5 Where Is the Closest Health Clinic? YouthMappers Map Their Communities Before and During the COVID-19 Pandemic

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Abstract

YouthMappers chapters are both locally and globally situated, fostering a confluence of community input, GIS skill sets, subject-matter expertise, and creativity that drives progress toward the Sustainable Development Goals (SDGs). Examining Hudson Valley Mappers' and Gaston Berger University YouthMappers' community mapping projects in parallel offers rich insights on open mapping for SDG 3 Good Health and Well-being and highlights the value of SDG 4 Quality Education. Both YouthMappers chapters collaborated with local partners to map health facilities and other community resources; the resulting maps and data filled critical information gaps during the COVID-19 pandemic. The project outcomes underscore the unique niche that the YouthMappers network occupies in the open mapping world.

Keywords

Health · Community assets · Pandemic · GIS · New York · Senegal

1 Amid a Global Health Crisis

In the wake of the COVID-19 pandemic, access to reliable healthcare location data is more vital than ever. Both prior to and during the pandemic, YouthMappers chapters around the world strengthened their communities by providing residents and local stakeholders with accurate and up-to-date information on healthcare facilities and other resources. They designed these mapping projects with community input and in collaboration with local and international partner organizations. In doing so, YouthMappers chapters contributed to the third Sustainable Development Goal (SDG): Ensure healthy lives and promote well-being for all at all ages. This chapter demonstrates how open mapping efforts can "strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national

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and global health risks" (SDG Target 3.d). Additionally, the chapter illustrates how quality education (SDG 4) equips university students with the knowledge and skills needed to promote sustainable development (SDG Target 4.7).

This chapter discusses two community resource mapping projects led by YouthMappers chapters at Vassar College in Poughkeepsie, New York, and Gaston Berger University in Saint-Louis, Senegal. At the onset of the COVID-19 pandemic in the spring of 2020, Hudson Valley Mappers at Vassar College created a shareable online web map of local resources, including healthcare facilities, COVID-19 testing sites, and food pantries, to help residents of Dutchess County navigate life during the pandemic. In 2019, Gaston Berger University YouthMappers added over 100 healthcare facilities in Saint-Louis to OpenStreetMap using the Healthsites OpenDataKit (ODK) collection tool. By the time the pandemic hit, this comprehensive dataset was already available in OpenStreetMap for public use. Both of these projects serve as models for how students can execute volunteer-led community Geographic Information Systems (GIS) projects in preparation for and during times of crisis. The success of the two initiatives is rooted in the chapters' commitment to engaging local stakeholders and community organizations and incorporating their needs into mapping processes and products.

2 Community Resources in Dutchess County, New York

Whereas some YouthMappers chapters in the United States may focus solely on global humanitarian and disaster relief efforts, Hudson Valley Mappers prides itself on our commitment to community geography and working with local organizations to help achieve their vision of community engagement and development. Our ability to build and maintain relationships with community partners in our home locations of Poughkeepsie and Dutchess County in New York has been invaluable to our COVID-19 mapping efforts. Our community partners provided essential feedback throughout multiple stages of the project and helped disseminate the map to as many eyes as possible. With a combination of community input and dedication from a passionate student volunteer base, we were able to produce a tool that was immediately available to community members in a time of crisis.

2.1 Poughkeepsie and the Hudson Valley Mappers

Hudson Valley Mappers is a YouthMappers chapter at Vassar College in Poughkeepsie, New York. Poughkeepsie is located in Dutchess County in the Hudson Valley, midway between the state capital, Albany, and New York City. The city and town of Poughkeepsie have a total of 74,558 residents, and Dutchess County has 294,218 residents (American Community Survey 2019). The city of Poughkeepsie, which neighbors the town, shares a similar history with other smaller rustbelt cities that have an industrial past. In the 1940s, the arrival of IBM and other manufacturing and design firms brought an influx of jobs to the area, which led to a rise in housing and commercial development in the city (Flad and Griffen 2009). However, in the 1960s, the city experienced the effects of suburbanization and white flight, and major industries relocated outside of the city. Federal investment in urban renewal projects led to the construction of highways and arterials that cut through and demolished existing neighborhoods, severely impacting the quality of life of the residents. The processes of urban renewal, suburbanization, and deindustrialization spurred spatial and socio-economic changes that resulted in a higher concentration of lower-income communities of color and a cityscape of abandoned factories and buildings.

