers suggest that there are two forms of utility that motivate actors to post content on Twitter. First, intrinsic utility assumes that a user receives inherent satisfaction from posting content on Twitter.[20] While global health actors do not necessarily receive the same "inherent satisfaction" as individual Twitter users, global health actors acquire more intrinsic utility as their communications reach a greater number of users. Second, image-related utility assumes that the perceptions of others,[21,22] and seeking status are strong motivators for posting content.[23,24] As global health actors operate best with high public approval, posting content on Twitter can improve public perception. Twitter is the ideal platform for global health actors to simultaneously share their work to a greater number of individuals and to improve their public perception.

Because Twitter limits each post to 280 characters, the platform promotes short, frequent, and straightforward manners of communication. The tweets of global health actors are regular ways of communicating their work, preferences, and priorities to the public.[25–28] The tweets of global health actors act as an archive, a record of historical preferences, priorities, goals, and implemented programs.[29]

We consider tweets equally to funding data as they both reveal priorities through documentation of past decisions, preferences, and goals. Funding data is a record of priorities in the form of financial flows and transactions towards certain global health issues. Twitter is a record of priorities in the form of programs, policies, and opinions deemed important and necessary to communicate with the world. Because of their archival nature, both funding data and tweets reveal priorities through complementing records of decisions.

While tweets can represent both stated and revealed priorities, for this study, we use tweets to represent revealed priorities. Since this study analyzes tweets in aggregation, our findings reveal the top themes discussed by each actor from 2016-2020. Because we do not analyze each tweet at an individual level, tweets are considered revealed priorities and not stated priorities.

Obtaining revealed priorities from Twitter data

NLP is a subfield in artificial intelligence, computer science, and linguistics at the intersection of the human language and computers. NLP utilizes computers to process and analyze large quantities of human language data. We use NLP to analyze the tweets of the global health actors for two reasons. First, NLP allows for the efficient analysis of tens of thousands of rows of text data that could not be done manually.[30–32] Second, NLP allows for topic modeling, an algorithm that generates lists of words frequently used together.[33–35] These lists of words correspond to themes, topics, or issues that can be used to identify the top 10 priorities of each global health actor. The results are then used in a network analysis that visualizes where actors converge or diverge in global health priorities.

As seen in Table 3, ten topics were generated using the Latent Dirichlet Allocation (LDA) topic model for each global health actor's tweets to reveal their priorities from 2016 to 2020. LDA is a generative probabilistic modeling method where words in a corpus of text that are frequently used together are categorized into topics.[36] This follows the assumption that documents, or in this case Twitter profiles, can be broken down into multiple topics that are identified by certain combinations of words.

Table 3. Revealed Priorities from Twitter Topic Modeling. Ten revealed priorities of each of the 20 global health actors based on their tweets from 2016 to 2020. Priorities are alphabetically arranged. Red indicates Funding Organizations. Blue indicates Channels of DAH. Gray indicates Implementing Institution.

United States	United Kingdom	Gates Foundation	WHO	World Bank	UNAIDS	UNFPA	UNICEF	UNITAID	GAVI
Africa	Africa	Africa	Africa	Africa	Access	Africa	Africa	Access	Africa
Children	Agriculture	Breastfeeding	Breastfeeding	Agriculture	Africa	Child Marriage	Breastfeeding	Cancer	Cancer
Education	Children	Children	Children	Children	Discrimination	Children	Children	Children	Children
Food Security	Development	Education	Ebola	Climate Change	HIV/AIDS	Family Planning	Climate Change	Hepatitis	Cholera
HIV/AIDS	Ebola	HIV/AIDS	HIV/AIDS	Food Security	Human Rights	FGM	Ebola	HIV/AIDS	Ebola
Humanitarian Aid	Education	Malaria	Malaria	Humanitarian Aid	Innovation	Human Rights	Education	Malaria	Measles
Mothers	Food Security	Mothers	Measles	Poverty	Prevention	Humanitarian Aid	Human Rights	Testing	Pneumonia
South America	HIV/AIDS	Polio	Mothers	Sanitation	Testing	Nutrition	Online	Treatment	Polio
Water	Humanitarian Aid	Sanitation	Polio	Water	Treatment	Violence	Violence	Tuberculosis	Poverty
Women	Water	Women	Women	Women	Women	Women	Water	Vaccines	Vaccines
Global Fund	**CDC**	**EU CDC**	**NIH**	**FAO**	**UNDP**	**MSF**	**PATH**	**Save the Children**	**Oxfam**
Africa	Children	Ebola	Africa	Africa	Africa	Africa	Access	Africa	Africa
Children	Diarrhea	Hepatitis	Cancer	Agriculture	Children	Children	Africa	Children	Climate Change
Cholera	E. Coli	HIV/AIDS	Funding	Biodiversity	Climate Change	Cholera	Breastfeeding	Donations	Ebola
Ebola	Influenza	Influenza	Heart Disease	Climate Change	Education	Ebola	Cancer	Education	Food Security
HIV/AIDS	Measles	Measles	HIV/AIDS	Families	FGM	HIV/AIDS	Children	Food Security	Humanitarian Aid
Malaria	Prevention	Outbreaks	News	Farmers	Food Security	Humanitarian Aid	Ebola	Humanitarian Aid	Malaria
Pneumonia	Vaccines	Report	Rare Disease	Fisheries	HIV/AIDS	Refugees	Innovation	Pneumonia	Pneumonia
Polio	Water	Surveillance	Research	Food Security	Malaria	Treatment	Malaria	Refugees	Refugees
Tuberculosis	Women	Tuberculosis	Stress	Forests	Water	Tuberculosis	Pneumonia	Schools	Water
Women	Zika	West Nile	Veterans	Water	Women	Violence	Vaccines	Water	Women

Additionally, we model a network map from the priorities generated using the LDA topic model also using the Fruchterman-Reingold algorithm. This network map visualizes the similarities in priorities between the 20 actors. Data used for this network map can be found in Supplementary Table 4. This network map is compared with the network map generated using financial data from IHME in the findings section. This comparison between network maps can illustrate if priorities from tweets and from financial data are aligned. Further details on LDA and network maps can be found in Supplemental Methods.

Testing if GHG operates under the RAM

By combining evidence for stated and revealed priorities of 20 key global health actors, we can determine if GHG operates under the RAM.

The rational actor model (RAM) in international cooperation is categorized as the "linchpin of foreign policy decision making."[37] This approach is rooted in expected utility theory in microeconomics introduced by von Neumann and Morgenstern in the 1940s and subsequent theories of rationality.[38]

RAM is most useful in explanations of economic behavior if the three conditions of the rationality assumption are fulfilled.[37] First, it is assumed that an actor's goal is pre-determined before intentionally acting to achieve it.[37] Second, actors are assumed to "display consistent preferences as manifested in the ability to rank the preferences in transitive order."[37] Third, actors are assumed to maximize utility while choosing an alternative that provides the highest amount of net personal benefit.[37]

"Rational" in this case does not simply mean a dispassionate calculation of costs and benefits. In the case of global health actors, acting rationally means weighing both economic and political factors, and acting according to the three assumptions of RAM.

"To maximize utility" in this study refers to maximizing the net personal benefits however defined by the health actor. It can be defined as financial benefits, ethical benefits such as equity, or however else the health actor defines their utility.

GHG operates under RAM if each of the 20 global health actors and the global health system collectively fulfill the three assumptions of pre-determined goal, rank order preferences, and benefit maximization.

To test the first assumption of pre-determined goal, we determine the stated priorities of each global health actor from policy documents. We test whether there exist explicit statements on goals and priorities and note what health areas or issues are the stated priorities of each global health actor.

To test the second assumption of consistent rank order preferences, we compare revealed priorities from DAH funding data and revealed priorities from tweets. From the funding data, we can determine rank order preferences based on which health issues are allocated the most funding in 2019. From tweets, we can determine rank order preferences based on the top 10 topics each global health actor tweeted about from 2016 to 2020. If there is consistency in rank order preferences between the revealed priorities from funding data and revealed priorities from tweets, then the second assumption is fulfilled.

To test the third assumption of benefit maximization, we compare the stated and revealed priorities from all three data sources. The priorities that are consistent across stated priorities from policy documents and revealed priorities from funding data and from tweets are revealed to be the priority that the global health actor determines to be benefit maximizing. An alignment of a preference across the three different sources can lead us to believe with some certainty that it is the actor's benefit-maximizing preference. While indirect, we believe this method of determining benefit-maximizing preference is the best method given the available data.

We also test the three assumptions at the global health system level. Pre-determined goals are obtained from stated priorities from collective stated commitments to global health based on Sustainable Development Goal 3 (SDG3) of "good health and well-being" as all 20 of the actors in this study have stated commitments to this goal.

Consistent rank order preferences are derived from the alignment between aggregated DAH funding allocations of all global health actors and the most common topics generated from tweets across all global health actors. The consistent preferences across stated and revealed priorities are inferred to be the global health systems' benefit-maximizing preference.

If each global health actor and the global health system collectively fulfill the three assumptions, then GHG operates under the RAM.

Characterizing power dynamics in GHG

We use the following typology of power when characterizing power dynamics in GHG. "Power is exercised everywhere in global health although its presence may be more apparent in some instances than others,"[39] one global health researcher notes. The power concept in global health does not stray far from Robert Dahl's (1957) definition in his seminal study where he describes "A has power over B to the extent that he can get B to do something B would not otherwise do."[40] One way to categorize power is through the four types introduced by Barnett and Duvall (2005), each manifesting in different manners in global health.[41] Supplementary Table 5 summarizes Barnett and Duvall's four types of power. First, compulsory power is defined as "direct control of one actor over the conditions of existence or the actions of another."[41] In global health, compulsory power can be seen in how donor countries dictate the conditions in low and middle-income countries (LMICs) through development aid.[42] Second, institutional power is "the control actors exercise indirectly over others through diffuse relations of interactions."[41] High-income countries control funding allocations for LMICs through institutional power via their contributions to multilateral organizations. Third, structural power refers to the "constitution of subjects' capacities in direct structural relation to one another."[41] The structural and historical disempowerment of indigenous populations have resulted in their disproportionate outcomes in health.[43,44] Fourth, "productive power works through diffuse constitutive relations to produce the situated social capacities of actors."[40] Research institutions funded by high-income countries direct what health issues are studied and addressed.[45]

To characterize the power dynamics in GHG, we analyze the interplay of stated and revealed priorities between funding organizations, channels of DAH, and implementing organizations. Particularly, we identify which global health actors have the most influence in setting global health priorities. The global health actors which have the most priorities aligned with the stated and revealed priorities of the global health system are determined to have the most influence and power in priority-setting.

DISCUSSION

GHG operates under RAM

As seen in Supplementary Table 1, we find that each of the 20 key global health actors fulfills the three assumptions of the RAM. Each actor has a pre-determined goal stated in policy documents, annual reports, and official websites. Each actor has consistent rank order preferences as observed in the alignment of order of preferences in DAH

funding data and top identified topics from tweets. Consistent, top-ranking preferences across policy documents, funding data, and tweets are the alternatives that maximize benefits for each global health actor based on their pre-determined goal.

As an example, USAID's pre-determined goal is "advancing American security and prosperity" through providing aid in the health areas of child and maternal health, HIV/AIDS, malaria, and tuberculosis as found on their official website.[46] In 2019, 49% of aid from USAID support HIV/AIDS, 22% supported child and maternal health, and 7% to malaria.[47] The topic modelling for USAID's tweets shows that HIV/ADIS, child and maternal health, and malaria are the top themes tweeted about by the organization from 2016-2020 (See Supplementary Table 1). USAID behaves under the RAM since their revealed priorities from past funding behavior and from tweets align with their pre-determined goal.

As shown in the last row of Supplementary Table 1, we find that the global health system collectively fulfills the three assumptions of the RAM. The pre-determined goal of the global health system can be found in the WHO constitution and the 9 target areas for SDG3 on good health and well-being. All 20 global health actors have stated commitments to the WHO mission and the SDGs. The alignment of DAH funding allocations and most common health issues from Twitter reveal that in terms of rank order, HIV/AIDS, child health, and maternal health are the top 3 priorities of the global health system collectively. To maximize benefits of the pre-determined goal of "health for all" and "SDG3: good health and well-being", the global health system prioritizes HIV/AIDS, child health, and maternal health. Among all 9 stated targets in SDG3, only these three issues are prioritized. Effectively, the 6 other stated targets in SDG3 are deprioritized and underfunded by the global health system.

Since each global health actor and the global health system collectively fulfills the three assumptions, we find that GHG operates under the RAM. This finding demonstrates that each global health actor operates based on their rational self-interest and that the global health system pursues only some pre-determined health priorities. Who determines which priorities are pursued by the global health system? The findings on power dynamics in GHG reveal the actors who determine global priorities.

Compulsory and institutional power asymmetries in GHG

As demonstrated in the following network maps, we find that there is compulsory and institutional power asymmetry in GHG.

Compulsory power asymmetry can be found in how funding organizations strongly influence channels of DAH and implementing institutions based on their relationship. Channels of DAH and implementing institutions rely on funding organizations for resources to continue operating. We find that the top priorities of the 3 funding organizations in this study are also the priorities of channels of DAH and implementing institutions.

[INSERT FIGURE 1 HERE]

As seen in Figure 1, HIV/AIDS is 1st priority of United States Agency for International Development (USAID), 2nd priority of United Kingdom Department for International Development (UK-DFID), and 2nd priority of the Bill and Melinda Gates Foundation

(BMGF) based on the alignment of stated and revealed priorities. HIV/AIDS is a priority of 4 of 8 channels of DAH and 4 of 9 implementing institutions based on its presence in policy documents, DAH funding, and tweets of each actor.

Figure 1 also demonstrates that maternal and child health is 2nd priority of USAID, 1st priority of UK-DFID, and 1st priority of BMGF based on the alignment stated and revealed priorities. Maternal and child health is a priority of 6 of 8 channels of DAH and 7 of 9 implementing institutions based on its presence in policy documents, DAH funding, and tweets of each actor.

[INSERT FIGURE 2 HERE]

Following the flow of the funding in Figure 2 and the similarities in tweets in Figure 1, we can see that institutional power asymmetry can be found in how funding organizations strongly influence implementing institutions through outsized influence of channels of DAH that allocate funding to these implementing institutions. As some implementing institutions do not get direct funding from funding organizations, but through channels of DAH, their funding is controlled by channels of DAH. Because wealthy funding organizations influence the priorities of channels of DAH, transitively, funders have power over implementing institutions. Implementing institutions in turn align their priorities with the priorities of channels of DAH, and transitively with the priorities of funding organizations.

Both network analyses of revealed priorities from DAH funding data and from tweets show how there is asymmetric levels of power held by the United States, United Kingdom, and the Gates Foundation. Figure 2 reveals how these three funding organizations are the largest funders of the Global Fund, WHO, World Bank, US Foundations, UN organizations, and Gavi. The IHME DAH database reveals that 24% of all DAH funding was allocated to HIV/AIDS, 21% to child health, and 12% to maternal health – the three top priorities of funding organizations.[16] Only 14% was allocated to health system strengthening and 2% to non-communicable diseases.[16]

Figure 1 reveals how the most common topics generated across all global health actors include Africa, HIV/AIDS, child health, women health, and infectious diseases. These are the same health issues highly prioritized by the United States, United Kingdom, and Gates Foundation. Comparing figures 1 and 2, we find that these three funding organizations have outsized influence in priority-setting because of how much DAH funding these three organizations have provided relative to other funders. We find that the priorities from 2016 to 2020 documented through the tweets of actors align with these funders' priorities of HIV/AIDS, child health, maternal health, infectious disease, and Africa. This outsized influence of global health funders limits the range of funded programs and policies, especially making it difficult for smaller implementers to fund local programs and policies that do not neatly align with the priorities of large funders.

