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Comparison of influenza surveillance data from the Republic of Korea, selected northern hemisphere countries and Hong Kong SAR (China) from 2012 to 2017

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Influenza surveillance is conducted in many countries; it is one of the most important types of infectious disease surveillance due to the significant impact and burden of the influenza virus. The Republic of Korea has a temperate climate, and influenza activity usually peaks in the winter as in other temperate-climate countries in the northern hemisphere. This descriptive study compared the influenza surveillance data from the Korea Centers for Disease Control and Prevention with that from other countries and areas in the northern hemisphere, namely China, including Hong Kong SAR, Japan and the United States of America, to identify seasonal influenza patterns from 2012 to 2017. Data on influenza-like illnesses (ILIs) and laboratory surveillance were collected from various sources; visual comparisons were conducted on the onset, duration and the peak timing of each influenza season based on subtypes. Correlation coefficients were estimated, and time differences for the beginning of influenza seasons between the Republic of Korea and other countries were measured. ILIs in North China and cases reported from Japan's sentinel surveillance showed high correlations with the Republic of Korea. The number of confirmed influenza cases in Japan showed a high correlation with the laboratory-confirmed influenza cases in the Republic of Korea. We found that there are similarities in the influenza patterns of the Republic of Korea, Japan and North China. Monitoring these neighbouring countries' data may be useful for understanding influenza patterns in the Republic of Korea. Continuous monitoring and comparison of influenza surveillance data with neighbouring countries is recommended to enhance preparedness against influenza.

The influenza virus is a respiratory pathogen that is transmitted through respiratory droplets.¹ During seasonal influenza epidemics, high attack rates cause a significant public health burden.² The infection is usually self-limited in young adults but can lead to severe infections in people in high-risk groups, including elderly people (>65 years old), pregnant women, children aged 6–59 months and adults with chronic illnesses.³

The Republic of Korea is located in a temperate region where a seasonal pattern of influenza is normally observed.⁴ The annual peak is usually in January. Since the establishment of the Republic of Korea's influenza surveillance system in 2000,⁵ the early prediction of seasonal influenza epidemics has been a major priority. The surveillance systems in China, including Hong Kong SAR, Japan and the

United States of America (USA) differ, but their overall structure and scope are similar. The influenza surveillance systems for all four operate year-round to detect influenza; however, their data have not been systematically compared and similarities and differences in patterns have not been identified. For this reason, this study compared the Korea Centers for Disease Control and Prevention (KCDC) influenza surveillance data with influenza surveillance data in other northern hemisphere countries.

MATERIALS AND METHODS

Study design

A descriptive study compared the Republic of Korea's influenza surveillance data with that from China,

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including Hong Kong SAR, Japan and USA from week 36 of 2012 to week 12 of 2017 (238 weeks total) to understand the relative onset, duration and peaks of seasonal influenza. China, including Hong Kong SAR, and Japan were selected because of their geographical proximity to the Republic of Korea. The USA was selected because it is located in the northern hemisphere, and it has a comprehensive influenza surveillance system. The selected countries and areas operate influenza surveillance year-round and have both an influenza surveillance system that monitors clinical symptoms such as influenza-like illness (ILI) and a laboratory-based influenza surveillance system. The KCDC's definition of ILI is temperature $\geq 38^{\circ}\text{C}$ with cough or sore throat. There were some differences in ILI case definitions. China defines ILI as temperature $\geq 38^{\circ}\text{C}$, either cough or sore throat and no laboratory confirmation of alternative diagnosis;⁶ Hong Kong SAR (China) defines ILI as temperature $\geq 38^{\circ}\text{C}$ plus two of the following: sore throat, cough, rhinorrhoea, myalgia, arthralgia;⁷ and the USA defines ILI as temperature $\geq 37.8^{\circ}\text{C}$ and cough and/or sore throat and without a known non-influenza cause. Japan's ILI case definition is sudden onset of illness, temperature $> 38^{\circ}\text{C}$, upper respiratory inflammation systemic symptoms such as general fatigue or one of these clinical criteria and a positive rapid laboratory diagnostic test for influenza.⁹ The ILI case definitions of each participating country were used in this study to determine seasonal influenza epidemics.⁸ There were inherent differences in all of the influenza surveillance systems. For laboratory surveillance systems, per cent positive was used in all countries except Japan where the number of confirmed cases was used instead. In-depth statistical analysis was limited due to differences in surveillance system settings.

The surveillance system in the Republic of Korea is composed of 200 sentinel sites that report ILI cases and rates. All influenza data are reported on a weekly basis. The ILI rate in the Republic of Korea is defined as the number of ILI cases divided by the number of 1000 outpatients per week. Thirty-six sentinel sites also participate in the laboratory surveillance, sending respiratory specimens for confirmation and subtyping of influenza virus. In China, ILI consultation rates reflect the percentage of hospital visits attributed to ILI. In Hong Kong SAR (China), ILI rates are reported as cases per 1000 consultations in general outpatient clinics. In

the USA, the rate of ILI is the national percentage of ILI patient visits to health-care providers. In Japan, the number of cases per sentinel site is reported.

Data collection

Data were retrospectively collected through national weekly surveillance reports of each country or region, official websites and the World Health Organization's FluNet.^{10–15} China produces two separate sets of surveillance data: one each for North and South China (not including Hong Kong SAR [China]),¹² and data from both sets were collected for the analysis.

