FASSSTER:

A Strategy Note on the Disease Surveillance Platform of the Government of the Philippines in Managing the COVID-19 Pandemic

Lessons Learned and Best Practices

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By the United Nations Development Programme
15th Floor North Tower, Rockwell Business Center Sheridan
Sheridan Street corner United Street
Highway Hills, 1554 Mandaluyong City, Philippines

Authors: Dr. Maria Regina Justina E. Estuar (Professor, Ateneo de Manila University) and Gabriel Deladia Baleos

Cover Design: Karla Mae Ujano

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ACRONYMS

ACCCRe	Ateneo Center for Computing Competency and Research
AJWCC	Ateneo Java Wire Competency Center
ASTI	Advanced Science and Technology Institute
AuTuMN	Australian Tuberculosis Modeling Network
CESI	Capacity for Experience Sharing Initiative
COVID-19	Coronavirus Disease 2019
CSQAU	COVID-19 Surveillance and Quick Action Unit
DICT	Department of Information and Communication Technology
DILG	Department of the Interior and Local Government
DOH	Department of Health
DOST	Department of Science and Technology
EB	Epidemiology Bureau
FASSSTER	Feasibility Analysis of Syndromic Surveillance Using Spatio-Temporal Epidemiological Modeler for Early Detection of Diseases
IATF-EID	Inter-Agency Task Force for the Management of Emerging Infectious Diseases
ICT	Information and Communications Technology
KMITS	Knowledge Management and Information Technology Service
LGU	Local Government Unit
NEDA	National Economic and Development Authority
PCHRD	Philippine Council for Health Research and Development
PIDSR	Philippine Integrated Disease Surveillance and Response System
RID	Risk-Informed Development
SEIR	Susceptible-Exposed-Infectious-Recovered
STEM	Spatiotemporal Epidemiological Modeler
SVEIR	Susceptible-Vaccinated-Exposed-Infectious-Recovered
SWTG-DA	Sub-Technical Working Group for Data Analytics
UNDP	United Nations Development Programme

BACKGROUND

This Strategy Note offers FASSSTER or the Feasibility Analysis of Syndromic Surveillance Using Spatio-Temporal Epidemiological Modeler for Early Detection of Diseases – the principal disease surveillance platform of the Philippine Government for COVID-19 — as a model for the international community, particularly Ministries of Health and local public health authorities. As part of the program of strategic support provided by the United Nations Development Program (UNDP) in assisting the Philippines to respond to and to recover from the pandemic, the UNDP Philippine Country Office had the opportunity to support the Department of Health (DOH) in adopting and in rolling out of FASSSTER for COVID-19. This is consistent with the global UNDP COVID-19 offer which support three outputs, namely: (1) strengthened health systems; (2) inclusive and integrated crisis management and responses; and (3) addressing the socio-economic impact of COVID-19.

The UNDP Philippine Country Office packaged and implemented its support to the Philippine Government, civil society organizations, and vulnerable groups in the project: "Enhancing Human Security in the Philippines by Addressing the Socio-Economic Impact of COVID-19", with funding from the Government of Japan. Specifically, the project package focused on the following outcomes: (1) timely collection, collation, and analysis of all relevant data to support the design and targeting of programs; (2) effective, inclusive, and comprehensive assessment of the socio-economic impact of COVID-19; (3) strengthening of crisis management capabilities; and (4) innovative community-led responses to support the most marginalized and vulnerable.

One of the 16 activities that UNDP Philippines carried out under this project is the operationalization of Pintig Lab (Pulse Lab), established to build capacities for data-driven governance for the COVID-19 pandemic. FASSSTER is one of four Information and Communication Technology (ICT) platforms supported by Pintig Lab.

FASSSTER originated as a disease surveillance platform for Dengue, Measles, and Typhoid from the Ateneo de Manila University in 2016 with funding from the Philippine Government. FASSSTER was then redeveloped for COVID-19 with assistance from the Philippine Council for Health Research and Development (PCHRD) and UNDP and intended for use by DOH, the cabinet-level Inter-Agency Task Force (IATF) managing the pandemic response and local governments.

The platform's scenario-based forecasting capabilities provide information and key metrics used in high-level decision-making, especially for quarantine regulations and resource allocation throughout the Philippines. For instance, the IATF has assessed that projections from FASSSTER as early as April 2020 helped inform government interventions that prevented as many as 1.3 to 3.5 million infections in the following months.

This Strategy Note features FASSSTER as a platform and an initiative that governments and development partners can explore not only for COVID-19 but also for other diseases as well. The first part of this report presents a brief overview of the platform, its capabilities, and key project details. The second part features lessons learned and best practices from FASSSTER's journey as a platform and project.

The production of this Strategy Note is part of the Capacity for Experience Sharing Initiative (CESI) by the UNDP Regional Bureau for Asia and the Pacific (RBAP). CESI is a UNDP project aimed at supporting capacity for experience sharing and operationalizing "Beyond Borders Country Offices" in Asia-Pacific. The implementation of CESI by the UNDP Philippine Country Office focuses on Risk-Informed Development (RID), a framework to reduce risks and avoid risk creation in resilient and sustainable development efforts — with the understanding of multiple, concurrent threats and complex risks, trade-offs, and opportunities arising from development decisions, and acting on that knowledge.

In this light, UNDP Philippines believes that the international community and other UNDP Country Offices can benefit from studying FASSSTER, not only as a disease surveillance platform, but as a Risk-Informed Development strategy.

ABOUT FASSSTER

FASSSTER is the principal disease surveillance platform being used by the Philippine Government in managing the COVID-19 pandemic. It originated as a spatio-temporal disease surveillance system for Dengue, Measles, and Typhoid proposed and developed by a research team from Ateneo de Manila University in 2016 with funding support from the government.

In March 2020, FASSSTER was redesigned and relaunched as the operational COVID-19 surveillance and scenario-based monitoring tool for the DOH, the cabinet-level IATF managing the pandemic response, and local government units.

As the Philippine National Government built ICT assets and data pipelines in its COVID-19 response in the succeeding months, the government's IATF recognized and established FASSSTER as a critical part of its suite of ICT tools for the pandemic. Specifically, as the principal COVID-19 surveillance platform of the national government, FASSSTER's scenario-based forecasting capabilities provide information used in high-level decision-making and interventions involving public health measures, quarantine regulations, and resource allocation throughout the country.

For example, the IATF has assessed that projections from FASSSTER as early as April 2020 helped inform government interventions that prevented as many as 1.3 to 3.5 million infections in the following months. In addition, during the surge of the Delta variant in Metro Manila in the 3rd quarter of 2021, where there was a projected worst-case scenario of 510,268 cases on September 11, there were only 52,567 actual cases, a 10-fold reduction.

BEFORE THE PANDEMIC (2016-2019)

In 2015, the DOH launched the Philippine Integrated Disease Surveillance and Response System (PIDSR), a framework that integrates detection, registration, reporting, confirmation, analysis, and feedback into a harmonized set of protocols. This attempted to address the problem of managing several disease surveillance systems that use different and separate data collection, reporting, and analytical tools.

