Global Perspectives on Health Geography

Melinda Laituri · Robert B. Richardson
Junghwan Kim *Editors*

The Geographies of COVID-19

Geospatial Stories of a Global Pandemic

Springer

Global Perspectives on Health Geography

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This book is dedicated to the scientists and researchers around the world who have contributed to our understanding of the global pandemic. And to the lives lost – 6,000,000 and counting.

Foreword

I count myself fortunate to have had the opportunity to work with Dr. Melinda Laituri and Dr. Robby Richardson during their tenures as Jefferson Science Fellows in the U.S. Department of State's Office of the Geographer and Global Issues, which I direct in my role as the Department's Geographer. This office conducts research and analysis with a geographer's lens on a broad range of issues that includes, among others, food security, water security, climate change, migration, infectious disease, and human rights. The COVID-19 global pandemic impacts each of these issues, regionally and differentially. And I can think of few scientists better positioned than the editors of this book to provide expert guidance in stitching together this collection of geospatial "stories" the pandemic has spawned.

During the course of their fellowships in the Office of the Geographer, Dr. Laituri and Dr. Richardson helped my office spearhead participatory mapping projects in more than a dozen "secondary cities" around the world. These projects were designed to tap local knowledge to create geospatial data and build human geography content and knowledge in order to explore rapidly growing urban areas that were often underexamined, poorly mapped, and ill understood by scientific inquiry. A spin-off of one of those projects, the "COVID-19 Cities' Mapping and Mitigation" initiative, introduced me to Junghwan Kim, who is a postdoctoral fellow at Harvard University's Center for Geographic Analysis and the third editor of this book. The combination of expertise these three editors bring to this endeavor are both exceptional and complementary. Dr. Laituri is a geographer who specializes in participatory mapping and geospatial tools and techniques; Dr. Richardson is an ecological economist who studies the contribution of ecosystem services to socioeconomic well-being; and Dr. Kim brings an urban planning and engineering background to the editorial team. (Each of them also contributed chapters to the book). Their training, research, fieldwork, and tradecraft have positioned them, collectively, to generate an outstanding and diverse group of papers that fit seamlessly into an integrated volume but also merit examining as singular contributions to what is one of the most impactful social and economic issue of the day, i.e., the impacts of COVID-19 on society – globally, regionally, and locally.

And just what are those impacts? And how are they manifest over space and time? That is what this volume of storytelling geographies attempts to explore. "Geographies" – because each has a scale of spatial analysis unique to the place or context of the pandemic's impact. "Storytelling" – because the COVID-19 pandemic has become a personal experience, either directly (primary impact) or indirectly (secondary impact) for millions of people worldwide. And many of these stories reveal trends and patterns that can be exceptionally explored though geospatial analyses. Analyses that are underpinned by geographic factors such as scale and location lay bare the power and influence of location, race, age, wealth, politics, media, and their collective consequences. Analyses that also expose and explore possible solutions that meet the challenges of addressing the pandemic's differential impact on communities, governments, industries, educational institutions, economic transactions, mobility, consumption patterns, and, not least of all, public health infrastructures.

What stands out more than anything in this collection of research topics, however, is the landscape of inequality on which it is painted: inequality that is regionally differentiated, dependent on scale, and thus ripe for geographic analysis. This volume of collected stories lays bare some of the truths of the pandemic that spatial analysis and maps effectively lay bare, the downstream consequences of which are yet to be told. The chapters herein not only address well-documented factors related to rich/poor, urban/rural, access to healthcare, race and ethnicity, educational, and digital divides but also delve into less explored differentials in transportation, housing, communication, access to open space, physical barriers, employment sector, legal norms, and the importance of neighborhoods. And, of course, maps and geospatial analysis provide a common language by which these stories are told. Indeed, maps generated by GIS tools and methods of spatial analysis often reveal patterns of inequity, particularly at different scales or via Earth observation processes, which might otherwise not be obvious by scientific inquiry alone, e.g., the impact the pandemic has had on small cities, its relationship to housing quality, and the relationships between mobility and deprived communities. In every case, further study is warranted that would utilize the power of geospatial technologies to develop place-specific tools, e.g., Francis Koti in his chapter calls for the development of an Africa-specific index for assessing socio-spatial vulnerabilities prompted by downstream impacts of the COVID-19 pandemic.

