National Reference Laboratory Surge Capacity Response to a Massive Nationwide Measles Outbreak in 2013-2014*

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ABSTRACT

This management case documents the experience of the Research Institute for Tropical Medicine (RITM) National Reference Laboratory, when a massive nationwide outbreak of Measles occurred during the last quarter of 2013 to the whole of 2014. This was the largest infectious disease outbreak referred thus far to the Institute, with an unprecedented 40,000 blood specimens from all over the country received by the laboratory, overwhelming its testing capacity, and causing large backlogs. The incident revealed significant gaps in the laboratory's preparedness to respond to a sudden large surge of specimens.

The activation of a department-level Incident Command System was the most appropriate management approach to implement due to the urgency and scale of the surge of specimens. The response to the specimen surge was prioritized leading to temporary rearrangements in the organizational structure of the department in order to effectively and rapidly coordinate the staff and allocate resources.

Key words: measles, outbreak, surge capacity, outbreak response, incident command system, laboratory management

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INTRODUCTION

Background

The Research Institute for Tropical Medicine (RITM) is one of the National Reference Laboratories (NRL) designated by the DOH, following the dissolution of the Bureau of Research and Laboratories in 2000. RITM was particularly assigned as the NRL for most infectious diseases, such as dengue, influenza, polio, measles, tuberculosis, bacterial enteric diseases, mycology, malaria, emerging bacterial diseases, and transfusion-transmissible infections, to include antimicrobial resistance surveillance. As NRL, RITM is tasked to provide laboratory support services to the DOH for patient management as well as public health, i.e., confirmatory testing for disease-specific surveillance, and outbreak investigations.

The National Measles Laboratory (NML), under the Department of Virology, is the specific NRL responsible for testing of serum specimens referred by the DOH measles surveillance (i.e., collected from suspect measles cases identified by the disease reporting units and referred by the local surveillance units to RITM). Accredited by the WHO and a member of the Global Measles-Rubella Laboratory Network, it is the only laboratory in the country performing measles confirmatory serologic testing for the whole Philippines using Enzyme-Linked Immunosorbent Assay (ELISA) platform.

Management Problem

The 2013-2014 Outbreak

From the 1st to 3rd quarter of 2013, measles outbreaks have already been noted in the National Capital Region, followed by Regions 3 and 4A, which further spread to Regions 5 and 6. By the 4th quarter, measles rapidly spread to almost all regions of the country, causing a