To complement and support the PIDSR framework, Ateneo de Manila University through its Ateneo Java Wire Competency Center (AJWCC), which is now called the Ateneo Center for Computing Competency and Research (ACCCRe), proposed and initiated FASSSTER in 2016 as a web-based syndromic surveillance platform that collects real-time information from various data sources that contribute parameter data to analytics and models needed for surveillance and monitoring of high priority diseases.

While PIDSR functioned as the system used by hospitals and health facilities to submit case findings of monitored diseases, serving to integrate the government's disease surveillance procedures, the university-based team from then AJWCC proposed FASSSTER to function as the platform that will integrate PIDSR alongside other data sources to further enhance syndromic surveillance and disease modeling in the country.

With public funding from PCHRD, an attached agency to the Department of Science and Technology (DOST), the team from Ateneo de Manila University worked on the FASSSTER project for three and a half years delivering the following:

- **Year 1:** Development of a localized disease model for dengue, measles, and typhoid
- **Year 2:** Development of a web and mobile disease surveillance platform
- **Year 3:** Institutionalization of FASSSTER within the Department of Health through capacity-building and localization in selected rural health units in the region of Western Visayas

The original FASSSTER platform utilized an opensource tool from IBM or the International Business Machines Corporation called Spatiotemporal Epidemiological Modeler (STEM), which had the capability to design compartmental disease models and forecast the potential spread of infectious diseases. STEM, for instance, offered the capability to estimate how soon after detecting the first few cases of a new influenza strain it will peak in a given area, including the total number of potential cases — as FASSSTER is similarly able to do with COVID-19 in the Philippines.

FASSSTER is a nod to STEM's primary function of enabling users to create spatial and temporal models of emerging infectious diseases on a web-based platform, which can then assist public health professionals to simulate the spread of a given disease across space and time and assess the impact of preventive and mitigation measures.

GOVERNMENT ADOPTION FOR COVID-19

Even as a university-based project years before the pandemic, particularly one that received public funding and established relationships with the DOH, the project team proposed and worked on the institutionalization of FASSSTER within DOH and local health authorities.

While public funding for the FASSSTER project ended in July 2019, the advent of COVID-19 a few months thereafter placed it in a position to be re-endorsed to DOH by key stakeholders and champions.

This also helped pave the way for the Inter-Agency Task Force for the Management of Emerging Infectious Diseases (IATF-EID), beginning from the earliest days of the pandemic, to invite the university-based Senior Leads of the FASSSTER project to join its Experts Group in advising the cabinet-level IATF-EID and its various subcommittees such as the IATF sub-Technical Working Group on Data Analytics and the IATF ICT Governance group.

Further, the PCHRD of the DOST, the government research agency that initially funded the project in 2016, provided additional funding to redesign and redevelop the platform for the emerging pandemic.

Reigniting interest from the DOH to revisit the project, its Epidemiology Bureau provided support to the FASSSTER team from Ateneo de Manila University in recalibrating both the model and the platform for COVID-19. As the months progressed in 2020, the DOH heavily engaged the university-based FASSSTER team to help inform high-level decision-making using the platform's analytical tools, particularly its capability to generate scenario-based case projections.

In September 2020, Ateneo de Manila University officially donated and turned over the "DOH-themed" COVID-19 version of the FASSSTER platform to the DOH. It is important to note that the rights and ownership of the original FASSSTER platform are still held by Ateneo de Manila University. Governments, organizations, and academic institutions may connect with the university in exploring partnerships or licensing options, which the UNDP can also help facilitate.

As the platform has matured, the most vital use case for FASSSTER is generating projections for the National Government's IATF, particularly in reclassifying community quarantine measures and more recently, in determining appropriate the Alert Level classification. This process typically starts with a committee within the IATF called the Sub-Technical Working Group for Data Analytics (STWG-DA) wherein experts, including representatives from the FASSSTER team, discuss various conditions and scenarios such as vaccination, mobility, and compliance to minimum health standards, among many others.

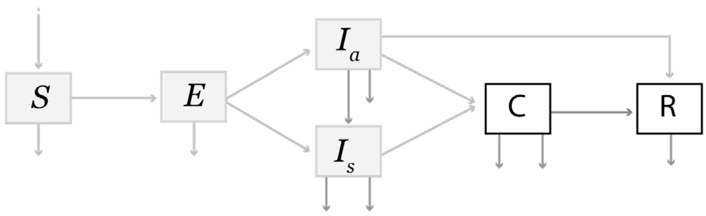
The FASSSTER team then computes for parameters and runs a two-month projection at the most (or in the case of Omicron, weekly). The team presents these scenario-based projections to the STWG-DA for vetting. Finally, the DOH tables these projections and recommendations with the cabinet-level IATF, typically every two weeks, for decisions on quarantine regulations and health resource allocation for the next few weeks.

The special unit within the Epidemiology Bureau of the DOH established to focus on the ongoing pandemic called the COVID-19 Surveillance and Quick Action Unit (CSQAU) now functions as the primary user and business owner of the COVID-19 FASSSTER platform.

FASSSTER COVID-19 MODEL

The most valuable functionality of FASSSTER for DOH and local health authorities is its capability to provide scenario-based projections, which the platform delivers through the Time Series Projections Section. The platform's ability to do this is based on the official FASSSTER COVID-19 Model, which the FASSSTER modeling team developed using the classical SEIR or Susceptible-Exposed-Infectious-Recovered, compartmental model. The flow diagram for the first version of the model is presented in Figure 1.

Figure 1 . FASSSTER COVID-19 SEIR Model



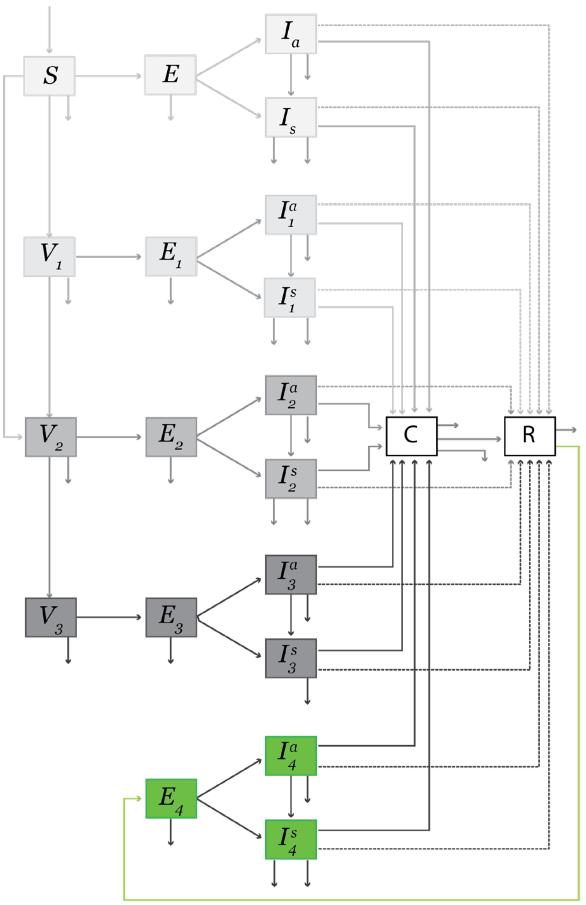
The SEIR model and its modifications, such as FASSSTER's present SVEIR models (Susceptible-Vaccinated-Exposed-Infectious-Recovered) with Reinfection, are mathematical tools for modeling the spread of an infectious disease. The model works by assigning individuals in a population into different groups or so-called compartments where a person only fits into one group at any point in time. In the official FASSSTER COVID-19 Model, the compartments into which the members of the population are placed in are described are shown in Table 1.