What this volume further underscores are the value of data – methods of their collection, tools for their analysis, veracity, completeness, quality, and integrity. Several of the chapters also highlight the fact that the quality and integrity of COVID-19 related data, and their interpretation and communication, also suffer from inequality and uncertainty. For an event as pervasive as a global pandemic, the challenges of collecting accurate data abound, making it difficult for policy makers to make timely decisions – to address care needs, allocate resources, devise communication strategies, and plan and implement mitigation strategies and actions. Data collection challenges are further compounded by privacy issues and ethical concerns, particularly as Albanese and Senesi point out, in an age of "surveillance capitalism."

In my role as the Geographer of the Department of State, I also serve as one of the co-chairs of the Worldwide Human Geography Data Working Group (WWHGD WG), which since 2011 has provided a platform for a discussion of human geography issues shaping our world, and a venue to better understand the importance of place in the ongoing development of culture and society. The goal of this community is to discover, share, and map human geography data to support decision making with the goal of improving human security. While reading the chapters of *Geospatial Stories of the Global COVID-19 Pandemic* I found myself contextualizing the themes of these stories with those of the WWHGD WG, which include demographics, ethnicity, education, health, economy, transportation, and communication, among others. It struck me how coincident these themes, underlying the range of human geography data essential both for understanding and sustaining communities, align with the geospatial "stories" in this collection, and how the pandemic touches so many distinct aspects of our collective human security that can be explored via geographic inquiry. Another one of my roles as the State Department Geographer is to maintain and disseminate the official U.S. government–recognized international boundaries for all countries of the world. It struck me as ironic that while in my job I demand the integrity of such borders in an unbending fashion, at the same time the world is mired in a pandemic that both shows little respect for borders yet is subject to policies that are strictly prescribed by governments defined by such borders and guide the "human geography" behavior of the citizens living within them.

The transdisciplinary nature of geography allows for an examination of the many facets of the coronavirus pandemic that are essential for understanding the COVID-19 story or, in this case, stories. Using case studies and examples of geospatial analyses, this volume examines several places around the world that have experienced the effects of the pandemic in different ways. As Melinda Laituri described in her opening chapter, the "consequential geography" of the pandemic exposes a landscape of inequality and vulnerable populations. The team of authors she and her co-editors put together for this volume were well positioned and well represented to explore the pandemic's inherent inequality from different regional, national, and academic backgrounds – but always with a geographic perspective grounded on differential scales of analysis. They themselves hail from every continent and represent a diverse and inclusive set of viewpoints, backgrounds, expertise, gender, race, and ethnicity – enriching their stories about the differential impact the COVID-19 pandemic had on diverse socioeconomic and demographic sectors of communities around the world.

Lee Schwartz
U.S. Department of State
Washington, DC, USA
28 February 2022

Disclaimer: The views in this report are solely of the authors and do not represent those of the U.S. government agencies or any of the organizations mentioned. Assumptions made within the analysis are not a reflection of the position of any U.S. government entity.

Preface

When we first considered this volume in early 2021, we assumed that by the time this book was published the pandemic would be behind us, and this would be a reflective volume. Instead, at the beginning of 2022, we find ourselves continuing to be in the midst of the pandemic globally. The COVID-19 pandemic is an on-going and persistent global experience. The keyword is *experience* – as we soon discovered – who you are and where you live have a profound impact on your experience with the pandemic. Using a geographic lens, we were interested in that juxtaposition of the commonality created by the pandemic, the people's pandemic experiences in different places, and myriad reflections of inequality exposed. The existing inequalities are revealed through the increasing differences of income inequality, the deepening digital divide highlighting access to technology – a necessary tool during the pandemic, and the availability of and access to basic healthcare services and vaccinations. This is the moment to examine these inequalities through sharing geospatial stories of the pandemic.