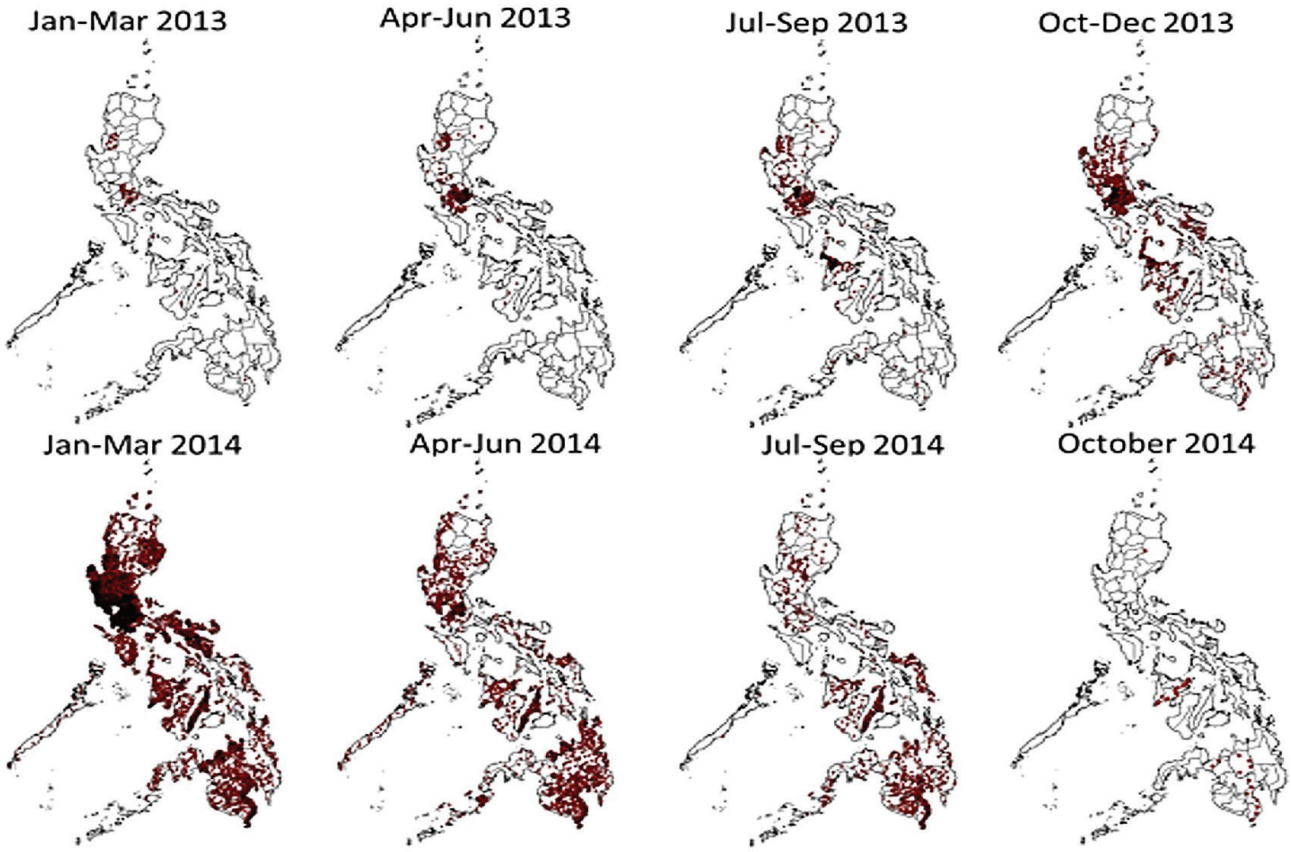

Figure 1. Distribution of measles cases by quarter 2013-2014 *(Adapted from Silva, 2016).*

sharp increase in measles reporting and investigation (Figure 1).[1] By December, specifically during the last 2 weeks of 2013, blood specimen referrals to the NML rose sharply and remained untested until the 1st two weeks of January 2014 due to the holiday season. This served as the "incident" which prompted laboratory management response.

Management Response

Rapid Baseline Capacity Review

A rapid baseline capacity assessment was conducted (Table 1). Based on the review, it was determined that the NML was not prepared to cope with 100% testing within the acceptable turnaround time of seven (7) days.

Activation of Incident Command System (ICS) at department-level and engagement of other support offices within the agency for improving internal surge capacity

Several bottlenecks were recognized in the set-up of the NML which contributed to the delays in testing. This included receipt and encoding of specimens, specimen processing, and data management/results reporting.

A whole-of-department approach was needed to augment the NML in addressing the incident (i.e., the surge of specimens). To do this, laboratory management decided to activate a department-level Incident Command System. Originally developed to address challenges in inter-agency responses to forest fires/wild fires in the United States of America, the ICS is a standardized operational management approach to emergency response by providing command (i.e., leadership), control, and coordination mechanisms so that responders from multiple agencies can be effective.[2,3] It is designed to be used from the time an incident occurs until the requirement for operational management has been completed and/or no longer needed. Its application has evolved to include all hazards situations, and this includes hospital emergencies, public health emergencies, and even outbreaks.[4,5]

The ICS strategy called for rearrangements within the structure of the department's organization to provide additional technical support in terms of logistics and procurement of supplies, capacity for testing and data management, in order to allow NML to scale up its operations.

The ICS activation was undertaken with the following objectives:

1. Provide additional manpower to NML to manage all of its operations/processes.
2. Maintain adequate supplies/reagents for continued testing.
3. Ensure generation of timely and accurate laboratory results.
4. Ensure accountability of all specimens and records (prevent loss of specimens/records)
5. Perform further testing and analysis of data as expected

Table 1. Baseline capacity review of National Measles Laboratory (2014)

