"Towards Equity in the COVID-19 Response in Western Visayas"

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ABSTRACT

The COVID-19 pandemic has burdened the public health system in the Philippines since January 2020. In Western Visayas (Region 6), Philippines, issues have been raised on the limitations of the government's response on testing, contact tracing, and augmentation of healthcare facilities. Using data from the Western Visayas - Regional Epidemiologic Surveillance Unit (WV - RESU) from March 20 – June 20, 2020, the following observations were made: 1) Of the 6 provinces, Iloilo has the highest % tests done per capita which may be linked to the presence of the only regional COVID-19 testing facility in the province, 2) There are delays in the overall processing times for specimens from Antique and Negros Occidental which may be linked to transport logistics and/or laboratory processing, 3) Contact tracing in Western Visayas is adequate (3,420/3,503, 97.63%), but less than 50% (1,668/3,420) were tested, 4) Hospital and quarantine facility capacities are still adequate, but their utilization rates need to be monitored continuously for further augmentation, if needed. Reports have shown that Western Visayas may already be in the deceleration phase of the epidemic curve, however, there is still a need to improve testing and contact tracing in the provinces, and closely monitor health facilities for possible capacity augmentation in case a surge in cases occur, particularly as we enter the transition into the post-quarantine scenario.

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INTRODUCTION

Since its first confirmed case in Jan 30, 2020, the Philippines has gone through multisectoral changes to curb the spread of COVID-19. The government has implemented varying levels of quarantine measures all over the country to flatten the curve, i.e., prevent a surge in cases and deaths that could overwhelm healthcare capacity (Kabiling, 2020). In addition to these measures, efforts were also focused on ramping up testing, intensifying contact tracing, and augmenting health facility capacity (Esguerra, 2020; Gonzales, 2020). It has been more than 2 months since the series of lockdowns has been imposed, but the country's response to the pandemic is still impeded due to delays in case reporting, inefficient tracing of patient contacts, poor support for laboratory and hospital personnel, and inadequate testing among others (Abano, 2020; WHO, 2020). All these are symptoms of an ailing and persistently unprepared public health system, exposed wholly by emergency situations such as the COVID-19 pandemic (Quintos, 2020).

The Western Visayas region (Region 6) has been relatively aggressive in its preventive measures since its first reported case on March 20, 2020. The enhanced community quarantine (ECQ) was implemented starting March 20 through May 15 for Iloilo province, and April 30 for the other provinces in the region. Currently, the entire region is placed under general community quarantine (GCQ), a more relaxed version of the ECQ. As of June 20, 2020, the region has a total of 177 cases with the number of deaths pegged at 11 since June 6, 2020, and 109 recoveries which continue to grow in number daily (Figure 1) (Alvior and others, 2020; DOH-WVCHD, 2020). Despite the region's lauded control over the spread of COVID-19, it has also encountered numerous issues in its response, similar to what is being observed nationwide. As such, this study aims to provide an overview of the COVID-19 scenario in Western Visayas, and highlight aspects that need to be focused on to improve the region's response.

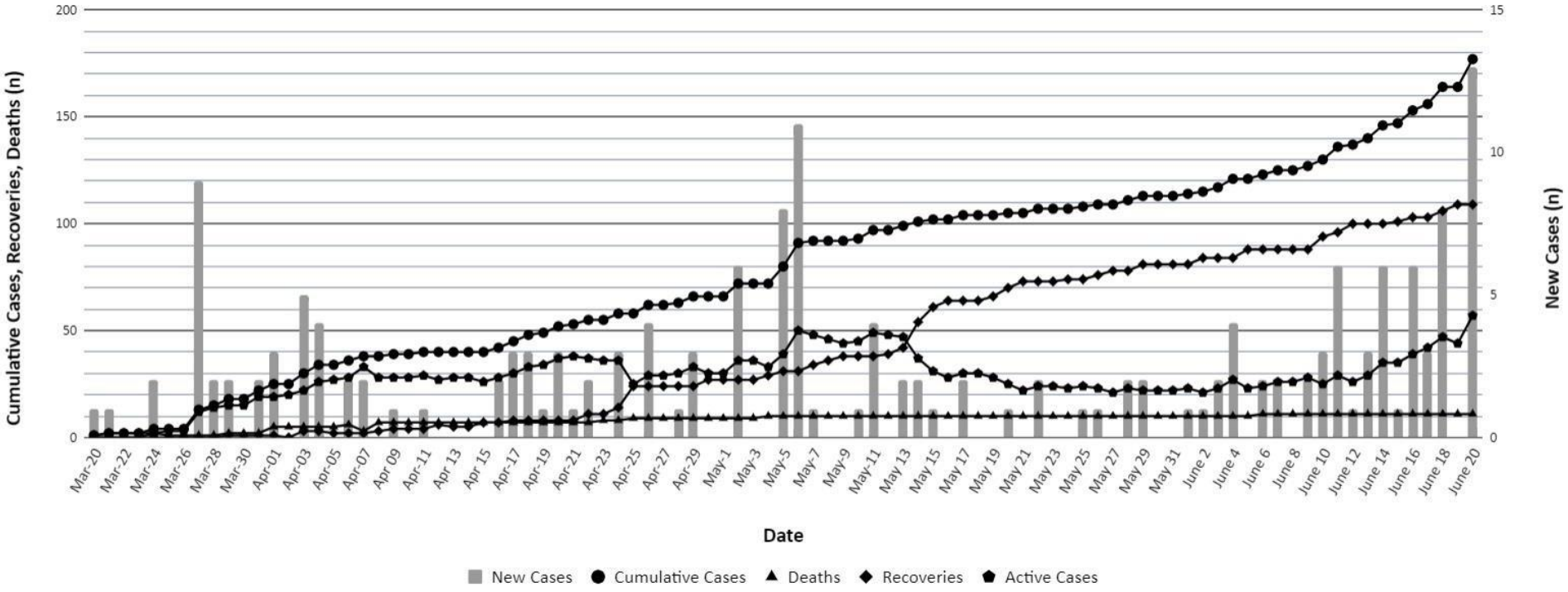

Figure 1. COVID-19 Data in Western Visayas: New and Cumulative Cases, Recoveries, and Deaths (as of June 20, 2020)
(Source: DOH-WVCHD, 2020)

METHODS

COVID-19 data for the period of March 20, 2020 – June 20, 2020 from the Western Visayas - Regional Epidemiology Surveillance Unit (RESU) were used in the analysis. These were as follows:

a. Deidentified case profiles of confirmed cases in Western Visayas
b. Number of positive and negative results released by the Western Visayas Medical Center – Subnational Laboratory (WVMC-SNL) for COVID-19 testing
c. Capacity and Utilization of Hospital and Quarantine Facilities in Western Visayas
d. Contact tracing data for each confirmed case in Western Visayas

RESULTS AND DISCUSSION

COVID-19 Testing

The Western Visayas Medical Center – Subnational Laboratory (WVMC-SNL) for COVID-19 testing became operational last March 24, 2020 (French, 2020). As of June 02, 2020, the WVMC-SNL has tested ~11,200 individuals (Ramos, 2020). In % tests per capita (*number of individuals tested/total population, multiplied by 100*) for each province, Iloilo had the highest percentage with 0.318%. Within the same period, the % tests per capita of the other provinces ranged from 0.021 – 0.098% (Figure 2). A similar trend has been seen in the available testing data in the previous weeks (Western Visayas RESU[a,b,c]).