In the late twentieth century, the city introduced a myriad of strategies to revitalize

Poughkeepsie and enhance its reputation. The non-profit sector grew in response to glaring socio-economic inequality and the needs of its residents. As many cities in the nation transitioned from an industrial to a service economy, newer businesses in the service sector also came to Poughkeepsie. In recent years, Poughkeepsie has undergone rapid changes, such as the construction of new apartment buildings, the opening of new businesses and restaurants, and the expansion of anchor institutions.

However, revitalization and rising property values in the city have increased the risk of pricing out current residents. To address the deepening socio-economic inequality in the city, the city has instituted a variety of policy interventions and programs. For instance, an anti-blight task force and the Dutchess County and City of Poughkeepsie Land Bank were created to return vacant and abandoned properties in the community to productive use. The city updated its comprehensive plan in 2021; the plan will provide a long-range vision for future growth and development (pk4keeps.org). The city also has a robust network of community-based organizations that creatively address the legacies of urban renewal and the impacts of systemic racism and promote equity and enhance the quality of life for Poughkeepsie residents.

Vassar students, through coursework and internships, have served as a key volunteer labor force for these community organizations. At the helm of fostering local collaborations is the Office of Community-Engaged Learning (OCEL), which facilitates semester-long community-engaged learning (CEL) internships for students at various organizations in Poughkeepsie as part of their coursework. Vassar geography students have frequently participated in CEL internships focused on providing GIS support to local organizations. Due to the individualized nature of CEL placements (i.e., one to two students placed at an organization each semester), partner organizations lacked a way to formally engage large groups of students in projects involving extensive field data collection or longer-term analytical work. This type of volunteer effort is critical to the operations of local nonprofits that require up-to-date geospatial data on on-the-ground conditions but do not have the financial resources to hire paid GIS specialists. Thus, Vassar's YouthMappers chapter, Hudson Valley Mappers, was born out of a need to formalize and consolidate the volunteer geographical support that Vassar students provide to the college's community partners in the city of Poughkeepsie.

Hudson Valley Mappers was founded in September 2018 as a joint venture between the OCEL and the Department of Earth Science & Geography. The OCEL created a part-time community geographer work-study position to help ensure adequate resourcing for the chapter. In the year and a half between Hudson Valley Mappers' inception and the onset of the COVID-19 pandemic, the chapter conducted several sustained mapping projects in close collaboration with local nonprofits and the city of Poughkeepsie government. These organizations were part of the OCEL's existing network of community partners. The projects included mapping sites for the city government's tree plantings, businesses and vacant buildings along Main Street for the nonprofit Hudson River Housing, and waste disposal infrastructure as part of a partnership with the environmental education program No Child Left Inside. Consequently, by March 2020, Hudson Valley Mappers had already cultivated long-term relationships with local partners that contribute to community health and well-being in Poughkeepsie (Fig. 5.1).

2.2 Immediate GIS Response

At the start of COVID-19 in March 2020, Hudson Valley Mappers began exploring how Vassar students, faculty, and staff, as well as Poughkeepsie community members, might use their GIS interests and backgrounds to meaningfully engage in COVID-19 response efforts. While most collective mapping efforts related to COVID-19 were primarily dedicated to mapping COVID-19 cases or healthcare-related facilities, Hudson Valley Mappers decided to create a web map of community resources and services in Dutchess

Fig. 5.1 Hudson Valley Mappers identify tree planting sites in collaboration with the City of Poughkeepsie government and other community partners at their inaugural community mapping event in November 2018

County. There were numerous new community efforts and changes beginning in mid-March 2020, and various news sites and social media circulated information about the different types of community resources available in Dutchess County. It was becoming difficult to keep track of the services available, given that information was constantly updating and changing. Our YouthMappers chapter concluded that making a web map to consolidate the wealth of information about community resources that lived on disparate websites and social media could help residents easily visualize where resources were located and how to access them. We also viewed this project as a way for the Vassar community to continue to engage with the local community virtually when the college transitioned to remote learning.

Centering community priorities is a core practice of Hudson Valley Mappers and one that we carried into this project. Therefore, our first step was to solicit input from our community partners on what data they believed should be included in the map. We contacted nonprofit staff, city government officials, and school district administrators, who provided lists of categories of resources to prioritize and raw data to represent spatially. Data included locations and hours of operation of food services (such as food pantries, meal programs, and school meal distribution sites) and health services (such as coronavirus testing facilities, hospitals, and pharmacies). We loaded the data layers in a prototype web map on ArcGIS Online and circulated it to our partners. They responded enthusiastically with their approval of the map and suggestions for improvement. At that point, with such strong support from our partners, we were confident that the tool filled a niche in terms of resources available to County residents at the onset of the pandemic; consequently, we decided to launch the project on a larger scale.