Operational Aspect	Baseline Status (Pre-Outbreak)
Man/Human Resources	• Two (2) technical staff and one (1) data encoder. Only the senior technical staff holds a *plantilla* position • Technical staff can run up to a maximum of 320 tests a day (specimens, excluding controls) • One (1) administrative staff doing the encoding of all specimens in the database
Material/Laboratory Reagents and Supplies	• Limited number of reagents and supplies on hand and depended on WHO donations of Measles IgM testing kits[1] • Testing kits were limited due to concurrent measles outbreaks experienced by other countries in the Western Pacific Region at the time
Machine/Laboratory Equipment/Facilities	• ELISA equipment (washer, reader) and testing facilities shared with other NRLs in the Department
Method/Laboratory Processes	• In the measles elimination phase, surveillance required 100% of specimens tested using ELISA. The Measles IgM ELISA test is semi-automated (i.e., several steps of the testing process are manually done). The laboratory was expected to provide testing results to DOH and WHO within seven (7) calendar days from receipt of specimens.[†] After testing, the technical staff also had to encode the results and release them to the disease reporting units, the DOH surveillance bureau, and the WHO • Testing scheduled 3 times a week (Monday-Wednesday-Friday) • Testing algorithm for each sample was sequential, consisting of Measles IgM, with repeat for Measles equivocals (i.e., below cutoff for Measles IgM positive result), followed by Rubella IgM for Measles IgM negatives and repeat for Rubella equivocals (i.e., below cutoff for Rubella IgM positive results)[‡] • Technical staff were the ones sorting and processing the specimens prior to testing. • Specimens collected using alternative methods (i.e., dried blood spots and oral fluid) necessitated extra steps before they could be tested • Additional respiratory specimens (oral and nasopharyngeal swabs) were also submitted for viral culture and molecular tests which were also important in identifying the circulating measles genotype causing the outbreak • No documented outbreak preparedness plan in place • Technical staff attended meetings called by the DOH and had to be the ones to coordinate directly with the WHO to request for additional testing kits • The NML was able to meet the laboratory testing standards set by the WHO for turnaround time and timeliness of reporting[§, 1-6] • Reporting requirements to the DOH Epidemiology Bureau (DOH-EB), which runs the Measles surveillance were met • Provision of laboratory results to the disease reporting units (DRUs) which reported the cases, as well as the surveillance officers in the DOH regional offices and local government unit health offices in the cities and provinces, were achieved within the 7-day turnaround time
Money/Funding	• The NML derived its funding for operational expenses and personnel augmentation from the General Appropriations Act through the Department of Virology budget • The laboratory, at the time, also received suballotments from the DOH surveillance bureau as well as immunization program for its work on vaccine-preventable disease surveillance • Often, the suballotments were not received at the start of the year • NML received some financial assistance from the WHO annually through a technical services agreement, as a WHO-accredited laboratory and member of the Measles Laboratory Network

1 Measles IgM Enzygnost™ (Siemens, Marburg, Germany), as pre-evaluated and recommended by the WHO. The WHO regularly provided Measles testing kits to the Philippines and countries in the Western Pacific Region as part of its technical assistance.
† In 2012, to accelerate reporting in support of measles elimination, the Global Measles Laboratory network adopted four (4) calendar days among its member laboratories, as the prescribed turn-around time from the previous seven (7) calendar days. Between 2013-2014, the NML was transitioning to the four (4) calendar days turn-around time. For DOH measles surveillance purposes, the NML reported its results weekly.
‡ Depending on the serologic status, a single serum specimen may undergo testing to as much as four times.
§ Measles IgM test results are reported by the laboratory within 7 days for ≥80% of specimens.

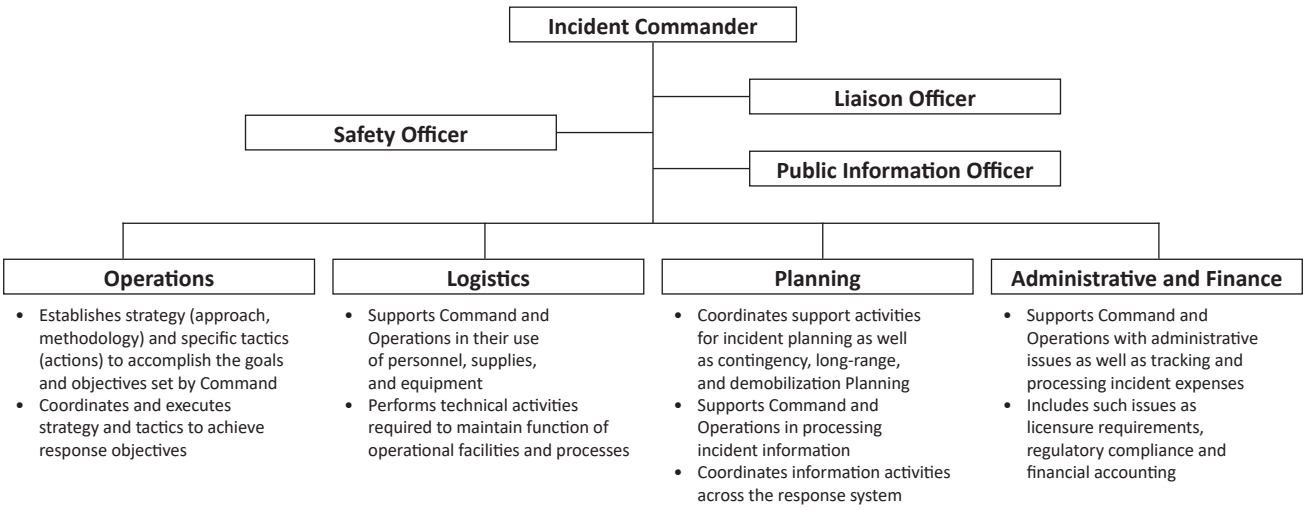

Figure 2. Incident Command System structure.