Data analysis

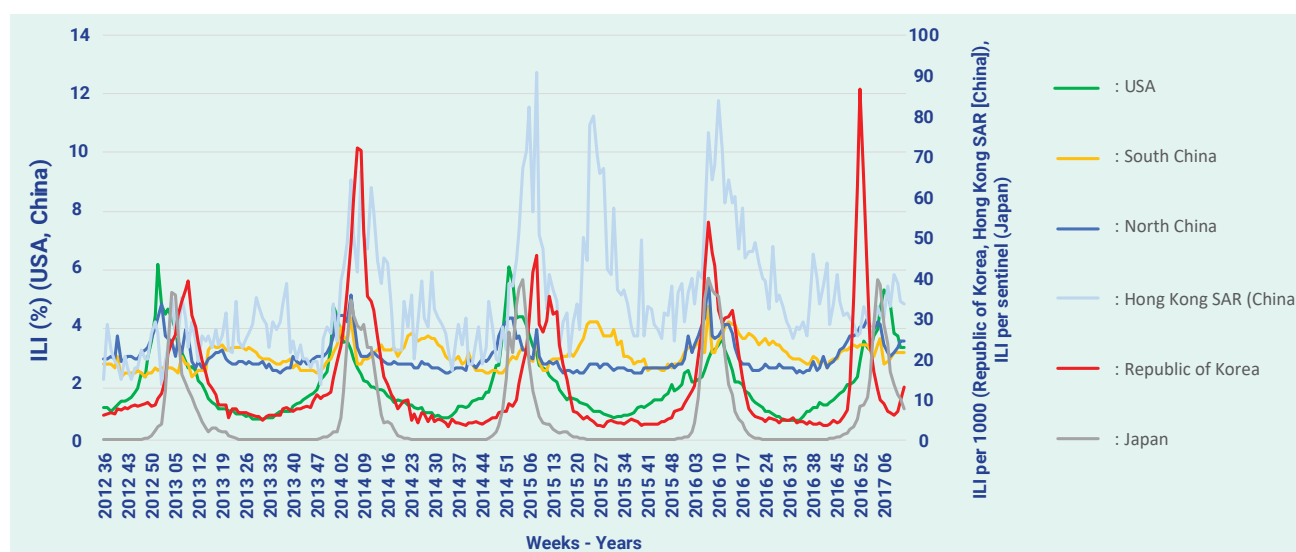
Descriptive statistics including means, standard deviations, minimum and maximum values of ILI and per cent positive of influenza virus were calculated. Weekly surveillance data were plotted using the same epi-weeks to enable visual comparisons (Fig. 1 and 2). Onset, peak and the duration of each seasonal influenza epidemic were graphically presented by country for further comparisons (Fig. 3).

The week of onset was defined as the first week that exceeded the pre-defined level for countries using their own thresholds. The peak of the influenza season refers to the week that shows the highest ILIs (or cases per sentinel surveillance site for Japan) during epidemic periods of each influenza season.

As China and Hong Kong SAR (China) do not use an influenza epidemic threshold, the period in which influenza positivity rate was greater than 10% was used to define the epidemic period; this is normally used as the reference value of seasonal influenza in the Republic of Korea, the USA and other countries.^{16,17}

Pearson correlation coefficients were calculated to compare the Republic of Korea's surveillance data with the surveillance data of other countries and areas. We used weekly time lags (i.e. 1 week prior, 2 weeks prior, 3 weeks prior, 4 weeks prior) and considered typical influenza transmission patterns to find the best data sources. *P* values less than 0.05 were considered statistically significant.

Fig 1. ILI surveillance data, 2012–2017



ILI (%): Percentage of outpatients with ILI symptoms per epi-week; ILI per 1000: The number of ILI cases per 1000 outpatient; ILI per sentinel: The number of ILI cases per sentinel site

RESULTS

ILI surveillance data

The mean weekly ILI rates varied by country during the study period. The mean rate for the Republic of Korea was 13.8 per 1000 outpatients (standard deviation [SD] 14.2); the mean rate for North China was 2.9% of ILI cases (SD 0.6%); the mean rate for South China was 3.0% of ILI cases (SD 0.5%); the mean rate for the USA was 1.9% (SD 1.2%); the mean rate for Hong Kong SAR (China) was 4.8 per 1000 consultations (SD 2.0); and the mean number of cases reported per sentinel site in Japan was 6.0 (SD 10.4). North and South China ILI rates had small variations (North: 2.3–5.6, South: 2.2–4.5) by year compared to the Republic of Korea and Japan.

The maximum per cent positive of influenza virus in the Republic of Korea was 71.7%; it was significantly higher than that of the other countries, which was around 40%. Among three influenza virus subtypes, the annual per cent positive of H3N2 was generally higher than the other two subtypes, except in the USA. In the USA, H3N2 and H1N1pdm09 showed similar proportions of positivity during the peak week (22.5% and 19.6%, respectively). No influenza viruses were detected during the intra-epidemic period (period between one influenza season and the next influenza season) in the Republic of Korea, North China or Japan (Table 1). In contrast,

influenza was detected throughout the intra-epidemic period in the USA.

The ILI rates of countries and cases per sentinel surveillance site (Japan) data showed seasonality with winter season peaks during the study period (Fig. 1). The ILI rate in the Republic of Korea and cases per sentinel site in Japan showed sharp increases and clear peaks of seasonal influenza during the winter. In contrast, the USA's ILI data showed gradual increases as well as decreases during influenza seasons every year. The USA's ILI data showed earlier onset of epidemics four of the five previous influenza seasons. The Hong Kong SAR (China) and South China surveillance data demonstrated a pattern of summer epidemics.

Laboratory surveillance data

Circulating subtypes varied among countries by each influenza season, and no clear patterns were identified. The per cent positive or the total number of confirmed cases (Japan) of H1N1pdm09 showed similar patterns among countries for onset and duration. The Republic of Korea was the only country that reported H1N1pdm09 during the 2014–15 season, but it was reported every year during the study period in the Republic of Korea. H1N1pdm09 showed a biennial pattern, being observed every other year in Japan and the USA. H3N2 showed more variations and irregularities compared with other subtypes, and the timing varied among countries and areas.