Limitations

It is necessary to acknowledge the limitations of this study. First, we assume stated priorities match what is specified in organizational documents. It may be the case that some organizations communicate priorities differently from what is written in their foundational documents. Moreover, what is fundable may not necessarily be what is

deemed important. Second, we assume that health funding is indeed spent on what it is ostensibly spent on when deriving revealed preferences from funding data, which may not always be true. Third, our scope is limited to examining 20 global health actors from 2016 to 2020. There are non-health actors and processes that likely influence health outcomes. Studying the stated and revealed priorities of non-health actors and processes such as foreign relations between nations and the influence of the private sector on health can improve the characterization of current GHG. Fourth, tweets may only reveal priorities that the actor wants to communicate. As organizations have teams that plan communications, priorities derived from Twitter may be limited and not reveal all priorities. While what happens behind closed doors in GHG is unknowable, tweets can reveal some of the implicit priorities of actors. Fifth, we derived benefit-maximizing preferences by identifying consistently top-ranking preferences across stated priorities from policy documents and revealed preferences from tweets and funding data. This manner of identifying benefit-maximizing preferences is indirect and does not necessitate that it is indeed what the actor believes is a benefit-maximizing preference. To be certain about what is benefit-maximizing can only be done by directly asking health actors. However, even within organizations, there are inconsistencies about what members think are benefit-maximizing. We acknowledge this indirect manner of deriving benefit-maximizing priorities is a limitation.

CONCLUSION

We find empirical evidence at the global level showing that GHG operates under the RAM. Additionally, we find that at the global level, there is asymmetric compulsory and institutional power held by funding organizations, allowing global health priorities to be largely influenced by large funders. In the past years, these funders have been the United States, United Kingdom, and the Gates Foundation.

We find that there is a correlation between the priorities of large funders and the priorities of channels of DAH and implementing institutions. This correlation in conjunction with GHG operating under the RAM and the asymmetric power held by funders raises issues. What is worrying is that GHG under the RAM grants large funders majority of the power to determine where GHG resources go, and ultimately influencing outcomes. Effectively, this limits the range of health issues that are adequately funded. Additionally, if outcomes are unfavorable, funding organizations do not have full accountability even if they have outsized influence in GHG priority-setting. It is an issue that implementing organizations, especially smaller local organizations, who have the closest relationship with target populations, have little to no say in how resources are distributed in GHG under the RAM. GHG under the RAM can only lead to equitable health outcomes if and only if major funding organizations have a joint commitment towards the same goals of health equity and justice. If funders set priorities that is grounded on equity and justice, then it would be good for all actors to adhere to the RAM and seek funding by aligning their priorities with funder priorities. In this situation, all actors' individual goals will be aligned with the funding organizations' goals of equity and justice. These findings are aligned with current literature discussing how "philantrocapitalists" and large funders have an outsized influence on global health agenda-setting even without having an ethical framework for decision-making.[48,49]

Our paper complements the current research on agenda-setting in global health, which discusses of how agenda-setting is not purely a rational deliberation of evidence but the convergence of problems, solutions, and political developments.[50] This study attempts to deepen the understanding power's manifestation and influence in agenda-setting through the lens of stated and revealed priorities.

The priorities of funders of HIV/AIDS, child health, and maternal health have been prioritized from 2016-2020. While we have seen improvements in these three areas, the existence of significant and severe preventable health inequalities demonstrates that this prioritization architecture does not necessarily promote equity and justice in global health. Additionally, other core health issues such as horizontal health system improvements were not found to be prioritized which may have affected the persistence of health inequities. We have empirical evidence supporting the arguments that current GHG operates under the RAM, and existing power asymmetries limit the range of choice for health policies and programs that aim to reduce inequities.

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Competing interests: No author has competing interests to declare.

Ethics approval: The study did not have any human or animal participants. Additionally, the study did not require ethical approval as the Twitter data used were already in the public domain.

Data and materials availability: Under the "Content Redistribution" section of Twitter's Developer Agreement and Policy, "We restrict the redistribution of Twitter Content to third parties. If you provide Twitter Content to third parties, including downloadable datasets or via an API, you may only distribute Tweet IDs, Direct Message IDs, and/or User IDs." Because the data collected using the Twitter API does not allow for redistribution under the Twitter Developer Agreement and Policy, tweets cannot be made publicly available. Only Tweet ID's and User ID's are allowed to be redistributed according to the Twitter policy. Please email jenpr@upenn.edu if you wish to receive a copy of the Tweet ID's and User ID's of the data and/or the code used in the study. The IHME DAH Database can be found at http://ghdx.healthdata.org/record/ihme-data/development-assistance-health-database-1990-2019

FIGURE LEGENDS

Figure 1. Network Analysis of Revealed Priorities from Tweets. Line thickness represents how many similar priorities one global health actor has with another. Font size of global health priorities represent the number of organizations have it as a priority. Data used found in Supplementary Table 4.

Figure 2. Network Analysis of Revealed Priorities from Funding for DAH (2019). Line thickness represents the amount of funding for health that was transferred between two actors. Font size represents the total amount of funding for health donated or received in 2019.

REFERENCES

1 Ng NY, Ruger JP. Global Health Governance at a Crossroads. *Global health governance : the scholarly journal for the new health security paradigm* 2011;**3**.

2 Giaimo S. Interest Groups, Think Tanks, and Health Care Policy (1960s-Present). In: *Guide to U.S. Health and Health Care Policy*. Thousand Oaks CA: : SAGE Publications 2014. 375–92.

3 Spicer N, Agyepong I, Ottersen T, *et al.* 'It's far too complicated': why fragmentation persists in global health. *Globalization and Health* 2020;**16**. doi:10.1186/s12992-020-00592-1

4 Szlezák NA, Bloom BR, Jamison DT, *et al.* The Global Health System: Actors, Norms, and Expectations in Transition. *PLoS Medicine* 2010;**7**. doi:10.1371/journal.pmed.1000183

5 United Kingdom House of Lords. Chapter 3: International health: the institutional labyrinth. Select Committee on Intergovernmental Organisations First Report. 2008.

6 Ottersen OP, Dasgupta J, Blouin C, *et al.* The political origins of health inequity: Prospects for change. The Lancet. 2014;**383**. doi:10.1016/S0140-6736(13)62407-1

7 Walt G. Global cooperation in international public health. In: Merson M, Black R, Mills A, eds. *International Public Health*. Gaithersburg, Maryland: : Aspen Publishers 2001.

8 Mayhew SH, Walt G, Lush L, *et al.* Donor Agencies' Involvement in Reproductive Health: Saying One Thing and Doing Another? *International Journal of Health Services* 2005;**35**. doi:10.2190/K46B-RRXJ-95M4-JDQU

9 Burris S. Governance, Microgovernance and Health. *Temple Law Review* 2004;**77**:335–62.

10 Brooks A, Cutts FT, Walt G. Policy study of factors influencing the adoption of new and underutilized vaccines in developing countries. Washington D.C.: 1999.

11 Travis P, Bennett S, Haines A, *et al.* Overcoming health-systems constraints to achieve the Millennium Development Goals. *The Lancet* 2004;**364**. doi:10.1016/S0140-6736(04)16987-0

12 Hoffman SJ, Røttingen J-A. Dark sides of the proposed Framework Convention on Global Health's many virtues: A systematic review and critical analysis. *Health and Human Rights* 2013;**15**:117–34.

13 Ruger JP. Global health governance as shared health governance. *Journal of Epidemiology and Community Health* 2012;**66**. doi:10.1136/jech.2009.101097

14 Frenk J, Moon S. Governance Challenges in Global Health. *New England Journal of Medicine* 2013;**368**. doi:10.1056/NEJMra1109339

15 Hoffman SJ, Cole CB. Defining the global health system and systematically mapping its network of actors. *Globalization and Health* 2018;**14**. doi:10.1186/s12992-018-0340-2

16 Institute for Health Metrics and Evaluation (IHME). Development Assistance for Health Database 1990-2019. *Institute for Health Metrics and Evaluation (IHME)* 2020.

17 Lopreite M, Puliga M, Riccaboni M, *et al.* A social network analysis of the organizations focusing on tuberculosis, malaria and pneumonia. *Social Science and Medicine* 2021;**278**. doi:10.1016/j.socscimed.2021.113940

18 Quissell K, Berlan D, Shiffman J, *et al.* Explaining global network emergence and nonemergence: Comparing the processes of network formation for tuberculosis and pneumonia. *Public Administration and Development* 2018;**38**. doi:10.1002/pad.1836

19 Hevey D. Network analysis: A brief overview and tutorial. *Health Psychology and Behavioral Medicine* 2018;**6**. doi:10.1080/21642850.2018.1521283

20 Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist* 2000;**55**. doi:10.1037/0003-066X.55.1.68

21 Donelle L, Booth R. Health Tweets: An Exploration of Health Promotion on Twitter. *American Nurses Association* 2012;**17**.

22 Park H, Rodgers S, Stemmle J. Analyzing Health Organizations' Use of Twitter for Promoting Health Literacy. *Journal of Health Communication* 2013;**18**. doi:10.1080/10810730.2012.727956

23 Glazer A, Konrad K. A Signaling Explanation for Charity. *American Economic Review* 1996;**86**:1019–28.

24 Harbaugh W. The Prestige Motive for Making Charitable Transfers. *American Economic Review* 1998;**88**:227–82.

25 Fung IC-H, Jackson AM, Ahweyevu JO, *et al.* #Globalhealth Twitter Conversations on #Malaria, #HIV, #TB, #NCDS, and #NTDS: a Cross-Sectional Analysis. *Annals of Global Health* 2017;**83**. doi:10.1016/j.aogh.2017.09.006

26 Goff DA, Kullar R, Laxminarayan R, *et al.* Twitter to engage, educate, and advocate for global antibiotic stewardship and antimicrobial resistance. *The Lancet Infectious Diseases* 2019;**19**. doi:10.1016/S1473-3099(19)30058-1

27 Guidry JPD, Jin Y, Orr CA, *et al.* Ebola on Instagram and Twitter: How health organizations address the health crisis in their social media engagement. *Public Relations Review* 2017;**43**. doi:10.1016/j.pubrev.2017.04.009

28 Scanfeld D, Scanfeld V, Larson EL. Dissemination of health information through social networks: Twitter and antibiotics. *American Journal of Infection Control* 2010;**38**. doi:10.1016/j.ajic.2009.11.004

29 Zamora A. Making Room For Big Data: Web Scraping and an Affirmative Right to Access Publicly Available Information Online. *Journal of Business, Entrepreneurship & the Law* 2019;**12**:203–28.

30 Alvarez-Melis D, Saveski M. Topic Modeling in Twitter: Aggregating Tweets by Conversations. *Tenth International AAAI Conference on Web and Social Media* 2016.

31 Hong L, Davison BD. Empirical study of topic modeling in Twitter. In: *Proceedings of the First Workshop on Social Media Analytics - SOMA '10*. New York, New York, USA: : ACM Press 2010. doi:10.1145/1964858.1964870

32 Yang S-H, Kolcz A, Schlaikjer A, *et al.* Large-scale high-precision topic modeling on twitter. In: *Proceedings of the 20th ACM SIGKDD international conference on Knowledge discovery and data mining - KDD '14*. New York, New York, USA: : ACM Press 2014. doi:10.1145/2623330.2623336

33 Bakshi RK, Kaur N, Kaur R, *et al.* Opinion mining and sentiment analysis. *2016 3rd International Conference on Computing for Sustainable Global Development (INDIACom)* 2016;:452–5.

34 Pak A, Paroubek P. Twitter as a Corpus for Sentiment Analysis and Opinion Mining. *LREc* 2010;**10**:1320–6.

35 Saif H, He Y, Alani H. Semantic Sentiment Analysis of Twitter. 2012. doi:10.1007/978-3-642-35176-1_32

36 Blei DM, Ng AY, Jordan MI. Latent Dirichlet allocation. *Journal of Machine Learning Research* 2003;**3**. doi:10.1016/b978-0-12-411519-4.00006-9

37 Mintz A, DeRouen K. The Rational Actor Model. In: *Understanding Foreign Policy Decision Making*. Cambridge: : Cambridge University Press 2010. 57–68.

38 MacDonald PK. Useful Fiction or Miracle Maker: The Competing Epistemological Foundations of Rational Choice Theory. *American Political Science Review* 2003;**97**. doi:10.1017/S000305540300087X

39 Shiffman J. Knowledge, moral claims and the exercise of power in global health. *International Journal of Health Policy and Management* 2014;**3**. doi:10.15171/ijhpm.2014.120

40 Dahl RA. The concept of power. *Behavioral Science* 2007;**2**. doi:10.1002/bs.3830020303

41 Barnett M, Duvall R. Power in International Politics. *International Organization* 2005;**59**. doi:10.1017/S0020818305050010

42 Shawar YR, Ruger JP. The Politics of Global Health Inequalities: Approaches to Studying the Role of Power. In: McInnes C, Lee K, Youde J, eds. *The Oxford Handbook of Global Health Politics*. Oxford: 2020. 59–76.

43 Holmes SM. Structural Vulnerability and Hierarchies of Ethnicity and Citizenship on the Farm. *Medical Anthropology* 2011;**30**. doi:10.1080/01459740.2011.576728

44 Goldade K. "Health Is Hard Here" or "Health for All"? *Medical Anthropology Quarterly* 2009;**23**. doi:10.1111/j.1548-1387.2009.01074.x

45 Sridhar D. Who Sets the Global Health Research Agenda? The Challenge of Multi-Bi Financing. *PLoS Medicine* 2012;**9**. doi:10.1371/journal.pmed.1001312

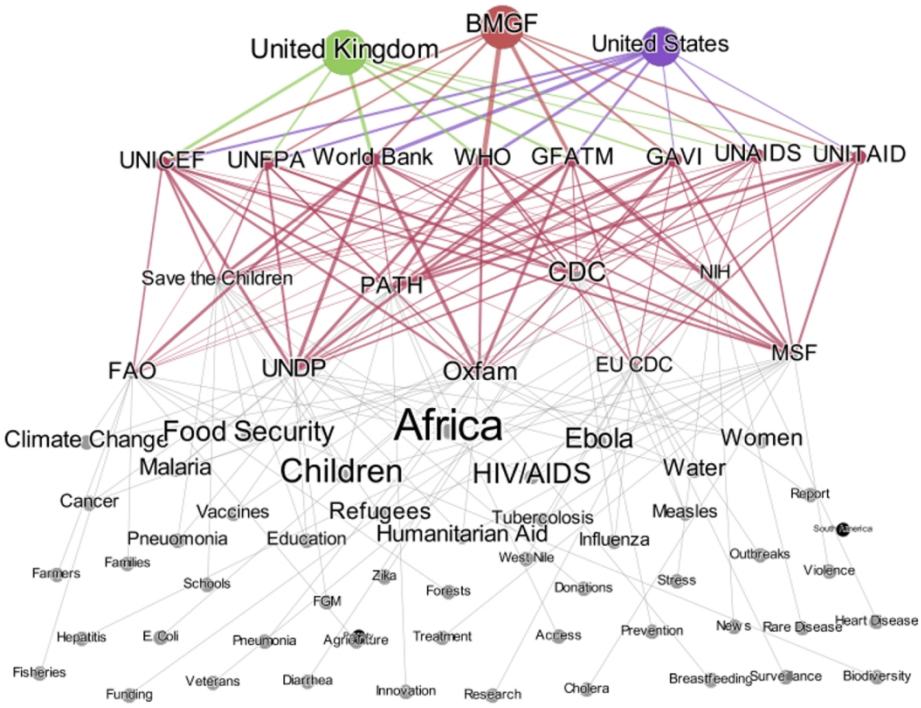
46 Usaid.gov. 2021. Global Health. [online] Available at: <https://www.usaid.gov/global-health> [Accessed 1 November 2021].

