

Aue, Luis

Article — Accepted Manuscript (Postprint)

How Do Metrics Shape Politics? From Analogue to Digital Measurement Regimes in International Health Politics

International Political Sociology

Provided in Cooperation with:

WZB Berlin Social Science Center

Suggested Citation: Aue, Luis (2021) : How Do Metrics Shape Politics? From Analogue to Digital Measurement Regimes in International Health Politics, International Political Sociology, ISSN 1749-5687, Oxford University Press, Oxford, Vol. 15, Iss. 1, pp. 83-101, <https://doi.org/10.1093/ips/olaa018>

This Version is available at:

<https://hdl.handle.net/10419/240901>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

How Do Metrics Shape Politics? From Analogue to Digital Measurement Regimes in International Health Politics

Luis Aue

Social Science Center Berlin (WZB)

Free University of Berlin

luis.aue@wzb.eu

This article analyzes a historical shift from analogue to digital measurement regimes that have produced international health metrics. The historical comparative study shows that each of these measurement regimes was deeply influential in shaping the international health polity. The article conceptualizes measurement regimes based on science and technology studies as techno-social assemblages producing international health metrics. Building on polity theory, I argue that these regimes exert participation, problematization, and mode-of intervention effects in international politics. I analyze how the analogue international regime of measuring health acquired dominance after the Second World War. It built on national statistical infrastructures and international organizations and problematized international health politics as guiding nations along the development path of the Global North. It limited participation to medical and statistical experts. The digital regime—influential since the 1990s—is embedded into a private research institute and focuses on the digital recalculation of health metrics. It has shaped the field of international health politics as continuously searching for neglected problems, extended participation to a large group of passive users and supports cost-effective interventions. This article contributes conceptually and empirically to the international political sociology of health. It describes how socio-technical assemblages like measurement regimes shape international politics.

Cet article analyse le passage historique des régimes de mesure analogiques aux régimes numériques qui ont produit des métriques de santé internationales. L'étude comparative historique montre que chacun de ces régimes de mesure a profondément façonné la politique de santé internationale. Cet article conceptualise les régimes de mesure en se basant sur des études scientifiques et technologiques en tant qu'assemblages techno-sociaux producteurs de métriques de santé internationales. Je soutiens que ces régimes exercent des effets de participation, de problématisation et de mode d'intervention dans la politique internationale en m'appuyant sur la théorie politique. J'analyse la manière dont le régime analogique international de mesure de la santé a acquis une position dominante après la Seconde Guerre mondiale. Il reposait sur des infrastructures statistiques nationales, des organisations internationales et une politique de santé internationale problématisée pour guider les nations sur la voie du développement des pays du Nord. Il limitait la participation aux experts médicaux et statisticiens. Le régime numérique, qui est influent depuis les années 90, est intégré à un institut de recherche privé et se concentre sur le recalcul numérique des métriques de santé. Il a façonné le

champ de la politique internationale de santé de par sa recherche continue des problèmes négligés, son extension de la participation à un large groupe d'utilisateurs passifs et son soutien des interventions rentables. Cet article contribue conceptuellement et empiriquement à la sociologie politique internationale dans le domaine de la santé. Il décrit la manière dont les assemblages socio-techniques tels que les régimes de mesure façonnent les politiques internationales.

En este artículo se analiza el cambio histórico de los regímenes de medición analógicos a los digitales, los cuales produjeron mediciones sanitarias internacionales. El estudio comparativo histórico muestra que cada uno de estos regímenes de medición configuró profundamente la política sanitaria internacional. En el artículo se conceptualizan los regímenes de medición basados en estudios científicos y tecnológicos como sistemas tecnosociales que producen mediciones sanitarias internacionales. Partiendo de la teoría de sistemas de gobiernos, sostengo que estos regímenes producen efectos de participación, de problematización y de modo de intervención en la política internacional. También analizo cómo el régimen internacional análogo de medición sanitaria adquirió poder después de la Segunda Guerra Mundial. Este se basó en las infraestructuras estadísticas nacionales y en las organizaciones internacionales y problematizó la política sanitaria internacional como guía para las naciones en el camino de desarrollo del hemisferio norte. Limitó la participación a expertos en medicina y estadística. El régimen digital, que ejerce su influencia desde la década de 1990, está integrado en un instituto de investigación privado y se centra en el recálculo digital de las mediciones sanitarias. Le ha dado forma al ámbito de la política sanitaria internacional, ya que no deja de buscar problemas que han sido ignorados para solucionar, ha ampliado la participación a un gran grupo de usuarios pasivos y apoya las intervenciones rentables. Este artículo contribuye en términos conceptuales y empíricos a la sociología política internacional del ámbito de la salud. Describe cómo los sistemas sociotécnicos como los regímenes de medición determinan las políticas internacionales.

With the rise of the digital, practices of quantification have extended their reach and influence. New digital tracking technologies measure all types of bodily functions—and transform everyday practices, such as walking, into practices of self-observation and discipline (Lupton 2016). Algorithmic calculative technologies have deepened the reach of security and surveillance systems (Aradau and Blanke 2018). Digital quantification techniques have enabled new modes of capitalism, in which experiences become the raw material for profit generation (Zuboff 2015).

As indicated by these insights, our understanding of digital quantification in the political economy and everyday life has greatly expanded (c.f. Fuchs and Chandler 2019). Still, the question of what the shift toward digital quantification means for international politics remains underexplored. This is surprising, as research in the field of international political sociology has been vocal on the political importance of quantification practices. Metrics constitute power relationships in transnational governance (Hansen and Porter 2012), and establish problems for international politics (Robinson 2018) despite their acknowledged weaknesses (Rocha de Siqueira 2017). With regard to domestic and European statistical practices, the shift toward digital techniques has received attention (Ruppert and Scheel 2019) that, until now, has not translated into research on digital quantification in international politics.

In response, this article explores how digital quantification practices have reshaped international health politics compared to former analogue quantification

practices.¹ I will provide a historical comparison of digital and analogue quantification practices in international health politics. During the last decade, the Institute for Health Metrics and Evaluation (IHME)—funded by the Bill and Melinda Gates Foundation (BMGF)—has established health metrics calculated with big data technologies in international health politics. I will compare these new quantification practices with former analogue quantification practices, mainly located at the World Health Organization (WHO). How did this shift in quantification practices affect international health politics? Have analogue and digital quantification practices contributed to different types of international health politics?

By conceptualizing and analyzing the polity effects of analogue and digital measurement regimes, the article contributes to a conundrum within international political sociology beyond research on metrics and quantification. International (health) politics is increasingly understood as a sphere of partly autonomous social practice whose underlying logics have to be deciphered by researchers (Kessler 2009; Bigo and Madsen 2011; Howell 2012). This perspective on international politics has led to a new conundrum. Thus, if we understand international politics as a social sphere with situated social practices, how do some actors manage to become “international” actors? How do they manage to establish some problems as “international” problems? Why do specific interventions become “international”? In response, scholars have argued that experts make international problems like piracy knowable (Bueger 2015) and analyzed how professionals create new spaces for international health interventions (Hanrieder 2019). Robinson shows that indicators and benchmarks can establish governance objects for international politics (Robinson 2018). Extending on this work, this paper establishes how quantification practices shape the basic logic of who and what becomes part of “the international” and, more specifically, of international health politics.

The first section of the paper conceptualizes quantification practices and their polity effects. I will build on concepts from science and technology studies (STS) (Star 1999; Bowker and Star 2000) that have already informed closely related work in international political sociology (Bueger 2015; Ruppert and Scheel 2019). I will analyze analogue and digital quantification practices as part of analogue and digital measurement regimes in international health politics. A measurement regime is understood as an assemblage of practices producing metrics; it contains a specific constituency, a system of classification, and an infrastructure. The concept of a measurement regime will make it possible to describe the shift toward digital quantification in international health politics as part of a broader re-configuration of quantification practices.² Building on Robinson, I afterwards derive the participation, problematization, and mode-of-intervention effects of measurement regimes from current polity theory (Corry 2013, 2014; Robinson 2018).