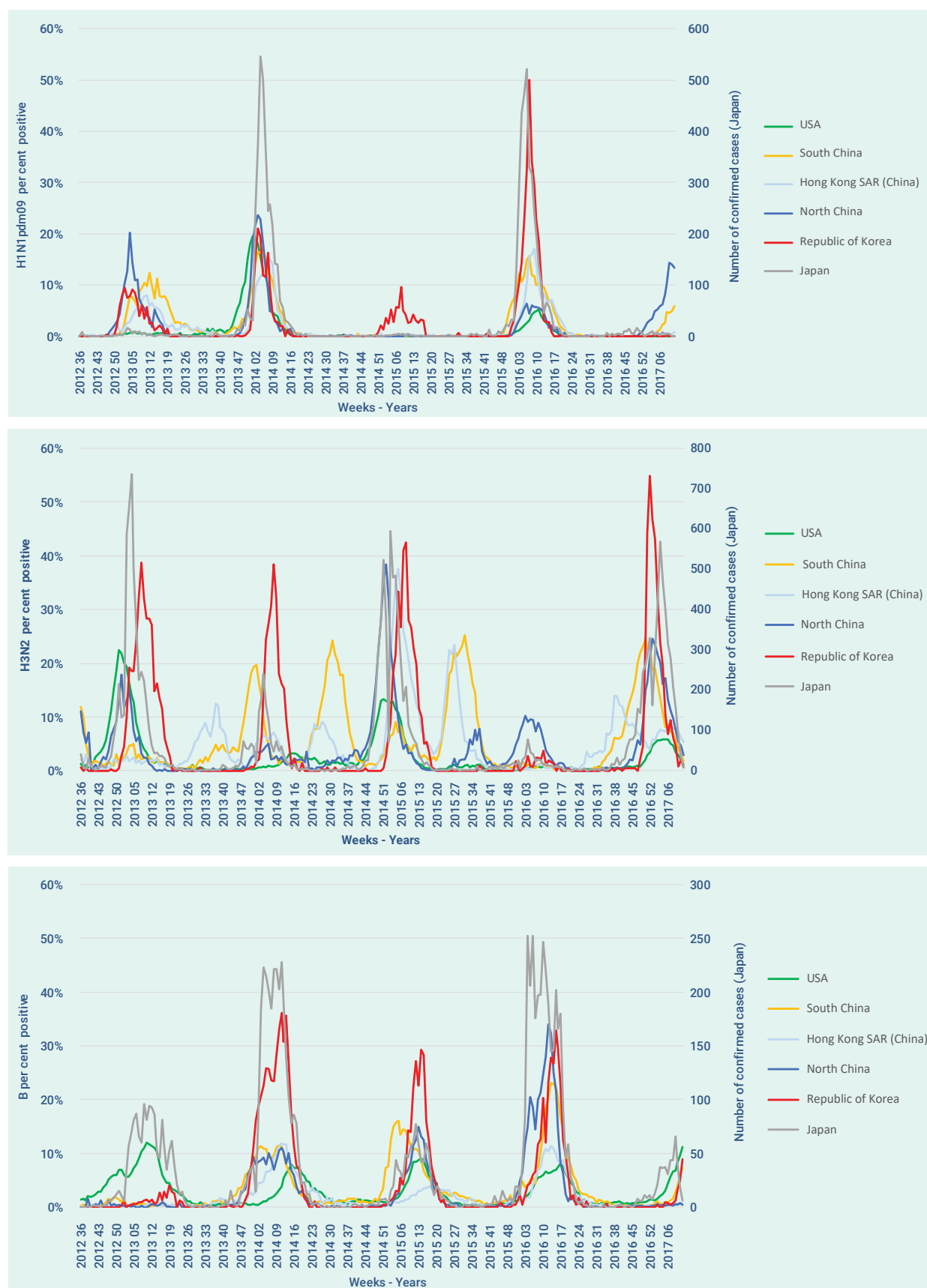
Fig 2. Influenza laboratory surveillance data by virus subtype, 2012–2017

Table 1. Descriptive statistics of the influenza surveillance data of the Republic of Korea, Japan, North and South China, Hong Kong SAR (China) and USA, 2012–2017

Country and data source	Unit	Mean	SD	Min	Max
Republic of Korea					
ILI	Per 1000 outpatients	13.8	14.2	3.3	86.6
Influenza per cent positive (total)	% *	12.2	18.2	0.0	71.7
H1N1pdm09	% *	2.4	6.1	0.0	50.0
H3N2	% *	5.5	10.9	0.0	54.8
B	% *	4.3	8.5	0.0	36.2
Japan					
ILI	Cases per sentinel surveillance site	6.0	10.4	0.0	40.0
Influenza per cent positive (total)	Number of confirmed cases	144.8	204.2	0.0	1009.0
H1N1pdm09		31.7	92.3	0.0	546.0
H3N2		75.1	135.8	0.0	736.0
B		37.9	61.5	0.0	252.0
North China					
ILI	% **	2.9	0.6	2.3	5.6
Influenza per cent positive (total)	% *	9.4	10.7	0.0	42.1
H1N1pdm09	% *	2.6	4.1	0.0	23.7
H3N2	% *	4.3	6.4	0.0	38.5
B	% *	2.9	5.8	0.0	34.0
South China					
ILI	% **	3.0	0.5	2.2	4.6
Influenza per cent positive (total)		12.2	9.1	1.5	42.6
H1N1pdm09		2.4	6.1	0.0	17.0
H3N2		5.8	6.7	0.0	25.2
B	% *	3.6	4.8	0.0	23.0
Hong Kong SAR (China)					
ILI	Per 1000 consultations	4.8	2.0	1.9	12.7
Influenza per cent positive (total)		8.9	7.8	0.3	38.7
H1N1pdm09	% *	1.9	3.5	0.0	17.1
H3N2	% *	4.9	6.2	0.1	37.5
B	% *	1.9	2.8	0.0	11.8
USA ILI					
ILI	% ***	1.9	1.2	0.7	6.1
Influenza (total)		10.4	9.3	1.2	38.2
A(total)	% *	7.5	8.3	0.3	31.4
H1N1pdm09	% *	1.2	3.3	0.0	19.6
H3N2	% *	2.6	4.1	0.1	22.5
B	% *	3.0	3.0	0.1	12.0

ILI = influenza-like illness, SD = standard deviation, Min = minimum value, Max = maximum value

* Percentage of influenza-positive samples over all tested clinical samples

** Percentage of hospital visits attributed to influenza-like illness

*** National percentage of patient visits to health-care providers for influenza-like illness

Hong Kong SAR (China) and South China showed H3N2 epidemics in the summer seasons, but the timing varied in each influenza season. Influenza B virus showed lower per cent positive (or confirmed cases in Japan) and the onset was relatively delayed compared to other subtypes in all countries and areas (Fig. 2).