The higher % tests per capita in Iloilo indicates that a greater percentage of individuals are being tested in the province compared to the rest of the region. The presence of the COVID-19 testing facility in the province of Iloilo may attribute to this. The proximity to the testing center places Iloilo at an advantage as its healthcare facilities can immediately transport samples to the facility for testing.

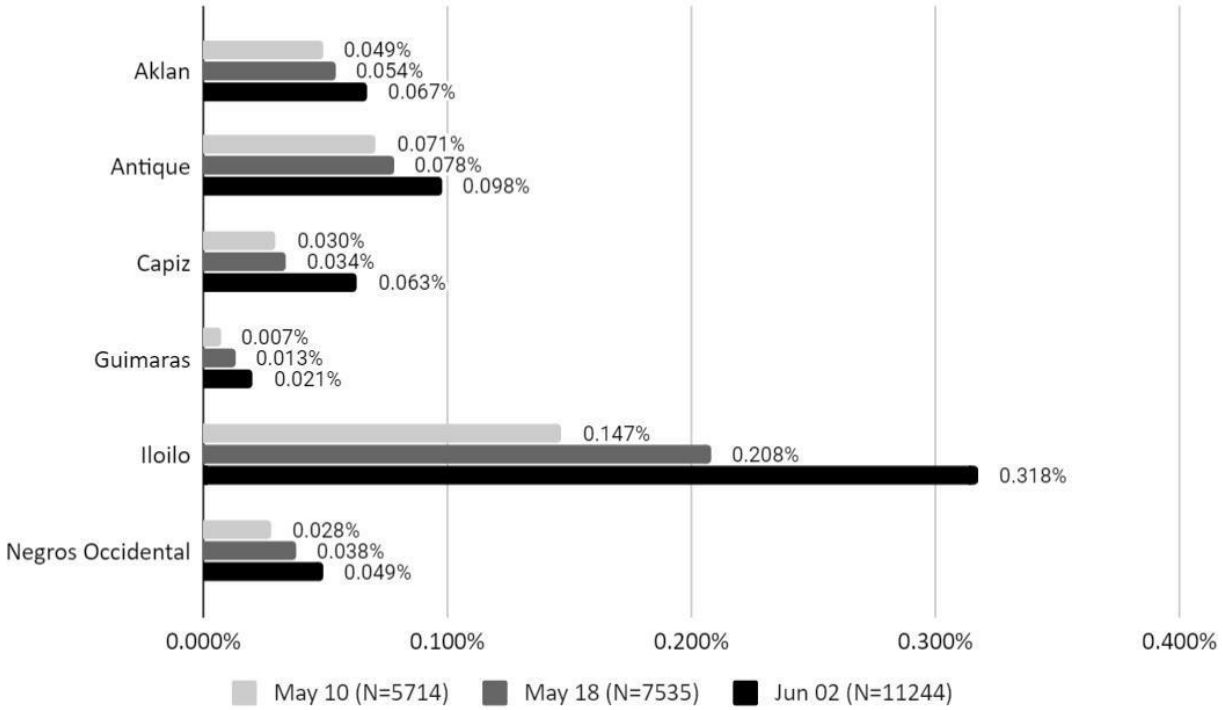

Figure 2. COVID-19 laboratory testing in Western Visayas: % tests per capita (as of June 02, 2020) *(Source: Western Visayas RESU[a,b,c])*

This finding is interesting in light of the tally of cases in the region per province (Figure 3). That the location of the testing center, in Iloilo City, coincides with the highest number of cases consistently since the epidemic began, even though the first case was registered in Negros Occidental, was impetus for us to investigate. This was fueled by the rough observation at the national level that the regional location of COVID-19 testing centers seems to always give the highest number of cases (Figure 4). This is the "streetlight effect" that we previously discussed (de Castro and others, 2020)

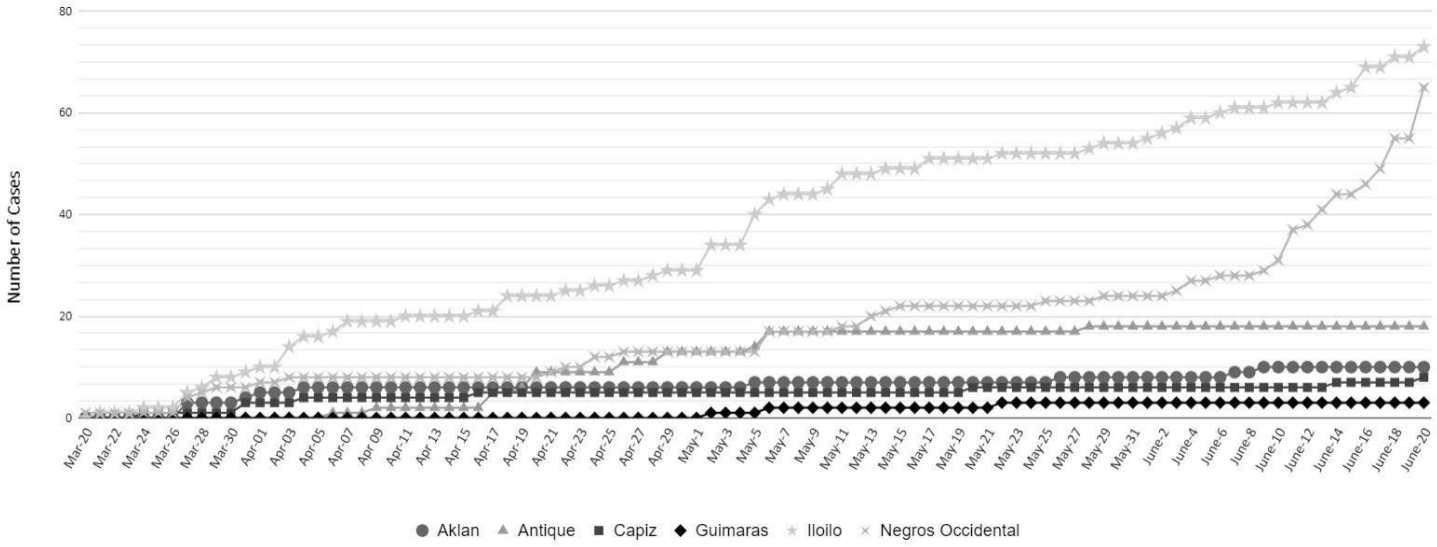

Figure 3. Cumulative Covid-19 cases in Western Visayas, per province, as of June 20, 2020. *(Source: DOH-WVCHD, 2020)*