In the empirical section, I will utilize the conceptual framework for a comparative historical analysis of the digital and the analogue measurement regime within international health politics, engaging with broader social science research on the rise of the digital. I will present the different polity effects of these regimes—how each regime shaped international health politics differently (c.f. p. 7, Table 1). The analogue regime established deviation from the development path of the Global North as the main problem of international health politics to be tackled by a transnational community of experts. In contrast, the digital regime favors the focus on cost-effective interventions by private actors. The regime broadens participation in international health to a lay public that can only know the surface

¹ I will speak about international health politics and not about global health politics, to stress the institutional continuity between so called “international” and “global” health since the late nineteenth century (Birn 2009).

² The concept avoids techno-determinism, which depicts the rise of the digital as caused only by technological developments (Garnham 1998).

of the digitally produced metrics. In concluding, I argue that the article supports a different assessment of digital politics compared to dominant scholarly views.

Measurement Regimes and the Politics of Quantification

I conceptualize measurement regimes as assemblages of practices producing quantifications. I build on concepts developed by STS scholar Susan Leigh Star colleagues. These concepts have been utilized for analyses of similar phenomena such as digital information systems (Star and Ruhleder 1996; Bishop et al. 2000).

Accordingly, a measurement regime contains, first, a system of *classifications*. Classification orders human interaction—in everyday life just as in larger bureaucratic organizations. Classification provides “a spatial, temporal, or spatio-temporal segmentation of the world. A “classification system” is a set of boxes (metaphorical or literal) into which things can be put to then do some kind of work—bureaucratic or knowledge production” (Bowker and Star 2000, 10). It is through classification that a thing has the necessary stability to do collective work with it. If we want to count a thing—the starting point to represent a thing with a metric—we need a classification system that establishes the sameness of several occurrences of the thing. Imagine that we have to prove to the state that a company has the legally required share of female board members. It will be necessary to utilize categories for the gender of the board members in order to report metrics that represent the gender share on the board. The business administrator of the company could utilize the category “male” and “female,” s/he could utilize an “X” as a non-classification, or s/he could utilize a long verbal classification. Still, in order to count the gender of board members, s/he will have to decide on some kind of classification. It comes to symbolic domination when classifications do not fit a thing or contain omissions (Star 1990).

It needs someone who conducts the practices of quantification. One possibility is communities of practice that are socialized into utilizing specific classification systems (Star 1999, 381). Still, the group that implements a specific system of categorization to produce a metric can be expected to be internally fragmented—single members probably do not even consider each other as part of one episteme or community of practice. Conflicts between the members of such a community of practice are likely to occur (Ruppert and Scheel 2019). To stress this internal fragmentation, I describe the actors who produce metrics in a measurement regime not as a community of practice but as a *constituency* (Simons and Voß 2018). A constituency is not necessarily part of one episteme and does not need to be homogeneous in terms of its knowledge and identity. Besides the business administrator, there might be a statistician in another office who builds on the administrator’s classification work to calculate the share of female employees on the board. These two individuals might not have a lot in common, might even not know about each other’s existence, and might have completely different opinions of how the measurement regime should look. Still, they are part of one constituency as they produce a specific metric together.

Star and collaborators coined the term a boundary *infrastructure* (Star 1999; Clarke 2010); a concept that features prominently in STS-inspired research in international political sociology (Bueger 2015; Ruppert and Scheel 2019). When we imagine the production of representations like metrics as an ever-changing assemblage, in which even constituencies are internally fragmented, there must be something that connects and stabilizes practices in such a manner that collective work and routine interaction becomes possible. In response, Star and collaborators stress the importance of infrastructures as connecting the scattered epistemic practices of knowledge production. An infrastructure connects and stabilizes a measurement regime due to its embedding in human practice and in materialized environments (c.f. Knorr Cetina 2009). Thus, a measurement regime has to comply with some

basic material infrastructural demands. Funds have to be made available to set up organizations and material objects like computers. For example, to produce a metric of the share of female board members, the accountant's computer provides an important infrastructure to stabilize the epistemic practices. S/he only ticks a box underwritten with "female" or "male" when a new individual enters the board. The computer then sends the result of this epistemic work to the statistician. These infrastructures stabilize epistemic practices over a long time and large distances (Star 1999; Bowker and Star 2000). Digital infrastructures thereby have the capability to establish especially wide-spanned and silent networks of epistemic production (Ruppert, Isin, and Bigo 2017, 49).

The Polity Effects of Measurement Regimes

This article argues that measurement regimes producing quantifications shape the polity structure of international health politics. Corry's polity theory provides the possibility to heuristically systematize and operationalize polity dimensions of international politics that measurement regimes affect (Corry 2013). Corry understands a polity as constituted by its orientation toward "governance objects." The common concern for a governance object connects the actors of a polity (Corry 2013, 88). For example, the climate polity can be conceptualized as the sphere of political practice where the governance object of the climate is politicized and problematized (Allan 2017). Second, the actors of a polity are "governance subjects" who orient themselves toward the governance object. The extension of a polity is influenced by the spread of governance subjects: "Anyone who defines or enacts their identities in relation to a governance object becomes de facto a member of the polity" (Corry 2013, 96). Third, each polity contains a specific type of relationship between the governance objects and the governance subjects. Foucauldian scholars often characterize this relationship as an instance of governmentality, inscribed with disciplining power relations (Neumann and Sending 2010). Following Corry, this is not necessarily the case. It depends on the polity whether the relationship between subjects and objects has a disciplining character.

I follow up Robinson who assesses the political effects of quantification in the transnational governance of migration with Corry's polity theory (Robinson 2018). Polity theory is well suited to analyze the effects of measurement regimes, due to a metatheoretical affinity between Corry's polity lens and Star's localization of knowledge production within assemblages. Thus, Corry regards his notion of a polity—the relational network between governance objects and subjects—as an assemblage, too (Corry 2014). Expressed in abstract terms, we can therefore imagine the relationship between a measurement regime and international health politics, understood as a polity, as the interaction between two overlapping assemblages. The complexity of this relationship is apparent—there are many different pathways of how measurement regimes might affect the international health polity. Facing this plurality of pathways of interactions, I want to show empirically single historical instances of how measurement regimes affected the international health polity.

Polity theory makes it possible to differentiate between different fundamental dimensions of international politics that a measurement regime can affect. Measurement regimes exert different types of polity effects when they shape governance objects, governance subjects, or the relationship between objects and subjects of a polity. First, measurement regimes influence the object dimension of a polity when they shape how a governance object is represented in international politics. A measurement regime produces the quantified representations that make it possible for members of a polity to "see" their objects (Broome and Seabrooke 2012). In discriminating against alternative notions of a governance object, measurement regimes exert a problematization effect. Thus, measurement regimes influence a polity in shaping what is known as the problematized governance object of the polity.

Robinson focuses on this polity dimension in his analysis. He analyses how migration became regarded as a transnational governance object in response to the Migration Governance Index (Robinson 2018).

Second, measurement regimes influence the governance subjects participating in a specific polity and exert a participation effect. On the one hand, there is an indirect participation effect mediated over the metrics produced by the measurement regime. When a measurement regime produces a specific quantified representation, this influences the actors who can relate themselves to the polity (Corry 2013, 97). When the object “climate” became represented by metrics as a geophysical entity, this led to the establishment of new governance subjects such as the Intergovernmental Panel on Climate Change, which focuses on geophysical interventions (Allan 2017). On the other hand, a measurement regime has a direct participation effect. Each measurement regime comes with a specific constituency that produces its metrics and this constituency participates in the polity. The geophysical notion of the climate entailed better financing of physicists to produce quantified representations of the climate; they became an important member of the climate constituency (Allan 2017).