Overall seasonal influenza pattern

There were yearly seasonal influenza epidemics for all countries and areas during the study period. The Republic of Korea, North China, Japan and the USA showed relatively similar influenza epidemic periods; there were interseason epidemics during the summer period in South China and Hong Kong SAR (China) (Fig. 1 and 3).

Pearson correlation (r) analysis demonstrated that most of the data from other countries were significantly

correlated with the Republic of Korea's data (Tables 2 and 3). There was a relatively higher correlation of ILI in North China ($r = 0.54$, $P < 0.0001$) and Japan's sentinel surveillance cases ($r = 0.60$, $P < 0.0001$) with the ILI of the Republic of Korea. The number of confirmed influenza cases in Japan showed a high correlation ($r = 0.71$, $P < 0.0001$) with the Republic of Korea's laboratory surveillance data.

The onset of influenza epidemics in Japan usually preceded that in the Republic of Korea by an average of 2.8 weeks, except in the 2015–16 influenza season. The onset of the influenza epidemic season started between one week (2013/2014) and seven weeks (2014/2015) earlier in Japan compared to the Republic of Korea. The duration of the influenza season was longer in Japan (average 21.5 weeks) than in the Republic of Korea (average 15.3 weeks). North China also preceded the

Table 2. Pearson correlation coefficient between the Republic of Korea ILI data and time lag surveillance data of other countries/areas, 2012–2017

Time lag	North China	South China	Hong Kong SAR (China)	Japan ^a	USA
No time lag	0.54 ($P < 0.0001$)	0.15 ($P 0.020$)	0.38 ($P < 0.0001$)	0.60 ($P < 0.0001$)	0.40 ($P < 0.0001$)
1 week time lag	0.59 ($P < 0.0001$)	0.14 ($P 0.030$)	0.35 ($P < 0.0001$)	0.60 ($P < 0.0001$)	0.43 ($P < 0.0001$)
2 weeks time lag	0.63 ($P < 0.0001$)	0.15 ($P 0.019$)	0.34 ($P < 0.0001$)	0.59 ($P < 0.0001$)	0.47 ($P < 0.0001$)
3 weeks time lag	0.64 ($P < 0.0001$)	0.13 ($P 0.041$)	0.30 ($P < 0.0001$)	0.55 ($P < 0.0001$)	0.51 ($P < 0.0001$)
4 weeks time lag	0.63 ($P < 0.0001$)	0.09 ($P 0.148$)	0.26 ($P < 0.0001$)	0.49 ($P < 0.0001$)	0.55 ($P < 0.0001$)

^a Cases per sentinel site

Table 3. Pearson correlation coefficient between the Republic of Korea influenza laboratory surveillance data and influenza laboratory surveillance data of other countries/areas, 2012–2017

Influenza specimens by type/subtype	North China	South China	Hong Kong SAR (China)	Japan ^a	USA
Influenza per cent positive (total)	0.64 ($P < 0.0001$)	0.58 ($P < 0.0001$)	0.67 ($P < 0.0001$)	0.71 ($P < 0.0001$)	0.48 ($P < 0.0001$)
H1N1pdm09	0.50 ($P < 0.0001$)	0.71 ($P < 0.0001$)	0.78 ($P < 0.0001$)	0.79 ($P < 0.0001$)	0.42 ($P < 0.0001$)
H3N2	0.34 ($P < 0.0001$)	0.14 ($P 0.028$)	0.33 ($P < 0.0001$)	0.54 ($P < 0.0001$)	0.26 ($P < 0.0001$)
B	0.75 ($P < 0.0001$)	0.76 ($P < 0.0001$)	0.84 ($P < 0.0001$)	0.75 ($P < 0.0001$)	0.39 ($P < 0.0001$)