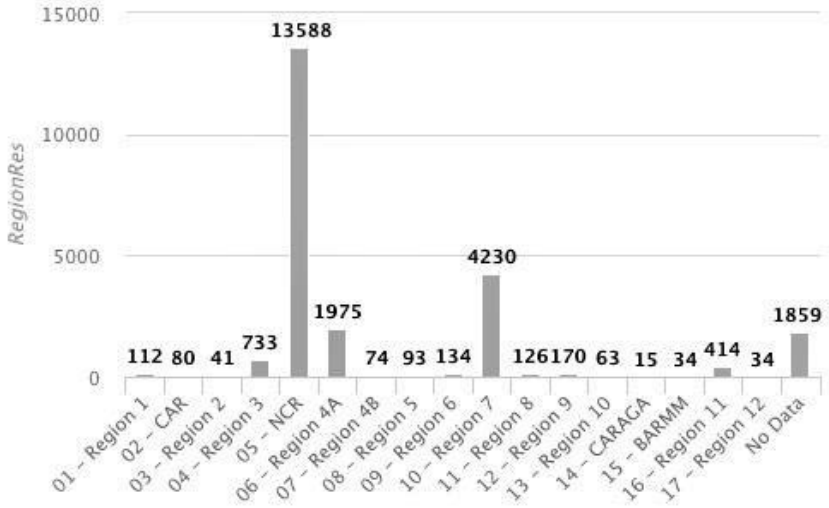

Figure 4. Covid-19 cases by region (as of June 20, 2020) *(Source: DOH COVID Data Drop, 2020)*

It was worthwhile to look into the overall processing time of samples from collection to release of results. Among 103 confirmed cases (with data), the overall processing time of samples ranged from 2 to 12 days. On average, samples from Aklan, Capiz, and Guimaras had an overall processing time of ~3 days. This duration did not differ significantly with that of Iloilo (3.2 days) where the WVMC-SNL is located. Samples from Antique and Negros Occidental had an overall processing time of ~5 days, and this differed significantly with that of Iloilo (Table 1; $p = 0.0016$ and $p = 0.0089$, respectively).

Table 1. Overall processing time (Iloilo vs other Western Visayas provinces) among COVID-19 positive individuals (N = 103) (as of June 02, 2020)

Province	Number of specimen	Overall Processing Time (vs Iloilo)	
		Average (days)	*p-value*
Aklan	5	3.4	0.7283
Antique	18	5.1	0.0016*
Capiz	5	2.8	0.6356
Guimaras	3	3	0.9125
Negros Occidental	20	5.4	0.0089*
Iloilo	52	3.2	--

*t-test: significant difference at $\alpha = 0.05$

(Source: Western Visayas RESU[c])

The overall processing time was further subdivided into the following: 1) sample collection to laboratory receipt, and 2) laboratory receipt to release of results. The first component refers to the time it takes for the specimen to be sent to the laboratory after collection, and the second component refers to the duration from laboratory processing and results validation up to the release of results.

Looking into the first component, it was observed that majority of the specimen from Guimaras, Capiz and Iloilo were transported to the WVMC-SNL within 24 hours after collection, while those from Aklan, Antique, and Negros Occidental were transported within 24 - 48 hours after collection. Taking into consideration the proximity of the different specimen collection sites (i.e. hospitals, municipal health centers) to the WVMC-SNL, the estimated travel time from provinces within the Panay island to the laboratory ranges from < 1 hr up to 4 hours. For the provinces outside Panay Island (Guimaras and Negros Occidental), the modes of transport include both land and sea travel. The estimated travel time from Guimaras and Negros Occidental to the laboratory ranges from 1-2 hours and 2-5 hours, respectively (Table 2). The travel time from Negros Occidental and Antique to the laboratory may have contributed to the longer overall processing time. It is possible that there are logistical preparations that need to be made before transporting the specimens which may have led to the processing delay. The transport delays for Antique, however, needs to be further investigated as it does not seem to be observed in Aklan and Capiz which are also located in Panay island.

Table 2. Duration from collection to laboratory receipt of specimens (N = 103) *(as of June 02, 2020)* and the estimated travel time from collection sites to the WVMC-SNL

Province	Number of specimen	Duration between specimen collection to laboratory receipt						Estimated travel time to WVMC-SNL*
		≤ 24 hours		24 - 48 hours		>48 hours		
		Number	*%*	*Number*	*%*	*Number*	*%*	
Aklan	5	2	40%	3	60%	--	--	~ 4 hrs (land)
Antique	18	5	27.78%	12	66.67%	1	5.55%	~ 2-4 hrs (land)
Capiz	5	4	80%	1	20%	--	--	~ 2-3 hrs (land)
Guimaras	3	3	100%	--	--	--	--	~ 1-2 hrs (land,sea)
Negros Occidental	20	4	20%	8	40%	8	40%	~ 2-5 hrs (land,sea)
Iloilo	52	49	94.23%	2	3.85%	1	1.92%	~ <1 hr – 3 hrs (land)

(Source: Western Visayas RESU[c], Google Maps[*])

In the second time component which includes laboratory processing and results validation, a significant difference was found between the average laboratory processing times between Iloilo and Antique (Table 2, $p = 0.0375$). Such a difference requires further examination since it was not found between Iloilo and the other 4 provinces. Presumably, processing all happens within the testing center so it is peculiar that there seems to be a disparity against samples from Antique.