Third, measurement regimes can influence the relationship between governance objects and subjects in a polity. The quantified representation of an object affects how the governance subjects in a polity act upon the object. Current governance subjects in global climate politics focus on interventions such as CO2 certificates to affect the climate—this is shaped by the geophysical metrics of the governance object “climate” (Allan 2017). This is what I characterize as the intervention-mode effect of measurement regimes. By representing governance objects in a specific manner, measurement regimes influence choices between different modes of interventions. This effect has been described by governmentality theory. Thus, the establishment of new health metrics like the Disability Adjusted Life Years Index (DALY) had led to interventions that economized life in health politics—the measurement regime exerted what I describe as an intervention-mode effect (Kenny 2015).

Measurement Regimes in International Health Politics

The paper provides an historical qualitative analysis of two measurement regimes and their polity effects (Thies 2002). Other scholars have demonstrated the feasibility of historical analysis to support conceptual arguments based on STS (e.g., Latour 1993; Anderson 2006; Seth 2017). Historical qualitative analysis typically shifts from secondary to primary sources when the information from secondary sources is regarded as insufficient (Trachtenberg 2009, 140). For the analysis of the analogue regime, I was able to largely rely on secondary sources due to well established research from political science, sociology and historical scholarship. As additional primary sources, I analyzed the WHO statistical yearbooks since World War II (e.g., World Health Organization 1952, 1962, 1971). This corpus provided additional information on the participation effect of the analogue regime. The analysis of the digital regime and its polity effects is more strongly based on the analysis of primary sources. I analyzed the publications from former or current members of the IHME to establish the characteristics of the digital measurement regime exhaustively (e.g., Murray 1987; Murray, Lopez, and Wibulpolprasert 2004; Lopez et al. 2006; Kulikoff et al. 2016; Murray and Lopez 2017; Leach-Kemon and Gall 2018). A broader use of primary sources—for example, from different national statistical archives—would have provided a more directly informed analysis; still, the information from the analyzed secondary and primary sources was considered sufficient to assess the conceptual arguments on measurement regimes and their polity effects.

Historical qualitative analysis in the study of international politics aims at establishing reliable information to assess conceptual arguments empirically (Thies 2002;

Table 1. Measurement regimes in international health politics and their polity effects

		The analogue regime	The digital regime
Measurement regime	Infrastructure	Fragmented global reach, international organizations compile data from national statistical offices	Lean private infrastructure to challenge public data gathering
	System of classification	Stable focus on mortality based on the International List of Causes of Death/Diseases	Contingent reclassification of data with digital technologies
	Constituency	Medical and statistical experts; tensions between center and periphery	Medical, statistical, and modeling experts; tension toward disease specialists
Polity effects	Problematization effect	Development of nation states in the Global North as global reference point	Constantly shifting focus to neglected diseases
	Participation effect	Expert centered but expansion toward Global South	Extension to private actors and a general public of passive users
	Intervention-mode effect	Support of development policies with nationwide impact	Prioritization of policies according to cost-effectiveness

Trachtenberg 2009, 30–50). In accordance, I analyzed both primary and secondary sources, guided by my conceptual argument on the polity effects of measurement regimes. I explored whether my concepts and their interactions reflect in the information on historical events, actions and situations provided by secondary and primary sources. I triangulated information from sources and utilized the historical method of source criticism to ensure reliability of the information. Source criticism assumes that all sources have to be evaluated considering the positionality of the author as sources are never neutral providers of information (Howell and Prevenier 2001; Thies 2002, 357). My analysis therefore reflected on the intention of the authors, their audience, their available knowledge, and the specific historical context. Reflections on positionality provided important information for the analysis, for example on the targeted audience of the WHO's statistical publications (c.f. p. 10).

As implied by the conceptualization of measurement regimes, the two analyzed regimes are not considered “analogue” or “digital” because of essentialist differences of their metrics. Both regimes are large sociotechnical assemblages that shape politics not only due to the metrics they produce. For example, they enable the participation of specific constituencies of metric producers into politics. The adverbs “digital” and “analogue” should therefore be understood as empirically justified denominators of both assemblages. Being aware of the heuristic function of historical sequencing, I locate the emergence of the analogue measurement regime in the mid-nineteenth century, producing international metrics largely unchallenged until the 1990s. The digital regime has been established since the 1990s. During recent years, the digital regime has apparently succeeded the analogue regime as the main network of producing international health metrics. Still, some elements of the analogue regime have been integrated into the digital regime, as

described in related scholarship (c.f. Ruppert and Scheel 2019). Table 1 provides a summary of the characteristics of the measurement regimes and their polity effects.

The Analogue Measurement Regime

In the following, I will analyze the infrastructure, classification system, and constituency of the analogue measurement regime. The regime focused especially on the production of mortality measurements and traces back its classification system to the mid-nineteenth century. This analysis will enable us to assess the polity effects due to the specificities of the analogue regime in the next section.

After World War I, a basic infrastructure was established to produce analogue international health metrics. Financed by the Rockefeller Foundation, the Service of Epidemiological Intelligence and Public Health Statistics at the League of Nations Health Organization (LNHO) calculated mortality statistics since 1921 and published the “World Health Statistics” series (Borowy 2005, 87). Still, this early infrastructure was highly fragile and it broke apart during the world financial crisis (Gorsky and Sirrs 2017, 375). After World War II, the newly founded WHO revived this series of annual statistical publications. The United Nations tried to establish a “World Statistical System” with UN organizations as its center of calculation (Latham 1946). In this statistical infrastructure, doctors worldwide were to register all deaths with an “International Form of Medical Certificate of Cause of Death” (Heintz 2012, 13), standardized according to the classifications of the International List of Causes of Death, which has been redefined as the International Classification of Diseases (ICD). The raw data was to be aggregated by national statistical offices into health metrics—highlighting the importance of the state in pre-digital knowledge production (Castells 2000). The United Nations Statistical Council would accumulate and disburse this standardized information for the benefit of the whole world (Ward 2004, 106). To support a global reach of this statistical system, the WHO set up national statistical committees around the globe to disburse knowledge of how to establish national statistical infrastructures (Ward 2004, 156–157). Still, the global extension of this infrastructure remained an unfulfilled promise. The infrastructure focused on the Global North, where the system of death registration could build on a public statistical infrastructure established over centuries (Heintz 2012, 14). In the Global South, the statistical infrastructure was highly deficient given colonizers’ lack of interest in setting up functioning statistical systems (Chassé 2016, 224–225). Conclusively, official health data could provide reports for just three African countries up to the 1970s (Gorsky and Sirrs 2017). Partly responding to these difficulties, international investment in the analogue infrastructure decreased in the 1970s (Mahapatra et al. 2007, 1659).

The classification system of the ICD was deeply engrained into this infrastructure; it provided templates for data gathering in national statistical offices around the world. This classification system—initially called the International List of Causes of Death—has a much longer history than the analogue infrastructure and can be traced back to 1853. Here, the international statistical congress “requested from William Farr and Marc d’Espine, of Geneva, to prepare an internationally applicable, uniform classification of death” (Hacking 1990, 53). After a long sequence of reworkings, in 1893 the first ICD was produced in Paris (World Health Organization 2004, 104). The new statistical standard made the international aggregation of national statistics possible, as it provided the categories of how to collect data globally. This list continues to be adjusted by international experts every 10 years; in 2019 the eleventh revision of what is now called the “International Statistical Classification of Diseases and Related Health Problems” was accepted by the member states of the WHO (The Lancet 2019). For the analogue regime, this classification system provides the standardized classifications for doctors around the world on how to assess a specific death statistically, enabling the international aggregation of

metrics. Over the centuries, the ICD grew from 200 categories to three major volumes and became deeply incorporated into medical training and practice— ensuring the longevity of the analogue regime (Bowker and Star 2000).³

While this classification system is key to the longevity and stability of the analogue regime, the constituency of the analogue regime remained strongly fragmented, responding to the broad scale of the infrastructure. The constituency is divided between actors close to the international center of calculation and actors at the margins of the infrastructure. After World War I, international bureaucrats acquired ownership over the center of the analogue regime at the LNHO. This “internationally minded cadre of public health experts” intended to guide the world toward a progressive future, in line with their convictions of social medicine (Gorsky and Sirrs 2017, 375). Statistical and medical experts dominated the constituency at the international level. In contrast, the constituency that was to classify the observations differed substantially from these international bureaucrats. For medical doctors, the data collection according to the ICD is a routine technique with low rewards and conducted with low scrutiny (Bowker and Star 2000, 23–24, 149). Besides a motivational gap between the center and the margins, the center imagines a globally highly trained workforce at the margins of the infrastructure with a basic knowledge of Greek and Latin to classify diseases (Bowker and Star 2000, 94). Still, in the Global South, the providers of health information often do not have this level of training (Jerven 2013). The constituency imagined at the center exists at the margins of the infrastructure only to a limited degree.