Source: Korea Centers for Disease Control and Prevention.¹⁵

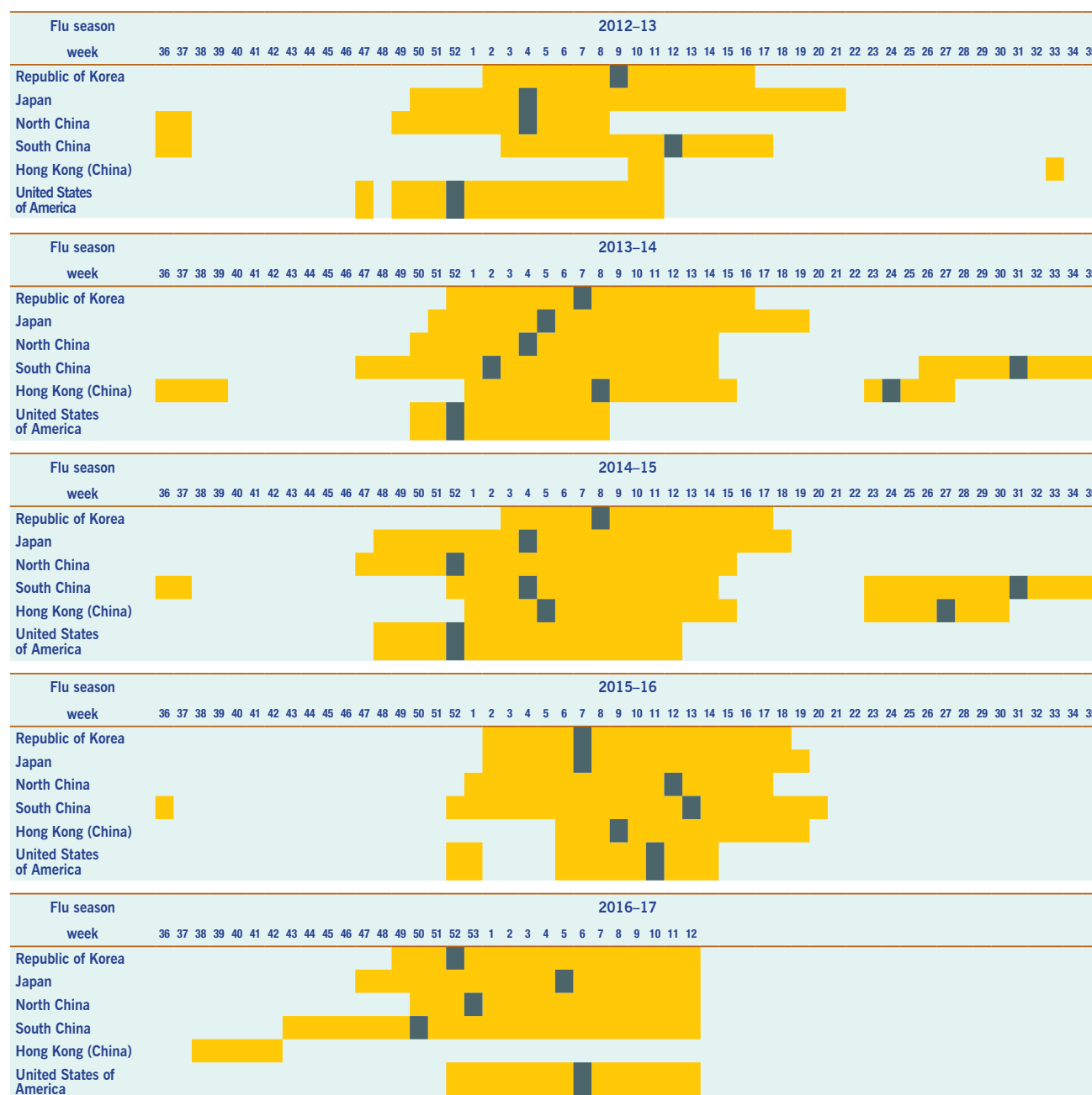
^a Number of subtypes

Republic of Korea for the onset of the influenza epidemic season by one to eight weeks except for the 2016/2017 season.

The periods between the onset and the peak were significantly shorter in the Republic of Korea compared to Japan; in the 2016/2017 season it took only four weeks to reach the peak. The 2016/2017 season, was

unique as the Republic of Korea and Japan experienced earlier onsets of seasonal influenza than in other years. Summer epidemics in Hong Kong SAR (China) and South China occurred in 2013/2014 and 2014/2015. However, this pattern was not observed in the 2012/2013 or 2015/2016 seasons. The summer epidemic was delayed and eventually started in the beginning of 2016/2017 season in Hong Kong SAR (China). An early

Fig 3. Comparisons of influenza seasons by country during the study period, 2012–2017



Yellow box: epidemic period

Grey box: peak of epidemic

epidemic in South China was observed and it may have influenced the earlier beginning of seasonal influenza in the 2016/2017 season in the Republic of Korea and Japan. The USA usually reported earlier onsets compared to other countries, but the pattern reversed after the 2015/2016 season (Fig. 3).

DISCUSSION

The study results indicated that Japan and North China had similar trends and tended to have earlier influenza onsets than the Republic of Korea. These countries and areas are located in East Asia, and geographical proximity might have resulted in similar patterns of seasonal influenza in both countries.¹⁸ Also, similarities in climate conditions of the countries might explain the similar influenza surveillance results. We also found that the influenza data in the Republic of Korea and Japan varied more than it did in other countries. In North China, clear peaks in the winter season were also observed, but there were smaller ranges of ILI rates (differences between maximum and minimum) compared to the Republic of Korea and Japan. Influenza was reported throughout the year in South China and Hong Kong SAR (China) based on laboratory surveillance data, presumably due to their geographic locations in lower latitudes and closer to the equator.¹⁹ Among subtypes, influenza B and H1N1pdm09 showed better correlation than the H3N2 subtype. This may be related to the irregularities of the H3N2 subtype and relatively large variations.

Even though this study covered fewer than five influenza seasons, our findings suggest that there potentially may be similarities in epidemic patterns in Japan, North China and the Republic of Korea. It is noteworthy that the onset of seasonal influenza epidemics in Japan tends to precede the onset in the Republic of Korea. The influenza virus shows clear seasonal trends in countries with temperate climates, and the correlation analysis showed statistically significant results. Nevertheless, the high correlation of ILI and confirmed cases in Japan and the Republic of Korea and in North China and the Republic of Korea suggests that there are similarities in the influenza patterns of these countries and areas.

There are some limitations to this study. As Japan uses a unique case definition for influenza surveillance,

direct comparison with other countries and areas is somewhat limited. Although the case definitions for influenza surveillance were generally similar for the other countries, each system operates within different settings, potentially contributing to differential sensitivity and specificity for detecting influenza cases.²⁰ Surveillance systems in each country may also have been updated during the study period. The direct comparison of these diverse data may not fully capture or sufficiently explain the differences in patterns among countries. Laboratory surveillance data are also more likely to be affected by variations in surveillance system settings as they are strongly associated with the number of specimens tested. Also, annual influenza vaccination coverages of each country were not taken into consideration in the analysis due to the lack of access to the vaccination data. Despite the inherent discrepancies and potential lack of representativeness due to sentinel surveillance systems, these were the best national influenza data available.