47 Usaid.gov. 2021. Health Areas. [online] Available at: <https://www.usaid.gov/global-health/health-areas> [Accessed 1 November 2021].

48 Birn A-E. Philanthrocapitalism Past and Present: The Rockefeller Foundation, the Gates Foundation and the Setting(s) of the International/Global Health Agenda. *Hypothesis* 2014;**12**.

49 McGoey L. Philanthrocapitalism and its critics. *Poetics* 2012;**40**. doi:10.1016/j.poetic.2012.02.006

50 Shiffman J. Agenda Setting in Public Health Policy. In: *International Encyclopedia of Public Health*. 2016. doi:10.1016/B978-0-12-803678-5.00007-2



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282x210mm (144 x 144 DPI)

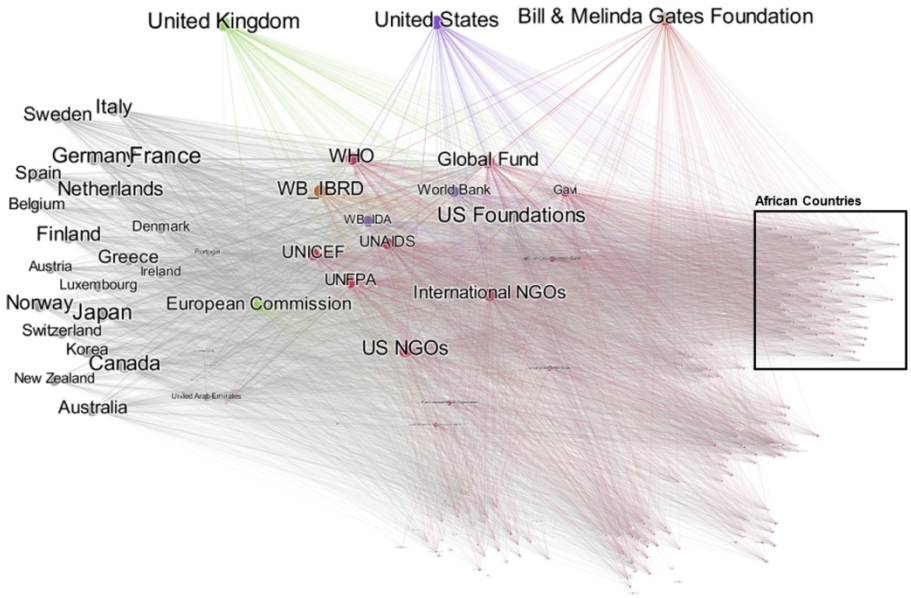


Figure 2. Network Analysis of Revealed Priorities from Funding for DAH (2019). Line thickness represents the amount of funding for health that was transferred between two actors. Font size represents the total amount of funding for health donated or received in 2019.

366x230mm (144 x 144 DPI)

Supplemental Material

Supplementary Table 1. Evidence and Testing RAM by Actor. Evidence for stated and revealed priorities and testing of RAM for each actor and the global health system as a whole. Light red indicates funding organization, blue indicates channel of DAH, yellow indicates implementing institution, and dark red indicates global health system as a whole.

	Evidence			Testing Assumptions of RAM			
	Stated Priorities from Policy Documents	**Revealed Priorities from DAH Data**	**Revealed Priorities from Tweets**	**Pre-determined goal?**	**Consistent preferences?**	**Utility maximizing?**	**Operates under RAM?**
USAID	"On behalf of the American people, we promote and demonstrate democratic values abroad, and advance a free, peaceful, and prosperous world. **In support of America's foreign policy**, the U.S. Agency for International Development leads the U.S. Government's international development and disaster assistance through partnerships and investments that save lives, reduce poverty, strengthen democratic governance, and help people emerge from humanitarian crises and progress beyond assistance." (2019 USAID Financial Report) "For over 50 years, USAID's global health programs have saved lives, protected people most vulnerable to disease, and promoted the stability of communities and nations, while advancing American security and prosperity. **America is safer and stronger when people can live healthy and productive lives and when nations around the world are self-reliant and resilient.**" (USAID Website) **Health Focus Area** (USAID Website) • Child and maternal death • HIV/AIDS • Malaria • Tuberculosis	Health Focus Area 49.0% of 2019 US DAH ($6.0 billion) supported **HIV/AIDS**; 7.0% ($862.5 million) supported **malaria**; 11.4% ($1.4 billion) was disbursed for **child health**, and 10.8% ($1.3 billion) went to **maternal health**. Region In 2017, the most recent year for which regional DAH estimates are available, the US directed much of its resources to **sub-Saharan Africa**, sending 50.5%, or $6.9 billion, of 2017 DAH. Channel The US provided 59.2% of its funding in 2019 through its own bilateral agencies, including the United States Agency for International Development (**USAID**), the President's Malaria Initiative (**PMI**), and **PEPFAR**. **UN agencies** received 6.2% of US DAH in 2019, or $761.4 million. **Gavi** received $307.0 million, up 9.0% from 2018, and the **Global Fund** received $636.5 million, down 25.8%. **NGOs** received 26.8% of US DAH in 2019, or $3.3 billion.	Topics from 2016-2020 tweets (no order) Africa Children Education Food Security HIV/AIDS Humanitarian Aid Mothers South America Water Women	National security National interests Global health focus: Child and maternal health, HIV/AIDS, malaria, tuberculosis	HIV/AIDS, child and maternal health, and Africa are consistent across DAH data and tweets	HIV/AIDS, child and maternal health are consistent across stated and revealed priorities. To maximize benefits for national security and interests, USAID prioritizes HIV/AIDS and child and maternal health in Africa.	Yes
UK DFID	"**We pursue our national interests and project the UK as a force for good in the world**. We promote the interests of British citizens, safeguard the UK's security, defend our values, reduce poverty and tackle global challenges with our international partners." (UK FCDO, formerly DFID website) "We are responsible for: 1. honouring the UK's international commitments and taking	Health Focus Area **Reproductive, maternal, newborn, and child health** was the focus of $1.4 billion (38.5%) of the UK's DAH in 2019, followed by **HIV/AIDS** with $553.9 million (15.8%). Region By GBD super-regions, the UK contributed $1.3 billion, or 37.3% of its 2017 DAH, to **sub-**	Topics from 2016-2020 tweets (no order) Africa Agriculture Children Development Ebola Education Food Security HIV/AIDS Humanitarian Aid Water	National interests National security Global peace, security, and governance; Crisis response and resilience; Global prosperity; Extreme poverty and helping most vulnerable; Value for money	Child and maternal health, HIV/AIDS, and Africa are consistent across DAH data and tweets.	Child and maternal health, HIV/AIDS, and Africa are consistent across stated and revealed priorities. To maximize benefits for national security and interests, UK DFID prioritizes child and maternal	Yes

	action to achieve the **United Nations' Global Goals** 2. making British aid more effective by improving transparency, openness and value for money 3. targeting British international development policy on economic growth and wealth creation **4.** improving the coherence and performance of British international development policy in **fragile and conflict-affected countries** 5. improving the lives of **girls and women** through better education and a greater choice on **family planning** 6. **preventing violence against girls and women** in the developing world 7. helping to prevent climate change and encouraging adaptation and low-carbon growth in developing countries Priorities • strengthening global peace, security and governance • **strengthening resilience and response to crisis** • promoting global prosperity • tackling extreme poverty and **helping the world's most vulnerable** • delivering value for money" (UK DFID About Page)	**Saharan Africa**; $301.0 million (8.7%) to South Asia; $163.9 million (4.7%) to Southeast Asia, East Asia, and Oceania; $237.9 million (6.9%) to North Africa and the Middle East; and $41.0 million (1.2%) to Central Europe, Eastern Europe, and Central Asia. Channel Of the UK's 2019 DAH, $990.3 million (28.2%) was channeled to **UK bilateral agencies**; $524.6 million (14.9%) to **UN agencies**; $306.4 million (8.7%) to **Gavi**; and $817.1 million (23.3%) to the **Global Fund**.					health and HIV/AIDS in Africa.	
BMGF	**"Strategic Investments.** We partner with entrepreneurs, companies, and other organizations to create incentives that **harness the power of private enterprise to create change for those who need it most**." (BMGF: how we work) **Global development.** "Our Global Development Division focuses on improving the delivery of **high-impact health**	Health Focus Area In 2019, the Gates Foundation directed $1.5 billion, or 38.3%, of its DAH to **reproductive, maternal, newborn, and child health**; $709.3 million, or 18.1%, to **HIV/AIDS**; $303.9 million, or 7.8% to **malaria**; $237.6 million, or 6.1%, to	Topics from 2016-2020 tweets (no order) Africa Breastfeeding Children Education HIV/AIDS Malaria Mothers Polio Sanitation Women	Strategic investments -- private enterprise solutions for most disadvantaged; High-impact health products and services to world's poorest Stated global development areas: Emergency	Child and maternal health, HIV/AIDS, malaria, and Africa are consistent across DAH data and tweets.	Child and maternal health, HIV/AIDS, malaria, and Africa are consistent across stated and revealed priorities. To maximize returns of their strategic	Yes

	products and services to the world's poorest communities and helps countries expand access to health coverage. **Areas**: Emergency Response, Family Planning ,Global Delivery Programs, Global Libraries, Maternal, Newborn & Child Health, Nutrition, Polio" (BMGF: our work) **Global health. "**Our Global Health Division aims to **reduce inequities in health** by developing new tools and strategies to reduce the **burden of infectious disease** and the **leading causes of child mortality** in developing countries. **Areas**: Discovery & Translational Sciences, Enteric and Diarrheal Diseases. HIV, Innovative Technology Solutions, Institute for Disease Modeling, Integrated Development, Malaria, Maternal, Newborn & Child Health, Discovery & Tools, Neglected Tropical Diseases, Pneumonia Tuberculosis, Vaccine Development and Surveillance**"** (BMGF: our work)	**tuberculosis**; $266.5 million, or 6.8%, to **health systems strengthening**; and $72.4 million, or 1.9%, to **non-communicable diseases**. Region In 2017, the Foundation provided 41% of its DAH to **global recipients** and programs and 18% to **sub- Saharan Africa.** Channel The Gates Foundation's 2019 DAH total of $3.9 billion was an increase of 9.9% from 2018. Of this, $2.5 billion or 64.0% was channeled through the Gates Foundation **directly to implementing institutions**. In 2019, $266.8 million (7%) in Gates Foundation DAH went to **UN agencies**, $256.9 million (7%) went to the **Global Fund**, and $406.1 million (10%) was directed to **Gavi**.		Response, Family Planning ,Global Delivery Programs, Global Libraries, Maternal, Newborn & Child Health, Nutrition, Polio Stated global health areas: Discovery & Translational Sciences, Enteric and Diarrheal Diseases. HIV, Innovative Technology Solutions, Institute for Disease Modeling, Integrated Development, Malaria, Maternal, Newborn & Child Health, Discovery & Tools, Neglected Tropical Diseases, Pneumonia Tuberculosis, Vaccine Development and Surveillance		investments, BMGF prioritizes child and maternal health, HIV/AIDS, and malaria in Africa.	
WHO	**"Health for all.** Ensuring universal health coverage without impoverishment is the foundation for achieving the health objectives of the Sustainable Development Goals – because when people are healthy, their families, communities and countries benefit. Our top priority must be to support national health authorities' efforts to strengthen all the building blocks of health systems and to enact policies aimed at ensuring health care is equitable and affordable for all. **Health emergencies.** In today's interconnected world, public health emergencies can affect anyone, anywhere – and the Ebola crisis in West Africa showed us the dangers of being unprepared. The development of resilient and robust global and local health systems capable of preventing, monitoring, detecting and responding to public health emergencies must therefore be a key priority, closely linked to our efforts to achieve universal health coverage. **Women, children and adolescents.** We cannot achieve the ambitious health and development targets in the Sustainable Development Goals unless we secure the health, dignity and rights of women, children and adolescents. Yet, in too many places, gender gaps, harmful cultural and social practices and gender-based violence are negatively impacting these individuals. Because of that,	Health Focus Area WHO provided $2.5 billion of DAH in 2019, down 1.2% from 2018. Of this, $630.7 million or 24.9% was disbursed to other **infectious diseases** and $1.0 billion or 39.8% to **health systems strengthening**. Region DAH data for the WHO in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Breastfeeding Children Ebola HIVA/AIDS Malaria Measles Mothers Polio Women	Universal health coverage, health systems strengthening, health equity, health emergencies, infectious diseases, maternal and child health, gender equity, climate and environmental impacts on health, improved WHO governance	Infectious diseases (ebola, HIV/AIDS, malaria, measles, polio) are consistent across DAH data and tweets.	Infectious diseases (ebola, HIV/AIDS, malaria, measles, polio) are consistent across stated and revealed priorities. To maximize the benefits of their pre-determined goal of health for all, WHO prioritizes on infectious diseases like Ebola, HIV/AIDS, malaria, measles, and polio.	Yes

	we must put the well-being of women, children and adolescents at the centre of global health and development. **The health impacts of climate and environmental change.** Climate and environmental change impact many aspects of life that are inextricably linked to health – food security, economic livelihoods, air safety and water and sanitation systems – and WHO estimates that 12.6 million people die each year as a result of living or working in an unhealthy environment. To address this, WHO has a key role to play advancing both mitigation and adaptation strategies for climate and environmental change, working in close partnership with other UN agencies and stakeholders. **A transformed WHO.** Building WHO into a more effective, transparent and accountable agency will require striking a balance between bold reform and stability of the organization. To meet the evolving needs and challenges of the 21st century and deliver game-changing, sustainable results, WHO will need to focus its work where it has the most value, broaden and intensify its engagement across stakeholders, attract more predictable, flexible financing, and work to identify and retain the best global talent." (WHO Priorities)						
World Bank	"The World Bank Group works in every major area of development. We provide a wide array of financial products and technical assistance, and we help countries share and apply innovative knowledge and solutions to the challenges they face. Three priorities guide our work with countries **to end poverty and boost prosperity for the poorest people.** Helping **create sustainable economic growth**, **investing in people** and **building resilience to shocks and threats** that can roll back decades of progress. **Themes** • Economic Policy • Environment and Resource Development • Finance • Human Development and Gender • Private Sector Development • Public Sector Management • Social Development and Protection • Urban and Rural Development" (World Bank Annual Report 2019)	Health Focus Area Focused on ending poverty in the world's poorest countries, the World Bank's International Development Association (IDA) disbursed $1.1 billion of DAH in 2019, down 33.9% from 2018. The International Bank for Reconstruction and Development (IBRD) is a global development cooperative owned by 189 countries. As "the world's largest development bank," the IBRD helps countries reduce poverty and extend the benefits of sustainable growth to all people. In 2019, the IBRD disbursed $11.1 billion of DAH, up 25.4% from 2018. Funds were targeted at **reproductive, maternal, newborn, and child health**; **vaccination programs**; **infectious diseases**; and **NCDs**. Region 27.6% of DAH disbursed by development banks	Topics from 2016-2020 tweets (no order) Africa Agriculture Children Climate change Food security Humanitarian aid Poverty Sanitation Water Women	End poverty and boost prosperity through sustainable economic growth, investing in people, and building resilience to shocks and threats; Maternal and child health, health emergencies, nutrition, infectious diseases, tobacco control, mental health	Child and maternal health and Africa are consistent across DAH data and tweets.	Child and maternal health are consistent across stated and revealed priorities. To maximize the benefits of their pre-determined goal of ending poverty and boosting prosperity for the poorest people, the World Bank prioritizes on child and maternal health issues in Africa.	Yes