... and Its Polity Effects

These characteristics of the analogue measurement regime—a state centered assemblage, highly stable but at the same time internally fragmented—affected broader international health politics. Since the foundation of the League of Nations, problematization, participation, and modes of interventions in international health politics have been deeply shaped by the described characteristics of this measurement regime.

The analogue regime influenced the problematizations of international health politics in the twentieth century, on the one hand, as the infrastructure connected national statistical systems and therefore enabled the problematization of health on the scale of nation states. The regime built on “data that nation-states had computed and published or otherwise released through official channels. This meant that most of these reports did not include any global or regional numbers but only tabulated, country by country, the national statistics that these states had formally released” (Reubi 2018, 95). As argued before, the classification system of the ICD was utilized by a network of national statistical offices that provided data aggregated on the national level. On the other hand, the data supported not only a focus on nation states, but problematized the development of these states over long time spans, due to the deep embedding of the ICD standard into medical practice and the high comparability between editions of the ICD. The availability of such metrics made it possible to argue that the main problem of international health politics was to guide nations along one pre-written development path; deviation from this development path was regarded as a problem to be tackled by international actors (Wahlberg and Rose 2015, 61). This long-term development path was thereby the development path of the Global North—due to the limited extension of the analogue infrastructure, analogue metrics were simply not available for the Global South (Heintz 2012, 21–26). Instead of providing differentiated data for countries

³ After World War II, the ICD started to cover non-fatal diseases, too, allowing for the production of morbidity statistics (World Health Organization 2004, 106–107). Still, these classifications were never broadly utilized by national statistical offices.

of the Global South, the analogue regime established the development of mortality in the Global North as the most important reference point for international health politics in the pre-digital age.

The analogue regime was designed by statistical and medical experts and made international health politics into a sphere that favored participation of this constituency. Annual statistical publications demanded an expert reader to interpret the data. For example, WHO data entries were distinguished with an * for “preliminary, approximate, or estimated data,” ... for “data not available,” + for “data not yet available,” 0,0 for “magnitude less than half of unit employed,” an × for “unofficial data (or estimate),” and r for “revised data” (World Health Organization 1962, 9–21). The fragility of the analogue infrastructure that could not gather all information globally as intended was still reflected in these publications and not black-boxed in algorithmic reprocessing. The meta-information ensured transparency about this fragility but expected that an “informed reader will know that considerable differences still exist ... Any comparison that does not allow for this reservation runs the risk of coming to conclusions that will be [at] best hazardous” (World Health Organization 1952, 10). Thereby, the regime supported especially the participation of experts from the Global North. In 1971, the statistical reports of the WHO could order from book stores in twenty-two European countries; in Africa it was only available in bookstores in Nigeria, Morocco, Kenya, Democratic Republic of Congo, and Tunisia (World Health Organization 1971: cover).

At the same time, the analogue regime tried to exert a progressive direct participation effect by broadening the constituency of statistical experts toward the Global South—responding to the limits of the constituency at the margins of the infrastructure. The WHO supported statistical training as part of developing health planning capacities in the Global South in the 1950s (World Health Organization 1968, 285) and “recognized that the expansion of technical education by such methods as the granting of fellowships and the promotion of wider teaching facilities is an investment that gives returns out of all proportion” (Anonymous 1954, 251). Such international statistical knowledge transfer was to enable “a new post-colonial service to translate national aspirations into technocratic process” (Manton and Gorsky 2018, 446). Exercising a strong direct participation effect was regarded as even more important than providing a thorough representation of problems. The designers extended the aspirations of the regime—for example, when including morbidity statistics—knowing that the margins of the infrastructure did not have the constituency to produce metrics according to the standards of the ICD. This overburdening was to increase the demand for a new workforce of statistically trained experts who could steer national health systems (Bowker and Star 2000, 118). The analogue regime’s global extension of statistical and planning capacity was an imposition of ideas from the Global North on the Global South. Still, while imposing Western ideas, the regime at least tried to work toward the participation of a global statistical constituency; in contrast, digital knowledge production tends to centralize quantification practices at digital platforms (Taylor 2014).

The metrics of the analogue regime supported interventions that promised effects on a national scale—in a progressive and a fascist manner. The focus of the analogue regime on long-term mortality changes provided the factual basis for such types of grand interventions. Already when progressive advocates of social medicine utilized and designed the LNHO’s statistical yearbook, they saw the potential to argue with the metrics of the analogue regime for the global spread of Bismarck’s social insurance system as the most rational health system (Borowy 2005; Gorsky and Sirrs 2017). The Primary Health Care Agenda—following the Alma Ata conference in 1978—argued for the advantages of basic health systems and made supportive factual claims with mortality metrics of the analogue regime (Cueto 2004, 1869–1870). Maternal health advocacy groups referred to the long-term data of the analogue regime to stress societal and political determinants of maternal mortality (Béahgue

and Storeng 2013). On the other hand, the metrics of the analogue regime supported one of the most forceful international campaigns of post-war international health politics. For interventions against the “population explosion,” international population statistics provided a special sense of legitimacy (Connelly 2008, 125). In response, the transnational population control movement intervened with forceful sterilization campaigns and distribution of lethal contraception methods in the Global South to change birth rates. At the same time, the expert focus of the analogue regime made it difficult for broader publics to challenge such interventions—it took decades to debut arguments about engineering population growth despite early instances of critique (Connelly 2006).

The Digital Measurement Regime

Since the 1990s, new types of digital quantification practices enabled the calculation of new metrics like the DALY. The following section describes how these new digital quantification practices entailed a different infrastructure, classification system, and constituency compared to the analogue measurement regime. This analysis will make it possible to connect this new measurement regime with a very different type of polity effects compared to the analogue regime.

The first rudimentary digital infrastructure became established for the calculation of the DALY and the burden of disease study for the World Bank report, “Investing in Health,” in 1993 (Smith 2015). The new type of digitally estimated metrics was used for cost-effectiveness studies on health interventions. Afterwards, the regime became briefly embedded into the WHO until experts at the WHO developed a more critical position toward digital econometric techniques for calculating health metrics (Jensen 2017, 148). In 2007, Bill Gates and BMGF committed a first grant over \$105 million to set up the IHME in Seattle with Chris Murray as its director—following up a withdrawn funding commitment from another digital entrepreneur, Oracle founder Larry Ellison (Horton 2005; Paulson 2007). With this funding from surveillance capitalists (Zuboff 2015), the IHME has produced digital metrics to consciously challenge the WHO’s authority over the production of metrics (Murray, Lopez, and Wibulpolprasert 2004). To support the authority of these metrics, the institute incorporates a broad network of disease experts as advisors for its quantification practices (Murray and Lopez 2017, 1461). With the organizational embedding of the infrastructure at the IHME, the number of metrics increased beyond the DALY and related measurements. The institute proceeded to metrics on health risk factors or international health financing besides the content of the original burden of disease study (Lopez et al. 2006). As the digital regime stabilized and became more influential due to this organizational embedding, the WHO lost its principled opposition. Under the secretary general Tedros Adhanom, the WHO and the IHME signed a Memorandum of Understanding. From 2018 onwards, the “WHO will make full use of the GBD [Global Burden of Disease] data and analyses and publish summary GBD estimates in WHO policy documents” (World Health Organization 2018). Following a more general trend to locate governing expertise outside of IOs (Seabrooke and Sending 2019), the WHO has accepted the metrics of the digital regime as even more valuable for its internal restructuring than the metrics calculated in-house (Horton 2019).