The general ICS layout was followed (Figure 2) with team leaders identified for the areas of Operations (Dengue NRL technical supervisor), Logistics (Polio NRL technical supervisor), and Finance/Administrative support (Influenza technical supervisor), and the department head as the Incident Commander and lead of Planning.

Non-NML members of each team were selected based on technical competencies vis-à-vis current load of duties and responsibilities (i.e., technical staff from the other NRLs doing molecular work were assigned to do the PCR tests and genotyping, those doing viral culture were assigned to do culture work, et cetera). Laboratory aides and technicians were assigned to specimen reception, sorting, and processing. Administrative staff were assigned to support encoding.

At the outset, the ICS functioned through 24-hour operational periods and daily meetings during which team leaders reviewed and reported on the status of their

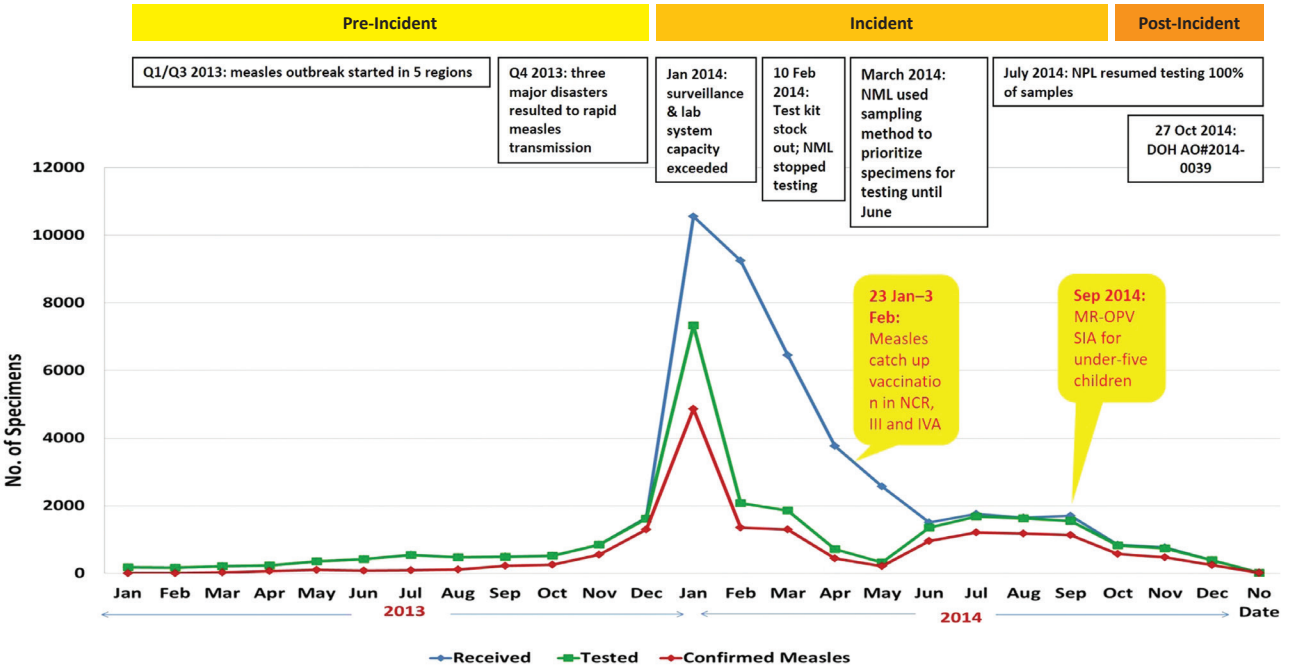

Figure 3. Measles Outbreak 2013-2014 and timeline of National Measles Laboratory Incident Command System.

respective areas, status is reviewed, objectives for the period are set, and action plans per area are discussed. Despite some adjustment challenges among the senior and junior staff who had regular daily activities and responsibilities, the measles outbreak laboratory response was tagged as the highest priority in the department. Other activities were put on hold, except for routine diagnostics (for RITM inpatients and outpatients) and testing of the other NRLs which were of a programmatic nature and cannot be deferred (e.g., viral culture and intratypic differentiation for poliovirus, realtime PCR for dengue serotype surveillance, viral culture, immunofluorescence assay and realtime PCR for influenza surveillance). The set-up increased oversight and facilitated measles laboratory operations.