Table 3. Duration of laboratory processing to release of results (Iloilo vs other Western Visayas provinces) among COVID-19 positive individuals (N = 103) (as of June 02, 2020)

Province	Laboratory receipt to results release (vs Iloilo)	
	Average (days)	*p-value*
Aklan	2.8	0.5893
Antique	4.6	0.0375*
Capiz	2.6	0.5091
Guimaras	3	0.9474
Negros Occidental	3.8	0.2661
Iloilo	3.12	--

[*]t-test: significant difference at $\alpha = 0.05$
(Source: Western Visayas RESU[c])

Overall, the delays in the overall processing time for specimens from Negros Occidental may be linked to transport logistics, while those from Antique may be linked with both transport logistics, and laboratory processing/results validation (or, the time from receipt to release of results; $p = 0.0375$). Interestingly, despite the testing center being in Iloilo City only, no processing disparity occurs against Aklan, Capiz and Guimaras, demonstrating that processing can certainly improve with Antique and Negros Occidental.

Contact Tracing

In the three-pronged approach - testing, contact tracing, augmenting health facilities - of the Department of Health to curb COVID-19 spread, contact tracing seems to be the most limited. The number of trained contact tracers, only 35 per 100,000 population (De Vera & Yee, 2020; Quintos, 2020), can still be considered inadequate. This hampers the capacity of the country to locate and monitor all patient contacts, especially with the number of cases still continuously growing.

In addition, the Inter-Agency Task Force for the Management of Emerging Infectious Diseases (IATF - EID) still does not have a contact tracing application which can digitalize information for efficient reporting and analysis. StaySafe.ph, the official app chosen by the government seems mainly for self-reporting, is currently faced with privacy issues impeding its widespread adoption in the country (Camus, 2020). Until the number of trained personnel is increased and a contact tracing app is in place, the implementation of an efficient contact tracing system in the country will remain elusive.

In Western Visayas, 3,503 patient contacts of the 104 confirmed cases have already been identified as of May 18, 2020. Of these, 3,420 (97.63%) contacts have been traced. The untraced contacts were likely encountered in the community, workplace, and during travel. Of the 3,420 contacts traced, less than 50% (1,668) were tested (Western Visayas RESU[g]).

Although contact tracing in Western Visayas seems to have high coverage, it seems de-linked from testing. Thus, the guidelines for testing patient contacts may need to be reviewed, revised, and enforced among all contacts (Alvior and others, 2020).

Health Facilities

Hospitals

As of June 19, 2020, the region had 586 COVID-19-dedicated beds: 82 COVID ward beds, 55 intensive care unit (ICU) beds, and 449 isolation beds. These beds were allotted for severe and critical cases. More than 70% of the beds are in Iloilo (39.9%) and Negros Occidental (34.8%) (Figure 5). With respect to each province's population (per 100,000 population), Aklan and Iloilo have ~10 beds each, Capiz and Negros Occidental have ~7 beds each, Antique has ~6 beds, and Guimaras has only ~1 bed (Figure 6). On average the bed capacity of the region per 100,000 population is in the range of only 1-10, a grossly inadequate figure considering the number of Covid-19 cases observed per 100,000 tested nationwide is 6,656 (DOH COVID Data Drop, 2020 Jun 13).

Daily hospital utilization for the entire region has been below 60% since April 20, 2020 (Figure 7) – which indicates that the overwhelming majority of cases are either mild or asymptomatic requiring no hospitalization, plus many who may get sick but are not hospitalized because they cannot afford it. We have not actually entered an unhampered post-quarantine period, thus, we think that our facilities still need to be augmented for a potential surge according to our results in simulating the hospital resources needed for Iloilo province using FluSurge (Rico and others, unpublished report, available online).

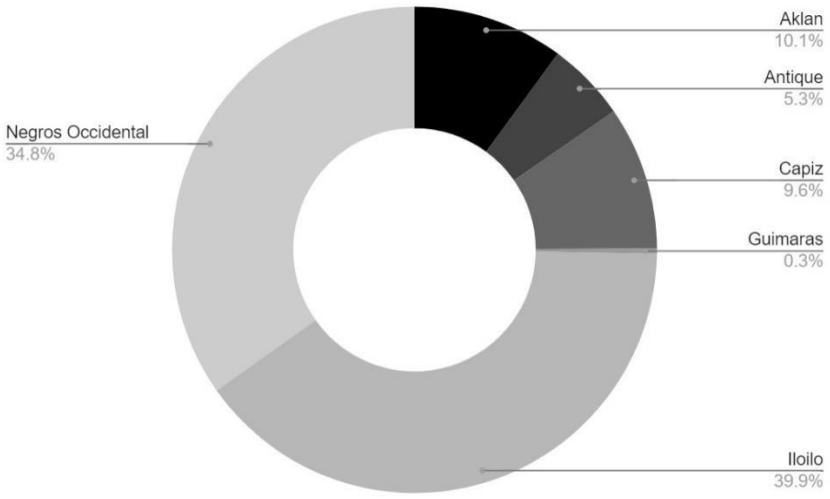

Figure 5. Distribution of hospital bed capacity per province (as of June 19, 2020) *(Source: Western Visayas – RESU[h])*

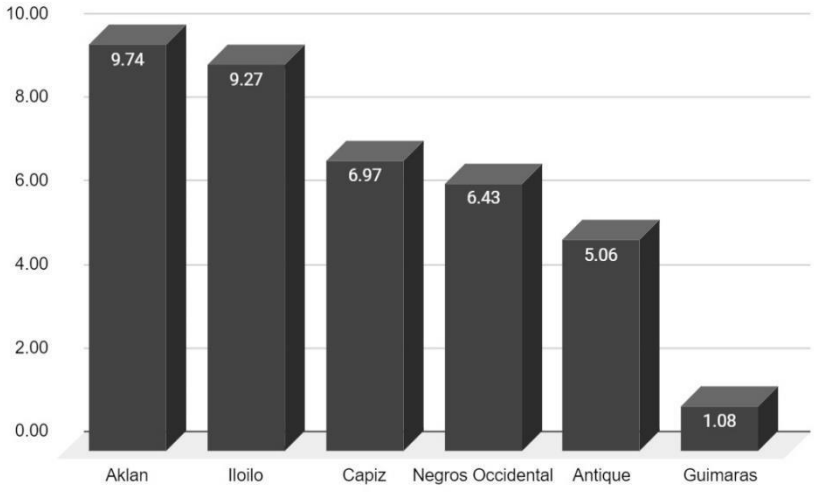

Figure 6. Hospital bed capacity per province (per 100,000 population) (as of June 19, 2020) *(Source: Western Visayas – RESU[h])*