Where the analogue regime inscribed the most important classification decisions into the ICD, the digital regime builds on the dynamic reclassification of existing data. The big data approach utilizes all types of information from health surveys to economic statistics, scientific publications, and mortality data from the analogue regime. According to Chris Murray, these metrics classified observations in a deficient manner and could only be used as raw data (Murray 1987). In response, the digital regime reclassifies this information with algorithms and econometric methods, and calculates metrics based on reclassified “correct” data.

With the DisMod tool, the digital regime developed algorithmic and econometric techniques for reclassifying the current 60,000 data sources (Leach-Kemon and Gall 2018). This complicated and contingent process of algorithmic reclassification led to claims that metrics of the digital regime were not trustworthy, echoing scholarly debate about new algorithmic knowledge based mainly on correlative truth claims (Fuchs and Chandler 2019, 6). Thereby, these digital re-classification practices arguably empower the researcher who applies the algorithm even more than they empower the algorithm itself. Lead researchers become the final authority on whether “something has gone wrong with the numbers” during the digital reclassification (Smith 2015, 182–183). In the process of algorithmic reclassification, countries can be wrongly classified as having an outbreak of a disease like cholera and the data needs to be checked manually for such inconsistencies. In response, the IHME and other institutes established the GATHER initiative to “release documentation for each source, provide an online searchable catalogue of all sources used, and post the code for each step in the analysis” (Murray and Lopez 2017, 1462). While this initiative makes the process of reclassification visible, the econometric methods still cut off the direct link between observations and the representing metrics that was more or less present in the analogue regime; they demand more trust in the contingent decisions of the regime.

The constituency of the digital regime integrates experts both from medical science and demography, similar to the analogue regime. Its lead scientist, Chris Murray, trained as a medical doctor and as a health economist while Allan Lopez, the second founding director of the IHME, had worked as a demographer for the WHO (Smith 2015, 90–91). In addition, modeling experts who work with econometric methods constitute the core of the constituency. For the calculation of metrics, “health economics (or at least its language and conceptual frame) became the dominant discipline among the data providers” (Gorsky and Sirrs 2017, 381). These actors came from elite organizations like the World Bank or Harvard (Jensen 2017, 138) and are predominantly white and male (Kulikoff et al. 2016). Major tensions within the constituency occurred between modelers and disease specialists. Thus, the digital regime could not be embedded within the WHO because of resistance from specialist units that had focused on specific diseases. These units had calculated their own data; a centralized econometric recalculation challenged their data ownership (Smith 2015, 194–195). In a similar vein, controversies took place between the digital regime and maternal mortality advocates. The digital regime’s reclassification of existing metrics challenged the metrics of this advocacy network, which had been designed to increase attention on maternal mortality (Storeng and Béhague 2017). Where the analogue regime had provided disease-specific mortality data for each disease-specific constituency, the digital regime’s reclassification practices challenged such metrics. This challenge of traditional expert authorities was a major obstacle for the early phase of the digital regime. Arguably, they could only be overcome due to the high financial and ideational support of the BMGF.

... and Its Polity Effects

The stark differences between the digital regime and the analogue regime in infrastructure, classification system, and constituency did not remain without consequences. With regard to the problematization effect, the analogue regime supported a focus on the problem of national development. In contrast, the digital regime shaped international health politics as a field that constantly searches for neglected issues to be problematized. The regime reclassifies raw data with algorithms to represent all types of diseases in a clean database. When there is no appropriate data, it estimates the metrics; the digital regime tries to know everything, no matter with what quality of knowledge, in order to avoid non-knowledge (Aradau 2017). Otherwise, there is a “risk that policy debates could focus on well

documented or popular health issues to the exclusion of poorly documented or ignored challenges that could turn out to be of greater relevance to improvement of a population's health" (Murray and Lopez 2017, 1460). The DALY supports this problematization effect especially. This summary measurement—calculated based on the digitally cleaned database—weights the disease burden of all diseases according to the unit of healthy life years lost (Kenny 2015). The total comparability of all diseases enables a continuous search for diseases that had been neglected in terms of "healthy years lost" and captured by "measurement traps" (Storeng and Béhague 2017). Accordingly, the digital regime can be aligned with various shifts of focus within international health politics toward issues considered neglected. With metrics from the digital regime, mental health claimed importance in the 1990s (Wahlberg and Rose 2015, 68–70). Based on the DALY, a debate about the focus of pharmaceutical production on diseases of the Global North started in the 1990s (Smith 2015, 50). The shift of international politics toward non-communicable diseases in the Global South was justified in the 2000s with reference toward metrics from the digital regime (Reubi, Herrick, and Brown 2016). Arguably, the detached positioning of the digital regime's constituency and infrastructure from established international health organizations provides further incentives to contradict conventional wisdom—the IHME received philanthropic funding to be disruptive and to shift international health toward new problems.

The digital regime supports the increasing participation of digital modelers—mainly white and male—besides statisticians and medical professionals within international health politics. Compared to the analogue regime, the digital regime does not depend on the extension of a global statistical workforce to classify observations within the widely spread public statistical infrastructure. The Weberian state, and its statistical personnel, is less important as a vehicle of information gathering in digitalized practices of quantification (Hanrieder 2015, 209–211). Therefore, the digital regime lowered international attention on the extension of the public statistical workforce into the Global South, despite the broader advantages of statistical training for tasks such as the steering of health systems (Jerven 2018). Besides this direct participation effect, the digital regime supported—mediated by its metrics—the participation of private actors in international health politics. In the 2000s, private or quasi-private actors, such as Gavi and the Global Fund to Fight AIDS, Tuberculosis and Malaria, became main funding organizations for international health (Dieleman et al. 2016, 5). These actors conduct a small number of focused interventions such as distributing antiviral medication against HIV and AIDS or childhood vaccines. Digital metrics supported the rise of such specialized actors because they are highly flexible in scale—echoing digitality's ability to reconfigure space (Castells 2000)—and depict the effect of any intervention, be it even of granular size such as a Malaria diagnostic tool of a single start-up (Shillcutt et al. 2008). In contrast, the analogue regime had made the international observation of interventions possible, which affected health on a national scale. This privileged states as implementers of policies; they could convincingly claim to affect health status on a very broad scale. In contrast, the privately funded infrastructure of the digital regime supports private actors supplying small-scale interventions in the international health polity.

The digital regime exerts another indirect participation effect by extending beyond the expert audiences of the analogue regime toward "community members, knowledge brokers, policy makers, and health agencies" (Kulikoff et al. 2016). It produces digital data visualization that depict health data in an interactive manner; algorithms make it possible to depict the data according to various dimensions such as time, space, risk factors, age, or sex (IHME 2019). In 2016, the IHME stated that "more than 400,000 people have accessed compelling, easy-to-use visualizations of comprehensive global health estimates through IHME's GBD Compare tool" (Kulikoff et al. 2016). This direct and interactive accessibility of the metrics on the GBD compare platform is possible because of the cleanness of the

reclassified data. Analogue data shows gaps or aggregation mismatches while switching between dimensions of a data set—digital reclassification of the data and algorithmic data representations avoid such inconveniences for the user (Just and Latzer 2017). At the same time, and as introduced before, these digital practices have consequences. The connection between metrics and observations can no longer be traced by the user, as reclassification of data and the algorithmic depiction of data is black-boxed (Pasquale 2015). The IHME accepts the lower transparency of their reclassified metrics, but argues that such was needed as “a useful tool for helping decision-makers develop a better understanding of health trends in their country, their region, and the world” (Leach-Kemon and Gall 2018). The analogue regime supported the participation of a narrow constituency of experts that could make sense of the transparent fragility of the infrastructure; the digital regime extends participation toward a large number of users who know only the surface of the digitally represented metrics.