	"World Bank Health Focus Areas: 1. **Women and children's health** 2. **Health emergencies** 3. **Nutrition** 4. **Infectious diseases** 5. **Tobacco control** 6. **Mental health"** (World Bank Health Focus Areas)	as group went to **sub-Saharan Africa** and 20.5% to North Africa and the Middle East.					
UNAIDS	**"Strategic leadership agenda** In the light of the need for change, this Strategy seeks to achieve a set of far-reaching and people-centred goals and targets that must be met by 2020 if we are to reach our 2030 ambition of ending the AIDS epidemic. The goals correspond to each of the three strategic directions, and include achieving by 2020: • Fewer than 500 000 people newly infected with HIV • Fewer than 500 000 people dying from AIDS-related causes • Elimination of HIV-related discrimination" (UNAIDS 2016-2021 Strategy)	Health Focus Area UNAIDS is leading the global effort to end **AIDS** as a public health threat by 2030. In addition, the agency is working toward its 2020 90-90-90 targets: for 90% of people living with HIV/AIDS to know their status; for 90% of those diagnosed with infections to receive antiretroviral treatments; and for 90% of patients receiving antiretroviral therapy to have viral suppression. In 2019, the agency disbursed $207.3 million, up 1.7% from 2018. The top five contributors to UNAIDS in 2019 were the US, Sweden, the Netherlands, the UK, and Norway. Region DAH data for UNAIDS in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Access Africa Discrimination HIV/AIDS Human Rights Innovation Prevention Testing Treatment Women	Ending the AIDS epidemic by 2030.	HIV/AIDS prevention, testing, and treatment is consistent across DAH data and tweets.	HIV/AIDS prevention, testing, and treatment are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of ending the AIDS epidemic by 2030, UNAIDS focuses on HIV/AIDS prevention, testing, and treatment.	Yes
UNFPA	"Our goal is to achieve **universal access to sexual and reproductive health, realize reproductive rights, and reduce maternal mortality** to accelerate progress on the agenda of the Programme of Action of the International Conference on Population and Development (ICPD), to **improve the lives of women, adolescents and youth,** enabled by population dynamics, human rights and gender equality. **Priority Areas** • Sexual and reproductive health services and reproductive rights • Adolescent and youth empowerment • Gender equality and women's empowerment • Population data for development" (UNFPA Strategic Plan)	Health Focus Area The United Nations Population Fund (UNFPA) is the United Nations' **sexual and reproductive health** agency. UNFPA's programs include the Maternal and Newborn Health Thematic Fund, focused on preventing maternal deaths through strategic interventions. Training midwives and ending fistula, a childbirth injury caused by prolonged obstructed labor, are also part of the **Maternal and Newborn Health Thematic Fund**. In 2019, UNFPA disbursed $1.1 billion in DAH, down 1.7% from 2018. Of this, UNFPA received $466.8 million, or 43.8%, from governments. In	Topics from 2016-2020 tweets (no order) Africa Child Marriage Children Family planning FGM Human Rights Humanitarian Aid Nutrition Violence Women	Universal access to sexual and reproductive health, reproductive rights, maternal mortality, child health	Sexual and reproductive health, and maternal and child health are consistent across DAH data and tweets.	HIV/AIDS prevention, testing, and treatment are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of ending the AIDS epidemic by 2030, UNAIDS focuses on HIV/AIDS prevention, testing, and treatment.	Yes

		2018, the US withheld funding from UNFPA for the third year in a row under the Kemp-Kasten amendment. Region DAH data for UNFPA in 2019 have unallocated or unspecified regions.					
UNICEF	**"Vision:** Realizing the rights of every child, especially the most disadvantaged. **Goal areas:** • Every child survives and thrives • Every child learns • Every child is protected from violence and exploitation • Every child lives in a safe and clean environment • Every child has an equitable chance in life" **(UNICEF Strategic Plan 2018-2021)**	Health Focus Area UNICEF provides long-term **humanitarian and development assistance to children and mothers**, with a specific focus on **nutrition, immunization, and HIV/AIDS**, as well as **emergency (i.e., pandemic) assistance**. UNICEF disbursed $2.6 billion in DAH in 2019, up 12.5% from 2018. Private philanthropies provided UNICEF with $519.3 million, or 19.8% of its funding in 2019, and the US contributed $316.9 million, or 12.1%. Region DAH data for UNICEF in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Breastfeeding Children Climate Change Ebola Education Human Rights Online Violence Water	Realizing the rights of every child, especially the most disadvantaged. Health related: child health, child mortality	Child and maternal health are consistent across DAH data and tweets.	Child and maternal health are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of realizing the rights of every child, UNICEF focuses on child and maternal health.	Yes
UNITAID	"Unitaid's Strategy for 2017-2021 is firmly grounded in its Constitution, which states that Unitaid aims to 'contribute to scale up access to treatment for **HIV/AIDS, malaria and tuberculosis** for the people in developing countries by **leveraging price reductions of quality drugs and diagnostics**, which currently are unaffordable for most developing countries, and to accelerate the pace at which they are made available.' Innovation, access, and scalability. They guide the design of unitaid's interventions, which • Promote innovation. Unitaid connects those who are developing innovations with people who need them the most. Innovation means both using existing commodities in new ways and developing new products and approaches. • Catalyze equitable access to better health products. Unitaid leverages its market expertise and its relationships with partners to design a portfolio of projects that will overcome barriers to access to	Health Focus Area In 2019, Unitaid disbursed $154.1 million in DAH, up 35.2% from 2018. Projects Unitaid has been working on include a net program to combat malaria and a program to distribute and promote HIV self-testing kits in Africa. US contributed $316.9 million, or 12.1%. Region DAH data for UNITAID in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Access Cancer Children Hepatitis HIV/AIDS Malaria Testing Treatment Tuberculosis Vaccines	Access to treatment of, affordability of drugs, and innovation in addressing HIV/AIDS, malaria, tuberculosis	Increasing access, testing, and treatment of HIV/AIDS, malaria, and tuberculosis are consistent across DAH data and tweets.	HIV/AIDS, malaria, and tuberculosis are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of scaling up treatment for HIV/AIDS, malaria, and tuberculosis in developing countries, UNITAID prioritizes HIV/AIDS, malaria, and tuberculosis.	Yes

	innovative health products • Create the right conditions for scale up, so better health products reach all people who need them. From conception through implementation, Unitaid works with partners to ensure that projects transition to scale." (Unitaid Strategy 2017-2021)						
Gavi	"Our 2016–2020 mission, to **save children's lives** and **protect people's health** by **increasing equitable use of vaccines in lower-income countries**, is guided by four strategic goals 1. Accelerate equitable uptake and coverage of vaccines. 2. Increase effectiveness and efficiency of immunisation delivery as an integrated part of strengthened health systems. 3. Improve sustainability of national immunisation programmes. 4. Shape markets for vaccines and other immunisation products. The current five-year strategy was approved by the Board in June 2014 – the full implementation of the strategy will see developing countries immunise 300 million children, saving 5–6 million lives in the long term. **Coverage and equity** are at the core of our current strategy. While we continue to support countries to introduce new vaccines, our focus is expanding to reach every child with these vaccines. With as many as 20 countries transitioning out of our financial support in this period, ensuring that programmes are sustainable in the long term is essential. " (Gavi Strategy 2016-2020)	Health Focus Area In 2019, Gavi channeled $1.8 billion in development assistance for health to **child health** (94.4% of Gavi funding) and non-communicable disease-related programs. Top sources of funding for Gavi in 2019 were the Bill & Melinda Gates Foundation, the United States, and the United Kingdom. Region In 2017, 52.6% of DAH disbursed by Gavi went to **sub-Saharan Africa** and 25.5% to South Asia. DAH data for Gavi in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Cancer Children Cholera Ebola Measles Pneumonia Polio Poverty Vaccines	Increasing overall coverage and equity in vaccinating children in lower-income countries.	Child health, vaccination, infectious diseases, and Africa are consistent across DAH data and tweets.	Child health, vaccination, infectious diseases, and Africa are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of "saving children's lives by increasing equitable use of vaccines in lower-income countries", Gavi prioritizes child health and vaccination of infectious diseases in Africa.	Yes
Global Fund	"The Global Fund Strategy 2017-2022: Investing to End Epidemics outlines our partnership's bold agenda for 2017-2022 based on an ambitious vision **to end the epidemics**. These four strategic objectives are at the core of the strategy: • Maximize impact against **HIV, TB**, and **Malaria** • Promote and protect **human rights** and **gender equality** • Mobilize increased resources • Build **resilient and sustainable systems for health**" (Global	Health Focus Area In 2019, the Global Fund channeled a total of $3.5 billion to programs worldwide. Leading sources of Global Fund contributions were the United States, the United Kingdom, and Japan. The UK provided $817.1 million or 23.3% to the Global Fund in 2019, more than any other contributor. The US contributed $636.5 million or 18.1%, Japan contributed $442.4 million or 12.6%, and Germany	Topics from 2016-2020 tweets (no order) Africa Children Cholera Ebola HIV/AIDS Malaria Pneumonia Polio Tuberculosis Women	To end HIV/AIDS, malaria, and tuberculosis epidemics	HIV/AIDS, malaria, tuberculosis, and Africa are consistent across DAH data and tweets.	HIV/AIDS, malaria, tuberculosis, and Africa are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of "ending the epidemics", the Global Fund prioritizes child health and vaccination of	Yes

	Fund Strategy 2017-2022)	contributed $396.7 million or 11.3%. 50.4% of funding were allocated to address **HIV/AIDS**, 31.7% to **Malaria**, and 17.8% to **Tuberculosis**. Region In 2019, 72.7% of DAH disbursed by the Global Fund went to **sub-Saharan Africa** and 10.5% to Southeast Asia, East Asia, and Oceania. DAH data for the Global Fund in 2019 have unallocated or unspecified regions.				infectious diseases in Africa.	

CDC	"CDC's Strategic Framework consists of five core capabilities that enable the agency's three strategic priorities, all united behind one mission: **protect America's safety, health, and security**. Our work is underscored by the agency's Pledge to the American People.
	Strategic Priorities
	• Securing global health and America's preparedness
	  • By stopping the spread of pandemic contagions, addressing public health terror threats, and protecting people from vector-borne diseases.
	• Eliminating disease
	  • By controlling vaccine-preventable disease, targeting Hepatitis C, and reducing the maternal mortality rate.
	• Ending epidemics
	  • Such as HIV, decreasing opioid overdoses, improving strategies and interventions to stem seasonal influenza, developing and deploying new answers for antibiotic resistance, and reducing new incidents of diabetes.
	Core Capabilities
	• World-class data and analytics
	• State-of-the-art laboratory capacity
		Health Focus Area
		Protecting Americans from Infectious Diseases at Home and Abroad ($3.0 billion)
		Preventing the Leading Causes of Disease, Disability, & Death ($2.0 billion)
		Protecting Americans from Natural Disasters, Terrorist Threats, Environmental & Occupational Hazards ($1.5 billion)
		Monitoring Health & Ensuring Laboratory Excellence ($496 million)
		Cross-cutting Support & PHHS Block Grant & Buildings & Facilities ($357 million)
		
		Region
		United States and global
			Topics from 2016-2020 tweets
			(no order)
			
			Children
			Diarrhea
			E. Coli
			Influenza
			Measles
			Prevention
			Vaccines
			Water
			Women
			Zika
				National security from infectious diseases
				
				Securing global health and national preparedness
					Protecting the USA from infectious diseases is consistent across DAH data and tweets.	HIV/AIDS, malaria, tuberculosis, and Africa are consistent across stated and revealed priorities.
						