Table 1. FASSSTER COVID-19 SVEIR Model with Reinfection

Compartment	Definition
S (Susceptible)	These are unvaccinated individuals whoa re susceptible to the disease.
V_1, V_2, V_3 (Vaccinated)	These are vaccinated compartments which are still susceptible to the disease containing partially vaccinated, fully vaccinatted, and boosted individuals, respectively
R (Recovered)	These are individuals who have recovered from the disease and may become reinfected again.
E, E_1, E_2, E_3, E_4 (Exposed)	These are individuals who have caught the virus, but still not yet infectious. The exposed individuals in E, E_1, E_2, E_3 and E_4 come from compartments S, V_1, V_2, V_3 and R respectively
I, I^a_1, I^a_2, I^a_3, I^a_4 (Infectious Asymptomatic)	These are all the infectious and asymptomatic individuals that do not exhibit symptoms, and are not yet clinically diagnosed nor documented to have COVID-19. The individuals in these compartments come from E, E_1, E_2, E_3 and E_4, respectively.
I, I^s_1, I^s_2, I^s_3, I^s_4 Infectious Symptomatic	These are all the infectious individuals who exhibit symptoms, and are not yet clinically diagnosed nor documented to have COVID-19. The individuals in these compartments come from E, E_1, E_2, E_3 and E_4, respectively. Presymptomatic individuals from I, I^a_1, I^a_2, I^a_3 and I^a_4 will also eventually move to these compartments.
C (Confirmed)	These are all the infectious individuals that have been detected. They are assumed to be isolated from the rest of the population, and are receiving appropriate treatment. The individuals in this compartment compromise the total active cases in the region.

The compartments are mapped into each other as shown in the diagram of the FASSSTER COVID-19 Model shown in Figure 2. The model makes use of ordinary differential equations to determine the number of individuals classified in each of the compartment at any given time and provides projections based on these values .

Figure 2 . FASSSTER COVID-19 SVEIR Model with Reinfection



The enhanced FASSSTER model extends the original SEIR model and has a total of 21 compartments, accounting the effects of vaccination (including boosters) and reinfection.

PLATFORM CAPABILITIES

The FASSSTER platform offers its capabilities across five sections, as presented in the following table. Table 2 to 7 present the functionalities under each section.

Table 2. FASSSTER Platform Core Functionalities

	Section	Core functionalities
1.	Health Section	Presents health metrics providing an overview of the current status of the COVID 19 pandemic in the country.
2.	Time Series Projections Section	Presents scenario based case projections based on the FASSSTER COVID 19 Model. Compared to the functions under the Health Section, the functions in this section present information in helping understand the dynamics of disease transmission in the population that will contribute to better approaches to reducing the spread of disease.
3.	Health Capacity Section	Presents capacity utilization of main health system resources critical during the pandemic.
4.	Socio Economic Section	Presents social and economic indicators of localities throughout the country and their corresponding risk rating and classifications.
5.	Security Section	Presents security indicators of localities throughout the country based on the recorded crimes and their corresponding risk index.

Image 1. Case Statistics Dashboard in the FASSSTER Platform

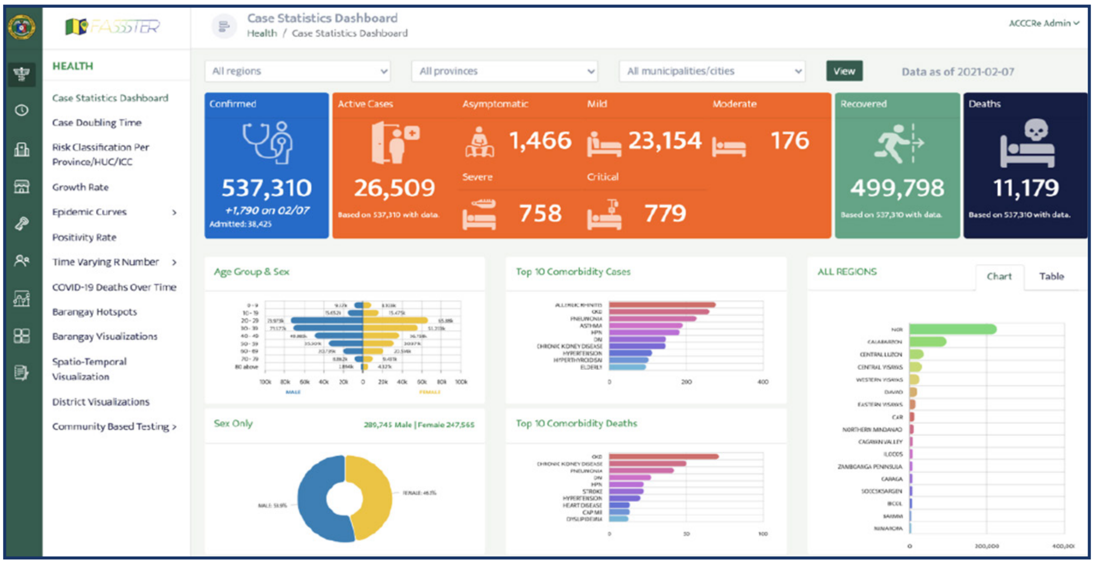


Table 3. Description of FASSSTER Platform Functions, Health Section

Functionality	Description
Case Statistics Dashboard	Provides the breakdown of COVID-19 cases in the country, wherein cases are classified as follows: cumulative confirmed, active, asymptomatic, mild, critical, severe, recovered, and deaths.
Case Doubling Time	Provides the average number of days where cases double from the start of the epidemic with these two metrics: case doubling time and mortality doubling time.
Risk Classification per Province or City	Provides the risk classification of a locality as computed by the platform based on several factors considered for assessing the community quarantine classification of a locality.
Growth Rate	Provides visualizations of the historical changes in the average cases being reported week by week.
Epidemic Curves	Provides visualizations of the recorded confirmed cases since Day 1 of the pandemic.
Positivity Rate	Provides the positivity rate graph, which shows the percentage of people who tested positive out of all tests done in approved testing laboratories. Users can view the data per facility.
Time Varying R Number	Provides the effective reproduction number of COVID-19 for the locality selected.
COVID-19 Deaths Over Time	Provides a visualization of the recorded deaths due to COVID-19 since Day 1 of the pandemic.
Barangay [Village] Hotspots	Tags *barangays* [villages] that have recorded new cases in the selected span of days as "hotspots" so that the concerned local governments could give more focus on these localities.
Barangay [Village] Visualizations	Provides different types of visualizations concerning the status of villages in a selected city for insights into which barangays or clusters of barangays need more attention.