Chronology of Management Response (Figure 3)

January 2014

1st round of ICS operational adjustments to increase testing capacity

Measles ELISA IgM testing shifted from the previous 3-day testing schedule of Monday-Wednesday and Friday to daily testing. Additional testing, such as virus isolation, conventional and realtime PCR, followed by genotyping were covered by medical technologists from the other NRLs of the department. This allowed the 2 technical staff of NML to focus exclusively on ELISA testing. Laboratory aides of other sections were assigned to specimen sorting and processing. Administrative staff were pulled out and re-assigned to assist in the encoding of case investigation forms which accompanied the specimens.

Release of specimen collection guidelines and laboratory testing updates

The ICS prepared and disseminated updated guidelines on laboratory testing of suspected measles cases to standardize the collection of specimens from the field. The guidelines were released along with laboratory updates as of the 1st week of January 2014 and an advisory to the DOH and regional surveillance units regarding the status of the pending specimens for testing and the expected lag in provision of results from the turn-around time of seven days to two weeks.

Provision of specimen collection supplies

Red top blood tubes, dried blood spot filter papers, viral transport media, and respiratory swabs, were provided to the regional surveillance units, health offices, and other requesting agencies to improve specimen collection. Regions/areas with high rates of measles suspected cases were prioritized. Supply provision was distributed, tracked and monitored closely by the logistics team.

Internal agency support

The ICS sought the assistance of the Institutional Surveillance and Response Unit for centralization of results release, coordination of specimen referrals, and handling of inquiries from the surveillance units, health offices, and referring hospitals. Other departments were tapped for additional volunteers to assist in specimen sorting, processing, and testing. Moreover, the ICS requested the Administrative Division through General Services Department to provide accommodations for those who shall go on overtime duty, and the Finance Division to provide overtime compensation.

Strengthening data management

Recognizing the department's limitations in terms of big data management, the ICS sought and obtained the support of the WHO. The WHO extended technical assistance to RITM by deploying a data manager to the Institute to work with the Measles laboratory in analyzing laboratory testing results. The assigned staff from WHO facilitated the database cleaning and encoding in the

Philippine integrated disease surveillance and response software. The staff also generated the graphs and the GIS maps weekly and forwarded it to the immunization program manager for analysis. At RITM, the WHO staff assigned at the Measles Laboratory, was tasked to generate graphs, maps and identification of laboratory prioritization to be tested weekly to be analyzed by the measles technical officer. The WHO staff also facilitated the cleaning of the laboratory database used by the department. Data from the DOH surveillance bureau and NML were collected and analyzed by frequency, distribution, and location, incidence rate and Case Fatality Ratio. The process of unifying the databases of the surveillance system with the laboratory was fraught with difficulties as there was no common identification number for linking cases to specimens. The DOH conducted catch-up immunization in the National Capital Region, Region III and Region IV, the top 3 regions with the highest measles transmission based on the data generated.

Request for Additional Testing Kits

With supplies running out, the ICS requested WHO for additional ELISA testing kits. However, only a few kits were provided as even WHO was allotting kits to other countries in the Western Pacific Region which were also experiencing outbreaks concurrently.

February 2014

By the end of January and with more areas reporting measles cases throughout the country, the NML received a total of 10,616 samples, which was already 640% more than those received in December. Significant backlogs in testing piled up as the number of testing staff doing ELISA (i.e., the 2 NML staff) and equipment was no longer sufficient. The Incident Commander realized that the operational adjustments were not enough to address the laboratory testing.

By mid-February, the laboratory stopped testing due to stock out of the kits. WHO informed the Institute that it will provide 100 kits (enough for conducting 8,800 tests only) but that these will be delivered by first week of March. The ICS recognized the need to source testing kits aside from the donations of WHO, but had to identify funds and local suppliers if available.

By the end of February, another 10,016 samples were received. As the DOH, in collaboration with the local government units, were conducting outbreak response immunization activities, the need for laboratory confirmation further increased. Discussions with DOH and WHO began on strategies for maximizing use of the already depleted resources.

Request for Funding Support from DOH

The ICS facilitated the NML's request for additional funding to the DOH. The DOH approved the laboratory's request for additional funds in the amount of PhP 10M, however, this was transferred only in the 2nd quarter of 2014. The funds were utilized for hiring of contractual laboratory testing personnel (4 technical staff and 2 data encoders) as well as purchasing ELISA kits from the identified exclusive local distributor.

Request for Additional Equipment

The ICS also submitted a request for additional equipment to the WHO to address the limited ELISA equipment being shared by the NRLs of the department. The funds provided by the DOH were classified as Maintenance and Other Operating Expenses (MOOE) and not Capital Outlay (CO), and therefore could not be utilized to procure equipment, under government accounting laws.