We created the COVID-19 Community Resources in Dutchess County Map, an interactive map using online software that enabled community partners, including those without prior experience with GIS, to update the map with information related to their areas of expertise. We accomplished this by linking the web map to Google Sheets spreadsheets so that the

map automatically reflected all changes that community partners made to the spreadsheets. We also recruited a team of student and faculty volunteers who assisted with additional data input tasks to get the map up and running, such as transferring information on community resources from PDFs and webpages to the Google Sheets spreadsheets.

The final stage of the first phase of the project was distributing the map to residents of Dutchess County through the leveraging of a range of platforms, including social media, e-mail, and the city of Poughkeepsie's weekly e-newsletter. Community partners also included the map on their websites and in informational handouts.

After the map was distributed, several community partners and Vassar faculty members requested that we add additional layers to the map, such as restaurants offering delivery and curbside pickup and locations with free public Wi-Fi. Faculty and students from Bard College in Annandale-on-Hudson also collaborated with us to add locations of various community services in Northern Dutchess County. A team of students and faculty from Vassar and Bard, as well as a few community partners, continued to update the map throughout the spring of 2020 (Figs. 5.2 and 5.3).

2.3 Longer-Term GIS Support to the Community

Updates to the COVID-19 Community Resources Map paused in the summer and fall months as cases significantly dropped and remained low in New York following the April 2020 spike. However, cases were on the rise again by November 2020. With renewed COVID-19 restrictions, Hudson Valley Mappers decided it was time to reopen the project. In January 2021, we updated each layer on the map using the most recent information available, most of which we gathered from Dutchess County's COVID-19 Response website. We prioritized food pantries and COVID-19 testing sites, and a core group of student volunteers tackled the restaurants.

On December 11, 2020, the FDA issued emergency use authorization for the first COVID-19 vaccine developed by Pfizer (Hinton 2021), and on January 13, 2021, New York opened up its

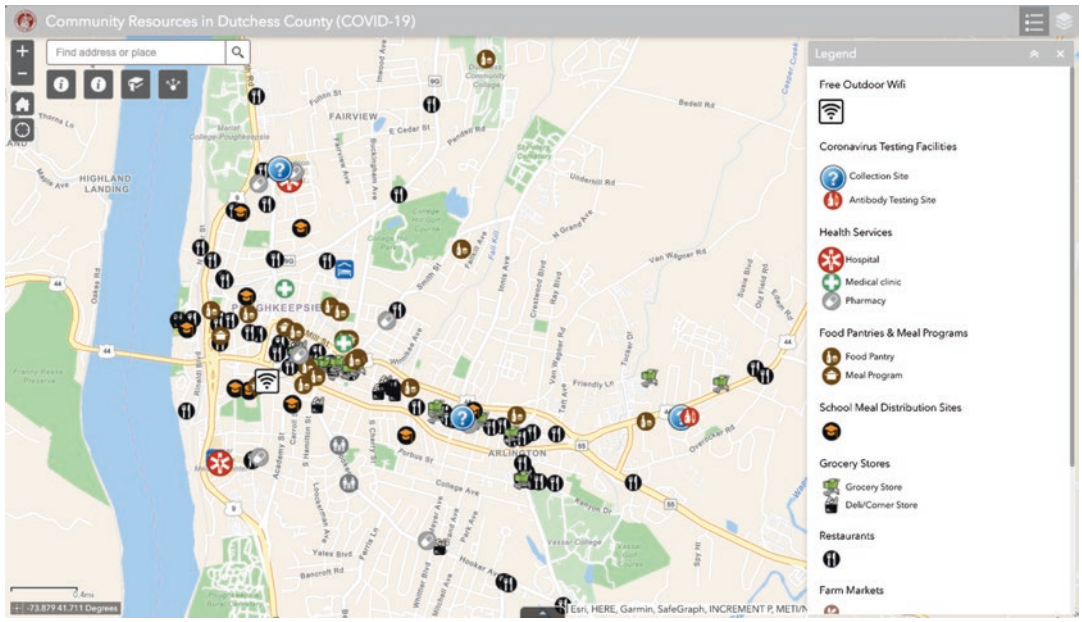

Fig. 5.2 City of Poughkeepsie community resources are shown in this interactive map at the end of the first phase of the project, June 2020