Image 2. COVID-19 Case Projections Over Time in the FASSSTER Platform

Table 4. Description of FASSSTER Platform Functions, Time Series Projections Section

Functionality	Description
FASSSTER COVID-19 Model	Generates projections of the number of cases in the future using the platform's COVID-19 model.
Hospital Requirements Projection	Provides projections on the amount of resources needed to be able to provide care for severe and critical cases. The hospital requirements visualized in this functionality are ICU beds, Regular beds, ER beds, Ventilators, Suction machines, ICU doctors, ICU nurses, ER doctors, ER nurses, Proning Personnel, Regular doctors, Regular nurses, Medtech - venous, Medtech - arterial, Respiratory Therapists, and Full PPEs.
Testing Requirements Projection	Provides projections on the amount of resources needed to be able to test people at optimal levels. The testing requirements visualized are the following: Testing kits, Healthcare workers, a Diagnostic PPE Set, and Outer gloves.
Community Center Requirements Projection	Provides projections on the amount of resources needed to be able to provide care for mild and asymptomatic cases. The hospital requirements visualized are the following: Cohorted beds, Isolation beds, Facility physician, Nurse or midwife, Healthcare workers, Nutritionist dietician, Pharmacists, Food handler, Healthcare worker PPEs, and Patient surgical masks.
Economics Model	Provides projections on the healthcare costs and cost of death that are expected to be realized at a certain point in time.
Map Visualizations	Provides a visualization that integrates the projections of the SEIR model displayed in a temporal and spatial manner, which presents how the pandemic is expected to spread geographically along a timeline.
Age-structured SEIR Model	Provides projections through an alternative, age-structured SEIR model that complements the FASSSTER model. This page is maintained by the Australian Tuberculosis Modeling Network (AuTuMN).

Table 5. Description of FASSSTER Platform Functions, Health Capacity Section

Functionality	Description
Regional Critical Care Utilization Rate (CUR)	Provides a visualization on the utilization rate of the following resources: Mechanical ventilators, Intensive care units, Isolation beds, and Beds for wards.
Bed Capacity	Provides information on utilization of hospital beds in wards, isolation, and ICUs.

Table 6. Description of FASSSTER Platform Functions, Socio-economic Section

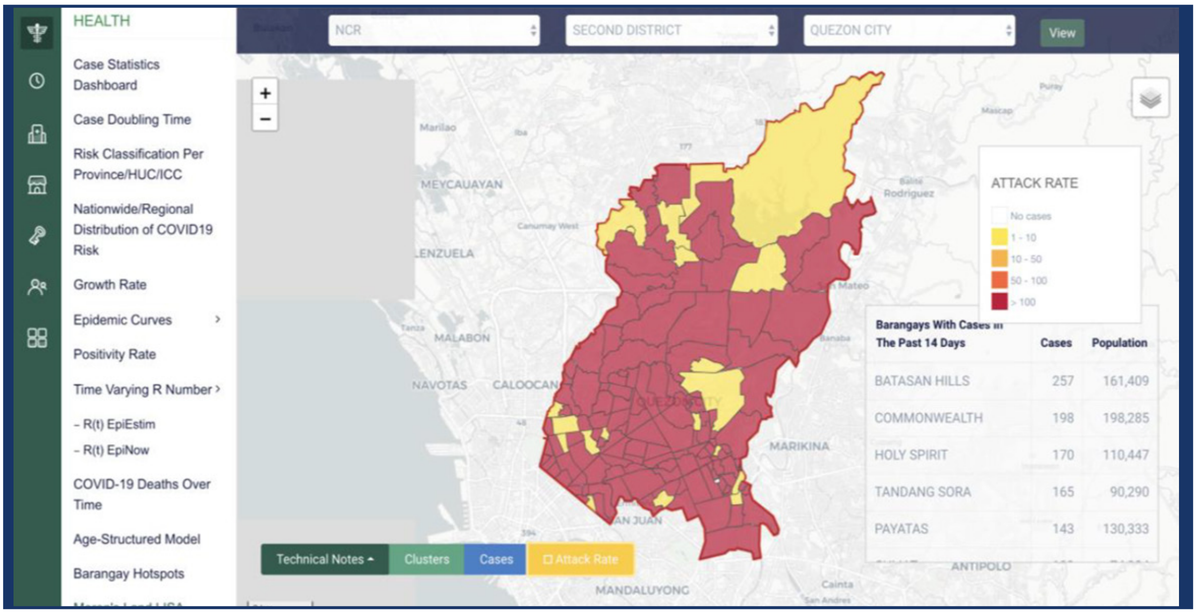
Functionality	Description
Socio-Economic Portal	Provides the main interface of the socio-economic model developed by the Economics Department of Ateneo de Manila University.
Socio-Economic Risk Index	Summarizes the proneness of localities to vulnerabilities expressed through the following four pillars: population, health systems, disaster response capacity, and economy.
Context Panel	Provides information on the socio-economic and development context of localities prior to the effects of COVID-19.
Disruption Panel	Provides information on how workers and establishments in localities were affected during the pandemic.
Amelioration and Recovery Panel	Provides information on the social welfare funding and services provided to localities.
Social Risk Rating & Classification	Provides information about factors considered for determining the social risk and classification of certain localities. These factors are as follows: poverty rating, unemployment rating, lack of access rating, overall rating, and the risk rating.
Economic Risk Classification	Provides information about factors considered for determining the economic risk classification of certain localities.

Table 7. Description of FASSSTER Platform Functions, Security Section

Functionality	Description
Security Index	Provides the security risk classification based on the computed Major and Minor Crimes Score. This page also shows the number of incidences for both major and minor crimes.

Further, users can view data on specific localities depending on their access privilege: national, regional, provincial, and city or municipal levels. A key feature of the FASSSTER platform is its capability to provide the spatial and temporal presentation of its data. (See Image 3.)

Image 3. Barangay (or Village) Visualizations in the FASSSTER Platform

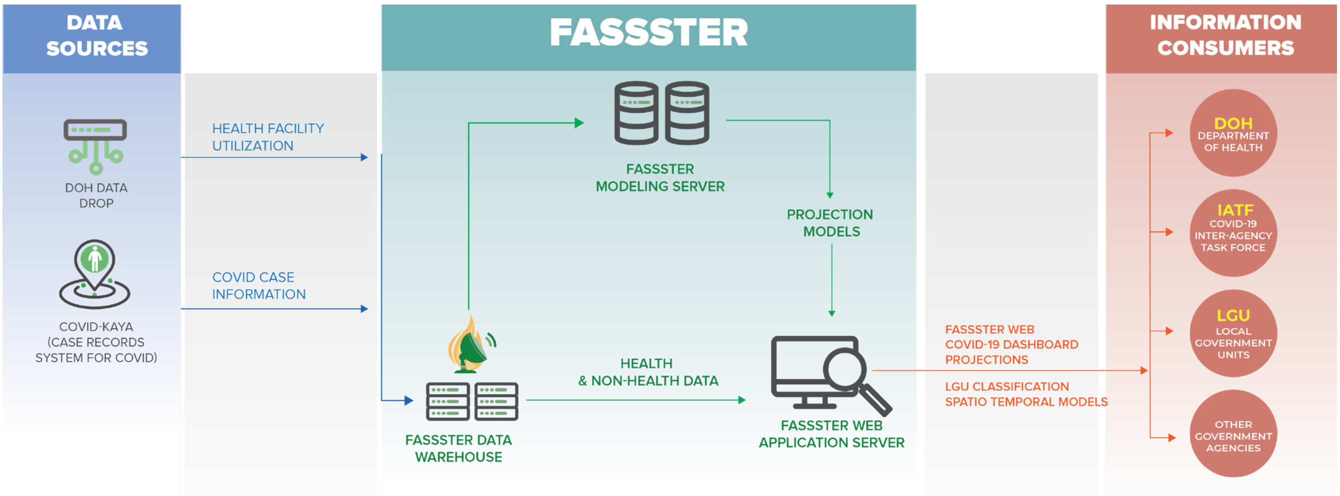


DATA PIPELINE

All data used to generate analytics and models within the FASSSTER platform, both health and non-health data, come from a number of sources set up by the DOH and other government agencies with guidance and ascent from the IATF, particularly its sub-Technical Working Group on Data Analytics. These data sources are available for public consumption in a public portal referred to as the DOH Data Drop.