The digital regime supports interventions that promise high cost-effectiveness—this echoes arguments that the rise of digital surveillance capitalism builds on the neoliberal structured society (Zuboff 2015). The regime reclassifies data into a clean database with comparable metrics for all diseases. Therefore, the regime can calculate for all possible interventions summary measurements of how many “healthy years” can be gained (Kenny 2015). The digital metrics provide knowledge to actors in international health politics about whether they gain more healthy years per dollar—measured in DALYs—if they vaccinate a child or build a latrine, and denote which “activities stand out because they are highly cost-effective” (World Bank 1993, 8). Since 2000, 479 cost-effectiveness studies have been based on the DALY and its measurement of healthy years gained (Leech et al. 2018, 760). These cost-effectiveness studies have shaped the mode of intervention of highly influential actors in international health politics. For the BMGF, the “starting point in deciding where to focus has been the disease burden in developing countries, as measured by disability-adjusted life years (DALYs)” (BMGF 2010, 1–4). The DALY metric even convinced Bill Gates that his entrepreneurial style—focusing on metrics to decide which project to fund—can be translated into international health politics and motivated the establishment of the BMGF (Herper 2011). In comparison, the former analogue regime produced metrics that supported interventions that could promise to affect long-term national development paths. During its contested embedding at the WHO, the digital regime even enabled the comparison of the cost-effectiveness of health systems as if different health systems could be regarded as a menu of projects to choose from. The World Health Report from 2000 described “how to set priorities for which services health systems should provide, and at the choices and mechanisms involved in rationing so as to make priorities effective” (World Health Organization 2000, 50). This outgrowth of cost-effectiveness studies was vividly contested by member states of the WHO (Almeida et al. 2001). Still, a few years later, the WHO accepted the value of these digital metrics and regards them as useful even for the WHO’s internal reorganization (Horton 2019).

Conclusion

This paper compared how analogue and digital measurement regimes have shaped the international health polity. Based on STS and related work in international political sociology, I conceptualized measurement regimes as assemblages of quantification practices that contain an infrastructure, a classification system, and a constituency. Engaging with polity theory, I argued that both the analogue and the digital regime shaped who participates, what is problematized, and what the modes of interventions are in international health politics. Based on these concepts, I compared the historical shift from an analogue to a digital regime of quantifying health and how this shift contributed to different types of polities underlying international

health politics (c.f. p. 7, Table 1). The analogue measurement regime established the deviation of national populations from the Western development path as the main problem of international health. In contrast, the digital regime has problematized neglected health issues, supported a focus on cost-effectiveness and opened-up international health politics for private and lay actors.

This paper contributes to debates in international political sociology on the political importance of metrics and quantifications (Hansen and Porter 2012; Rocha de Siqueira 2017). Going beyond Robinson's finding that quantification establishes transnational governance objects (Robinson 2018), I showed that quantification practices influence the participants, problems, and intervention modes of international politics. Future research can build on the developed concepts to analyze the polity effects of other assemblages producing metrics. Possibly, the polity effects of assemblages producing other types of representations—such as images, texts, or sounds—can be fruitfully analyzed with the developed concepts, too. Following up the call for an international political sociology of health (Howell 2012), I established the importance of quantification practices for the basic characteristic of international health politics: The shift toward digital quantification practices has contributed to a reconfiguration of international health politics.

Does this analysis provide insights into the rise of the digital beyond international health politics? Current social science scholars largely deploy dystopian narratives to describe current digital societies. On the one hand, my analysis aligns with such dystopian perspectives. The rise of information sharing platforms, like the IHME's "GBD compare" tool, has undermined the epistemic authority of the WHO, just as social media platforms challenge state authority in the broader society (c.f. van Dijck, Poell, and Waal 2018). The problem of black-boxed algorithms prevails in everyday life and in international health politics; the calculation of international health metrics has become obscure, even for experts (c.f. Pasquale 2015). Surveillance capitalists—most notably in the influence of the BMGF—have refocused international health to private actors by financially supporting the digital regime (c.f. Zuboff 2015). At the same time, the historical comparison with the analogue regime puts current scholarly dystopias of the digital into perspective. Digital platforms for information distribution enabled the participation of the lay public, making international health a subject not only for international elites. Where the analogue regime had produced the same metrics for decades, the digital regime made it possible to focus on the unknowns of international health (Aradau 2017). The trust in digital estimation techniques established a focus on formerly neglected health issues of the Global South.

Therefore, my historically comparative perspective supports not the rejection of the digital regime, but political action to preserve the advantages of the analogue regime. It remains important to build statistical capacity in the Global South, although such expertise is less needed for digital data production—otherwise, there will be no workforce to interpret current health metrics meaningfully (Jerven 2018). We should remain wary of private engagement in international health politics. Although private financing can support extended knowledge production, privately funded digital quantification practices can end up supporting especially the activities of private actors. We should continue limiting the black-boxing of data calculation. Although black-boxing improves accessibility for the lay public, we risk becoming more informed and less knowledgeable when we can only know the surface of our metrics.

Funder Information

This research has benefited from the support of the Volkswagen Foundation Freigeist program.

Acknowledgments

This article has benefited from the feedback of many colleagues. I thank in particular Bentley Allan, Katja Freistein, Frank Gadinger, Sassan Gholiagha, Tine Hanrieder, Anna Holzscheiter, Katharina Krause, Ole Jacob Sending, Nadine Voelkner, the members of the WZB Global Governance colloquium and anonymous reviewers and editors of *International Political Sociology*. I also thank Barçın Uluişik for her editorial support.