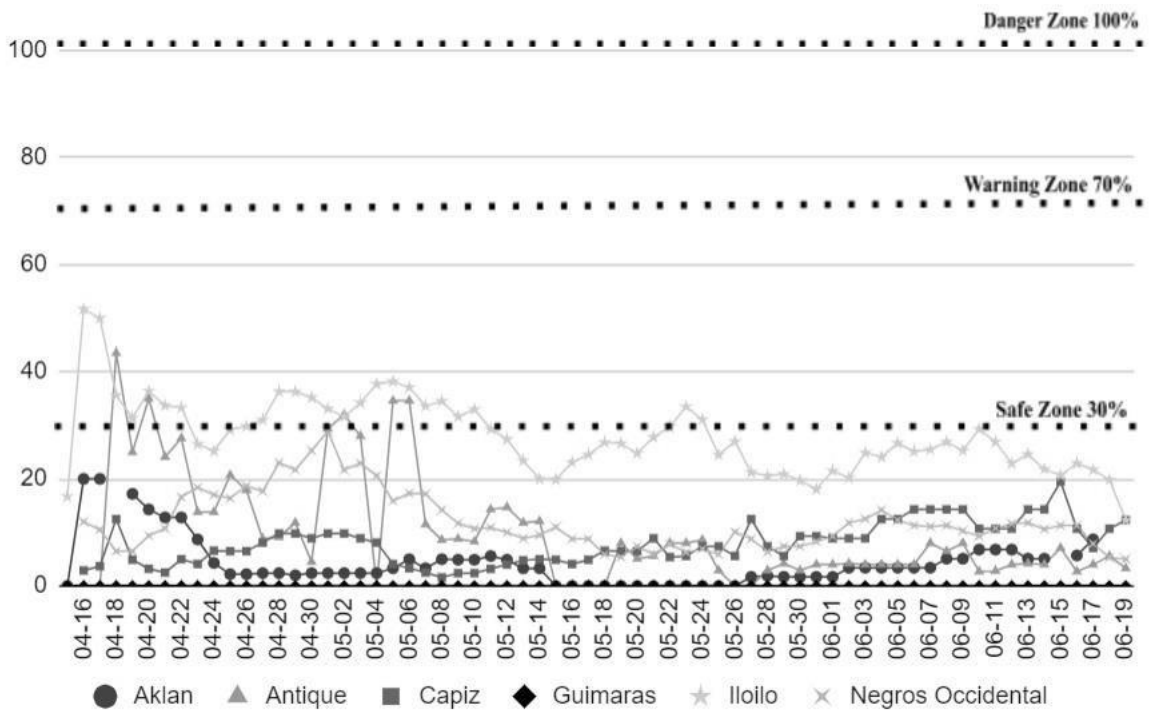

Figure 7. Utilization of hospital facilities in Western Visayas (as of June 19, 2020)
(Source: Western Visayas – RESU[h])

Quarantine Facility

As of June 20, 2020, the region had 281 quarantine facilities housing 10,810 quarantine beds. These beds were allotted for patient contacts and, mild and asymptomatic cases that need to be isolated (ABSCBN News, 2020). Similar to the distribution of hospital beds, majority of the quarantine beds in the region are in Negros Occidental (35.5%) and Iloilo (35.4%) (Figure 8). With respect to each province's population (per 100,000 population), Antique actually has the highest number of allotted quarantine beds with ~313, followed by Iloilo (~167 beds), Negros Occidental (~121 beds), Capiz (~86 beds), Aklan (~54 beds), and Guimaras (~6 beds) (Figure 9). Overall, the daily utilization rates of quarantine facilities in Aklan, Antique, Capiz, and Guimaras have not yet exceeded ~60% capacity. On the other hand, the trends for Iloilo and Negros Occidental have risen to more than ~70% starting June 15, 2020 (Figure 10). The respective local government units (LGUs) of these provinces must prepare contingencies (e.g. add quarantine beds, etc) in case their capacities are exceeded. The provinces must also be prepared as locally-stranded individuals (LSIs) and overseas Filipino worker (OFW) repatriates are expected to be flown in weekly into the region beginning on June 20, 2020 (Momblan, 2020). These individuals will be housed in quarantine facilities for at least 14 days before they are allowed to go back to their respective communities (CNN Philippines Staff, 2020). As with hospital facilities, the utilization rate of quarantine facilities needs to be continuously monitored for a possible surge in cases.

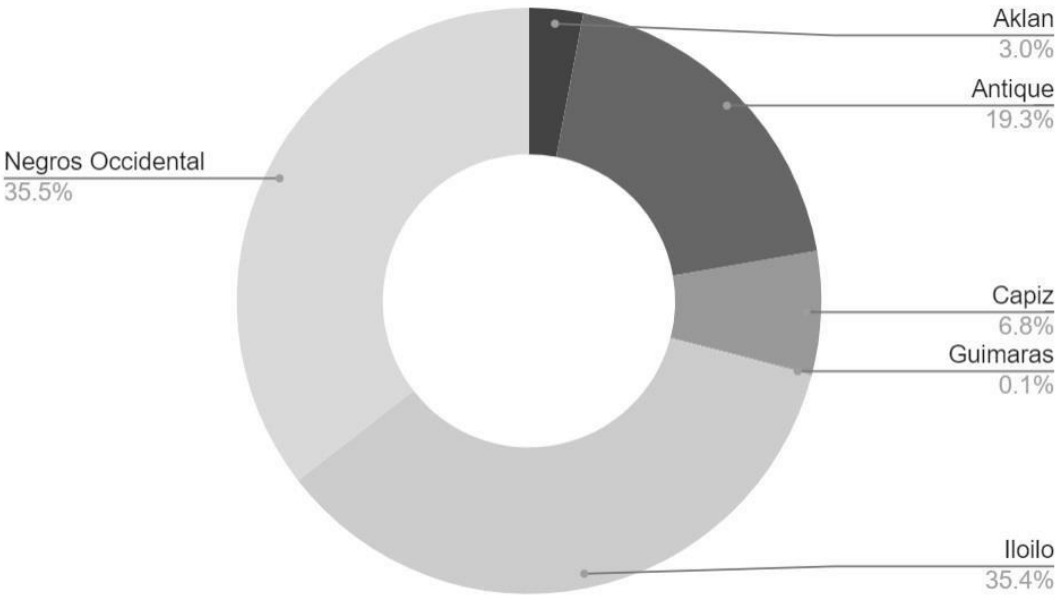

Figure 8. Distribution of quarantine bed capacity per province (as of June 20, 2020)
(Source: Western Visayas – RESU[h])