March 2014

2nd Round of ICS Operational Adjustments

To maximize the limited number of WHO-donated ELISA kits and other resources available, and upon consultations with DOH and WHO, the ICS reviewed its operational adjustments and decided on the following:

- Changes in the original testing algorithm: samples for re-testing (such as equivocals) were no longer retested.
- Samples from epidemiologically-linked cases were no longer retested. If at least one case in the chain of transmission is laboratory confirmed, the other cases may already be considered as confirmed.
- Shift to priority testing of samples from the previous action plan of 100% testing.

To assist in the prioritization of samples for testing, WHO deployed additional technical staff to the NML for data management and analysis. Data of incoming referrals were analyzed, the index case was determined, and a few samples from the area of the confirmed index case were selected for testing. The premise of the priority testing was to ensure representative sampling to the barangay level if with few cases or at municipality level if cases are already confirmed in many barangays. The strategy also considered calamity areas (i.e., those provinces affected by Typhoon Haian/Yolanda) and the areas that were deemed as "urgent" or "priority" by the regional surveillance units as they are the ones who best know their respective areas. It was agreed with the RITM hospital management that all specimens taken from patients seen at the Institute shall also be included in the priority testing. All untested samples (i.e., those that were not selected in the priority testing strategy) were stored at RITM.

Coordination with DOH bureaus and stakeholders

It was challenging to communicate the continued backlogs in testing to the stakeholders, but even more so the shift in testing strategy, which meant that not all of the specimens they have been collecting were going to have laboratory results. Aside from the advisories it released, the ICS requested the support of the DOH central surveillance bureau to provide parallel information dissemination to the regions for cascading to their respective disease reporting units. Meetings with the regional surveillance units were taken as opportunities to provide updates on the laboratory testing.

Discussions with DOH and WHO began on coming up with guidelines for the local government units for measles outbreak and planning for appropriate response. This included clearer guidelines on specimen collection and sampling strategies in disease clusters identified at the barangay level, and highlighted the importance of

epidemiologic linkage to guide their action plans. This way, local surveillance units need not wait for 100% of specimens to be tested before making decisions on whether or not to conduct outbreak response immunization.

ICS also attended meetings with the immunization program to provide updates. Planning efforts were underway at the DOH at the time for mounting a country wide measles supplemental immunization activity (along with Rubella) by the 3rd quarter of the year. March ended with an additional 6,512 samples.

April-June 2014

From April to June, specimen referrals were still in the thousands but decreasing by month. The NML, using the revised algorithm and priority testing, was able to provide results—albeit still delayed by 2 weeks up to as much as 4 months—to the stakeholders. The revised operations proved useful in economizing the limited resources and increased the use of epidemiologic linkage as a public health tool. The ICS maintained the operational set-up and monitored the progress of testing.

July to December 2014

By July, ELISA kits purchased locally using the fund suballotment from DOH were delivered, and the ELISA/serology equipment requested to WHO for doubling testing capacity arrived. These included a microplate reader, washer, and pipettors.

Post-Outbreak

Final operational adjustment and ICS de-activation

The ICS, upon consultation with DOH and WHO, resumed 100% testing of all specimens received from July onwards while working on backlogs from earlier months. After reviewing the NML operations, the trends of specimen referrals, and the stock inventories, the ICS was finally deactivated in August 2014. There was no longer any need for additional shifts and the re-assigned staff returned to their normal operations. After the 2014 Measles-Rubella-Oral Polio Vaccine Supplemental Immunization Activity (MR-OPV SIA) in September, the number of cases further decreased until the end of the year.

By October, DOH issued Administrative Order 2014-0039 strengthening local government unit capacity for identifying measles outbreaks and planning for appropriate response, and declared the resumption to normal surveillance operations for measles elimination (i.e., 100% of suspected measles cases reported, investigated, and tested) by January 2015. The NML, with its additional contractual staff, was able to manage the specimens that were received until the end of the year.

Final Counts

At the end of the 2014, the NML received over 40,000 samples and tested 51% of them using its revised strategies (Table 2). Based on the data, 84% of the samples were received between January to June 2014 with the highest peak in January (Table 3). The final count is 3 times higher than the total specimen referrals the Institute tested for Influenza during the Influenza AH1N1 pandemic in 2009 in which 12,000 samples were tested, and is, by far, the largest number of specimens received by the Institute for a single outbreak to date.

DISCUSSION

Laboratories play a key role in generating information on health, whether for individual patient management, as in the case of routine diagnostic clinical laboratories, or for public health, in which case, laboratory services are utilized to support disease prevention and control programs.