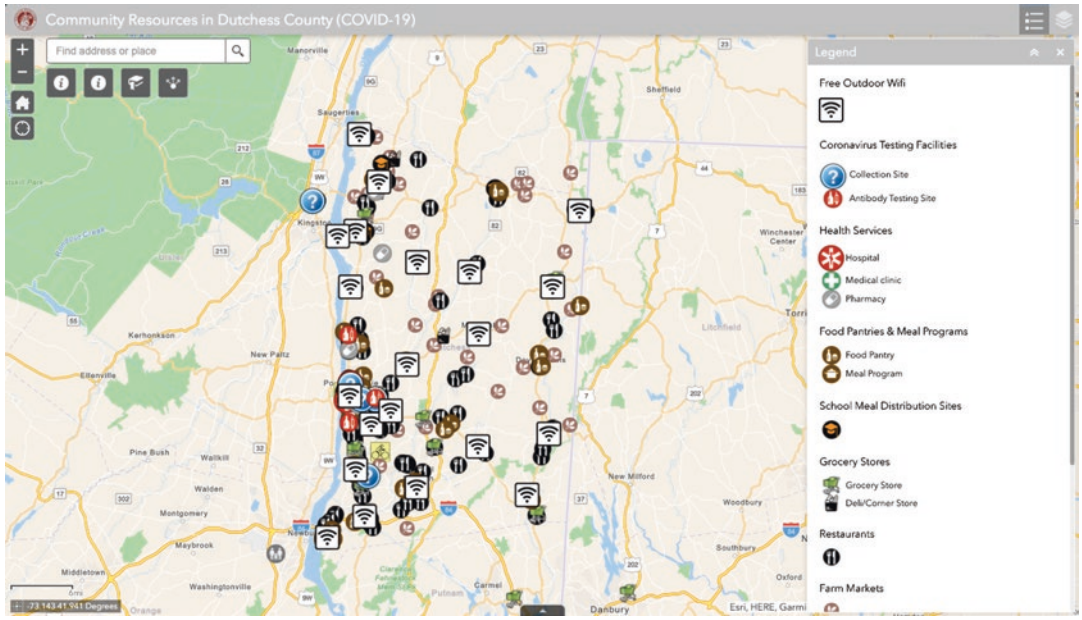

Fig. 5.3 Dutchess County community resources are shown in this interactive map at the end of the first phase of the project, June 2020

first statewide vaccination sites (Governor's Press Office 2021). Thus, in addition to updating existing layers, we created a new layer for vaccination sites. Unlike the other information on the map, vaccine information changed rapidly as more sites opened up, more people became eligible, and new vaccines were authorized. To ensure our map reflected the most up-to-date information, we monitored state and county websites and newsletters and committed to updating the site layer weekly throughout the winter and spring months.

We conducted a second outreach effort to inform the public that the map was still available and up-to-date. This consisted of reaching out to contacts in local government and nonprofits that facilitated and provided feedback on our work during Phase 1. We encouraged these groups to share the map with their constituents and member bases and welcomed any additional feedback. Anticipating the need for greater accessibility to Poughkeepsie's and Dutchess County's large Spanish-speaking population, we translated parts of the web map prior to the second outreach campaign.

2.4 Local Perspectives on Challenges and Opportunities

The effort to map community resources in Poughkeepsie and Dutchess County during the COVID-19 pandemic was not without its challenges. Indeed, the mapping process highlighted several key concerns that are common to similar mapping projects, including a lack of technology access among those most in need of community resources and the difficulty of keeping such a large dataset up-to-date and relevant in the long term, even when the heightened need of the pandemic had largely subsided.

According to usage data from the ArcGIS Online platform that hosted the COVID-19 Community Resources Map, usage peaked in the early days of the pandemic, with up to 296 unique views of the map occurring on some days during a period from March 25 to March 31, 2020. In the time that followed, viewership dropped but remained high during the months of April and May, then declined to a steady rate around three or four views per day. We suspect viewership was

higher in the early days of the pandemic because people were struggling to adapt to the rapidly evolving COVID-19 restrictions and were in need of a reliable, centralized information source. This viewership pattern could have also indicated the need for a stronger outreach campaign in Phase 2 of the project. Early in the pandemic, heightened need, increased communication across community networks, and widespread uncertainty over how individuals, businesses, and service providers would respond to the pandemic created a niche in which the COVID-19 Community Resources Map was able to connect community members with resources amid rapidly changing public health measures. Later in the pandemic, this role became less clear. Organizations and businesses adapted to communicate pandemic response measures to their patrons. Vaccination providers, including pharmacies and the state government, developed their own platforms to assist the public in finding appointments. Student mappers could not guarantee the same level of timeliness and accuracy in the COVID-19 Community Resources Map.