						To maximize benefits of their pre-determined goal of "protecting America's safety, health, and security", the CDC prioritizes infectious disease protection in the US and globally.
							Yes

	• Elite public health expertise • Responding to outbreaks at their source • Global capacity and domestic preparedness" (CDC Strategic Framework)						
EU CDC	""ECDC is an EU agency aimed at **strengthening Europe's defences against infectious diseases**. The core functions cover a wide spectrum of activities: surveillance, epidemic intelligence, response, scientific advice, microbiology, preparedness, public health training, international relations, health communication, and the scientific journal Eurosurveillance. **Strategic Work Areas** • Providing evidence for effective and efficient decision-making: We support efficient public health decisionmaking by providing **timely, accurate and relevant information**. • Support the **strengthening of public health systems**: We strengthen European capacities and capabilities effectively prevent and control communicable diseases. • Supporting **response to threats**: We support effective health threats detection, assessment and control." (ECDC Annual Report 2019)	Health Focus Area All funding is spent on expenses for staff, buildings and equipment, and operations for surveillance, research, and response to infectious disease epidemics. Region European Union and global	Topics from 2016-2020 tweets (no order) Ebola Hepatitis HIV/AIDS Influenza Measles Outbreaks Report Surveillance Tuberculosis West Nile	European security from infectious disease	Infectious disease surveillance, reporting, and research are consistent across DAH data and tweets.	Infectious disease surveillance, reporting, and research are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of "strengthening Europe's defences against infectious diseases", the EU CDC prioritizes infectious disease surveillance, reporting, and research.	Yes
NIH	"NIH's mission is to seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability. The goals of the agency are: • to foster **fundamental creative discoveries**, **innovative research strategies**, and their applications as a basis for ultimately **protecting and improving health**; • to develop, maintain, and renew scientific human and physical resources that will **ensure the Nation's capability to prevent disease**; • to expand the knowledge base in medical and associated sciences in order to enhance the Nation's economic well-being and ensure a continued high return on the public	Health Focus Area In 2019, NIH had a $39.2B discretionary budget. 1. NCI (14.7%) – cancer 2. NIAID (14.1%) – allergy and infectious disease 3. NHLBI (8.9%) – heart, lung, and blood 4. NIA (7.9%) – instate on aging 5. NIGMS (7.3%) – general medical sciences Region United States (with some global research)	Topics from 2016-2020 tweets (no order) Africa Cancer Funding Heart Disease HIV/AIDS News Rare Disease Research Stress Veterans	National security through developing new knowledge in enhancing health and lengthening life.	Research on cancer, HIV/AIDS, heart disease, and rare diseases are consistent across DAH data and tweets.	Research on cancer, HIV/AIDS, heart disease, and rare diseases are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of seeking knowledge to enhance life and ensure the US's capability to prevent disease, the NIH prioritizes research on cancer, HIV/AIDS, heart disease, and rare diseases.	Yes

	investment in research; and • to exemplify and promote the highest level of scientific integrity, public accountability, and social responsibility in the conduct of science. In realizing these goals, the NIH provides leadership and direction to programs designed to improve the health of the Nation by conducting and supporting research: • in the **causes, diagnosis, prevention, and cure of human diseases**; • in the processes of human growth and development; • in the biological effects of environmental contaminants; • in the **understanding of mental, addictive and physical disorders**; and • in directing programs for the collection, dissemination, and exchange of information in medicine and health, including the development and support of medical libraries and the training of medical librarians and other health information specialists.						
FAO	"Today, member states face an increasing number of demands and challenges in agricultural development. To support them, FAO has identified five key priorities on which it is best placed to intervene. These priorities, or Strategic Objectives, represent our main areas of work to achieve our **vision of a world free from hunger and malnutrition, where food and agriculture help to improve the living standards of all**, especially the poorest, in an economically, socially and environmentally sustainable manner – contributing to the implementation of the 2030 Agenda for Sustainable Development. 1. **Help eliminate hunger, food insecurity, and malnutrition** 2. Make agriculture, forestry, and fisheries more productive and sustainable 3. Reduce rural poverty 4. Enable inclusive and efficient agricultural food systems 5. Increase the resilience of livelihoods to threats and crises" (FAO Strategic Objectives 2019)	Health Focus Area All received funding is spent on staffing and program expenses in addressing hunger, food insecurity, malnutrition, and improving resiliency of food systems. Region Funding data for FAO in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Agriculture Biodiversity Climate Change Families Farmers Fisheries Food Security Forests Water	Addressing hunger, food insecurity, and malnutrition through improving food and agricultural systems.	Food insecurity, malnutrition, and food systems are consistent across DAH data and tweets.	Food insecurity, malnutrition, and food systems are consistent across stated and revealed priorities. To maximize benefits of their pre-determined goal of a world free from hunger and malnutrition, the FAO prioritizes eliminating hunger, food insecurity, and malnutrition	Yes
UNDP	"UNDP's Strategic Plan (2018-2021) has been designed to be	Tot/al budget allocation	Topics from 2016-2020 tweets	Poverty eradication,	HIV/AIDS, malaria, and	HIV/AIDS, malaria, and	Yes

	responsive to the wide diversity of the countries we serve. The diversity is reflected in three broad development contexts: • Eradicate poverty in all its forms and dimensions • Accelerate structural transformations • Build resilience to shocks and crises To respond to these issues, and better focus its resources and expertise to deliver on the 2030 Agenda, UNDP has identified a set of approaches that we call our Signature Solutions: • Keeping people out of POVERTY • GOVERNANCE for peaceful, just, and inclusive societies • Crisis prevention and increased RESILIENCE • ENVIRONMENT: nature-based solutions for development • Clean, affordable ENERGY • Women's empowerment and GENDER equality In all our activities, we encourage the **protection of human rights** and the **empowerment of women**, **minorities and the poorest and most vulnerable**." (UNDP About us) UNDP is the lead development agency in helping the achievement of the Sustainable Development Goals. **SDG 3: Ensure healthy lives and promote well-being for all at all ages.** (UNDP: SDGs)	$5.7 billion budget in 2019 By UNDP focus Eradicating poverty (43%), accelerate structural transformations (32%), build resilience to shocks and crises (11.5%), others (13.2%) By health focus area SDG3 was allotted $504M (9%) of total budget in 2019 –55% to HIV/AIDS, tuberculosis, and malaria (target 3.3), 26% to universal health coverage (target 3.8), 9% to child mortality (target 3.2) Region 23% of 2019 budget was allocated to Africa, 19% to Asia and the Pacific, 18% to Latin America and the Caribbean.	(no order) Africa Children Climate Change Education FGM Food Security HIV/AIDS Malaria Water Women	accelerate structural transformations, build resilience to shocks and crises SDG 3: Ensure healthy lives and promote well-being for all at all ages (includes: maternal mortality, child mortality, HIV/AIDS, tuberculosis, malaria, infectious diseases, mental health, substance abuse, road traffic accidents, sexual and reproductive health, universal health coverage, deaths from environmental pollution)	child and maternal health are consistent across DAH data and tweets.	child and maternal health are consistent across stated and revealed preferences. To maximize benefits of their pre-determined global health goal of ensuring healthy lives and promoting well-being for all, the UNDP prioritizes HIV/AIDS, malaria, and child and maternal health.	
MSF	"Médecins Sans Frontières brings **medical humanitarian assistance** to victims of **conflict**, **natural disasters**, **epidemics** or **healthcare exclusion**" (MSF About Us) "Program Priorities • Outpatient consultations • Birth assistance (including C-section) • Cholera treatment • Inpatient care • Vaccinations against measles • Malaria treatment • Sexual violence • Meningitis treatment • Inpatient feeding programs for malnourished children • TB treatment • HIV ART treatment • Mental health services • Distribution of relief goods" (International Activity Report 2019)	Health Focus Area "81% of our financial resources are allocated to fulfilling our social mission: 65% to our humanitarian programmes, 12% to support our projects and programmes, and 4% to awareness-raising, the Access Campaign, and the Drugs for Neglected Diseases initiative (DNDi). The rest is spent on general management and fundraising costs. We also maintain reserves that allow us to respond immediately to a crisis without having to wait for an appeal." Funding is allocated mostly to outpatient consultations, malaria treatment, and birth assistance Region	Topics from 2016-2020 tweets (no order) Africa Children Cholera Ebola HIV/AIDS Humanitarian Aid Refugees Treatment Tuberculosis Violence	Medical humanitarian assistance to victims of conflict, natural disasters, epidemics, or healthcare exclusion.	Humanitarian aid, HIV/AIDS, infectious diseases, and child health are consistent across DAH data and tweets.	Humanitarian aid, HIV/AIDS, infectious diseases, and child health are consistent across stated and revealed preferences. To maximize benefits of their pre-determined goal of bringing medical humanitarian assistance to victims of crises, MSF prioritizes humanitarian aid, HIV/AIDS, infectious diseases, and child health.	Yes

		Funding data for MSF in 2019 have unallocated or unspecified regions.					
PATH	"At PATH, we are a global team of innovators working to **accelerate health equity** so all people and communities can thrive. We advise and partner with public institutions, businesses, grassroots groups, and investors to solve the world's most pressing health challenges." (PATH About Us) "2019 Achievements • Controlling and eliminating **malaria** • Differentiating services for **HIV** patients • Reimagining **primary health care** • Creating **innovative devices** and diagnostics • Maximizing impact through **policy** • Advancing **essential medicines** • Reducing the cost of **sanitation** and cleaning • Expanding access to **contraception**" (PATH Annual Report 2019)	Health Focus Area Of the $303 million 2019 budget, 48% was allocated to global health programs, 37% to essential medicines, 11% to technology and innovation, 3.5% to other. Region Funding data for PATH in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Access Africa Breastfeeding Cancer Children Ebola Innovation Malaria Pneumonia Vaccines	Accelerating health equity Areas: Malaria, HIV/AIDS, primary health care, health innovations, health policy, essential medicines, sanitation, contraceptives	Malaria, vaccines, and innovations are consistent across DAH data and tweets.	Malaria, vaccines, and innovations are consistent across stated and revealed preferences. To maximize benefits of their pre-determined goal of "accelerating health equity", PATH prioritizes malaria, vaccines, and health innovations.	Yes
Save the Children	"For 100 years, we've been giving **children** in the U.S. and around the world a **healthy start in life**, the **opportunity to learn** and **protection from harm**. When crisis strikes, we are always among the first to respond and the last to leave. We do whatever it takes to save children, transforming their lives and the future we share." (Save the Children About Us) Focus Areas • Health and Nutrition • Education • Hunger and Livelihoods • Public Policy and Advocacy • HIV/AIDS • Child Protection and Rights Governance (Save the Children Annual Report 2019)	Health Focus Area In 2019, Save the Children had a budget of $836 million. • Health & Nutrition (38%) • Education (19%) • Hunger & Livelihoods (13%) • Public Policy & Advocacy (11%) • HIV/AIDS (7%) • Child Protection & Rights Governance (4%) • Other (8%) Region Funding data for Save the Children in 2019 have unallocated or unspecified regions.	Topics from 2016-2020 tweets (no order) Africa Children Donations Education Food Security Humanitarian Aid Pneumonia Refugees Schools Water	Health related: "giving children a healthy start", "protection from harm"	Child health, nutrition, and food security are consistent across DAH data and tweets.	Child health, nutrition, and food security are consistent across stated and revealed priorities. To maximize benefits of their pre-determined global health goals of "giving children a healthy start and protection from harm", Save the Children prioritizes child health, nutrition, and food security.	Yes
Oxfam	"Oxfam is a global organization working to **end the injustice of poverty**. We help people **build better futures for themselves**, **hold the powerful accountable**, and **save lives in disasters**." (About Oxfam) "Across Yemen, Puerto Rico, Bangladesh, Syria, Central America, and Mozambique, among many other places, our work is delivering tangible, measurable impact: providing lifesaving aid, partnering with local organizations to achieve long-term solutions, and using	Health Focus Area Of the $88 million 2019 budget, 36% was allocated to emergency response and preparedness, 28% to overcoming poverty, 28% to social justice campaigns, 8% to public education. Region Of the budget spent on emergency response and preparedness, 40% was allocated to Africa, 24% to Latin	Topics from 2016-2020 tweets (no order) Africa Climate Change Ebola Food Security Humanitarian Aid Malaria Pneumonia Refugees Water Women	Health related: "help people build better futures for themselves," "save lives in disasters"	Emergency response (humanitarian aid, Ebola, food security, and infectious disease) is consistent across DAH data and tweets.	Emergency response (humanitarian aid, Ebola, food security, and infectious disease) is consistent across stated and revealed preferences. To maximize benefits of their pre-determined global health goals of "helping	Yes

	our strong policy voice to advocate for change. **Program Services** • Saving Lives: Emergency Response and Preparedness • Programs to overcome poverty • Campaigning for social justice • Public education" (Oxfam Annual Report 2019)	America and the Caribbean, and 13% to Asia and the Pacific				people build better futures for themselves" and "saving lives in disasters", Oxfam prioritizes emergency response, humanitarian aid, Ebola, food security, and infectious diseases.	
Global health system	**WHO constitution (1948)**: "Health for All" and the right to the highest attainable standard of health. **Declaration of Alma-Ata (1978)**: universal access to primary health care. **MDGs (2000):** reduce child mortality (4), improve maternal health (5), combat HIV/AIDS and other diseases (6) **SDGs (2015) [Relevant to study's time period]:** good health and well-being (3) • By 2030, reduce the global **maternal mortality** ratio to less than 70 per 100,000 live births (3.1) • By 2030, end **preventable deaths of newborns and children** under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births (3.2) • By 2030, end the epidemics of **AIDS, tuberculosis, malaria** and **neglected tropical diseases** and combat **hepatitis,** water-borne diseases and other **communicable diseases** (3.3) • By 2030, reduce by one third premature mortality from **non-communicable diseases** through prevention and treatment and promote **mental health and well-being** (3.4) • Strengthen the prevention and treatment of **substance abuse**, including narcotic drug abuse and harmful use of alcohol (3.5) • By 2020, halve the number of global deaths and injuries from **road traffic accidents** (3.6) • By 2030, ensure universal access to	Health Focus Areas Of the $41 billion DAH transferred across all global health actors in 2019, 24% was allocated to **HIV/AIDS**, 21% to **newborn and child health**, 14% to **health system strengthening**, 12% to **reproductive and maternal health**, 6% to other infectious diseases, 6% to malaria, 4% to tuberculosis, and 2% to non-communicable diseases. Region Funding data in 2019 have unallocated or unspecified regions. In 2017, 33% of all DAH funding was allocated to **sub-Saharan Africa**, 5% to Southeast Asia, 5% to South Asia, 4% to North Africa and the Middle East, 3% to Latin America and the Caribbean, 2% to Europe and Central Asia, 15% globally, and 32% unallocated.	Most common topics from 2016-2020 across 20 key actors (number in parenthesis indicates count of actors that had the topic as a priority from 2016-2020 tweets) 1. Africa (17), 2. Children (15), 3. HIV/AIDS (11), 4. Women (10), 5. Ebola (9), 6. Water (9), 7. Food security (7), 8. Humanitarian aid (7), 9. Malaria (7), 10. Education (6), 11. Climate change (5), 12. Pneumonia (5), 13. Breastfeeding (4), 14. Cancer (4), 15. Measles (4), 16. Polio (4), 17. Tuberculosis (4), 18. Vaccines (4), 19. Access (3), 20. Agriculture (3), 21. Cholera (3), 22. Human Rights (3), 23. Mothers (3), 24. Refugees (3), 25. Treatment (3), 26. Violence (3), 27. FGM (2), 28. Hepatitis (2), 29. Influenza (2), 30. Innovation (2), 31. Poverty (2), 32. Prevention (2), 33. Sanitation (2), 34. Testing (2)	Health for all and the right to highest attainable standard of health. 9 important target areas under SDG 3.	HIV/AIDS, child and maternal health, and infectious diseases are consistent across DAH data and tweets.	HIV/AIDS, child and maternal health, and infectious diseases are consistent across stated and revealed priorities. To maximize benefits of the pre-determined goal of "health for all" and "SDG3: good health and well-being", the global health system prioritizes 3 of the 9 target areas of SDG 3: HIV/AIDS, child and maternal health, and infectious diseases. **Note:** These benefit-maximizing priorities are the same top priorities of the three funding organizations.	Yes

	• **sexual and reproductive health-care services**, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes (3.7) • Achieve **universal health coverage**, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all (3.8) • By 2030, substantially reduce the number of **deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination** (3.9)						

Supplementary Table 2. Breakdown of Collected Tweets by Actor and Month. Total tweets and average tweets per month for each of the 20 global health actors.

Global Health Actor	Total Tweets	Average Tweets per Month
World Health Organization	10,827	722
Oxfam International	5,694	380
Doctors Without Borders (MSF)	5,553	370
UN Children's Fund (UNICEF)	5,395	360
World Bank	5,365	358
UN Development Programme (UNDP)	4,912	327
UN Population Fund (UNFPA)	3,908	261
UK Department of International Development	3,823	255
Centers for Disease Control and Prevention (CDC)	3,701	247
United States Agency for International Development (USAID)	3,604	240
Food and Agriculture Organization (FAO)	3,263	218
Save the Children	3,121	208
Gavi, the Vaccine Alliance	2,739	183
National Institutes of Health (NIH)	2,664	178
Joint UN Programme on HIV/AIDS (UNAIDS)	2,214	148
PATH	1,954	130
Global Fund	1,727	115
European Centre for Disease Prevention and Control (ECDC)	1,311	87
Gates Foundation	1,249	83
Unitaid	1,217	81
Total	**74,241**	**4,949**

Supplementary Table 3. Breakdown of Collected Tweets by Year and Month Tweets per month and per year for all the tweets collected.