Given the results of this observational study, additional studies to evaluate and validate the potential relationships among countries or regions are needed. Further study for longer period of influenza seasons with additional countries is needed to achieve more generalized outcomes.

CONCLUSIONS

We found that there are similarities in the influenza pattern of the Republic of Korea, Japan and North China. Monitoring influenza patterns in Japan and North China may be useful for understanding influenza patterns in the Republic of Korea. Monitoring and comparing influenza surveillance data with neighbouring countries needs to be continued both for better understanding of influenza patterns and for possible earlier detection of onsets of seasonal influenza.

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Building the hospital event-based surveillance system in Viet Nam: a qualitative study to identify potential facilitators and barriers for event reporting

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Introduction: Hospitals are a key source of information for the early identification of emerging disease outbreaks and acute public health events for risk assessment, decision-making and public health response. The objective of this study was to identify potential facilitators and barriers for event reporting from the curative sector to the preventive medicine sector in Viet Nam.

Methods: In 2016, we conducted 18 semi-structured, in-depth interviews, as well as nine focus group discussions, with representatives from the curative and preventive medicine sectors in four provinces. We transcribed the interviews and focus group discussions and used thematic analysis to identify the factors that appeared to affect public health event reporting.

Results: We identified five major themes. First, the lack of a legal framework to guide reporting meant hospital staff relied on internal procedures that varied from hospital to hospital, which sometimes delayed reporting. Second, participants stated the importance of an enabling environment, such as leadership support and having focal points for reporting, to facilitate reporting. Third, participants described the potential benefits of reporting, such as support provided during outbreaks and information received about local outbreaks. Fourth, some challenges prohibited timely reporting such as not perceiving reporting to be the task of the curative sector and hesitancy to report without laboratory confirmation. Finally, limited resources and specialist capacities in remote areas hindered timely detection and reporting of unusual events.

Discussion: This study identified potential opportunities to promote the detection and reporting of unusual events from health-care workers to the public health sector, and thus to improve the overall health security system in Viet Nam.

Under the International Health Regulations, or IHR (2005), all Member States must develop core capacities to detect, assess, report and respond to acute public health events and emergencies.¹ For countries in the World Health Organization (WHO) South-East Asia and Western Pacific regions, the *Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies* (APSED III) has served as the regional framework for action to guide Member States to advance the implementation of the IHR (2005) for health security.²

APSED III proposes incorporating health-care workers in the surveillance system as a priority for the early detection of public health threats. Lessons learnt from previous public health emergencies have highlighted the potential benefits of engaging health-care workers in the event-based surveillance (EBS) system for the rapid and timely detection of emerging diseases and public health emergencies.^{3–6} APSED III further emphasizes using multiple sources of information, including event reporting from health-care facilities and laboratories during risk assessment to better inform decision-making.²

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In Viet Nam, the initial EBS system relied on media monitoring, and there was no systematic approach to promote timely reporting of public health events from health-care workers.⁷ In view of this, there have been plans to expand the EBS system in Viet Nam.

Viet Nam has a well-established notifiable disease surveillance and reporting system that is known, accepted and implemented by all levels of the health-care system – national, regional, provincial, district and commune levels. The reporting role relies on the curative (medicine) sector, which includes hospitals and other health-care facilities (both public and private), to report directly through an electronic reporting system and in coordination with the preventive medicine sector in their respective level – General Department of Preventive Medicine (GDPM) at the national level, Pasteur Institute or Institute of Hygiene and Epidemiology at the regional level, Provincial Preventive Medicine Centre (PPMC) or Provincial Centre of Disease Control (PCDC) at the provincial level, District Health/Preventive Medicine Centre (DPMC) at the district level, and Commune Health Station (CHS) at the commune level. While the curative sector is in charge of reporting disease and events, the preventive medicine sector is responsible for verification, investigation and response in coordination with the curative sector and other relevant stakeholders.

In this study, our overall goal was to gain insights into the current situation of event reporting from the curative sector and response from the preventive medicine sector, to inform broader system strengthening and to further engage health-care workers in the surveillance of public health threats. More specifically, we aimed to identify potential facilitators and barriers for signal detection, timely reporting and rapid response in the event of a public health emergency, which we hope to eventually use as the foundation to design a hospital EBS (HEBS) system in Viet Nam.

METHODS

Study design

From July to December 2016, we conducted semi-structured individual interviews and focus group discussions with representatives from the curative and preventive medicine sectors to explore and understand the reporting of “unusual events” from the curative to the

preventive medicine sector. We also reviewed documents and archival records as supplemental data. We employed a purposeful sampling strategy for the effective use of resources to allow data extraction from “information-rich cases” to yield “insights and in-depth understanding rather than empirical generalizations” as described by Patton in 2002.⁸ We carried out this study in four provinces: Ha Noi (capital of Viet Nam), Bac Giang (northern Viet Nam), Cao Bang (mountainous, remote area) and Binh Duong (southern Viet Nam) (Fig. 1). One district was purposively selected for each province to conduct the study based on convenience, their level of cooperation, having had a recent disease outbreak or has the potential to have disease outbreaks.