A geographic frame of reference that is both expansive and integrated is a useful approach to assessing the state of the pandemic around the world. Geography crosswalks physical, social, and economic themes to define and create a holistic understanding of place. Place is central to our collective experience because where and how we live is so disrupted – and we have all shared this experience in different ways. The spiraling impacts of the pandemic coupled with government policies and socio-economic disruption further reveal the landscape of vulnerability – who is vulnerable, who is becoming vulnerable, and what is the impact of vulnerability in terms of where people live and work? These are all questions that have a spatial dimension. As the pandemic and human behavior continue to evolve, these questions also have a temporal dimension.

The intersection of geography and technology is exhibited through the numerous online data dashboards that use maps to tell a story. Maps are accessible. Interactive maps are interesting. Highlighting geospatial platforms (interactive maps), data (demography), and applications (identifying hotspots of caseloads) demonstrate the value and importance of these tools to share stories and create visualizations. However, these tools also have their limitations. How do they circumscribe our own

geography and sense of place? How can they be employed while also ensuring that personal privacy is protected?

We invited researchers, students, and practitioners from around the world to do two things: (1) address a critical issue related to the pandemic through a geospatial and geographic lens; and (2) share a personal story of the pandemic. The pandemic provides a moment of reflection where we are embedded in the growing realization that the world has changed. In fact, *change* has been the most fundamental shared experience we have all had – the changing conditions of our everyday lives, during the past two years, and into the future. Adaptations to the virus will be place specific and long term. We have much to learn from each other, and this volume contributes to the on-going dialogue.

Melinda Laituri — Fort Collins, CO, USA
Robert B. Richardson — East Lansing, MI, USA
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Abbreviations

AGA	American Geographical Society
C2M2	Cities' COVID Mitigation Mapping
CARES	Coronavirus Aid, Relief, and Economic Security Act
CDC	Centers for Disease Control and Prevention
EO	Earth Observations
GDP	Gross Domestic Product
GEDI	Global Ecosystem Dynamics Investigation
GIS	Geographic Information System
GPS	Global Positioning System
LiDAR	Light Detection and Ranging
MAUP	Modifiable Area Unit Problem
MODIS	Moderate Resolution Imaging Spectroradiometer
MTUP	Modifiable Temporal Unit Problem
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
PPE	Personal Protective Equipment
RNA	Ribonucleic Acid
SARS	Severe Acute Respiratory Syndrome
SDG	Sustainable Development Goals
UK	United Kingdom
UN	United Nations
US	United States of America
WFP	World Food Programme
WHO	World Health Organization

Chapter 1
How COVID Changed Our Daily Geographies

Marie Price

Personal Story

I study human migration because of the many ways human mobility shapes and changes places. On March 1, 2020, I flew to Prague, Czechia, to begin a stint as a visiting scholar at Charles University working with geographers who study migration. As I left the United States, COVID was spreading, but the numbers were low. Taking precautions, I brought masks and hand sanitizers with me. I assumed my research would continue. In less than 2 weeks, the enchanting city of Prague, with its streetcars, cobbled squares, and steeples, began to shut down. By the second week of March, the university had closed to in-person instruction. On the night of March 12th, President Trump's news conference reported that international travel to the United States would end at midnight Friday March 13th. It was time to book a return flight.