One overarching challenge for community mapping projects is keeping datasets current as volunteer capacity changes over time. Student volunteers were not always able to keep up with rapidly changing information, meaning that some of the information in the map may have been inaccurate or out of date. The map included a field to indicate when information was last updated, but that required viewers to use discretion when interpreting the map and made it less appealing to government entities that were committed to providing the most accurate and up-to-date information at all times. We also learned that some local organizations were already offering services similar to the one provided by our map. For example, the United Way of Dutchess-Orange developed a 211 service in which users could call the number 211 to be connected with a number of services in the community.

Accessibility is a major concern for community mapping projects, and the COVID-19 Community Resources Map was no exception. First, even though the map was developed with the Spanish-speaking community in mind, English was used for most of the map text, aside from key labels. Second, lack of access to technology to view the map is a limitation that became clear over time. Many of those with the highest need for community resources do not have access to computers/smartphones and Wi-Fi that make viewing the map possible in the first place. New approaches to improve accessibility should be developed through software capabilities and map design. One of Hudson Valley Mappers' main community partners, Hudson River Housing, informed us that it would be difficult to share the map with residents of their affordable housing sites due to lack of internet access and technology. Many residents receive information primarily through a hard copy newsletter. Even though a QR-code link could be included in the newsletter, those without a smartphone could not read the code or access the internet to reach the map website. Moreover, because the ArcGIS Online interface is optimized for computer browsers, smartphone users may not find the interactive map sufficiently intuitive and easy to browse.

In spite of these limitations, the COVID-19 Community Resources Map served as an unparalleled tool for connecting Dutchess County residents with local services, especially during the first few months of the pandemic. Due to our existing relationships with community partners and close monitoring of local news sources, our YouthMappers chapter was able to identify an information gap within days of the onset of pandemic restrictions and design a platform well before other groups like medical providers and government entities developed their own systems.

2.5 Challenges and Opportunities for Open Mapping from a Youth Perspective

While designing and creating the community resource map, Hudson Valley Mappers connected with other YouthMappers undertaking similar COVID-19 response mapping projects. We presented our interactive map at a YouthMappers network-wide webinar and published a blog post

that detailed the steps of our project. We were also in close contact with María Fernanda Peña Valencia, a YouthMappers regional ambassador at the University of Antioquia in Medellin, Colombia. María Fernanda launched the Mappers4Med initiative to map community food and health resources available to residents of Medellín. Unlike our project, which used online Esri products, Mappers4Med's utilized OpenStreetMap, which better aligns with the open mapping principles of the YouthMappers community. Any member of the public can easily find, edit, and download the data that the Mappers4Med team added to OpenStreetMap, whereas with our project, members of the public would first have to know about our project and then contact us for editing access to the raw data (although it is downloadable from our web map) (Fig. 5.4).

Hudson Valley Mappers' decision to work with Esri software is a reflection of the students' and faculty members' expertise in proprietary GIS software. An open-source geospatial curriculum is far from the norm at US universities, and when we mapped in response to the crisis scenario of the COVID pandemic, we used the tools we knew best from coursework, even though they may not have facilitated maximum data sharing and transparency for the general public. At the same time, our approach did have advantages, such as allowing volunteers without geospatial expertise to update the map by editing our shared Google Sheets file.

Ultimately, Hudson Valley Mappers is committed to providing Vassar students with exposure to open-source mapping software via integration in GIS curricula and extracurricular training sessions. For instance, in the 2020–2021 school year, our group hosted a mapathon to train Vassar and local high school students in editing OpenStreetMap, with a focus on digitizing buildings in the city of Poughkeepsie. We also pivoted from employing Esri field surveying tools to using the open-source tool KoBo Toolbox. One of our long-term goals is to transfer data from the community resource map to OpenStreetMap so that our data can become part of a collective repository that is of use to community actors beyond the duration of the pandemic.