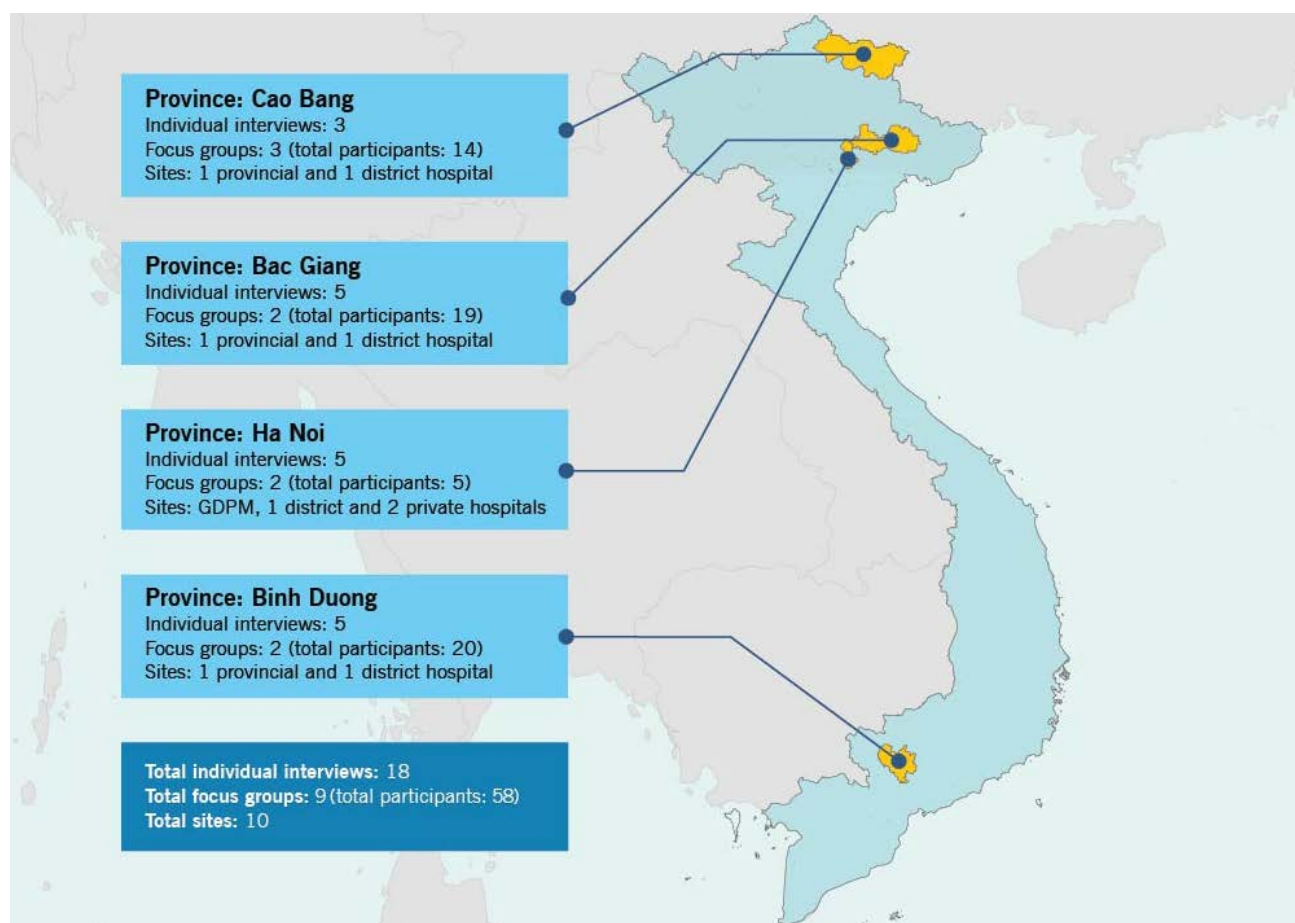
Participant characteristics

We conducted a total of 18 semi-structured, in-depth individual interviews and nine focus group discussions (with a total of 58 participants) (Fig. 1). Participants recruited in this study included hospital ward and laboratory staff who may detect unusual events for reporting; hospital leadership team members and planning department staff who are also the key decision-makers for determining the reporting process; and leaders and staff receiving reports at the preventive medicine centres (PMCs). We recruited participants from the GDPM (central governmental body in Ha Noi that oversees all PMCs), one DPMC, three provincial hospitals, four district hospitals and two private hospitals.

Data collection and analysis

Informed consent was obtained before conducting the interviews and focus group discussions. Three different semi-structured interview guides were developed and used to interview medical doctors, laboratory staff and hospital leadership teams. The focus group guide was developed and used to guide the discussion for provincial/district preventive medicine staff and hospital staff. Topics covered included the current reporting practice of unusual events, awareness, attitudes, potential barriers and solutions, and lessons learnt. Specific hypothetical scenarios were also used to identify possible actions that health-care workers may take upon detection of an unusual event. In addition, we also reviewed training records, logbooks and reporting forms to supplement interview data. Interviews and focus groups were led by experienced qualitative researchers, conducted in

Fig 1. **Participating sites in the qualitative study to identify facilitators and barriers for event reporting from hospitals to the public health system, Viet Nam, 2016**



GDPM, General Department of Preventive Medicine.

Vietnamese, and lasted approximately 60–90 minutes each; digital recordings of the sessions were transcribed verbatim for thematic analysis, which was performed in the NVIVO 8.0 software (QSR International, Melbourne, Australia). We conducted the data analysis simultaneously with data collection and data interpretation, which was iterative throughout the research process. We first used open coding to inductively classify data into initial categories or themes, which was then followed by axial coding to examine the data for regularities and variations within and between themes.⁹ The research team also met several times to discuss the key themes for verification and deepening the analysis of the results.

Ethical approval for this study

This study has been reviewed and approved by the Institutional Ethical Review Board of Ha Noi University of Public Health in 2016.

RESULTS

Five main themes emerged during the focus group discussions and in-depth interviews (Table 1).

Theme 1 – Legal framework and standard operating procedures may play an important role in guiding reporting and response.

Hospital staff reported the lack of a legal framework and standard operating procedures (SOPs) as challenges that hinder event reporting. At the time of the study, no legal framework or national guidelines on EBS in Viet Nam existed. Although some institutions have their own internal reporting procedure, many do not. Some participants expressed their desire to have a more formalized system in place, as one hospital staff stated:

“At present, we haven’t got an official system to enable hospital departments to easily share

Table 1. Summary of key findings – the current situation for reporting “unusual events” from hospitals, Viet Nam, 2016

Key findings				
1. Legal framework and standard operating procedures may play an important role in guiding reporting and response.	2. An enabling environment is necessary for timely reporting and response.	3. Potential benefits exist for the curative sector to work with the preventive medicine sector.	4. Health-care providers face multiple challenges to timely reporting.	5. Extra challenges exist for signal detection and reporting from remote areas and industrial zones.