In addition, FASSSTER uses a data warehouse to store and format all data as part of pre-processing before being fed into the different models and analytical tools. (See Figure 3.)

Figure 3. FASSSTER Data Pipeline



As FASSSTER is the endpoint in the COVID-19 data pipeline providing the aggregate or macro-level picture for the benefit of decision-makers it is critical to note that each of the data sources (e.g. ICT assets, applications, databases) dealt and continue to deal with challenges expected in a massive data operation such as system development and iteration, data cleaning, data privacy, and system and data interoperability, among others. The FASSSTER platform benefits from the work done by other teams managing these other data and ICT assets.

PROJECT MANAGEMENT TEAM

With the donation and turnover of FASSSTER from Ateneo de Manila University to the DOH in September 2020, management of the platform and its direction moving forward lies with the DOH - Epidemiology Bureau (EB) as its principal business user with support from the DOH - Knowledge Management and Information Technology Service and the COVID-19 Surveillance and Quick Action Unit (EB-CSQAU) as its system administrator.

Due to the platform's massive capacity and processing requirements, its infrastructure continues to be provided by the Advanced Science and Technology Institute (ASTI), an attached agency to DOST.

When FASSSTER was being adapted for COVID-19 operations in the early days of the pandemic, the FASSSTER project management team was composed of an interdisciplinary university-based staff organized across the following teams: disease modeling, model programming, system development, data management, data warehouse, and data science. The project management team also collaborated with experts in epidemiology, public health, and economics.

This university-based team at Ateneo de Manila's ACCCRe, continues to support the DOH as it institutionalizes FASSSTER within its day-to-day operations, particularly in generating backend projections, delivery of capacity-building sessions, and improving platform functionalities.

Table 8. Modules of the FASSSTER Training Curriculum

FASSSTER Training Curriculum	
Module	Coverage
Module 1: Overview of FASSSTER	• FASSSTER history and agency partners • Main functions of FASSSTER for COVID-19 surveillance • Data sources, pipeline, processing, and visualization
Module 2: Navigating FASSSTER	• Navigating through the platform • Platform registration • Data use agreements and privacy
Module 3: Using & Interpreting FASSSTER for Nowcasting	• Features needed to address specific needs in disease monitoring and surveillance • Interpreting results generated by models and analytics • Producing reports needed for decision-making
Module 4: Using & Interpreting FASSSTER for Forecasting	• The FASSSTER COVID-19 Model and analytical computations in FASSSTER • Basic mathematical and analytical concepts used in disease surveillance and modeling • Producing the reports needed for decision-making

CAPACITY-BUILDING

In the first few months of 2020, it was the ACCCRe team who were predominantly using the FASSSTER platform to execute runs, generate projections, and extract reports, which they provided to the DOH, the IATF, and local governments.

With the transition and turnover of the platform to the DOH, the FASSSTER team designed a training curriculum, not only for the Department's Epidemiology Bureau, but also for local government units. While DOH personnel were already being eased into using the platform throughout 2020, the formal training sessions started in the fourth quarter of the same year. (See Table 8.)

The standard training curriculum is set for 30 hours for DOH staff and 10 hours for local governments. Synchronous training sessions are typically spread over the course of a few days depending on the arrangements with a set of training participants. The FASSSTER team deployed the training materials through the learning platform Moodle following the Department's use of this learning management system in their existing training programs.

The capacity-building program continues as of the publication of this Strategy Note with more training sessions anticipated throughout 2022. The current training curriculum is organized into four modules, as follows:

The backgrounds of those who are designated to become FASSSTER users vary, especially those from local governments. Users may be medical doctors, health system administrators, and non-health sector professionals. In most cases, disease surveillance and modeling are novel subjects for prospective FASSSTER users. As much as the curriculum aims for users to learn how to use the platform, the most critical learning objective is for users to be able to apply and interpret the data in making public health recommendations and decisions.

The training program also includes prospective trainers, particularly from local universities, who can deliver the curriculum to local government units and help speed up and expand the rollout of FASSSTER to more provincial, city, and municipal governments.

UNDP ASSISTANCE

The UNDP Country Office in the Philippines engaged the university-based FASSSTER team in the fourth quarter of 2020 for partnership and funding support as part of UNDP's wide-ranging work in assisting the country to respond to and recover from the pandemic. At this time, Ateneo de Manila University has just donated and turned over the FASSSTER platform to DOH. Hence, UNDP's assistance centered on aiding this transition, particularly in supporting the following areas:

- Operations and maintenance of the platform;
- Platform development to support additional functions needed by the DOH and local governments;
- Capacity-building for DOH and at least 20 local government units; and
- Design and development of the socio-economic model.

Pintig Lab (Pulse Lab), an initiative of UNDP Philippines, worked with FASSSTER to determine the impact of quarantine regulations on the epidemiological and economic recession curves, and vice versa. Pintig Lab's multi-stakeholder network of data scientists, epidemiologists, economists, and other field experts synthesized data from the private and public sectors, including data from FASSSTER, into policy recommendations for the government in its response and recovery strategy against COVID-19.

FUTURE PLANS

The FASSSTER platform has achieved relative stability and maturity within the DOH. Now that it has been transitioned to become a government ICT asset, it is the DOH setting its direction moving forward. However, the university-based team continues their work in assisting and capacitating the Epidemiology Bureau in forecasting, especially in generating projections. Training for local governments in using the platform also continues.

LESSONS LEARNED AND BEST PRACTICES

Described below are key lessons learned from the journey of FASSSTER in becoming the country's COVID-19 surveillance system which stems from both hindering and enabling factors experienced by the FASSSTER team, the DOH, LGUs, and key stakeholders. The lessons learned and best practices are organized into the following areas: (1) Technical and Functional; (2) Organizational and Resourcing; (3) Local Adoption; and (4) Policy and Governance.

As this report offers FASSSTER as a model for Ministries of Health and local public health authorities, this Strategy Note concludes with some best practices and recommendations that may be applicable in building a similar disease surveillance platform.