In the context of public health systems, the laboratory is an integral component of disease surveillance, particularly in case investigation and confirmation.[6] Prior to outbreaks, laboratory testing of specimens derived from routine surveillance systems allows confirmation of suspected cases and analysis of disease trends. During outbreaks, on the other hand, specimens are also confirmed to determine the cause of the epidemic, which, in turn, is utilized to implement control measures to stop transmission, determine other appropriate management measures, and guide allocation of resources. Laboratory testing is also used for programmatic monitoring of diseases targeted for control, elimination, or eradication, and contributes to evidence-based public health action towards healthier communities.[7] It is very clear that much depends on the efficiency of the public health laboratory services and any delay in generating the information will also cause a delay in the public health action.

The NML, as the recognized public health laboratory for measles, despite being WHO-accredited for its consistent excellent performance in terms of quality assurance

Table 2. Summary of Referrals for Measles Testing and Results, 1 January – 31 December 2014

Category	Total (%)
Serum Referrals	40,861 (100%)
Tested	20,657 (50.6%)
Measles IgM Positive	13,932
Measles IgM Equivocal	1,675
Measles IgM Negative	5,000
Not Tested	20,144 (49.3%)
Rejected	50 (0.1%)

Table 3. Turn-around time (TAT) of Measles IgM Testing, January-December 2014

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Received	10565	9272	6450	3759	2569	1503	1761	1653	1698	848	776	395
Tested	7331	2065	1856	713	321	1351	1679	1621	1553	825	741	384
Unacceptable/ rejected samples	47	20	57	34	8	151	79	32	145	23	35	11
Not selected	3179	7128	4507	3004	2225	1	2	0	0	0	0	0
	10557	**9213**	**6420**	**3751**	**2554**	**1503**	**1760**	**1653**	**1698**	**848**	**776**	**395**
TAT (Average Calendar days)	34.8	68.9	99.0	98.9	82.0	220.0	82.0	95.3	57.3	22.1	15.1	20.4
Variance from Ideal TAT (7 days)	27.8	61.9	92.0	91.9	75.0	213.0	75.0	88.3	50.3	15.1	8.1	13.4

Note: Shaded portion reflects the period the ICS was active.

Table 4. Accomplishment of ICS Objectives

ICS Objectives	Operational Adjustments	Accomplishment
1. Provide additional manpower to NML to manage its operations.	• Re-assignment of staff	Yes
	• NML focused on outbreak testing	Yes
2. Maintain adequate supplies/reagents for continued testing	• Stock inventory monitoring	Yes
	• Allocative/priority distribution	Yes
	• Local sourcing	Yes
	• Acquisition of supplies/equipment	Yes
3. Ensure timely and accurate results	• 3-day testing to daily testing	Yes
	• Change in algorithm	Yes
	• TAT within 7 days	**No**
4. Ensure accountability of all specimens and records (prevent loss of specimens/records)	• Re-assignment of staff	Yes
	• Centralization of encoding, reports and results release	Yes
5. Perform further testing and analysis of data as expected	• Other tests done by other NRLs	Yes

and performance as part of measles surveillance, was ill-prepared in adjusting its operations to the surge of specimens caused by the nationwide outbreak. As the measles elimination target is looming in the horizon and the incidence has gone down,[8] the operational level of the laboratory remained the same. The absence of an outbreak response plan, surge capacity, and contingencies clearly manifested itself in the resulting backlogs and inability to provide results. Ultimately, the onus of ensuring operational efficiency rested in the laboratory management.

Evaluation of Incident Response

The ICS served as the department's operational management strategy to mitigate the surge of specimens in the background of limited resources. From this perspective, *was the ICS strategy effective and efficient?* Effectivity ("doing the right things"), is about providing accurate laboratory results (quality), whereas efficiency, ("doing things right") is about providing the laboratory results within the expected turn-around time (timeliness). An indirect means of ascertaining the quality of laboratory testing is through the NML's performance in the WHO quality assurance schemes in which the technical staff have consistently performed excellently until the present. For the turnaround time, however, analysis showed significant variance from the standard WHO turn-around time for measles surveillance (Table 3).

Much emphasis is placed on the TAT as efficiency indicator as the earlier the information is provided to the surveillance officers and program officers, the earlier their actions and response are executed. It is evident that from January to August (shaded in Table 3)—the period during which the ICS was active—the TAT from specimen receipt to results ranged from 28 days to as much as 214 days beyond the 7 days ideal. It must be noted, however, that the suballotment support was only released in the 2nd quarter of the year, and consequently, the 4 additional medical technologists were only hired by July. There is also the stock out of kits in February which temporarily stopped the operations until March as the kits from WHO was likewise delayed, but on the other hand, no contingency plan was in place to address this risk.

In consultation with WHO, the regular TAT of 4 days applies only to regular surveillance and does not apply to periods of high transmission. Despite this, while it is understandable that during periods of high transmission the TAT may be adjusted beyond 4 days, very prolonged TATs such as in this outbreak, also exerted a negative impact to program implementation.