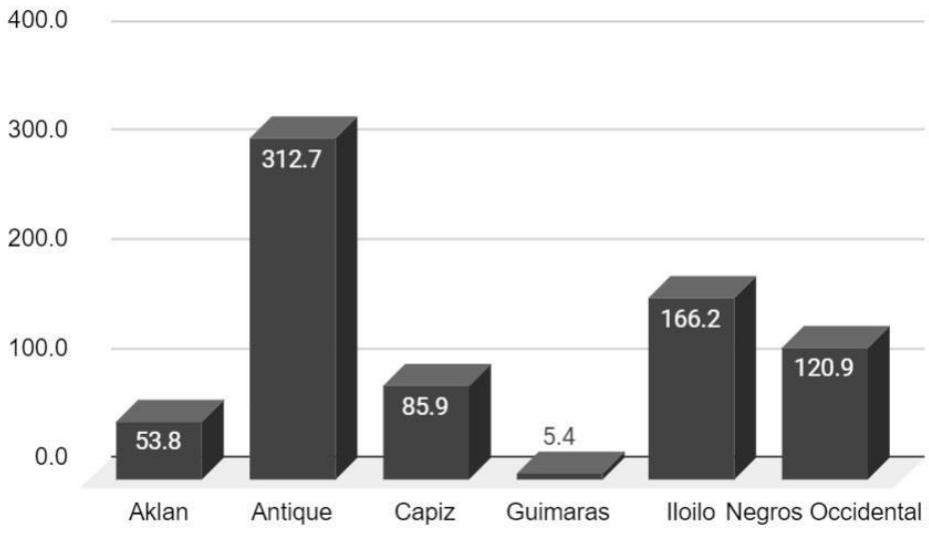

Figure 9. Quarantine bed capacity per province (per 100,000 population) (as of June 20, 2020)
(Source: Western Visayas – RESU[h])

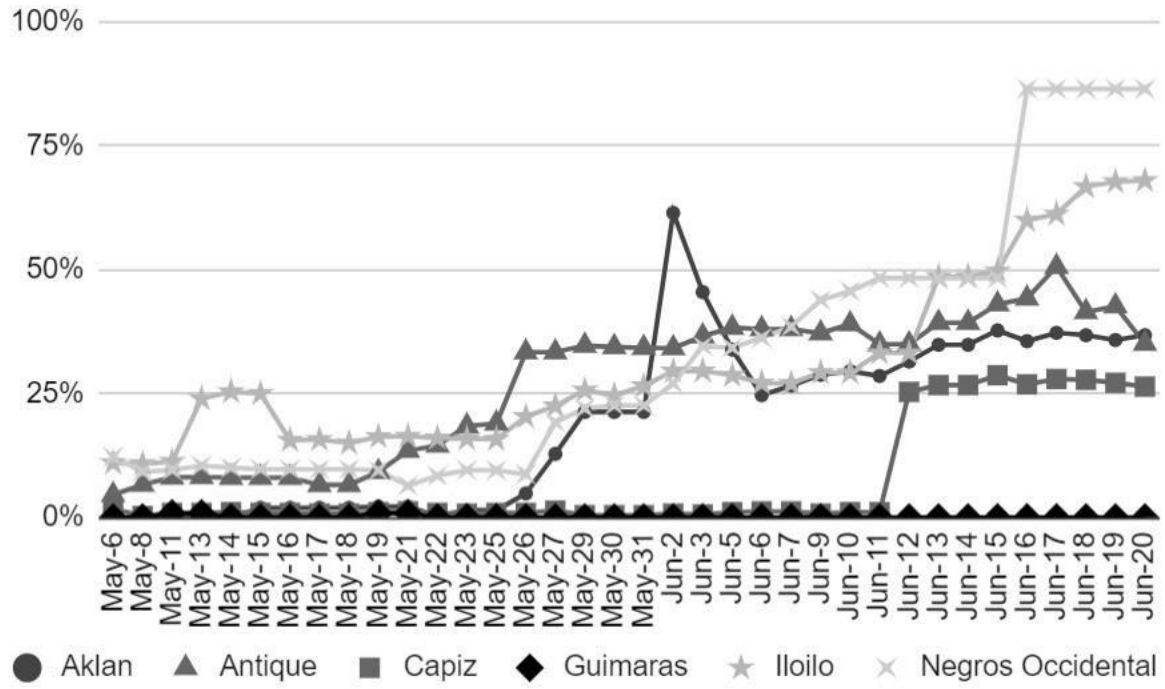

Figure 10. Utilization of quarantine facilities in Western Visayas (as of June 20, 2020)
(Source: Western Visayas – RESU[h])

CONCLUSION: PUBLIC HEALTH IMPLICATIONS AND RECOMMENDATIONS

An analysis of the COVID-19 situation in Western Visayas has shown that the region may be in the deceleration phase of the epidemic curve (Alvior and others, 2020), however, we still need testing, contact tracing, and health facility augmentation in case another wave of cases occur, particularly as we enter the transition into the post-quarantine scenario. In this regard, we recommend the following:

1) Testing capacity must be improved particularly with the easing of the quarantine. The testing conducted during the ECQ was inadequate, and many more cases exist than before the lockdown yet, ironically, we are actually relaxing the quarantine. More testing centers should be set up in remote provinces, or the transport and processing of samples must be improved in order to correct the disparities observed. The respective LGUs can play a role in the timely, proper, and secure transfer of specimen from their localities to the testing center, and our testing center must eliminate any geographic prioritization of samples in processing, if any.
2) Testing equality: the number of individuals tested in each region should be representative of its population. If there are not enough tests, a pooling strategy for testing may be employed (Caoili and others, 2020[a]). Rapid diagnostic (antibody) test kits may also be utilized (Li and others, 2020; Caoili and others, 2020[b]).
3) To further improve contact tracing strategies in the region; data should be digitalized to facilitate reporting. The Center for Informatics developed an online Community Contact Tracing & Monitoring tool (USACFI, 2020) that can be implemented in various types of communities not addressed by the current tools of the government, for example schools and universities, corporations or large

employers, and hospitals that want to keep track of their students, employees or healthcare workers, respectively.

4) Guidelines for testing of patient contacts need to be reviewed and possibly revised to support the public health measures being adopted post-quarantine.
5) Monitor hospital and quarantine facility admissions and release, as well as demand, all in real time. Contingency measures must be in place when the capacity of these facilities become overwhelmed, and rapidly mobilized.