TECHNICAL AND FUNCTIONAL

- **Generating models require high-performance computing.** Generating daily output from models designed to capture municipality, city, provincial, regional, and national behavior over time can take a toll on system performance. While the ASTI and the DICT have continued to provide resources and technologies to enhance system performance and efficiency, the platform draws from a database containing over three million cumulative cases as of the publication of this report. The FASSSTER team has grown to realize that robust computing capabilities as a critical technical requirement in disease modeling platforms, especially in prolonged pandemic situations.
- **The novelty of COVID-19, its changing behavior, and its effect on the public's behavior required a dynamic and iterative process in fine-tuning the surveillance platform while maintaining core features.** When the users of the FASSSTER platform were expanded from the Epidemiology Bureau to other units of the DOH, other government agencies, and LGUs, the FASSSTER platform had to be upgraded to accommodate additional analytical tools that were outside the original design or beyond the scope of a typical disease surveillance platform. With interventions such as vaccination and booster shots and effects such as reinfection, the FASSSTER COVID-19 Model continues to require constant redesigning and the corresponding computational implementation for scenario-based projections to be relevant to ongoing decision making by the IATF.
- **As an endpoint in the COVID-19 data pipeline, the FASSSTER platform benefited from the work done by project teams managing their respective data and ICT assets within the COVID-19 ICT Suite.** Issues on the data pipeline, while significant in itself and worth considering as a separate case study, were addressed and resolved outside of the operations of FASSSTER. By the time data is pushed to the FASSSTER data warehouse, there is already a relative degree of confidence in the accuracy of the datasets that FASSSTER uses for its projections and displays for its users.
- **The socio-economic and security sections in FASSSTER may be unique for a disease surveillance platform.** While FASSSTER functions as a disease surveillance tool, it can also be viewed as a broader data analytics tool for pandemic response going beyond health-related metrics. This can be a double-edged sword. On one hand, as the national government's premier analytical tool in its COVID-19 ICT Suite, it serves as a convenient all-in-one platform for key metrics and visualizations, adding socio-economic and security indicators to health data. On the other hand, it can also be seen as "doing too much" catering to different policy end users.
- **The LGUs can benefit from the entirety of the platform's functionalities.** However, it is DOH that are the principal users of the platform's Health Section, Time Series Projections Section, and Health Capacity Section, while the National Economic Development Authority (NEDA) is the intended audience for the Socio-Economic Section and the Department of Interior and Local Government (DILG) for the Security Section.

- **The FASSSTER platform requires robust internet connectivity from its users, especially when running models.** Given that the platform already processes large datasets and requires high- performance computing, FASSSTER users acknowledge that using the system can be sub-optimal because of poor broadband in their offices. This poses a challenge to adoption by local government units in remote areas or where connectivity is inadequate.

ORGANIZATIONAL AND RESOURCING

- **Contributions to FASSSTER (and the overall work on pandemic response) among civil servants and external or non-government experts and partners were done out of 'bayanihan' — a spirit of civic unity and cooperation.** This was particularly evident in the first few months of COVID-19 when no playbook was available on how to build these kinds of tools and data ecosystems, not to mention an overall strategy on responding to a global pandemic. For FASSSTER specifically, the team from Ateneo de Manila University developed the models, repurposed the platform, and contributed to government panels with minimal resources, especially during the beginning of the pandemic.
- **The university-based FASSSTER team faced resource constraints in adapting the project for COVID-19 and transitioning the platform for government use.** FASSSTER is likely a unique case among disease surveillance platforms used by governments in that in originating as a project out of an academic institution, it had to be transitioned rapidly for government use during a pandemic. This process of transition and redesign required financial resources that were not immediately available with FASSSTER still a university-based project in the first few months of the pandemic. The FASSSTER team credits the PCHRD and UNDP Philippines for providing this support.
- **Disease modeling and fine-tuning a disease surveillance platform requires full-time staff.** In the first few months of the pandemic, the university-based FASSSTER team of professors, researchers, teaching assistants, and graduate students were immediately requested to do work on modeling and systems development equivalent to a startup environment. This demonstrated that working on disease surveillance systems should not be a part-time endeavor, rather it requires dedicated personnel.
- **It helped that the university-based FASSSTER team established a working relationship with the DOH for years ahead of the COVID-19 pandemic.** Because the team from Ateneo de Manila University already worked with the Epidemiology Bureau on a localized disease model and platform for dengue, measles, and typhoid, this helped reestablish the credentials both of the team and the platform with the Department of Health in the early days of the pandemic. It also helped that FASSSTER had received public funding from the PCHRD.
- **The FASSSTER team from Ateneo de Manila University was consistent in providing their expertise to the government,** particularly their modeling work, from the time the IATFopened its doors to experts. In the first few months of the COVID-19 crisis, the National Government invited experts from academic institutions and other private entities to help navigate the pandemic. As time progressed, the DOH attested to the consistency of the FASSSTER Senior Leads, supported by their team of research assistants, data scientists, and developers, in generating case projections based on the data provided by the national government. This helped build FASSSTER's credibility, both as a team and as a platform, to be able to respond to the analytical requirements of the Philippine National Government.

LOCAL ADOPTION

- **The DOH wishes to see more LGUs use FASSSTER, especially in utilizing localized projections.** Considering that certain public health interventions can only be done at the local level, the DOH recognizes how the FASSSTER platform can help local governments better sharpen their COVID-19 response. Most LGUs rely only on historical or descriptive data on their respective jurisdictions without the benefit of inferential or predictive data that FASSSTER is able to provide.

> Pasig, a city in Metro Manila, is a key champion of the FASSSTER platform. According to the Pasig City Health Office, the most useful functionalities for them are the epidemiological curves, reproduction time, barangay [village] incidences, and the spatio-temporal presentation of cases.
>
> Before FASSSTER was introduced to Pasig, when asked to present trends based on case data to the city's coronavirus task force, the City Health Office could only show growth rates from the past two to four weeks. With the help of FASSSTER, they are now able to present and discuss localized projections focusing on the barangays most at risk and those with the propensity for uptick in cases.
>
> This has allowed them to advise the city's hospitals, labs, and quarantine facilities to increase their respective capacities. Examples of interventions that directly resulted from insights generated through FASSSTER include:
>
> - Freeing up classroom buildings to serve as backup isolation facilities;
> - Increasing bed capacity in a particular facility from around 100 to 160;
> - Increasing isolation and quarantine capacity in another facility from 220 to 400; and
> - Increasing the testing capacity of the city government's own molecular lab from 150 per day to 800 per day.

- **While FASSSTER can be perceived as "too technical" for local governments, the capacity-building sessions helped LGUs appreciate the platform and its value to their local needs.** The highly technical nature of disease surveillance and modeling can be a deterrent to the adoption of FASSSTER by LGUs. However, local governments that have adopted FASSSTER acknowledges that the training provided them with a deeper appreciation of how the platform's capabilities can help inform public health interventions in their localities.
- **Some LGUs that have been capacitated to use FASSSTER have not yet adopted the platform.** While the DOH has endorsed the use of FASSSTER in local governments, its use is not mandatory. There may be a range of reasons, which can be a subject for further investigation, why some local governments that have received training for the use of FASSSTER have not yet adopted the platform as an analytical tool in their local pandemic response. The FASSSTER team suspects that technical capacity among local health authorities is still a barrier despite the availability of training.
- **The variance in case counts between the national and local governments may cause confusion.** Case counts can vary between FASSSTER, which reflects data held by the national government, and the data produced by the data and ICT assets of local governments. This variance can sometimes cause some degree of confusion to local health authorities. However, local governments that have adopted FASSSTER attest that what matters to them is the consistency in the historical trends between FASSSTER and their own local information systems, which gives them confidence in the projections that FASSSTER can generate.