References

- ALLAN, BENTLEY B. 2017. "Producing the Climate: States, Scientists, and the Constitution of Global Governance Objects." *International Organization* 71 (1): 131–62.
- ALMEIDA, CELIA MARIA DE, PAULA BRAVEMAN, MARTHE R. GOLD, CELIA LANDMANN SZWARCOWALD, JOSE MENDES RIBEIRO, AMERICO MIGLIONICO, JOHN S. MILLAR, SILVIA MARTA PORTO, NILSON DO ROSARIO COSTA, AND VINCENTEORTUN RUBIO. 2001. "Methodological Concerns and Recommendations on Policy Consequences of the World Health Report 2000." *Lancet* 357 (9269): 1692–7.
- ANDERSON, WARWICK. 2006. *Colonial Pathologies: American Tropical Medicine, Race, and Hygiene in the Philippines*. Durham: Duke University Press.
- ANONYMOUS. 1954. "Training of Statistical Personnel: Role of the World Health Organization." *Bulletin of the World Health Organization* 11 (1–2): 251–5.
- ARADAU, CLAUDIA. 2017. "Assembling (Non) Knowledge: Security, Law, and Surveillance in a Digital World." *International Political Sociology* 11 (4): 327–42.
- ARADAU, CLAUDIA, AND TOBIAS BLANKE. 2018. "Governing Others: Anomaly and the Algorithmic Subject of Security." *European Journal of International Security* 3 (1): 1–21.
- BÉHAGUE, DOMINIQUE, AND KATERINI STORENG. 2013. "Pragmatic Politics and Epistemological Diversity: The Contested and Authoritative Uses of Historical Evidence in the Safe Motherhood Initiative." *Evidence and Policy: A Journal of Research, Debate and Practice* 9 (1): 65–85.
- BIGO, DIDIER, AND MIKAEL R. MADSEN. 2011. "Introduction to Symposium. 'A Different Reading of the International': Pierre Bourdieu and International Studies." *International Political Sociology* 5 (3): 219–24.
- BIRN, ANNE-EMANUELLE. 2009. "The Stages of International (Global) Health: Histories of Success Or Successes of History?" *Global Public Health* 4 (1): 50–68.
- BISHOP, ANN PETERSON, LAURA J. NEUMANN, SUSAN LEIGH STAR, CECELIA MERKEL, EMILY IGNACIO, AND ROBERT J. SANDUSKY. 2000. "Digital Libraries: Situating Use in Changing Information Infrastructure." *Journal of the American Society for Information Science* 51 (4): 394–413.
- BMGF. 2010. "Bill and Melinda Gates Foundation: Global Health Strategy Overview." Accessed March 18, 2020. <https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwi3teKyZzQAhVBPBQKHYGPCAsQFggaMAA&url=https%3A%2F%2Fdocs.gatesfoundation.org%2Fdocuments%2Fglobal-health-strategy-overview.pdf&usq=AFQjCNFW3xA5AsY7KrtorJkFLPBhtkHPMw&bvm=bv.138169073,d.d24&cad=rja>.
- BOROWY, IRIS. 2005. "World Health in a Book—The International Health Yearbooks." In *Facing Illness in Troubled Times*, edited by Iris Borowy, and Wolf D. Gruner. Oxford: Peter Lang.
- BOWKER, GEOFFREY C., AND SUSAN LEIGH STAR. 2000. *Sorting Things Out: Classification and its Consequences*. Cambridge: MIT Press.
- BROOME, ANDRÉ, AND LEONARD SEABROOKE. 2012. "Seeing Like an International Organisation." *New Political Economy* 17 (1): 1–16.
- BUEGER, CHRISTIAN. 2015. "Making Things Known: Epistemic Practices, the United Nations, and the Translation of Piracy." *International Political Sociology* 9 (1): 1–18.
- CASTELLS, MANUEL. 2000. *The Rise of the Network Society*. Oxford: Blackwell Publishers.
- CHASSÉ, DANIEL SPEICH. 2016. "The Roots of the Millennium Development Goals: A Framework for Studying the History of Global Statistics." *Historical Social Research/Historische Sozialforschung* 41 (2): 218–37.
- CLARKE, ADELE E. 2010. "In Memoriam: Susan Leigh Star (1954–2010)." *Science, Technology and Human Values* 35 (5): 581–600.
- CONNELLY, MATTHEW. 2006. "Seeing Beyond the State: The Population Control Movement and the Problem of Sovereignty." *Past and Present* 193 (1): 197–233.
- CONNELLY, MATTHEW JAMES. 2008. *Fatal Misconception: The Struggle to Control World Population*. Cambridge, MA: Harvard University Press.
- CORRY, OLAF. 2013. *Constructing a Global Polity: Theory, Discourse and Governance*. London: Palgrave Macmillan.

- . 2014. "Global Assemblages and Structural Models of International Relations." In *Reassembling International Theory*, edited by Michele Acuto, and Simon Curtis. London: Palgrave Pivot.
- CUETO, MARCOS. 2004. "The Origins of Primary Health Care and Selective Primary Health Care." *American Journal of Public Health* 94 (11): 1864–74.
- DIELEMAN, JOSEPH L., MATTHEW T. SCHNEIDER, ANNIE HAAKENSTAD, LAVANYA SINGH, NAFIS SADAT, MAXWELL BIRGER, ALEX REYNOLDS, TARA TEMPLIN, HANNAH HAMAVID, AND ABIGAIL CHAPIN. 2016. "Development Assistance for Health: Past Trends, Associations, and the Future of International Financial Flows for Health." *The Lancet* 387 (10037): 2536–44.
- FUCHS, CHRISTIAN, AND DAVID CHANDLER. 2019. "Introduction." In *Digital Objects, Digital Subjects: Interdisciplinary Perspectives on Capitalism, Labour and Politics in the Age of Big Data*, edited by Dave Chandler, and Christian Fuchs. London: University of Westminster Press.
- GARNHAM, NICHOLAS. 1998. "Information Society Theory as Ideology: A Critique." *Loisir et société/Society and Leisure* 21 (1): 97–120.
- GORSKY, MARTIN, AND CHRISTOPHER SIRRS. 2017. "World Health By Place: The Politics of International Health System Metrics, 1924–c. 2010." *Journal of Global History* 12 (3): 361–85.
- HACKING, IAN. 1990. *The Taming of Chance*. Cambridge: Cambridge University Press.
- HANRIEDER, TINE. 2015. "WHO Orchestrates? Coping with Competitors in Global Health." In *International Organizations as Orchestrators*, edited by Kenneth W. Abbott, Philipp Genschel, Duncan Snidal, and Bernhard Zangl. Cambridge: Cambridge University Press.
- . 2019. "How Do Professions Globalize? Lessons from the Global South in US Medical Education." *International Political Sociology* 13 (3): 296–314.
- HANSEN, HANS KRAUSE, AND TONY PORTER. 2012. "What Do Numbers Do in Transnational Governance?" *International Political Sociology* 6 (4): 409–26.
- HEINTZ, BETTINA. 2012. "Welterzeugung Durch Zahlen Modelle Politischer Differenzierung in Internationalen Statistiken, 1948–2010." *Soziale Systeme* 18 (1–2): 7–39.
- HERPER, MATTHEW. 2011. "With Vaccines, Bill Gates Changes the World Again." *Forbes Magazine*, November 11.
- HORTON, RICHARD. 2005. "The Ellison Institute. Monitoring Health, Challenging WHO." *The Lancet* 366 (9481): 179–81.
- . 2019. "Offline: WHO Powers Up in 2019." *Lancet* 393 (10166): 14.
- HOWELL, ALISON. 2012. "Toward an International Political Sociology of Health and Medicine." *International Political Sociology* 6 (3): 315–6.
- HOWELL, MARTHA C., AND WALTER PREVENIER. 2001. *From Reliable Sources: An Introduction to Historical Methods*. London: Cornell University Press.
- IHME. 2019. *GBD Compare*. Accessed August 3, 2020, <https://vizhub.healthdata.org/gbd-compare/>.
- JENSEN, NELE. 2017. "A Genealogy of Evidence At the WHO." In *Global Health and Geographical Imaginaries*, edited by Clare Herrick, and David Reubi. London: Routledge.
- JERVEN, MORTEN. 2013. *Poor Numbers: How We Are Misled by African Development Statistics and What to Do About It*. London: Cornell University Press.
- . 2018. "Beyond Precision: Embracing the Politics of Global Health Number." *Lancet* 392 (10146): 468–9.
- JUST, NATASCHA, AND MICHAEL LATZER. 2017. "Governance By Algorithms: Reality Construction By Algorithmic Selection on the Internet." *Media, Culture & Society* 39 (2): 238–58.
- KENNY, KATHERINE E. 2015. "The Biopolitics of Global Health: Life and Death in Neoliberal Time." *Journal of Sociology* 51 (1): 9–27.
- KESSLER, OLIVER. 2009. "Toward a Sociology of the International? International Relations Between Anarchy and World Society." *International Political Sociology* 3 (1): 87–108.
- KNORR CETINA, KARIN. 2009. *Epistemic Cultures. How the Sciences Make Knowledge*. Cambridge, MA: Harvard University Press.
- KULIKOFF, XIE RACHEL, JULIA MORRIS, GRANT NGUYEN, ALISON SMITH, AND TARA TEMPLIN. 2016. "Health Metrics Priorities: A Perspective from Young Researchers." *The Lancet* 388 (10058): 2353–4.
- LATHAM, EARL. 1946. "One Statistical World." *Journal of the American Statistical Association* 41 (235): 275–92.
- LATOUR, BRUNO. 1993. *The Pasteurization of France*. Cambridge, MA: Harvard University Press.
- LEACH-KEMON, KATHERINE, AND JULIA GALL. 2018. "Why Estimate?" Accessed August 3, 2020. http://www.healthdata.org/acting-data/why-estimate?utm_source=IHME+Updates&utm_campaign=c062742ac8-Weekly_Email_Sep_6_2018&utm_medium=email&utm_term=0_1790fa6746-c062742ac8-422249913.
- LEECH, ASHLEY A., DAVID D. KIM, JOSHUA T. COHEN, AND PETER J. NEUMANN. 2018. "Use and Misuse of Cost-Effectiveness Analysis Thresholds in Low-and Middle-Income Countries: Trends in Cost-per-DALY Studies." *Value in Health* 21 (7): 759–61.