	Tweets per Month	Tweets per Year
2016		5,973
November	5,973	
2017		21,193
February	4,474	
May	5,582	
August	5,103	
November	6,034	
2018		18,562
February	4,145	
May	4,965	
August	4,205	
November	5,247	
2019		17,884
February	4,500	
May	4,886	
August	3,987	
November	4,511	
2020		10,629
February	4,446	
May	6,183	
Total	**74,241**	**74,241**

Supplementary Table 4. Priority Similarity Matrix Scores are generated by comparing the list of 10 health priorities of actor A with that of actor B and the number of matching priorities is counted. Topic similarity scores range from 0-10.

	USA	UK	BMGF	WHO	World Bank	UNAIDS	UNFPA	UNICEF	UNITAID	GAVI	Oxfam	Global Fund	CDC	EU CDC	NIH	FAO	UNDP	MSF	PATH	Save the Children
USA		7	6	5	6	3	4	4	2	2	5	4	3	1	2	3	7	4	2	6
UK	7		4	4	6	2	3	5	2	3	5	4	2	2	2	4	6	5	3	6
BMGF	6	4		8	4	3	3	4	3	3	3	6	2	1	2	1	6	3	4	3
WHO	5	4	8		3	3	3	4	3	5	4	7	3	3	2	1	5	4	5	2
World Bank	6	6	4	3		2	4	4	1	3	6	3	3	0	1	5	6	3	2	5
UNAIDS	3	2	3	3	2		3	2	4	1	2	3	2	1	2	1	3	3	3	1
UNFPA	4	3	3	3	4	3		4	1	2	3	3	2	0	1	1	4	4	2	3
UNICEF	4	5	4	4	4	2	4		1	3	4	3	2	1	1	3	5	4	4	4
UNITAID	2	2	3	3	1	4	1	1		3	1	4	2	3	2	0	3	4	5	1
GAVI	2	3	3	5	3	1	2	3	3		3	6	3	2	2	1	2	4	5	2
Oxfam	5	5	3	4	6	2	3	4	1	3		5	2	1	1	4	6	4	3	5
Global Fund	4	4	6	7	3	3	3	3	4	6	5		2	3	2	1	5	6	4	2
CDC	3	2	2	3	3	2	2	2	2	3	2	2		2	0	1	3	1	2	2
EU CDC	1	2	1	3	0	1	0	1	3	2	1	3	2		1	0	1	3	1	0
NIH	2	2	2	2	1	2	1	1	2	2	1	2	0	1		1	2	2	2	1
FAO	3	4	1	1	5	1	1	3	0	1	4	1	1	0	1		4	1	1	3
UNDP	7	6	6	5	6	3	4	5	3	2	6	5	3	1	2	4		3	3	5
MSF	4	5	3	4	3	3	4	4	4	4	4	6	1	3	2	1	3		3	4
PATH	2	3	4	5	2	3	2	4	5	5	3	4	2	1	2	1	3	3		3
Save the Children	6	6	3	2	5	1	3	4	1	2	5	2	2	0	1	3	5	4	3	

Supplementary Table 5. Types of Power. A summary of the four types of power as presented by Barnett and Duvall (2005) with examples in global health.

Power Type	Relational specificity	Power works through…	Definition according to Barnett & Duvall (2005)	Global Health Example
Compulsory Power	Direct	Interactions of specific actors	"Direct control of one actor over the conditions of existence or the actions of another." (p. 48)	Donor countries dictate the conditions in low and middle-income countries (LMICs) through dictating requirements in development aid.
Institutional Power	Diffuse	Interactions of specific actors	"Control actors exercise indirectly over others through diffuse relations of interactions." (p. 43)	High-income countries control funding allocations for LMICs through institutional power via their contributions to the WHO and other multilateral organizations.
Structural Power	Direct	Social relations of constitution	"Constitution of subjects' capacities in direct structural relation to one another." (p. 43)	The structural and historical disempowerment of indigenous populations have resulted in their disproportionate outcomes in health.
Productive Power	Diffuse	Social relations of constitution	"Power [that] works through diffuse constitutive relations to produce the situated social capacities of actors." (p. 48)	High-income countries direct what research institutions prioritize and study, and ultimately determine what health issues are addressed.

SUPPLEMENTARY MATERIALS

Materials and Methods

Rationale for choosing the 20 global health actors

1. Hoffman & Cole (2018), Frenk & Moon (2013), and Szlezak et al. (2010) were the basis for the 20 global health actors in this study.[4, 15, 16]
    a. Hoffman & Cole (2018) used the related search function in Google in order to systematically map global health actors – 20 global health actors were identified as most important based on their methodology and was validated by 9 identified global health experts.
    b. Frenk & Moon (2013) identifies 9 primary types of actors in global health with 24 examples in their study on pluralism and other challenges in global health.
    c. Zlezak et al. (2010) describes their 8 identified types of actors in global health as a partnership in their article that argues for the norms and roles of each actor in the transition of global health.
2. The identified global health actors across the 3 studies were compared, and the 20 actors that were identified most important by all 3 studies were chosen.

Collection of tweets

1. Twitter is one of the social media platforms where global health actors actively and consistently share their work, research, and news to the general global public.
2. Using the Twitter Application Programming Interface (API), tweets from of the 20 global health actors were collected from November 2016 to May 2020 in three month intervals.
    a. All the tweets of each of the 20 global health actors were collected for the following 15 months:
        i. 2016: November
        ii. 2017: February, May, August, November
        iii. 2018: February, May, August, November
        iv. 2019: February, May, August, November
        v. 2020: February, May
    b. November 2019 is the identified beginning of the COVID-19 outbreak.
    c. This scope allows an analysis of tweets of global health actors 3 years leading up to the COVID-19 outbreak and 6-months into the pandemic.
3. Three month intervals were chosen with the assumption that a variance in the issues, topics, and themes that global health actors tweet can be seen in three month intervals while allowing for efficient usage of the request limit from the Twitter API.

Topic modelling

1. Topic Modeling was conducted to identify the 10 most tweeted global health issues/topics by each actor in each of the 15 months in the study.

2. The 10 most tweeted global health issues/topics were used to describe the set of issues/problems a specific global health actor prioritizes in a given month.
3. Latent Dirichlet Allocation (LDA) was used in topic modeling.
4. Topic modeling answers the questions:
    a. "What are the most prioritized issues among the identified global health actors from 2016 to 2020?"
    b. "When did global health actors have pandemic preparedness as a priority in the three years leading up to the COVID-19 pandemic?"
    c. "What are the trends in prioritization of global health issues between and among different types of global health actors?

FAQs about how LDA was used in this study

- What did the authors do with tweets that mentioned both "breastfeeding" and "mothers"? Do the authors believe that the revealed priorities of an organization that references both breastfeeding and mothers are substantively different than those of an organization that just references breastfeeding, and so on?
    - For context, LDA topic modeling is a form of "unsupervised machine learning" where the data used is "unlabeled." This means that when we ran the algorithm, we did not define what statements will be categorized as "breastfeeding" and what will be categorized as "mothers." We also did not define what words would fall under any other topics that were generated by the model. The only input from us is was how many topics we want the LDA algorithm to categorize the corpus of text. In our analysis, we generated 10 topics for each of the 20 actors. The LDA algorithm generates topics based on a generative probabilistic model that assumes each topic is a mixture over an underlying set of words, and each corpus of text is a mixture of sets of topic probabilities. In a nutshell, the algorithm analyzes all the words in all the tweets of a specific actor. It then generates probabilities of each unique word appearing with other words in a certain tweet or sentence. Topics are then generated by the model based on these sets of probabilities.
- Some topics are quite general (e.g., "Poverty", "Treatment", "News"), while others are more specific ("Fisheries", "Hepatitis", "Veterans"). In cases where one topic could be subsumed by another (e.g., "Schools" could be subsumed by "Education"), how did the authors disaggregate these?
    - We did not have any input in categorizing any of the topics generated. The topics generated are based on the words and language used by each respective actor in their tweets. The algorithm uses the words/language used by the actor in their tweets to generate topics. We did not make any other edits to the topics after they were generated.

Code for collecting tweets

```
# CREDENTIALS
import yaml

config = dict(
    search_tweets_api = dict(
        account_type = 'premium',
        endpoint = 'https://api.twitter.com/1.1/tweets/search/fullarchive/datacollection.json',
```

```
        consumer_key = 'xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx',
        consumer_secret = 'xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx'
    )
)

with open('twitter_keys_fullarchive.yaml', 'w') as config_file:
    yaml.dump(config, config_file, default_flow_style=False)

# LOAD CREDENTIALS
from searchtweets import load_credentials

premium_search_args = load_credentials("twitter_keys_fullarchive.yaml",
                                       yaml_key="search_tweets_api",
                                       env_overwrite=False)
print(premium_search_args)

# QUERY RULE SET UP
from searchtweets import gen_rule_payload

rule = gen_rule_payload("from:username",
                        results_per_call=500,
                        from_date="2020-02-01",
                        to_date="2020-03-01"
                       )

# WRITE TO JSONL config_file
import json

with open('tweets_feb_2020.jsonl', 'a', encoding='utf-8') as f:
    n = 0
    for tweet in rs.stream():
        n += 1
        if n % 10 == 0:
            print('{0}: {1}'.format(str(n), tweet['created_at']))
        json.dump(tweet, f)
        f.write('\n')
print('done')

# REPEAT FOR OTHER USERS AND MONTHS
```

Code for topic modelling

```
# Importing modules

import pandas as pd

# Read data into tweets_df
tweets_df = pd.read_csv('tweets_nov2016-may2020.csv')

# Print head
tweets.head()

# Remove the columns
tweets_df = tweets_df[["username","user_id","created_at","tweet"]]

# Print out the first rows of tweets_df
tweets_df.head()

# Create dataframe for each month in analysis
tweets_feb = tweets.loc[tweets.created_at.str.contains("Feb")]
tweets_feb_17 = tweets_feb.loc[tweets_feb.created_at.str.contains("2017")]
tweets_feb_18 = tweets_feb.loc[tweets_feb.created_at.str.contains("2018")]
tweets_feb_19 = tweets_feb.loc[tweets_feb.created_at.str.contains("2019")]
tweets_feb_20 = tweets_feb.loc[tweets_feb.created_at.str.contains("2020")]

tweets_may = tweets.loc[tweets.created_at.str.contains("May")]
tweets_may_17 = tweets_may.loc[tweets_may.created_at.str.contains("2017")]
tweets_may_18 = tweets_may.loc[tweets_may.created_at.str.contains("2018")]
tweets_may_19 = tweets_may.loc[tweets_may.created_at.str.contains("2019")]
tweets_may_20 = tweets_may.loc[tweets_may.created_at.str.contains("2020")]

tweets_aug = tweets.loc[tweets.created_at.str.contains("Aug")]
tweets_aug_17 = tweets_aug.loc[tweets_aug.created_at.str.contains("2017")]
tweets_aug_18 = tweets_aug.loc[tweets_aug.created_at.str.contains("2018")]
tweets_aug_19 = tweets_aug.loc[tweets_aug.created_at.str.contains("2019")]
```

```
tweets_nov = tweets.loc[tweets.created_at.str.contains("Nov")]
tweets_nov_16 = tweets_nov.loc[tweets_nov.created_at.str.contains("2016")]
tweets_nov_17 = tweets_nov.loc[tweets_nov.created_at.str.contains("2017")]
tweets_nov_18 = tweets_nov.loc[tweets_nov.created_at.str.contains("2018")]
tweets_nov_19 = tweets_nov.loc[tweets_nov.created_at.str.contains("2019")]

# Helper function
def plot_10_most_common_words(count_data, count_vectorizer):
    import matplotlib.pyplot as plt
    words = count_vectorizer.get_feature_names()
    total_counts = np.zeros(len(words))
    for t in count_data:
        total_counts+=t.toarray()[0]

    count_dict = (zip(words, total_counts))
    count_dict = sorted(count_dict, key=lambda x:x[1], reverse=True)[1:23]
    words = [w[0] for w in count_dict]
    counts = [w[1] for w in count_dict]
    x_pos = np.arange(len(words))

    plt.figure(2, figsize=(15, 2))
    plt.subplot(title=f'10 Most Common Words')
    sns.set_context("notebook", font_scale=1.25, rc={"lines.linewidth": 2.5})
    sns.barplot(x_pos, counts, palette='husl')
    plt.xticks(x_pos, words, rotation=90)
    plt.xlabel('words')
    plt.ylabel('counts')
    plt.show()

# Import Libraries
from sklearn.feature_extraction.text import CountVectorizer
import numpy as np

import matplotlib.pyplot as plt
import seaborn as sns

import re
import string

# Identify top 10 keywords, issues, topics of each actor for a given month
tweets = tweets_nov_16[tweets_nov_16["username"] == username]
tweets = tweets_df[tweets_df['username'].isin(username)]
printable = set(string.printable)
tweets['paper_text_processed'] = tweets['tweet'].map(lambda x: re.sub('[,\.!?]', '', x))
tweets['paper_text_processed'] = tweets['tweet'].map(lambda x: x.encode('ascii','ignore'))
exclusionList = ['amp','https','RT','people','know','living','new','2018','latest','use', 'week',
                 'ECDC_EU','thank','Thank','DYK','USAID','today','world','million','country',
                'foreignoffice','UK','billgates','melindagates','2019','des','33', 'DFID',
                '000','day','like','year','old','live','UNITAID','PATHtweets','PATH','para',
                'WorldBank','LIVE','WHOAFRO','WHOWPRO','WHOSEARO','WHOEMRO','GlobalFund','WHO_Europe','la'
                ]
exclusions = '|'.join(exclusionList)
tweets['paper_text_processed'] = tweets['tweet'].map(lambda x: re.sub(exclusions, '', x))
tweets['paper_text_processed'] = tweets['paper_text_processed'].map(lambda x: x.lower())
tweets['paper_text_processed'].head()
sns.set_style('whitegrid')
%matplotlib inline
count_vectorizer = CountVectorizer(stop_words='english')
count_data = count_vectorizer.fit_transform(tweets['paper_text_processed'])
import warnings
warnings.simplefilter("ignore")
plot_10_most_common_words(count_data, count_vectorizer)

# LDA Topic Modeling
import warnings
warnings.simplefilter("ignore", DeprecationWarning)
# Load the LDA model from sk-learn
from sklearn.decomposition import LatentDirichletAllocation as LDA

# Helper function
def print_topics(model, count_vectorizer, n_top_words):
    words = count_vectorizer.get_feature_names()
    for topic_idx, topic in enumerate(model.components_):
        print("\nTopic #%d:" % topic_idx)
        print(" ".join([words[i]
                        for i in topic.argsort()[:-n_top_words - 1:-1]]))

# Tweak the two parameters below
number_topics = 5
```

```
number_words = 10
# Create and fit the LDA model
lda = LDA(n_components=number_topics, n_jobs=-1)
lda.fit(count_data)
# Print the topics found by the LDA model
print("Topics found via LDA:")
print_topics(lda, count_vectorizer, number_words)
```

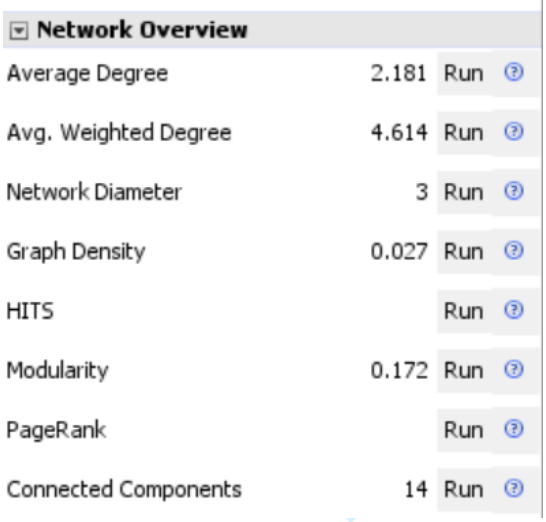
How network maps were analyzed

- **What is network analysis?** Network analysis is an analytic method that has proved to be useful in understanding relational dynamics across actors in global and public health. (Lopreite et al. 2021 and Quisell et al. 2018).
- **Why use network analysis for the study?** Network analysis was conducted to observe the funding relationships between global health actors.
- **What tool was used?** Gephi 0.9.2 was used in constructing and analyzing the network map.
- **How was the network map designed?**
    - The network modelled in the study allows for a graphical visualization of the flows of global health funding in 2019.
    - The network map was designed such that each global health actor is represented by a node and lines or “edges” indicate a flow of funding in global health.
    - The Fruchterman-Reingold algorithm was used in modelling the network map.
        - The algorithm “calculates the optimal layout so that nodes with less strength and less connections are placed further apart, and those with more and/or stronger connections are placed closer to each other.”[18]
        - The thickness of edges represents the amount of funding transferred between actors.
        - The modelled network map can be found and will be discussed in the findings section.