In retrospect, the backlogs, coupled with the challenges in the field (i.e., new surveillance officers were not yet trained on measles outbreak field investigation and epidemiologic linking, thus they were dependent on laboratory confirmation for initiating response activities), may have contributed, along with other factors to the spread and continued transmission of measles. Thus, despite the ICS strategy, in terms of TAT, operational efficiency is not achieved.

Have the objectives for the ICS activation been achieved, in the first place? Table 4 summarizes the ICS objectives, the specific activities per objective, and the assessment on the objectives' accomplishment. Due to the problems in TAT, objective 3 was not fully achieved; thus, only 4 out of the 5 ICS objectives at the outset, have been achieved. But this must be interpreted in the context of the kit stock out and the time the augmentation from DOH arrived.

The main objective of the ICS is the timely and accurate release of results. This is the core responsibility of the laboratory in the context of public health surveillance and action. The other ICS objectives are, in actuality, strategies to contribute to the main objective.

Key Management Lessons Learned

Looking at the Bigger Picture

In the course of daily operations, there is a tendency to miss the "bigger picture" or the context in which an organization operates and for what reason it is operating. In this case, the DOH central office and regional staff were all prioritizing the response efforts to Typhoon Haiyan/Yolanda, such that the extent of the silent spread of measles across provinces and regions was perceived only when it was just about to surge and the number of cases has exceeded thresholds. Even the laboratory was focused in testing specimens and releasing results, such that the increasing trend of laboratory confirmed cases was also missed. Operating units should make sense of the information that are being made available to them.

Operating in Silos vs Whole-of-Government Approach

Agencies should not *and cannot* operate in silos.[1] Open communication and coordination, sharing of information and transparency, integrative and collaborative problem-solving, must be the norm of public service agencies. The

1 *To "operate in silos" is to work as isolated, independent units without sharing information and/or resources.*

"us vs them" must be replaced with a "we" and "our" mentality. A vaccine-preventable disease outbreak, for example, is not *just* a DOH program concern, but also the concern of the surveillance bureau, the national laboratory, the surveillance officers and disease reporting units. This was our mindset when the ICS worked on standardized guidelines and provided standard specimen collection materials for the use of those in the field, collaborated with DOH and WHO in analyzing the data for priority testing, and worked with offices outside the Department during the surge response.

Adopting a VUCA Perspective as a Tool for Strategic Leadership

VUCA—volatility, uncertainty, complexity, ambiguity—are said to characterize the so-called "new normal," or the context in which organizations should perceive their situation and future.[9] VUCA has been used to highlight the importance of foresight and insight to strategic leadership.

Public health, with its unpredictability, scale, complexity, must be viewed through the VUCA lens. Thus, public health managers and practitioners, including those working in the public health laboratories, must never be complacent. There should be a proactive approach and attempt to forecast public health incidents by monitoring trends, scanning the environment, and analyzing data. In the context of RITM, this applies to emerging and re-emerging infectious threats and outbreak-prone diseases, as disease incidence, morbidity and mortality, may escalate rapidly.

Proactive Approach to Preparedness Planning

In addition, RITM recently achieved ISO 9001:2015 certification. The key difference between this standard and its 2008 predecessor is the establishment of an institutional systematic approach to risk identification and management which is applied throughout the agency's business process from inputs to outputs. The standard is designed to shift the organization's approach to management of the quality of its services, from being "reactive" to problems (correction) to being "pro-active" in addressing potential problems (prevention, mitigation, or elimination of risk, promotion of continual improvement).

This is very applicable to the public health laboratory function of the Institute's NRLs. The laboratory management must place a premium on regularly assessing risk (analyzing data, monitoring global, regional disease trends), taking action on those risks (maintaining staff proficiency, ensuring good equipment condition and calibration, monitoring inventories and initiating procurement of buffer stocks), and contingency planning, at the department-level, division-level, and institution-level, to address risks.

CONCLUSION

The National Reference Laboratory's response to the Measles outbreak of 2013 to 2014 was far from optimal as there were many operational challenges and limitations faced, factoring into the delay in laboratory testing. Despite this, the response was appropriate by assuming command and control of the situation. Necessary decisions were made and objective interventions were introduced.

The Incident Command System is an appropriate operational management strategy during acute incidents that place a high demand on the organization's limited resources. The experience with the ICS also led the management to important lessons, invest in preparedness for an even bigger outbreak, and challenged the leadership to think about ways of improving institutional resiliency.

STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

AUTHOR DISCLOSURE

The authors declared no conflict of interest.

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