REFERENCES

Abano I. 2020 Mar 24. Reporting the unknown: How reporters in the Philippines cover COVID-19. Earth Journalism Network. Available from: https://earthjournalism.net/stories/reporting-the-unknown-howreporters-in-the-philippines-cover-covid-19

ABS-CBN News. 2020 April 17. PH now has 2,780 quarantine facilities for suspected, 'mild' cases of COVID-19. ABS-CBN News. Available from: https://news.abs-cbn.com/news/04/17/20/ph-now-has2780-quarantine-facilities-for-suspected-mild-cases-of-covid-19

Alvior HML, Samson MC, Arbizo J, Padilla PI. 2020. Public Health Data Analysis and Recommendations for COVID-19 in Western Visayas as of 30 April 2020. UP Media and Public Relations Office. Available from: https://www.up.edu.ph/public-health-data-analysis-andrecommendations-for-covid-19-in-western-visayas-as-of-30-april-2020/

[a]Caoili SE, King RN, Dungog CC, Reyes JC, Sarol JN, de Castro RJ. 2020. Sample Pooling in a Resource-Limited Situation. PAASE. Available from: http://paase.org/downloads/PAASE%20Bulletin%204.pdf

Caoili SE, de Castro RJ. 2020. A 3-Step Recommendation For Diagnostic Testing Using Antibody And Pcr Tests In Low-Resource Areas. PAASE. Available from: http://paase.org/downloads/PAASE%20Bulletin%2011.pdf

Camus MR. 2020 June 16. Staysafe.ph developer: Trust issues hound contact tracing app. Philippine Daily Inquirer. Available from: https://technology.inquirer.net/100896/staysafe-ph-developer-trust-issueshound-contact-tracing-app

CNN Philippines Staff. 2020 June 01. PCG reverts guideline: All returning Filipinos must undergo quarantine in accredited facilities. CNN Philippines. Available from: https://www.cnn.ph/news/2020/6/1/OFW-NAIA-mandatory-quarantine.html

DOH COVID Data Drop. 2020 June 13. Available from: https://www.doh.gov.ph/2019-nCoV

Department of Health Western Visayas Center for Health Development (DOH - WVCHD). 2020. COVID-19 Case Bulletin No. 1-74. Available from: http://ro6.doh.gov.ph/index.ph/803-covid-19-bulletin

De Castro R, Caoili SE, Bongolan VP, Sevilleja JE. 2020 May 06. [ANALYSIS] When should we relax the lockdown. Rappler. Available from: https://www.rappler.com/thought-leaders/260032-analysis-whenrelax-coronavirus-lockdown

De Vera B, Yee J. 2020 May 21. Gov't to hire 136,000 contact tracers, says Neda chief. Inquirer.net. Available from: https://

newsinfo.inquirer.net/1278493/govt-to-hire-136000-contact-tracers-says-neda-chief

Esguerra DJ. 2020 May 10. Philippines now has 26 COVID-19 testing centers – DOH. Inquirer. Available from: https://newsinfo.inquirer.net/1272710/philippines-now-has-26-covid-19-testing-centersdoh#ixzz6M43WUW5K

French LA. 2020 Mar 25. WVMC starts testing for COVID-19. Philippine Information Agency [Internet]; [cited 2020 Jun 12]; Available from: https://pia.gov.ph/news/articles/1037155

Gonzales G. 2020 Apr 24. List: Coronavirus contact tracing apps in the Philippines. Rappler. Available from: https://www.rappler.com/technology/features/257931-coronavirus-contact-tracing-apps-philippines

Google Maps. Available from: google.com.ph/maps.

Kabiling D. 2020 Apr 14. Enhanced community quarantine averted COVID-19 disaster in PH. Manila Bulletin. Available from: https://news.mb.com.ph/2020/04/14/enhanced-community-quarantine-avertedcovid-19-disaster-in-ph/

Li L, Liu W, Zheng Y, Jiang X, Kou G, Ding J and others (2020) A preliminary study on serological assay for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in 238 admitted hospital patients. medRxiv. doi:10.1101/2020.03.06.20031856

Momblan G. 2020 June 20. Guv allows 1.5K weekly inbound flight passengers to Iloilo. Philippine News Agency. Available from: https://www.pna.gov.ph/articles/1106517

Quintos PL. 2020. The Philippines' COVID-19 Response: Symptoms of Deeper Malaise in the Philippine Health System. Available from: https://www.academia.edu/43362576/The_Philippines_COVID19_Response_Symptoms_of_Deeper_Malaise_in_the_Philippine_Health_System

Ramos CM. 2020 May 24. PH eyes COVID-19 tests for 2M Filipinos in 'epicenters'. Accessed: https://newsinfo.inquirer.net/1277658/ph-eyes-covid-19-tests-for-2m-filipinos-ramped-up-testing-inepicenters

Rico JA, Zamora PRF, Kwon J, Aguila RN, Sevilleja JE, de Castro R. Unpublished report. Estimating The Sufficiency Of Hospital Resources In Iloilo Province During The Covid-19 Pandemic. Available at https://drive.google.com/file/d/1tvu7Jw-nu4kGnZOiqM677QegCLu6Wbbp/view

Community Contact Tracing and Monitoring Tool [Internet]. [USACFI] University of San Agustin Iloilo – Center for Informatics; c2020 [cited 2020 June 22]. Available from: https://www.usacfi.net/covid-19-community-contact-tracingand-monitoring-tool.html

[a]Western Visayas - RESU. 2020 May 10. Case Profiles.

[b]Western Visayas - RESU. 2020 May 18. Case Profiles.

[c]Western Visayas – RESU. 2020 June 02. Case Profiles.

[d]Western Visayas - RESU. 2020 May 10. Total COVID-19 Testing by the WVMC-SNL.

[e]Western Visayas - RESU. 2020 May 18. Total COVID-19 Testing by the WVMC-SNL.

[f]Western Visayas – RESU. 2020 June 02. Total COVID-19 Testing by the WVMC-SNL.

[g]Western Visayas – RESU. 2020 June 02. Contact Tracing. [h]Western Visayas – RESU.

COVID-19 Health Facility Capacity.

World Health Organization. 2020 May 9. 100 days of COVID-19 in the Philippines: How WHO supported the Philippines response. Available from: https://www.who.int/philippines/news/featurestories/detail/100-days-of-covid-19-in-the-philippines-how-who-supported-the-philippine-response

Science, Technology, and Innovation (STI) Needs of Western Visayas in the Context of the COVID-19 Pandemic

This is an addendum to the manuscript titled, "Towards Equity in the COVID-19 Response in Western Visayas", submitted as a commissioned paper for the 42nd Annual Scientific Meeting (ASM) of the National Academy of Science and Technology (NAST). This is the authors' response to the inputs requested by the NAST for the project titled "Development of a Philippine STI Foresight and 30-Year Strategic Plan 2019-2050".