DAH funding data network analysis summary statistics

Network Overview		
Average Degree	25.403	Run
Avg. Weighted Degree	254.124	Run
Network Diameter	4	Run
Graph Density	0.113	Run
HITS		Run
Modularity	0.093	Run
PageRank		Run
Connected Components	1	Run

Twitter data network analysis summary statistics



Network Overview		
Average Degree	2.181	Run
Avg. Weighted Degree	4.614	Run
Network Diameter	3	Run
Graph Density	0.027	Run
HITS		Run
Modularity	0.172	Run
PageRank		Run
Connected Components	14	Run

DAH funding data network analysis statistics report

Label	indegree	outdegree	Degree	weighted indegree	weighted outdegree	Weighted Degree	Eccentricity	closnesscentrality	harmonicclosnesscentrality	betweenesscentrality	modularity_class	strongcompnum
African Development Bank	25	57	82	1149	1149	2298	1	1.00	1.00	54.18	1	57
Asian Development Bank	26	48	74	723	723	1446	3	0.42	0.53	52.20	0	160
United Arab Emirates	1	79	80	79	79	158	1	1.00	1.00	7.28	2	161
Australia	1	151	152	137	1021	1158	2	0.85	0.91	0.00	2	175
Austria	1	128	129	112	1083	1195	2	0.76	0.85	0.00	0	179
Belgium	1	140	141	123	1278	1401	2	0.80	0.87	0.00	0	181
Canada	1	163	164	146	1564	1710	2	0.89	0.94	0.00	2	183
Switzerland	1	138	139	124	866	990	2	0.82	0.89	0.00	2	184
China	39	12	51	251	380	631	2	0.52	0.53	661.00	1	160
Germany	1	165	166	147	1476	1623	2	0.90	0.94	0.00	0	185
Denmark	1	131	132	115	1229	1344	2	0.77	0.85	0.00	0	186
Spain	1	152	153	134	1498	1632	2	0.84	0.91	0.00	0	188
Finland	1	160	161	144	1210	1354	2	0.88	0.93	0.00	0	189
France	1	172	173	154	1466	1620	2	0.92	0.96	0.00	0	192
United Kingdom	1	168	169	150	1552	1702	2	0.91	0.95	0.00	0	193
Greece	1	148	149	133	1031	1164	2	0.83	0.90	0.00	0	194
Ireland	1	120	121	104	1081	1185	2	0.74	0.82	0.00	2	195
Italy	1	160	161	143	1433	1576	2	0.88	0.93	0.00	0	196
Japan	1	169	170	155	1111	1266	2	0.94	0.97	0.00	2	198
Korea	1	138	139	125	876	1001	2	0.82	0.89	0.00	2	199
Luxembourg	1	130	131	114	1124	1238	2	0.77	0.85	0.00	2	200

Netherlands	1	158	159	142	1380	1522	2	0.87	0.93	0.00	0	201
Norway	1	157	158	138	1221	1359	2	0.86	0.92	0.00	2	203
New Zealand	1	129	130	118	633	751	2	0.78	0.86	0.00	3	204
Portugal	1	73	74	57	885	942	3	0.62	0.69	0.00	0	205
Sweden	1	155	156	139	1464	1603	2	0.86	0.92	0.00	0	206
United States	1	165	166	150	1390	1540	2	0.92	0.96	0.00	2	207
Bill & Melinda Gates Foundation	1	162	163	146	1280	1426	2	0.89	0.94	0.00	1	208
Coalition for Epidemic Preparedness Innovations	10	1	11	10	10	20	1	1.00	1.00	0.23	1	163
European Commission	15	148	163	2184	2184	4368	3	0.83	0.92	53.93	0	178
European Economic Area	3	7	10	17	17	34	1	1.00	1.00	8.85	2	202
Gavi	28	118	146	2024	2024	4048	3	0.65	0.81	110.05	1	160
Global Fund	29	155	184	4119	4119	8238	3	0.91	0.96	336.01	2	160
Inter-American Development Bank	15	34	49	269	269	538	1	1.00	1.00	49.50	2	119
International NGOs	27	151	178	2323	2323	4646	3	0.86	0.94	198.03	2	171
US NGOs	27	158	185	442	442	884	3	0.90	0.95	306.65	1	174
Pan American Health Organization	23	44	67	318	318	636	3	0.41	0.52	28.46	2	162
UNAIDS	30	133	163	612	612	1224	3	0.73	0.87	198.05	1	160
UNFPA	30	141	171	1630	1630	3260	3	0.79	0.90	226.79	0	160
UNICEF	30	146	176	1913	1913	3826	3	0.83	0.92	250.51	1	160
UNITAID	9	2	11	14	14	28	1	1.00	1.00	0.28	1	187
US Foundations	1	164	165	164	164	328	3	0.92	0.96	23.90	1	210
World Bank	21	129	150	1134	1134	2268	3	0.71	0.85	32.25	0	176
WB_IBRD	20	153	173	1369	1369	2738	3	0.84	0.93	247.82	0	169
WB_IDA	27	117	144	2596	2596	5192	3	0.64	0.81	163.51	3	160
WHO	29	154	183	2476	2476	4952	3	0.90	0.95	314.53	0	160
Corporate Donations	0	2	2	0	2	2	4	0.48	0.49	0.00	1	211
Debt Repayments	0	2	2	0	173	173	4	0.47	0.48	0.00	3	212
Non-OECD DAC Countries	0	17	17	0	710	710	2	0.52	0.55	0.00	2	213
Other	0	11	11	0	285	285	3	0.52	0.53	0.00	2	214
Other OECD DAC Countries	0	8	8	0	220	220	3	0.51	0.52	0.00	2	215
Private Other	0	14	14	0	941	941	3	0.52	0.54	0.00	1	216
Unallocable	0	4	4	0	4	4	4	0.46	0.49	0.00	1	217
Afghanistan	40	0	40	275	0	275	0	0.00	0.00	0.00	0	134
Albania	34	0	34	190	0	190	0	0.00	0.00	0.00	3	122
Algeria	36	0	36	138	0	138	0	0.00	0.00	0.00	2	3
Angola	39	0	39	279	0	279	0	0.00	0.00	0.00	1	21
Anguilla	3	0	3	3	0	3	0	0.00	0.00	0.00	2	170
Antigua and Barbuda	19	0	19	65	0	65	0	0.00	0.00	0.00	2	87
Argentina	34	0	34	118	0	118	0	0.00	0.00	0.00	2	113
Armenia	36	0	36	218	0	218	0	0.00	0.00	0.00	3	75
Azerbaijan	36	0	36	199	0	199	0	0.00	0.00	0.00	3	74
Bahrain	1	0	1	1	0	1	0	0.00	0.00	0.00	0	190
Bangladesh	39	0	39	271	0	271	0	0.00	0.00	0.00	0	135
Barbados	6	0	6	47	0	47	0	0.00	0.00	0.00	2	107

Belarus	30	0	30	119	0	119	0	0.00	0.00	0.00	2	144
Belize	33	0	33	119	0	119	0	0.00	0.00	0.00	2	94
Benin	39	0	39	273	0	273	0	0.00	0.00	0.00	1	43
Bhutan	34	0	34	163	0	163	0	0.00	0.00	0.00	3	70
Bolivia	38	0	38	180	0	180	0	0.00	0.00	0.00	2	108
Bosnia and Herzegovina	35	0	35	182	0	182	0	0.00	0.00	0.00	3	121
Botswana	39	0	39	210	0	210	0	0.00	0.00	0.00	0	18
Brazil	37	0	37	131	0	131	0	0.00	0.00	0.00	2	117
Bulgaria	5	0	5	34	0	34	0	0.00	0.00	0.00	2	156
Burkina Faso	39	0	39	280	0	280	0	0.00	0.00	0.00	1	50
Burundi	39	0	39	264	0	264	0	0.00	0.00	0.00	1	19
Cambodia	37	0	37	266	0	266	0	0.00	0.00	0.00	0	130
Cameroon	39	0	39	277	0	277	0	0.00	0.00	0.00	1	37
Cape Verde	24	0	24	117	0	117	0	0.00	0.00	0.00	3	12
Central African Republic	39	0	39	259	0	259	0	0.00	0.00	0.00	1	14
Chad	39	0	39	266	0	266	0	0.00	0.00	0.00	1	29
Chile	34	0	34	112	0	112	0	0.00	0.00	0.00	2	102
Christmas Island	1	0	1	1	0	1	0	0.00	0.00	0.00	1	209
Colombia	36	0	36	126	0	126	0	0.00	0.00	0.00	2	118
Comoros	39	0	39	223	0	223	0	0.00	0.00	0.00	3	5
Congo	39	0	39	249	0	249	0	0.00	0.00	0.00	1	7
Cook Islands	9	0	9	49	0	49	0	0.00	0.00	0.00	2	149
Costa Rica	35	0	35	131	0	131	0	0.00	0.00	0.00	2	97
Cote d'Ivoire	39	0	39	276	0	276	0	0.00	0.00	0.00	1	20
Croatia	22	0	22	61	0	61	0	0.00	0.00	0.00	2	153
Cuba	36	0	36	166	0	166	0	0.00	0.00	0.00	2	92
Czech Republic	2	0	2	2	0	2	0	0.00	0.00	0.00	1	173
Democratic Republic of the Congo	37	0	37	199	0	199	0	0.00	0.00	0.00	1	46
Djibouti	39	0	39	247	0	247	0	0.00	0.00	0.00	1	25
Dominica	26	0	26	83	0	83	0	0.00	0.00	0.00	2	89
Dominican Republic	37	0	37	159	0	159	0	0.00	0.00	0.00	2	112
Ecuador	37	0	37	128	0	128	0	0.00	0.00	0.00	2	106
Egypt	39	0	39	254	0	254	0	0.00	0.00	0.00	1	35
El Salvador	37	0	37	161	0	161	0	0.00	0.00	0.00	2	100
Equatorial Guinea	38	0	38	197	0	197	0	0.00	0.00	0.00	3	51
Eritrea	39	0	39	255	0	255	0	0.00	0.00	0.00	1	16
Estonia	5	0	5	31	0	31	0	0.00	0.00	0.00	2	154
Ethiopia	39	0	39	288	0	288	0	0.00	0.00	0.00	1	41
Federated States of Micronesia	24	0	24	64	0	64	0	0.00	0.00	0.00	2	64
Fiji	26	0	26	81	0	81	0	0.00	0.00	0.00	2	139
Gabon	38	0	38	210	0	210	0	0.00	0.00	0.00	0	47
Georgia	36	0	36	245	0	245	0	0.00	0.00	0.00	3	81
Ghana	39	0	39	284	0	284	0	0.00	0.00	0.00	1	40
Global	43	0	43	260	0	260	0	0.00	0.00	0.00	1	6

Grenada	30	0	30	85	0	85	0	0.00	0.00	0.00	2	90
Guatemala	37	0	37	170	0	170	0	0.00	0.00	0.00	2	115
Guinea	39	0	39	270	0	270	0	0.00	0.00	0.00	1	31
Guinea-Bissau	39	0	39	259	0	259	0	0.00	0.00	0.00	1	30
Guyana	34	0	34	156	0	156	0	0.00	0.00	0.00	2	98
Haiti	38	0	38	234	0	234	0	0.00	0.00	0.00	2	111
Honduras	38	0	38	186	0	186	0	0.00	0.00	0.00	2	109
Hungary	3	0	3	3	0	3	0	0.00	0.00	0.00	1	166
India	39	0	39	274	0	274	0	0.00	0.00	0.00	0	136
Indonesia	39	0	39	265	0	265	0	0.00	0.00	0.00	0	132
Iran	36	0	36	142	0	142	0	0.00	0.00	0.00	2	73
Iraq	37	0	37	195	0	195	0	0.00	0.00	0.00	0	76
Jamaica	36	0	36	143	0	143	0	0.00	0.00	0.00	2	103
Jordan	37	0	37	198	0	198	0	0.00	0.00	0.00	0	80
Kazakhstan	37	0	37	212	0	212	0	0.00	0.00	0.00	3	78
Kenya	39	0	39	285	0	285	0	0.00	0.00	0.00	1	48
Kiribati	28	0	28	98	0	98	0	0.00	0.00	0.00	2	58
Kosovo	32	0	32	142	0	142	0	0.00	0.00	0.00	3	143
Kyrgyzstan	36	0	36	225	0	225	0	0.00	0.00	0.00	3	77
Laos	37	0	37	258	0	258	0	0.00	0.00	0.00	0	127
Latvia	5	0	5	7	0	7	0	0.00	0.00	0.00	1	157
Lebanon	38	0	38	162	0	162	0	0.00	0.00	0.00	0	68
Lesotho	39	0	39	253	0	253	0	0.00	0.00	0.00	1	22
Liberia	39	0	39	269	0	269	0	0.00	0.00	0.00	1	33
Libya	33	0	33	123	0	123	0	0.00	0.00	0.00	0	2
Lithuania	5	0	5	7	0	7	0	0.00	0.00	0.00	1	158
Macedonia	30	0	30	131	0	131	0	0.00	0.00	0.00	2	145
Madagascar	39	0	39	276	0	276	0	0.00	0.00	0.00	1	38
Malawi	39	0	39	277	0	277	0	0.00	0.00	0.00	1	44
Malaysia	31	0	31	132	0	132	0	0.00	0.00	0.00	0	140
Maldives	32	0	32	110	0	110	0	0.00	0.00	0.00	3	66
Mali	40	0	40	282	0	282	0	0.00	0.00	0.00	1	45
Malta	1	0	1	1	0	1	0	0.00	0.00	0.00	0	180
Marshall Islands	21	0	21	76	0	76	0	0.00	0.00	0.00	0	138
Mauritania	39	0	39	259	0	259	0	0.00	0.00	0.00	1	34
Mauritius	33	0	33	112	0	112	0	0.00	0.00	0.00	2	0
Mayotte	1	0	1	1	0	1	0	0.00	0.00	0.00	0	191
Mexico	37	0	37	161	0	161	0	0.00	0.00	0.00	2	114
Moldova	33	0	33	185	0	185	0	0.00	0.00	0.00	3	125
Mongolia	37	0	37	213	0	213	0	0.00	0.00	0.00	0	124
Montenegro	31	0	31	137	0	137	0	0.00	0.00	0.00	3	142
Montserrat	25	0	25	72	0	72	0	0.00	0.00	0.00	2	91
Morocco	39	0	39	218	0	218	0	0.00	0.00	0.00	1	55
Mozambique	39	0	39	288	0	288	0	0.00	0.00	0.00	1	36