- LOPEZ, ALAN D., COLIN D. MATHERS, MAJID EZZATI, DEAN T. JAMISON, AND CHRISTOPHER J. L. MURRAY. 2006. "Global and Regional Burden of Disease and Risk Factors, 2001: Systematic Analysis of Population Health Data." *Lancet* 367 (9524): 1747–57.
- LUPTON, DEBORAH. 2016. *The Quantified Self*. Cambridge: Polity Press.
- MAHAPATRA, PRASANTA, KENJI SHIBUYA, ALAN D. LOPEZ, FRANCESCA COULLARE, FRANCIS C. NOTZON, CHALAPATI RAO, AND SIMON SZRETER. 2007. "Civil Registration Systems and Vital Statistics: Successes and Missed Opportunities." *Lancet* 370 (9599): 1653–63.
- MANTON, JOHN, AND MARTIN GORSKY. 2018. "Health Planning in 1960s Africa: International Health Organisations and the Post-Colonial State." *Medical History* 62 (4): 425–48.
- MURRAY, CHRISTOPHER J.L. 1987. "A Critical Review of International Mortality Data." *Social Science & Medicine* 25 (7): 773–81.
- MURRAY, CHRISTOPHER J., AND ALAN D. LOPEZ. 2017. "Measuring Global Health: Motivation and Evolution of the Global Burden of Disease Study." *Lancet* 390 (10100): 1460–4.
- MURRAY, CHRISTOPHER J., ALAN D. LOPEZ, AND SUWIT WIBULPOLPRASERT. 2004. "Monitoring Global Health: Time for New Solutions." *BMJ (Clinical Research Ed.)* 329 (7474): 1096–100.
- NEUMANN, IVER, AND OLE JACOB SENDING. 2010. *Governing the Global Polity: Practice, Mentality, Rationality*. Ann Arbor: University of Michigan Press.
- PASQUALE, FRANK. 2015. *The Black Box Society*. Cambridge, MA: Harvard University Press.
- PAULSON, TOM. 2007. "\$105 Million Gates' Gift Helps Start Global Health Center." Accessed August 3, 2020. <http://www.seattlepi.com/local/article/105-million-Gates-gift-helps-start-global-1239473.php>.
- REUBI, DAVID. 2018. "A Genealogy of Epidemiological Reason: Saving Lives, Social Surveys and Global Population." *BioSocieties* 13 (1): 81–102.
- REUBI, DAVID, CLARE HERRICK, AND TIM BROWN. 2016. "The Politics of Non-communicable Diseases in the Global South." *Health and Place* 39: 179–87.
- ROBINSON, COREY. 2018. "Making Migration Knowable and Governable: Benchmarking Practices As Technologies of Global Migration Governance." *International Political Sociology* 12 (4): 418–37.
- ROCHA DE SIQUEIRA, ISABEL. 2017. Development By Trial and Error: The Authority of Good Enough Numbers." *International Political Sociology* 11 (2): 166–84.
- RUPPERT, EVELYN, ENGIN ISIN, AND DIDIER BIGO. 2017. "Data Politics." *Big Data and Society* 4 (2): 1–7.
- RUPPERT, EVELYN, AND STEPHAN SCHEEL. 2019. "The Politics of Method: Taming the New, Making Data Official." *International Political Sociology* 13 (3): 233–52.
- SEABROOKE, LEONARD, AND OLE JACOB SENDING. 2019. "Contracting Development: Managerialism and Consultants in Intergovernmental Organizations." *Review of International Political Economy* 27 (4): 802–27.
- SETH, SUMAN. 2017. "Colonial History and Postcolonial Science Studies." *Radical History Review* 2017 (127): 63–85.
- SHILLCUTT, SAMUEL, CHANTAL MOREL, CATHERINE GOODMAN, PAUL COLEMAN, DAVID BELL, CHRISTOPHER J. M. WHITTY, AND A. MILLS. 2008. "Cost-effectiveness of Malaria Diagnostic Methods in Sub-Saharan Africa in an Era of Combination Therapy." *Bulletin of the World Health Organization* 86: 101–10.
- SIMONS, ARNO, AND JAN-PETER VOSS. 2018. "The Concept of Instrument Constituencies. Accounting for Dynamics and Practices of Knowing Governance." *Policy and Society* 37 (1): 14–35.
- SMITH, JEREMY. 2015. *Epic Measures. One Doctor, Seven Billion Patients*. New York: Harper Wave.
- STAR, SUSAN LEIGH. 1990. "Power, Technology and the Phenomenology of Conventions: On Being Allergic to Onions." *The Sociological Review* 38 (1_suppl): 26–56.
- . 1999. "The Ethnography of Infrastructure." *American Behavioral Scientist* 43 (3): 377–91.
- STAR, SUSAN LEIGH, AND KAREN RUHLER. 1996. "Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces." *Information Systems Research* 7 (1): 111–34.
- STORENG, KATERINI T., AND DOMINIQUE P. BÉHAGUE. 2017. "Guilty Until Proven Innocent: The Contested Use of Maternal Mortality Indicators in Global Health." *Critical Public Health* 27 (2): 163–76.
- TAYLOR, ASTRA. 2014. *The People's Platform: Taking Back Power and Culture in the Digital Age*. London: Fourth Estate.
- THE LANCET. 2019. "ICD-11." *Lancet* 393 (10188): 2275.
- THIES, CAMERON G. 2002. "A Pragmatic Guide to Qualitative Historical Analysis in the Study of International Relations." *International Studies Perspectives* 3 (4): 351–72.
- TRACHTENBERG, MARC. 2009. *The Craft of International History: A Guide to Method*. Princeton: Princeton University Press.
- VAN DIJCK, JOSÉ, THOMAS POELL, AND MARTIJN DE WAAL. 2018. *The Platform Society: Public Values in a Connective World*. Oxford: Oxford University Press.
- WAHLBERG, AYO, AND NIKOLAS ROSE. 2015. "The Governmentalization of Living: Calculating Global Health." *Economy and Society* 44 (1): 60–90.
- WARD, MICHAEL. 2004. *Quantifying the World: UN Ideas and Statistics*. Bloomington: Indiana University Press.

- WORLD BANK. 1993. *World Development Report 1993. Investing in Health*. TheWorld Bank.
- WORLD HEALTH ORGANIZATION (WHO). 1952. *Annual Epidemiological and Vital Statistics 1947–1949. Part 1, Vital Statistics and Causes of Death*. Geneva: World Health Organization.
- . 1962. *Annual Epidemiological and Vital Statistics 1959*. Geneva: World Health Organization.
- . 1968. *The Second Ten Years of the World Health Organization, 1958–1967*. Geneva: World Health Organization.
- . 1971. *World Health Statistical Annual. 1968, Volume 1, Vital Statistics and Cause of Death*. Geneva: World Health Organization.
- . 2000. *The World Health Report 2000: Health Systems: Improving Performance*. Geneva: World Health Organization.
- . 2004. *ICD-10. International Statistical Classification of Diseases and Related Health Problems. Volume 2: Instruction Manual*. Geneva: World Health Organization.
- . 2018. “New Memorandum of Understanding Between WHO and IHME Brings Better Data and Evidence for More Informed Decision-making for Health.” Accessed March 18, 2020. <http://www.euro.who.int/en/data-and-evidence/news/news/2018/7/new-memorandum-ofunderstanding-between-who-and-ihme-brings-better-data-and-evidence-for-more-informed-decisionmaking-for-health>.
- ZUBOFF, SHOSHANA. 2015. “Big Other: Surveillance Capitalism and the Prospects of an Information Civilization.” *Journal of Information Technology* 30 (1): 75–89.