The following are the issues identified during the analysis of the COVID-19 situation in Western Visayas for the period March 20 - June 20, 2020. Middle-term and long-term recommendations on STI manpower and infrastructure that will improve the region's response to future pandemics are also highlighted.

1. **Lack of Equity in Testing**

   There was only one COVID-19 testing laboratory in Western Visayas from March 26 - July 2, 2020. Having only the one in Iloilo City led to more people tested in Iloilo compared to other provinces demonstrating the "Streetlight Effect", which is not equitable. In addition, operational and transport problems may have caused more inequities.

   Future needs for STI talents: There should always be an adequate pool of clinical laboratory personnel who are adept at performing high-level molecular techniques (i.e. PCR, "Omics" etc) in the region. Health education programs must include training for students to acquire such skills and professionals to undergo advanced training.

   Infrastructure needs: Given the biosafety requirements of highly infectious diseases, there should be an investment in at least one BSL 2/3 laboratory within the region. When this happens, regular accreditation must follow to ensure compliance to protocol at all times, not just during epidemics.

   Industry-Government-Academe Collaboration: Collaborations/cooperation among government (public health), healthcare industry (hospitals and other health-related establishments) and academia (universities and research institutions) must endure via continued partnerships in health research projects, specifically in diagnostics.

   Links with other disciplines: Experts from the fields of Engineering, Computer Science/Mathematics (Artificial Intelligence/Machine Learning), and Business can contribute to pre-implementation assessments and sustainability studies of the proposed technologies for diagnostic testing.

   Timeline: Middle-term (5-10 years)

2. **Inadequacies in Contact Tracing**

   In Region VI, contacts were logged into an Excel sheet that was not updated regularly. No contact tracing database and application is in place to facilitate the seamless flow of contact tracing data from the regional epidemiological unit down to the Barangay Health and Emergency Response Teams (BHERTS), and back.

   Future needs for STI talents: Data scientists and database developers can put together a contact tracing system for the region. Contact tracers can be trained on the system through healthcare education programs to rapidly respond to infectious disease epidemics. The University of San Agustin - Center for Informatics (USA-CFI) developed a community contact tracing application (USACFI, 2020), which is easy to use and can help communities, including LGUs, respond to epidemics with contact tracing.

Infrastructure needs: The national government or LGUs must invest in a secure and efficient contact tracing system, and a training program for contact tracers.

Industry-Government-Academe Collaboration: Proper management and security of contact tracing data need IT professionals, while its timely and sound analysis need experts in mathematics, public health and medicine.

Links with other disciplines: Experts in the social sciences should be sought to investigate how contact tracing is perceived by the public, to properly communicate its necessity, and to seek the public's support and cooperation in order to efficiently implement the system during epidemics. Public health education must also be offered to the public via information campaigns and science dissemination strategies.

Timeline: Middle-term (5 - 10 years)

3. **Inadequate testing among patient contacts**

Not enough test kits were available to test all patient contacts.

Future needs for STI talents: Clinical laboratory personnel training on pooled sample testing is needed (to extend the limited testing capacity, which was the case at the beginning of the pandemic). The USA-CFI in collaboration with UP Manila researchers sent recommendations on pooled sample testing (Caoili and others, 2020) as early as the last week of March 2020, but the unfamiliarity of the clinical diagnostics community with simple solutions coming from research experience was an impediment to what could have been an immediate expansion of testing capacity.

Infrastructure needs: Automated pooled sample testing should also be explored, with the aid of laboratory robotics. It is coming out now that AI/ML can aid in diagnosing Covid-19 using routine blood tests (Yang and others, 2020), thus, we need the capability to implement AI/ML which requires big data and computational power.

Industry-Government-Academe Collaboration: Investments in rapid molecular diagnostic development (Academe-Industry) and the regulatory capability (Government) must be in place. Development or identification of scientific talent (Government-Academe) that can carry out rapid innovations during public health emergencies should be a priority.

Links with other disciplines: Innovations arising out of necessity must be sustained by business use-cases during non-emergency times in order to be useful for the next emergency.

Timeline: Middle-term (5 - 10 years)

4. **Lack of adequate and good quality data for public health analyses and research**

Few data sources existed at the beginning of the pandemic, but even later our data situation was still not streamlined. Data exists in different platforms (e.g. cases from Data Drop, hospital capacity from Data Collect app) and formats (paper, excel, database), and no data governance seems to be in place for managing data collection and reporting from different sources. Data from different government platforms must give the same ground truth in order for the public to trust it.

Future needs for STI talents: Data governance is required for any data operation, and in turn requires knowledgeable data stewards. IT/database professionals and health data scientists must collaborate on public health issues and emergencies. Educational and research institutions need to offer training in data disciplines.

Infrastructure needs: Integrated and interoperable health data systems are necessary to address public health emergencies. Data from information systems for infectious diseases surveillance, contact tracing, diagnostic testing as well as hospital resources, electronic patient medical records and information systems of other healthcare facilities (for laboratory testing, imaging, pharmacy, etc.) must be accessible during emergencies and disasters. They must also be coordinated with resources (logistics, supply, etc.) data in order to match need with response.

Industry-Government-Academe Collaboration: Data sharing agreements across Government-Industry-Academe partnerships should be in place to facilitate the use of relevant datasets during public health emergencies.

Links with other disciplines: Epidemiological modeling must not be a unilateral effort, but rather use a multi-modeling approach (Shea and others, 2020). There are many things that a single modeling entity will miss, that multiple modeling teams from various disciplines can fill in to generate better public health policy recommendations.

Timeline: Long-term (10 - 20 years)

References:

1. Caoili SE, King RN, Dungog CC, Reyes JC, Sarol JN, de Castro RJ. 2020. Sample Pooling in a Resource-Limited Situation. PAASE. Available from: http://paase.org/downloads/PAASE%20Bulletin%204.pdf.
2. Community Contact Tracing and Monitoring Tool [Internet]. [USACFI] University of San Agustin Iloilo – Center for Informatics; c2020 [cited 2020 June 22]. Available from: https://www.usacfi.net/covid-19-community-contact-tracingand-monitoring-tool.html.
3. Shea K, Runge M, Pannell D, Probert W, Li S, Tildesley M and others. 2020. Harnessing multiple models for outbreak management. Science. doi: 10.1126/science.abb9934.
4. Yang H, Hou Y, Vasovic L, Steel P, Chadburn A, Racine-Brzostek S and others. 2020. Routine laboratory blood tests predict SARS-CoV-2 infection using machine learning. medRxiv. doi: 10.1101.2020.06.17.20133892.