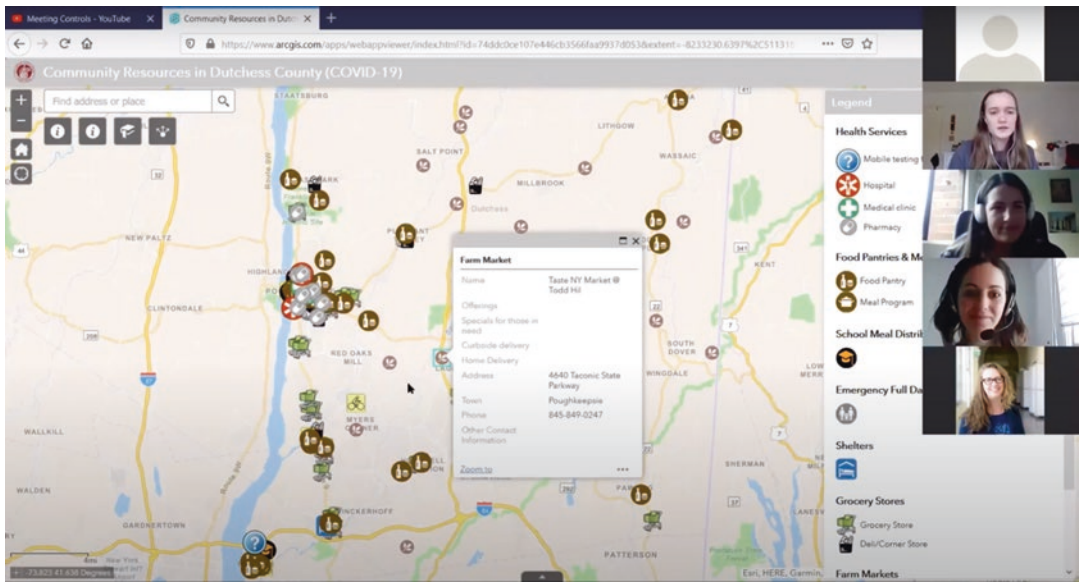

Fig. 5.4 Hudson Valley Mappers president Adele Birkenes presents the project at a virtual YouthMappers webinar in April 2020

3 Health Facilities in Saint-Louis, Senegal

Meanwhile, another engaged local mapping effort during the pandemic was happening as part of a pilot project to map health facilities in the department of Saint-Louis, Senegal. The work was cooperatively organized by Healthsites.io, CartONG, Geomatica, and the OpenStreetMap Senegal community.

We, YouthMappers from the UGB YouthMappers chapter at Gaston Berger University, participated in data collection trainings and field mapping activities. This work, similar to the one in New York, worked to make community resources known and visible.

3.1 Gaston Berger University YouthMappers

We are 10 enumerators who participated fully in the data collection phase on health facilities in our home locations. This entailed remote work and fieldwork and created spatial data in the form of attributes, tags, and descriptions, in addition to siting of features onto OSM. This was a critical phase especially since we collected exhaustive amounts of data, making it open through OSM and following the global community guidelines for quality.

In July 2019, we underwent extensive training on the use of Healthsites' open-source data collection tool. The mobile app ODK allows users to collect data and save it directly to OpenStreetMap through the healthsites.io platform (Fig. 5.5).

3.2 Mobilizing to Collect Health Asset Data in Saint-Louis

During the fieldwork period, it took us 48 hours to collect data on 104 health facilities located throughout the entire department of Saint-Louis. The data collection form generated by ODK was composed of several questions. It allowed us to collect as much information as possible from the health facilities, among the questions we can mention, and Table 5.1 outlines these data.

Fig. 5.5 The data collection team consists of (left to right) Ndeye Khady Ndoye and Ibrahima Sory Diallo of UGB YouthMappers, Mohamet Lamine Ndiaye of OSM Senegal

To start the pilot phase of the project, Mark Herringer, Healthsites project manager, and Mohamet Lamine Ndiaye of the OpenStreetMap Senegal community conducted several meetings with health stakeholders during the month of April 2019. The objective of these meetings was to create a synergy around the collaborative mapping of health structures in the district of Saint-Louis. Other meetings were planned to present the results to the various stakeholders.

The facilities collected included 41 private, 58 public, 3 community, one NGO, and one combination. Twenty-four facilities were not wheelchair accessible. Four facilities were powered by solar electricity (Healthsites.io). This information, stored on OpenStreetMap, is also shared directly with the Senegalese Ministry of Health (Fig. 5.6).