POLICY AND GOVERNANCE

- **The DOH acknowledges that the partnership with the university-based FASSSTER team** leading to the eventual donation and handover of the platform is unconventional for the national government. Both the DOH and the university recognize that the donation process for the FASSSTER platform was far from being a straightforward process. In addition to novel legal hurdles in donating the platform's intellectual property, from the perspective of the national government, FASSSTER itself was a leap in innovation for the DOH. The transition of FASSSTER as an asset from a university to the government was not just a matter of technology transfer but of building capacity in disease modeling against a backdrop of an ongoing global pandemic.

- **Senior officials with the DOH have grown accustomed to FASSSTER as a key source of information catering to specific policy questions.** For instance, if a senior official within DOH asks about the impact of a specific increase in the number of vaccinated individuals towards COVID-19 case data, they recognize FASSSTER as the likely source of this information with the help of technical staff in the Epidemiology Bureau. Principals within the DOH have grown to embrace the platform in informing specific public health interventions.

- **FASSSTER's leading use case is providing guidance towards the periodic adjustments in quarantine regulations throughout the country.** When the IATF reclassifies the community quarantine levels for all localities every two weeks, the DOH bases its recommendations to the IATF on metrics and projections from the FASSSTER platform. This is a testament to the credibility that FASSSTER has built not only within the DOH but also across the national government.

- **There is a need to strengthen mechanisms for data collection, data sharing, and alignment of data at the national and local levels given that the reliability of projections is dependent on the accuracy and integrity of raw data.** Acknowledging that sources of data are spread throughout government bureaucracy, the success of analytical tools, such as a disease surveillance system, is highly dependent on its data pipeline. Now that the COVID-19 pandemic has demonstrated the necessary data and ICT infrastructure when it comes to monitoring diseases, this now serves as an opportunity to apply these lessons on data ecosystems when it comes to the broader health system and specific diseases.

- **Setting up the data pipeline necessitates data sharing policies.** FASSSTER, along with other systems in the national government's COVID-19 ICT Suite, went through a dynamic and evolving process of hurdling legal and policy constraints with regard to the data pipeline. It is vital to recognize that building this kind of data and ICT infrastructure also requires a supporting policy infrastructure, particularly on data sharing. As an interim measure, these could be bilateral or multilateral data-sharing agreements between government offices, as is the case with FASSSTER. Ideally, when the systems have achieved a level of maturity, data sharing protocols and agreements should be institutionalized in the form of policies.

- **Institutionalizing pandemic innovations, such as FASSSTER, requires the necessary budget allocations.** Developing information systems is not a one-time investment whereby when the platform has been established and has achieved stability, it only requires maintenance afterward. Innovations such as a disease surveillance platform borne during this pandemic need to keep up with new developments. This requires constant iteration, which requires provisioning.

- **A new disease surveillance platform should expect public scrutiny, which requires earning public trust.** Data produced and reported by governments are always subject to scrutiny. As experienced by the DOH and the FASSSTER team, this scrutiny and criticism was leveled not only at public authorities and their officials but also at FASSSTER itself. As a novel system unfamiliar to the country's health sector and the broader public, questions were raised on the platform and the accuracy, quality, and integrity of its data and projections. Ministries of Health looking to establish new disease surveillance platforms will be served well by engaging the public and making the effort to explain this tool.

BEST PRACTICES AND RECOMMENDATIONS

- **There are conducive factors or available resources that governments can use as a springboard in building disease surveillance platforms.** While the disease modeling and platform development work will likely have to be done from the ground up, this does not mean that national governments have to completely start from scratch. Based on the journey of the FASSSTER project, here are a few conducive factors or available resources that governments can capitalize on in developing their disease surveillance capabilities:
    - Existing information systems that house case data on specific diseases
    - Data and ICT systems already owned and managed by Ministries of Health and local health authorities
    - Inter-agency data sharing policies or frameworks
    - Government-owned or contracted high-performance computing capabilities
    - In-country academic expertise on mathematical or disease modeling
    - Domestic research and development projects on disease modeling and surveillance, whether publicly or privately funded
    - Existing epidemiological and disease surveillance rules, protocols, programs, and other initiatives that Ministries of Health likely already have and play a leading role in
- **Partnerships are critical across government agencies and also with non-government actors.** With health and/or disease control agencies taking the lead on setting up and managing a disease surveillance platform, it is imperative to secure partnerships with other ministries and agencies particularly the ICT or eGovernment agency, data privacy regulator, public health research institutes, statistical agency, and mapping agency, among others. Should the platform also contain non-health data such as economic and security data similar to FASSSTER, then partnerships with ministries with these mandates should also be necessary.
- **Those managing disease surveillance platforms can also benefit from collaborating with non-government actors,** particularly academic institutions, civil society organizations, and multilateral development partners. In particular, health ministries may have to consult with or engage mathematical modelers to contribute to or advise in the development of the official models that the disease surveillance platform will be based on.
- **Adapt disease transmission models based on evolving circumstances and domestic context.** As experienced in other countries, COVID-19 disease modeling or any other disease modeling project, requires constant revision based on the dynamic relationship between the behavior of the public (e.g. compliance), national and local government responses (e.g. quarantine, vaccination), and its corresponding effect on the disease and its transmission (e.g. variants and reinfection). Modelers therefore should account for these changes in their initial design so that such changes will simply require extensions based on the base model instead of starting from scratch every time there is a need to update. The design of disease models also requires an understanding of what the model outputs are for so that projections are understood based on scenarios rather than simply the rise and fall of numbers.
- **Further, well-studied and implemented localization increases the adoption of science-based platforms.** This requires the development of a system that will accommodate the use of the model not only in large regions but also in smaller regions such as municipalities and towns. The approach to variances in data at the national and local levels should be to present both figures and focus on looking at trends rather than precise numbers.
- **Given a dedicated team assigned to focus on building a disease surveillance platform, a prototype capable of generating reliable projections for government use can be launched within a short period of time.** With the right team of experts and support from the health ministry, developing models on any given infectious disease can be done within a couple of weeks. Further, assuming that the most fundamental datasets can be readily made available to the project team, the software and the data pipeline can be built in around three months. Thereafter, optimizing the platform and introducing new functionalities should be a continuous iterative process beyond the launch of the prototype.
- **The financial investment in developing a disease surveillance platform is non-prohibitive and justifiable.** As a prototype can be launched within a few short months, the majority of the project cost will have to go to personnel or consultants, particularly project managers, modeling experts, software developers, and data specialists, among others. The other significant portion of the cost will have to go to infrastructure (i.e. hosting or servers) and other IT services necessary in

building and maintaining the platform. Cost estimates can vary depending on existing resources such as if the project is able to draw from available experts or specialists within the health ministry or hosting capacity that may already be at hand. Ultimately, despite the highly technical and specialized nature of a disease surveillance platform, the cost of building one is non-prohibitive. UNDP has the capability to scope in-country requirements and help pin down the necessary financial investment tailored for specific contexts.

- **The project management team in the development of a disease surveillance platform will be well-served by a multidisciplinary team composed of mathematical modelers, software developers, data specialists, and public health experts.** Building a disease surveillance platform is not simply a software development project. Based on the FASSSTER experience, here are the recommended staffing roles, qualifications, and responsibilities for a project management team. (See Table 9.)