Myanmar	37	0	37	258	0	258	0	0.00	0.00	0.00	0	131
Namibia	39	0	39	222	0	222	0	0.00	0.00	0.00	1	17
Nauru	19	0	19	52	0	52	0	0.00	0.00	0.00	2	59
Nepal	39	0	39	265	0	265	0	0.00	0.00	0.00	0	86
Netherlands Antilles	2	0	2	12	0	12	0	0.00	0.00	0.00	0	177
Nicaragua	37	0	37	201	0	201	0	0.00	0.00	0.00	2	110
Niger	39	0	39	276	0	276	0	0.00	0.00	0.00	1	42
Nigeria	39	0	39	287	0	287	0	0.00	0.00	0.00	1	52
Niue	18	0	18	64	0	64	0	0.00	0.00	0.00	2	63
North Korea	32	0	32	127	0	127	0	0.00	0.00	0.00	2	72
Northern Mariana Islands	2	0	2	2	0	2	0	0.00	0.00	0.00	2	197
Oman	5	0	5	5	0	5	0	0.00	0.00	0.00	1	164
Pakistan	39	0	39	273	0	273	0	0.00	0.00	0.00	0	137
Palau	18	0	18	50	0	50	0	0.00	0.00	0.00	2	62
Palestine	34	0	34	125	0	125	0	0.00	0.00	0.00	2	151
Panama	35	0	35	142	0	142	0	0.00	0.00	0.00	2	105
Papua New Guinea	32	0	32	138	0	138	0	0.00	0.00	0.00	0	128
Paraguay	36	0	36	116	0	116	0	0.00	0.00	0.00	2	95
Peru	37	0	37	131	0	131	0	0.00	0.00	0.00	2	104
Philippines	39	0	39	248	0	248	0	0.00	0.00	0.00	0	120
Poland	4	0	4	6	0	6	0	0.00	0.00	0.00	1	168
Romania	5	0	5	34	0	34	0	0.00	0.00	0.00	2	155
Russia	8	0	8	36	0	36	0	0.00	0.00	0.00	2	147
Rwanda	39	0	39	276	0	276	0	0.00	0.00	0.00	1	27
Saint Helena	33	0	33	130	0	130	0	0.00	0.00	0.00	0	10
Saint Kitts and Nevis	8	0	8	47	0	47	0	0.00	0.00	0.00	2	152
Saint Lucia	33	0	33	107	0	107	0	0.00	0.00	0.00	2	93
Saint Vincent and the Grenadines	32	0	32	95	0	95	0	0.00	0.00	0.00	2	88
Samoa	26	0	26	106	0	106	0	0.00	0.00	0.00	3	65
Sao Tome and Principe	38	0	38	230	0	230	0	0.00	0.00	0.00	3	4
Saudi Arabia	5	0	5	5	0	5	0	0.00	0.00	0.00	1	172
Senegal	39	0	39	283	0	283	0	0.00	0.00	0.00	1	39
Serbia	35	0	35	167	0	167	0	0.00	0.00	0.00	2	146
Seychelles	33	0	33	97	0	97	0	0.00	0.00	0.00	2	1
Sierra Leone	39	0	39	270	0	270	0	0.00	0.00	0.00	1	49
Slovakia	2	0	2	2	0	2	0	0.00	0.00	0.00	1	165
Slovenia	8	0	8	8	0	8	0	0.00	0.00	0.00	0	159
Solomon Islands	26	0	26	128	0	128	0	0.00	0.00	0.00	3	82
Somalia	39	0	39	252	0	252	0	0.00	0.00	0.00	1	15
South Africa	39	0	39	260	0	260	0	0.00	0.00	0.00	0	24
South Korea	7	0	7	7	0	7	0	0.00	0.00	0.00	0	167
South Sudan	39	0	39	245	0	245	0	0.00	0.00	0.00	1	13
Sri Lanka	37	0	37	231	0	231	0	0.00	0.00	0.00	0	126
Sudan	39	0	39	272	0	272	0	0.00	0.00	0.00	1	26

Suriname	34	0	34	107	0	107	0	0.00	0.00	0.00	2	96
Swaziland	38	0	38	201	0	201	0	0.00	0.00	0.00	0	11
Syria	38	0	38	195	0	195	0	0.00	0.00	0.00	0	67
Tajikistan	37	0	37	248	0	248	0	0.00	0.00	0.00	0	83
Tanzania	39	0	39	285	0	285	0	0.00	0.00	0.00	1	53
Thailand	38	0	38	193	0	193	0	0.00	0.00	0.00	0	85
The Gambia	39	0	39	248	0	248	0	0.00	0.00	0.00	1	28
Timor-Leste	37	0	37	231	0	231	0	0.00	0.00	0.00	0	79
Togo	39	0	39	255	0	255	0	0.00	0.00	0.00	1	9
Tokelau	13	0	13	18	0	18	0	0.00	0.00	0.00	2	148
Tonga	23	0	23	99	0	99	0	0.00	0.00	0.00	3	60
Trinidad and Tobago	11	0	11	52	0	52	0	0.00	0.00	0.00	2	116
Tunisia	37	0	37	172	0	172	0	0.00	0.00	0.00	2	8
Turkey	29	0	29	142	0	142	0	0.00	0.00	0.00	0	141
Turkmenistan	36	0	36	158	0	158	0	0.00	0.00	0.00	3	69
Turks and Caicos Islands	2	0	2	2	0	2	0	0.00	0.00	0.00	2	182
Tuvalu	21	0	21	93	0	93	0	0.00	0.00	0.00	3	61
Uganda	39	0	39	286	0	286	0	0.00	0.00	0.00	1	54
Ukraine	32	0	32	181	0	181	0	0.00	0.00	0.00	0	123
Unallocated/Unspecified	45	0	45	357	0	357	0	0.00	0.00	0.00	1	56
Uruguay	31	0	31	78	0	78	0	0.00	0.00	0.00	2	101
Uzbekistan	35	0	35	253	0	253	0	0.00	0.00	0.00	0	129
Vanuatu	25	0	25	76	0	76	0	0.00	0.00	0.00	2	71
Venezuela	34	0	34	106	0	106	0	0.00	0.00	0.00	2	99
Vietnam	39	0	39	270	0	270	0	0.00	0.00	0.00	0	133
Wallis and Futuna Islands	18	0	18	27	0	27	0	0.00	0.00	0.00	0	150
Yemen	37	0	37	249	0	249	0	0.00	0.00	0.00	3	84
Zambia	39	0	39	283	0	283	0	0.00	0.00	0.00	1	32
Zimbabwe	39	0	39	275	0	275	0	0.00	0.00	0.00	1	23

Twitter network analysis statistics report

Label	indegree	outdegree	Degree	weighted indegree	weighted outdegree	Weighted Degree	Eccentricity	closnesscentrality	harmonicclosnesscentrality	betweenesscentrality	modularity_class	strongcompnum
United States	0	8	8	0	30	30	3	0.38	0.44	0.00	0	67
United Kingdom	0	8	8	0	29	29	3	0.38	0.44	0.00	1	68
BMGF	0	8	8	0	35	35	3	0.38	0.44	0.00	0	69
WHO	3	9	12	17	29	46	2	0.54	0.58	23.50	0	66
World Bank	3	8	11	16	31	47	2	0.54	0.58	19.65	1	65
UNAIDS	3	9	12	8	18	26	2	0.54	0.58	23.50	0	64

UNFPA	3	8	11	10	20	30	2	0.54	0.58	19.65	1	63
UNICEF	3	9	12	13	28	41	2	0.54	0.58	23.50	1	62
UNITAID	3	8	11	7	21	28	2	0.54	0.58	20.21	4	61
GAVI	3	9	12	9	24	33	2	0.54	0.58	23.50	4	60
GFATM	3	9	12	14	30	44	2	0.54	0.58	23.50	3	59
Oxfam	8	10	18	28	10	38	1	1.00	1.00	40.64	1	58
CDC	8	10	18	19	10	29	1	1.00	1.00	72.46	2	56
EU CDC	6	10	16	13	10	23	1	1.00	1.00	62.06	3	51
NIH	8	10	18	13	10	23	1	1.00	1.00	87.07	4	43
FAO	7	9	16	13	9	22	1	1.00	1.00	67.06	1	35
UNDP	8	10	18	33	10	43	1	1.00	1.00	41.00	1	28
MSF	8	10	18	32	10	42	1	1.00	1.00	56.78	3	23
PATH	8	10	18	30	10	40	1	1.00	1.00	59.94	4	17
Save the Children	8	9	17	20	9	29	1	1.00	1.00	46.99	1	9
Access	1	0	1	1	0	1	0	0.00	0.00	0.00	4	16
Africa	7	0	7	7	0	7	0	0.00	0.00	0.00	1	8
Agriculture	1	0	1	1	0	1	0	0.00	0.00	0.00	1	34
Biodiversity	1	0	1	1	0	1	0	0.00	0.00	0.00	1	33
Breastfeeding	1	0	1	1	0	1	0	0.00	0.00	0.00	4	15
Cancer	2	0	2	2	0	2	0	0.00	0.00	0.00	4	14
Child Marriage	0	0	0	0	0	0	0	0.00	0.00	0.00	5	70
Children	5	0	5	5	0	5	0	0.00	0.00	0.00	1	7
Cholera	1	0	1	1	0	1	0	0.00	0.00	0.00	3	22
Climate Change	3	0	3	3	0	3	0	0.00	0.00	0.00	1	27
Development	0	0	0	0	0	0	0	0.00	0.00	0.00	6	71
Diarrhea	1	0	1	1	0	1	0	0.00	0.00	0.00	2	55
Discrimination	0	0	0	0	0	0	0	0.00	0.00	0.00	7	72
Donations	1	0	1	1	0	1	0	0.00	0.00	0.00	1	6
E. Coli	1	0	1	1	0	1	0	0.00	0.00	0.00	2	54
Ebola	4	0	4	4	0	4	0	0.00	0.00	0.00	3	13
Education	2	0	2	2	0	2	0	0.00	0.00	0.00	1	5
FGM	1	0	1	1	0	1	0	0.00	0.00	0.00	1	26
Families	1	0	1	1	0	1	0	0.00	0.00	0.00	1	32
Family Planning	0	0	0	0	0	0	0	0.00	0.00	0.00	8	73
Farmers	1	0	1	1	0	1	0	0.00	0.00	0.00	1	31
Fisheries	1	0	1	1	0	1	0	0.00	0.00	0.00	1	30
Food Security	4	0	4	4	0	4	0	0.00	0.00	0.00	1	4
Forests	1	0	1	1	0	1	0	0.00	0.00	0.00	1	29
Funding	1	0	1	1	0	1	0	0.00	0.00	0.00	4	42
HIV/AIDS	4	0	4	4	0	4	0	0.00	0.00	0.00	1	21
Heart Disease	1	0	1	1	0	1	0	0.00	0.00	0.00	4	41
Hepatitis	1	0	1	1	0	1	0	0.00	0.00	0.00	3	50
Human Rights	0	0	0	0	0	0	0	0.00	0.00	0.00	9	74

Humanitarian Aid	3	0	3	3	0	3	0	0.00	0.00	0.00	3	3
Influenza	2	0	2	2	0	2	0	0.00	0.00	0.00	2	49
Innovation	1	0	1	1	0	1	0	0.00	0.00	0.00	4	12
Malaria	3	0	3	3	0	3	0	0.00	0.00	0.00	1	11
Measles	2	0	2	2	0	2	0	0.00	0.00	0.00	3	48
Mothers	0	0	0	0	0	0	0	0.00	0.00	0.00	10	75
News	1	0	1	1	0	1	0	0.00	0.00	0.00	4	40
Nutrition	0	0	0	0	0	0	0	0.00	0.00	0.00	11	76
Online	0	0	0	0	0	0	0	0.00	0.00	0.00	12	77
Outbreaks	1	0	1	1	0	1	0	0.00	0.00	0.00	3	47
Pneumonia	1	0	1	1	0	1	0	0.00	0.00	0.00	1	57
Pneuomonia	2	0	2	2	0	2	0	0.00	0.00	0.00	1	2
Polio	0	0	0	0	0	0	0	0.00	0.00	0.00	13	78
Poverty	0	0	0	0	0	0	0	0.00	0.00	0.00	14	79
Prevention	1	0	1	1	0	1	0	0.00	0.00	0.00	2	53
Rare Disease	1	0	1	1	0	1	0	0.00	0.00	0.00	4	39
Refugees	3	0	3	3	0	3	0	0.00	0.00	0.00	3	1
Report	1	0	1	1	0	1	0	0.00	0.00	0.00	3	46
Research	1	0	1	1	0	1	0	0.00	0.00	0.00	4	38
Sanitation	0	0	0	0	0	0	0	0.00	0.00	0.00	15	80
Schools	1	0	1	1	0	1	0	0.00	0.00	0.00	1	0
South America	0	0	0	0	0	0	0	0.00	0.00	0.00	16	81
Stress	1	0	1	1	0	1	0	0.00	0.00	0.00	4	37
Surveillance	1	0	1	1	0	1	0	0.00	0.00	0.00	3	45
Testing	0	0	0	0	0	0	0	0.00	0.00	0.00	17	82
Treatment	1	0	1	1	0	1	0	0.00	0.00	0.00	3	20
Tubercolosis	2	0	2	2	0	2	0	0.00	0.00	0.00	3	19
Vaccines	2	0	2	2	0	2	0	0.00	0.00	0.00	2	10
Veterans	1	0	1	1	0	1	0	0.00	0.00	0.00	4	36
Violence	1	0	1	1	0	1	0	0.00	0.00	0.00	3	18
Water	3	0	3	3	0	3	0	0.00	0.00	0.00	2	25
West Nile	1	0	1	1	0	1	0	0.00	0.00	0.00	3	44
Women	3	0	3	3	0	3	0	0.00	0.00	0.00	2	24
Zika	1	0	1	1	0	1	0	0.00	0.00	0.00	2	52