Table 5.1 Description of data collected

Tag	Description
Amenity	For describing useful and important facilities for visitors and residents, e.g., identifying the health site was a clinic, doctor's office, hospital, dentist, pharmacy.
Healthcare	A key to tag all places that provide healthcare services or are related to the healthcare sector, e.g., doctor, pharmacy, hospital, clinic, dentist, physiotherapist, alternative, laboratory.
Healthcare: speciality	A key to detail the special services provided by a healthcare facility, e.g., biology, blood_ check, clinical_pathology.
Name	The primary tag used for naming an element.
Operator	The operator tag is used to name a company, corporation, person, or any other entity who is directly in charge of the current operation of a map object.
Operator: type	This tag is used to give more information about the type of operator for a feature, e.g., public, private, community, religious, government, NGO, combination.
Addr: full	Used for a full-text, often multi-line, address for buildings and facilities.
Contact: phone	The contact tag is the prefix for several contact: * keys to describe contacts.
Operational_status	Used to document an observation of the current functional status of a mapped feature.
Opening_hours	Describes when something is open or closed: days/times of opening.
Beds	Indicates the number of beds in a hotel or hospital
Staff_count: doctors	Indicates the number of doctors in a health facility.
Staff_count: nurses	Indicates the number of nurses in a health facility.
Healthcare: equipment	Indicates what type of specialty medical equipment is available at the health facility, e.g., ultrasound, MRI, x_ray, dialysis, operating_theater, laboratory, imaging_equipment, intensive_care_unit, emergency_department.
Dispensing	Whether a pharmacy dispenses prescription drugs or not.
Wheelchair	Used to mark places or ways that are suitable to be used with a wheelchair and a person with a disability who uses another mobility device (like a walker).
Emergency	This key describes various emergency services.
Insurance: health	This key describes the type of health insurance accepted at the health site.
Water_source	Used to indicate the source of the water for features that provide or use water, e.g., well, water_works, manual_pump, powered_pump, groundwater, rain.
Electricity	Used to indicate the source of the power generated, e.g., grid, generator, solar, other, none.
URL	Specifying a URL related to a feature, in this case, the wiki page if it is linked to an organized mapping effort, both through surveying and importing.
Source	Used to indicate the source of information (e.g., meta data) added to OpenStreetMap.

3.3 Validating Data to Identify User Stories

To validate the data, the team held additional meetings with health stakeholders. The Ministry of Health's regional manager for the Saint-Louis district appreciated the geolocation data of health facilities and the up-to-date information on the status of services present. Together, we identified several user stories enabled by the data, such as routing maps to determine travel times to health services and their accessibility. A meeting was also held with the team from the Centre Opérationnel d'Urgence Sanitaire du Sénégal to validate the data.

4 Social Impact of Data in a Pandemic for the SDGs

Many should benefit from the availability of the data created and visualized, both in New York and in Senegal, because the purpose of making open spatial data available as a public good is to allow decision-makers to better respond to the needs of the population. Healthcare industries could use this data to streamline supply chains or identify opportunities for innovation. This data on healthcare facilities could permit public health service providers to plan responses and awareness campaigns. As a public good, OSM data created by the YouthMappers could allow the