Table 9. Recommended Project Management Team in Building a Disease Surveillance Platform

Role	Qualifications	Responsibilities
Project manager	Management experience with an academic or professional background in public health, epidemiology, information systems, statistics mathematics, and social sciences	• Overall supervision of the project and the team • Interface with government stakeholders and external experts
Mathematical Modeling Team	Highly technical expertise in mathematical and disease modeling	• Develop the models on disease transmission and other analytical tools
Systems Development Team	Experienced professionals in software development and IT operations	• Develop the software of the platform • Program the models and analytical tools • Management of the development and operations of the entire platform
Data Specialists	Experienced professionals across a wide range of data specializations (e.g. data processing, database administration, data science, data visualizations, etc.)	• Build the data pipeline, which can range from cleaning and processing data to building databases or a data warehouse. • Develop data visualization tools with the software developers
Public health and epidemiology specialists		• Provide guidance and insights to the modeling and data teams
Other subject matter experts (e.g. economists)		• Provide guidance and insights to the team on the non-health data

- **Disease surveillance platforms for local governments may differ from the national government.** FASSSTER was primarily built and optimized for the DOH, but local governments are also able to view data and generate projections specific to their localities. Some local health authorities have voiced suggestions for the FASSSTER platform to be customizable to their specific needs and interoperable with their own local data and ICT systems. For health ministries or agencies looking to build their own disease surveillance platforms, they may also encounter this challenge whereby they must build and optimize their platform for their use at the national level but may receive requests for customization for local needs.

- **A risk that needs to be managed is that the platform may become "too many things for too many people", which can compromise user experience and even platform performance.** Health ministries must weigh this carefully and address issues on a case-to-case basis. It may be possible and even warranted, that disease surveillance platforms for local governments may have to be built differently or independently from national governments. Should this be the case, then national governments should be ready to render assistance or set frameworks for local governments by providing expertise and training, open sourcing the codes and models, and making other tools readily available.

- **UNDP can play a meaningful role in developing disease surveillance platforms, but governments must take the lead.** As demonstrated in the FASSSTER experience, the Philippine National Government had already taken steps to repurpose the platform for COVID-19 before the UNDP Philippine Country Office offered additional support. For countries looking to build their own disease surveillance systems whether for COVID-19 or other diseases, UNDP can offer technical expertise and project financing.

To enable this, it is critical for governments to demonstrate meaningful commitment. For example, the lead ministry or agency must embrace the operational minutiae, especially in the highly technical and novel areas of the project such as data privacy, intellectual property, and mathematical modeling, among many others. UNDP also recognizes that the adoption and institutionalization of new initiatives can only be successful when the government supports these by issuing the necessary policies, building internal capacities, and engaging with the public and key stakeholders.

- **Enabling policies are a prerequisite in the success of disease surveillance systems.** Depending on the context of each country exploring to build a new disease surveillance platform, governments will likely need to issue new policies or tweak existing ones to support its success, particularly in the following areas:
    - Data sharing and governance
    - Interoperability with other ICT platforms
    - Intellectual property ownership of the platform
    - Roles and responsibilities of government ministries, agencies, and/or offices
    - Funding and long-term program or project management
- **Decision-making frameworks optimize the use of a disease surveillance platform.** As use of FASSSTER has matured in the DOH, its users from the Epidemiology Bureau already have well-defined workflows in the form of decision-making frameworks. As presented, the platform's leading use case is providing guidance towards the periodic adjustments in quarantine regulations throughout the country every two weeks. When projections meet certain thresholds, the DOH already has a set of recommendations they can make to the IATF on tightening or loosening quarantine regulations and public health measures. While these frameworks and recommendations evolve based on new knowledge about COVID-19, the DOH has established decision-making workflows that help frame the metrics and projections from FASSSTER.

CONCLUSION

The base disease modeling framework of FASSSTER was reused for COVID-19 within the context of an emerging crisis when information about the virus was still scarce, lockdowns were still being explored, and the public was still digesting how this new phenomenon could turn out. As the FASSSTER model and platform were being fine-tuned, slowly building its value and credibility within the Department of Health, confirmed cases were increasing, health system resources were getting overstretched, the economic impact was setting in, and public dissatisfaction in the management of the crisis had been growing.

The team behind FASSSTER hopes that their experience can contribute to public health authorities looking to establish surveillance systems for COVID-19 and other diseases. Lessons learned from the COVID-19 pandemic, including those from developing response measures such as data and ICT tools that inform public health decision-making, will undoubtedly be valuable in managing the next phases of the current pandemic and addressing gaps in the readiness of public health systems in facing future pandemics.

RESOURCES

A. FASSSTER Links

FASSSTER Home Page: https://FASSSTER.ehealth.ph/

Unlocking FASSSTER. Video recording of a FASSSTER training session on Youtube:

https://www.youtube.com/watch?v=yM2w-FWOIt4

https://www.youtube.com/watch?v=YOkg23-3NsQ

Orientation Package for COVID-19 Response Online. DOH Academy online course: https://learn.doh.gov.ph/course/index.php?categoryid=22

FASSSTER Disease Surveillance and Modeling Toolkit. iADAPT online course: https://iadapt.pdrf.org/courses/FASSSTER-disease-surveillance-and-modeling-toolkit/

B. Policy Instruments

Inter-Agency Task Force for the Management of Emerging Infectious Diseases. Resolution No. 36, Series of 2020. 13 May 2020. https://www.officialgazette.gov.ph/downloads/2020/05may/20200513-IATF-RESOLUTION-NO-36.pdf

Inter-Agency Task Force for the Management of Emerging Infectious Diseases. Resolution No. 85, Series of 2020. 26 November 2020. https://www.officialgazette.gov.ph/downloads/2020/11nov/20201126-IATF-Resolution-No.-85.pdf

C. Publications

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Jann Railey Montalan, Maria Regina Justina Estuar, Kardi Teknomo, and Roselle Wednesday Gardon. 2019. Measles Metapopulation Modeling using Ideal Flow of Transportation Networks. In Proceedings of the 2nd International Conference on Software Engineering and Information Management (ICSIM 2019). Association for Computing Machinery, New York, NY, USA, 147–151. DOI: https://doi.org/10.1145/3305160.3305210

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Estuar et al (2020). Science and Public Service during a Pandemic: Reflections from Scientists of the Philippine Government's COVID-19 Surveillance Platform. Philippine Studies: Historical and Ethnographic Viewpoints. Vol 68, Nos. 3 - 4, September - December 2020.

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De Lara-Tuprio et al (2021). A Mathematical Model of COVID-19 in the Philippines. https://aip.scitation.org/doi/10.1063/5.0075333

Estadilla et al (2021). Impact of vaccine supplies and delays on Optimal Control of the COVID-19 Pandemic: Mapping Interventions for the Philippines. Infectious Diseases of Poverty. https://idpjournal.biomedcentral.com/track/pdf/10.1186/s40249-021-00886-5.pdf

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Chua & Estuar (2021). Automation of Data Cleaning Process by Understanding Nuances in COVID-19 Data. (Accepted. Waiting for publication).

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United Nations Development Programme

Philippines Country Office
15th Floor North Tower, Rockwell Business Center Sheridan
Sheridan Street corner United Street
Highway Hills, 1554 Mandaluyong City, Philippines
Email: registry.ph@undp.org Website: https://www.ph.undp.org