The eeriest moment of my return trip was walking through the virtually empty corridors of Frankfurt Airport. Two weeks earlier, the place buzzed with suited business travelers, families, and students. Now I felt alone. As I walked down a long corridor, I spied a lone traveler seated quietly on a bench. I walked closer, hoping to exchange a friendly word, only to realize that this 'stranger' was not a person at all, but a life-size statue of Albert Einstein. It was at that moment I realized the world of mobility that I had taken for granted had halted. I flew home in a half-empty plane and did not board an aircraft again for 6 months when I visited my ailing mother before she passed away. *Marie Price*

Much of the scientific effort to alter the trajectory of COVID-19 and produce vaccines and medical treatments has focused on the biomedical sciences. This book highlights the obvious and subtle ways that geography and geographical sciences informed our collective understanding of and response to COVID-19. Key concepts such as scale, space, diffusion, environmental context, and place were and are

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critical in guiding behaviors to slow COVID-19's transmission and understand the uneven impacts of the virus over time. Geospatial tools such as maps, remotely sensed imagery, dashboards, and location tracking technology all played a role in visualizing the virus's impact and developing human responses to it and will be detailed in this volume.

There is geography in the practices of social distancing, the privileging of outdoor settings, the stunning decline in mobility, and the attributes of place that help to explain various pandemic reactions and outcomes. This essay argues that an explicit set of geographic concepts and tools shaped our everyday geographies during the pandemic. Geospatial tools, especially maps, were invaluable in helping us understand the shifting extent and impact of the pandemic but as Melinda Laituri makes clear in Chap. 2, there is both power and limits to our geospatial tools and the data they rely upon. Authors in this volume apply a framework of first order impacts (immediate responses to the virus itself) and second order ones which derive from human responses to the virus. But as geographer Barney Warf suggests, there were also preconditions that, in the case of the United States, led to higher infection rates and deaths (Warf, 2021).

Now 2 years since the pandemic began, we better understand first order impacts. Yet there is a growing list of second order impacts that influence diverse race/class/age groups and the places they reside/work as popular headlines report declining school enrollments and struggling students (Day et al., 2021; June, 2021) or the Great Resignation of workers in 2021 (Thompson, 2021; Richardson, 2022). The long-term social, economic, and political consequences of COVID-19 will be the subject of scholarly investigation for decades; this volume sheds light on what we have learned so far, especially from a geo-spatial perspective. While the scope of this book is global, many of the examples in this chapter come from the US experience.

Daily Geographies Altered

The pandemic provided a dramatic example of how quickly human mobility and daily patterns can shift, remaking our daily geographies with varying intensity. In the early stages of the pandemic, some states and localities imposed extreme lockdown measures aimed at keeping people in their homes or reducing the distance they could travel from their homes. Others shifted to remote work and education strategies, dramatically altering the daily activity paths of household members. In short order, millions of home spaces became office spaces for workers and classrooms for children thrust into online education. In the United States, an essential worker class emerged (from grocery clerks to police officers and hospital staff) who went to actual places of work rather than work remotely from the relative safety of their home. Even so, millions lost jobs. Federal stimulus monies were issued to soften the economic blow of the pandemic in the United States. For those who did not have homes, cities turned unoccupied hotel rooms into homeless shelters. Even

innocuous tasks such as opening mail or shopping for groceries were stress inducing activities before COVID transmission was fully understood. For most parts of the world, mixed levels of fear infused and altered daily activities in some ways.

Before masking became a widely accepted—albeit contested—method to slow transmission, social distancing emerged as a time-honored low-tech approach to reduce the risk of infection. People isolated alone or in small groups, often referred to as COVID pods. Even walking down streets turned into a COVID dance of dodging and street crossing to avoid close and/or direct contact with others. By the summer of 2020, gathering outdoors emerged as the safest form of socializing, so people and companies expanded their outdoor gathering spaces, resulting in some cities turning sidewalks and even entire blocks into socially distanced and outdoor spaces to dine. Outdoor activities such as camping, hiking, canoeing, boating, biking, and walking experienced upticks in popularity. As social interaction declined, people turned to animal companionship; in the United States, dog and cat adoptions surged during COVID-19 as one in five households acquired a new pet during the pandemic (ASPCA, 2021).