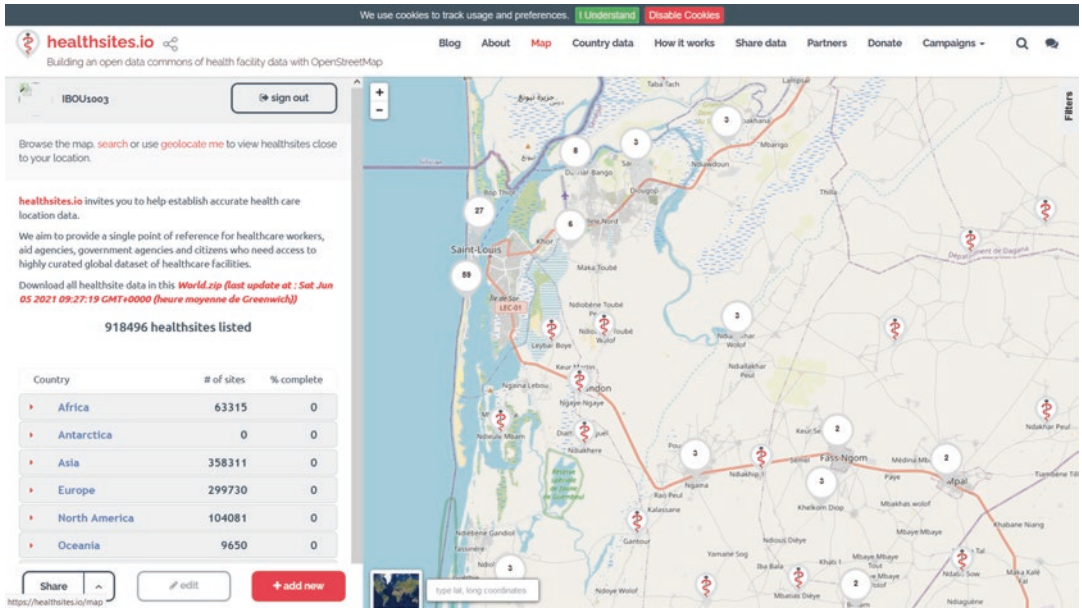

Fig. 5.6 A map features the contributed data on health facilities in Saint-Louis, Senegal. (Credit: www.healthsites.io)

Senegalese Ministry of Health and Dutchess County in their own ways to have a clear picture of the state of the healthcare system and identify gaps that may endanger the lives of the populations that they serve. Entrepreneurs and civil society could also use this data to develop innovative solutions to health crises. And, finally, the public, in general, and OpenStreetMap users alike can always build on this work and further develop user stories alongside response entities, public health agencies, and humanitarian aid organizations to optimize their support during health crises, in ways that advance Sustainable Development Goals. Yet it is not enough to simply create the data. In order for these projects to truly make a difference, stakeholders must recognize the value of the data as a public good for decision making.

Clearly, examining Hudson Valley Mappers' and Gaston Berger University (UGB) YouthMappers' community mapping projects in parallel offers rich insights on open mapping for SDG 3 for good health and well-being. Consistent and inclusive collaboration with local stakeholders and community organizations is key to the success and sustainability of these projects. Both YouthMappers chapters built these relationships long before the COVID-19 crisis hit. In the case of Hudson Valley Mappers, the chapter's existing community geography connections in the city of Poughkeepsie enabled student volunteers to immediately solicit input from community partners at the onset of the pandemic and design a mapping tool that best fit local residents' and nonprofits' needs. In the case of UGB YouthMappers, the chapter collaborated with partner organizations Healthsites.io, CartONG, Geomatica, and OpenStreetMap Senegal to map health facilities in Saint-Louis. Their mapping process involved input from both local healthcare stakeholders and the Senegalese government (Centre Opérationnel d'Urgence Sanitaire du Sénégal). As an outcome of these partnerships, UGB YouthMappers successfully added a comprehensive health facility dataset for Saint-Louis to OpenStreetMap even *before* the pandemic began.

These two examples of YouthMappers collaborating with local partners also underscore the unique niche that the YouthMappers network occupies in the open mapping world. On a global scale, YouthMappers is the premier bridge between academia and the development and humanitarian assistance community. Student

members of YouthMappers chapters listen to the needs articulated by community members, connect with local organizations and international partners, and mobilize groups of student volunteers to contribute geographic data before and during crises. Their specialized knowledge about their home communities enables them to be this bridge, and in doing so, they are simultaneously contributing directly to SDG 4 on education. During the COVID-19 pandemic, with many YouthMappers students mapping remotely from their own homes, the YouthMappers network served as connective tissue between chapters; through webinars, blog posts, and informal exchanges, students shared ideas on how best to employ open mapping tools to address local health and well-being needs. YouthMappers chapters are both locally and globally situated, fostering a confluence of community input, GIS skill sets, subject–matter expertise, and creativity that drives progress toward the SDGs.

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References

American Community Survey (2019) United States Bureau of the Census: Washington, DC

Flad HK, Griffen C (2009) Main street to main frames. State University of New York Press

Governor's Press Office (2021) Governor Cuomo announces expanded vaccination network to accelerate distribution of COVID-19 Vaccine. Available via New York State, 8 January. https://www.governor.ny.gov/news/governor-cuomo-announces-expanded-vaccination-network-accelerate-distribution-covid-19-vaccine. Cited 29 Jan 2022

Healthsites.io (2019) Healthsites Senegalese Pilot. Available via Medium, July. https://medium.com/healthsites-io/healthsites-sengalese-pilot-d7bd6f5a0b16. Cited 15 June 2021

Hinton DM (2021) Letter to Pfizer Inc. [Letter, 10 May]. Available via US FDA. https://www.fda.gov/media/144412/download. Cited 29 Jan 2022

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