The pivot to digital and virtual interactions also happened suddenly as a result of the pandemic. In particular, daily activities shifted to the home and neighborhood scales, especially in the early stages of the pandemic. Digital meetings and collaborations surged, and there was growing dependence upon platforms such as Zoom and later the phenomenon of Zoom fatigue. A reliance on virtual interactions introduced many second order impacts: from the nature of work, the shift to remote education, to the use of different systems of transport and the uncertainty of supply chains. Work, education, and transport continue to be impacted by COVID-19 although the intensity of these impacts has oscillated over time and space. With people not going to work or school or business meetings, planes, trains, buses, and subways were markedly underutilized. The private car, always popular in the United States, became the preferred safe mode of travel. With the widespread use of smart phones as sensors, telemetry analysis showed a stunning decline in daily mobility whether tracking public transportation usage or movement in general, especially in the spring of 2020 (Mapbox, 2020). As we enter 2022, human circulation has returned, in some places, to near pre-pandemic levels, but work settings continue to be affected.

One area where human circulation is still disrupted is international travel and migration. A report written by geographer Alan Gamlen (2020) for the International Organization of Migration notes that by March 2020, 91% of the world's population lived in countries where there were border restrictions imposed on people arriving from other countries who were not citizens or residents of that country. While many of these restrictions have been lifted, human movement across international borders has declined, especially for some of the most vulnerable people fleeing conflict or oppression. For example, during the first year of the pandemic, the resettlement of refugees virtually stopped. Gamlen concludes with a provocative second order impact question: might the pandemic mark the end of the current age of migration with its reliance on international migrant labor?

Led and Misled by the Map

Maps mattered during the COVID-19 pandemic and became the most public geographic tool deployed to inform our understanding of the changing scope of the pandemic. Freely available dashboards such as the ones created by Johns Hopkins University (JHU, 2022) and the New York Times (NYT, 2022) reported daily infections, hospitalizations, deaths, and vaccination rates at various scales from institutions (hot spots such as nursing homes, prisons, or universities) to county, state, and country totals around the globe. To deal with spatial and temporal differences, dashboards presented 2-week and 4-week averages, rates of infection (that allowed comparisons with smaller and larger demographic units), as well as overall counts during particular time frames. Being able to drill down to smaller units of geography, say a county instead of an entire state, provided a more precise understanding of the real-time pandemic threat. Remarkably this information was freely available to anyone with internet access. There is a long-established history of geographers mapping disease (Paul, 1985), yet the speed with which maps were created and updated during the pandemic is a stunning example of the geospatial digital revolution.

Visualizations of data in near real-time were readily available during this pandemic. Yet the choices made in data selection, areal units, and time period studied can greatly influence how the data are presented and interpreted. Geographers are keenly aware of how the areal unit of analysis can create bias or uncertainty. The modifiable area unit problem (MAUP), and its corollary, the modifiable temporal unit problem (MTUP), are recognized by geographers using geospatial data (Helbich et al., 2021). For example, data by county in the United States is often viewed as a refinement over state data. Yet counties vary enormously by size and density, resulting in patterns on the map that could visually overstate the problem in one area (a large but lightly populated western county) and downplay it in another (a small densely populated county in the east). Likewise, the time period mapped could yield radically different maps as infection spikes rose and fell unevenly. Since 80% of people live in cities in the United States, there is a tendency to think of COVID-19 having a greater impact on cities. The earliest images of New York City overrun with COVID patients in the spring of 2020 come to mind (Rothfeld et al., 2020). Yet a geographical analysis by Zhang and Schwartz (2020) based on US data from the first months of the pandemic concluded that the incidence of mortality in some small cities and nonmetropolitan counties was similar to that in New York City. When we see maps of the absolute mortality numbers, COVID-19 appears to be an urban problem, but when mortality rates are mapped, the pattern is more mixed.

For global COVID-19 data, country boundaries were the unit of convenience, but this tended to emphasize the most populous and larger territorial states, especially when total numbers of cases or deaths were considered. The tendency to privilege state boundaries over all others, especially in international affairs, has been termed the ‘territorial trap’ by political geographer John Agnew (1994). Seeing national borders as barriers of defense is a standard political response. By April 2020 most countries had closed their borders to non-citizens (Connor, 2020). Models suggest