SPECIFIC FINDINGS		
Signal detection	Timely reporting	Rapid response
<p>Challenges in detecting clusters despite awareness of “unusual events”</p> <ul style="list-style-type: none"> Although hospital and laboratory staff were sufficiently aware of what constitutes an “unusual event”, they were not aware of other similar unusual cases in other departments or other hospitals; therefore, they could not recognize clusters within the hospital. An electronic reporting system may be one way to facilitate detection of clusters of similar cases through easy data sharing within the hospital. Some doctors reported that the provision of information on disease trends in the locality might also help them be more aware. <p>Unfamiliarity with rare infectious diseases can result in missed signals.</p> <ul style="list-style-type: none"> Some medical staff were not familiar with rare infectious diseases; therefore, they failed to detect signals or facilitate timely referral due to misdiagnosis. <p>“Unusual events” were not considered signals for reporting until confirmatory diagnosis.</p> <ul style="list-style-type: none"> There was a misconception of the need to have a confirmatory diagnosis before reporting. Some doctors reported fear of being judged if the unusual event reported turned out to be not unusual. With most provincial and district laboratories having insufficient capacity to perform the necessary diagnostic tests, doctors were hesitant to report “unusual events”. Delayed laboratory results also decreased the incentive to send samples for confirmation to the provincial preventive medicine laboratories. <p>Additional challenges to detect signals in rural areas</p> <ul style="list-style-type: none"> The situation was exacerbated in rural areas because of limited access to hospitals, fewer doctors trained in infectious diseases, limited laboratory capacity and cultural differences. 	<p>Supportive leadership and designated focal points were critical for timely reporting.</p> <ul style="list-style-type: none"> Although timely reporting was challenging in hospitals with a hierarchical structure, it was facilitated in other hospitals with supportive leadership. Overall, reporting systems worked best in hospitals with a designated focal person and backup focal persons assigned for reporting. <p>Minimal ownership of reporting tasks among hospital staff</p> <ul style="list-style-type: none"> Following the introduction of Circular 54, which transferred the reporting task from the preventive medicine sector to the curative sector, some hospital staff have yet to fully accept this change. Medical doctors were reluctant to report “unusual events” as they were not familiar with this activity and found it complicated and time-consuming. In addition, the reporting procedure was unclear in some hospitals. <p>Unidirectional reporting reduced incentives to report.</p> <ul style="list-style-type: none"> Some hospital staff felt reporting to the preventive medicine sector was mostly a one-way relationship. A lack of feedback from the preventive medicine sector can decrease their incentives to report. Timely reporting was seen in hospitals with close links to the preventive medicine sector and regular two-way communication. Rapid response from the preventive medicine sector after receiving a report also enhanced the hospital staff's desire to report. <p>Extra difficulties for reporting from rural areas and industrial zones</p> <ul style="list-style-type: none"> Some areas, especially industrial zones, may not report because of the lack of or unclear reporting requirements/enforcement, and fear of economic ramifications. 	<p>Designated 24/7 focal points in the preventive medicine sector can facilitate rapid response.</p> <ul style="list-style-type: none"> Focal points assigned in the preventive medicine sector to receive reports from hospitals can facilitate rapid public health responses. It is ideal to appoint backup focal points when focal points are not available so hospitals can report 24/7. <p>Rapid response from the preventive medicine sector can build trust and a collaborative relationship between the two sectors.</p> <ul style="list-style-type: none"> Rapid response is not possible unless the preventive medicine sector is informed of possible public health events in a timely manner. However, once reports are received, rapid response from the preventive medicine sector can also help hospital staff to see the value in timely reporting, thus improving their attitude and cooperation towards reporting.

information with provincial preventive medicine centres. So I think we should have a system in the future. I support this idea.”

Furthermore, no legal process is in place to mandate reporting. In non-residential industrial zones where there are only enterprises, manufacturers and companies producing industrial products and services, some companies reportedly tried to hide disease outbreaks among their employees due to the potential economic impact. Respondents reported that companies do not see it as their responsibility to report to the health authority, as explained by one PMC staff:

“The Department of Health at the provincial level needs to inform all companies to report infectious diseases to them. They need to inform our disease control department. They might hide an unusual outbreak [or] ignore it because they are afraid the media will announce the disease. We only [know] after they bring their family member to the hospital for treatment.”

Theme 2 – An enabling environment is necessary for timely reporting and response.

Hospital staff described several factors in their work environment that promote timely reporting.

1. **Supportive leadership.** In hospitals with supportive leadership who believed in the value of reporting, timely reporting was not an issue. However, in hospitals with strict hierarchical reporting structures, staff may be punished, as one doctor explained:

“In case I report to the planning department without informing our head of department, the hospital director might ask, ‘Oh, what happened, does the head of the department know?’, and if he didn’t know, I am in trouble.”

2. **Availability of internal procedures to guide reporting.** Limited guidance regarding the reporting process can create confusion among hospital staff. In hospitals with internal procedures, reporting was better implemented, as one doctor described:

“If I find an unusual case, first, we will discuss within our department. Then, I will report to the head of our department to confirm the case is unusual and requires further reporting. If it is, we will report to the leader who is in charge of that shift, or report to the planning department so that they can inform systematically.”

3. **Good personal relationships between hospitals and PMCs.** In provinces where there were good personal relationships between hospitals and PMCs, we saw enhanced crosstalk and event reporting. As one PMC staff explained:

“The hospital often calls me if there is something unusual, no matter if it’s during or after working hours. They call me often; it is not under any system yet. ... If something happens, we have to get a sample, so we send a person there straight away to get a sample. Then we will investigate the situation, perform tests quickly, and help them as soon as possible. After investigating at the hospital, we have to investigate the community as well.”

4. **Assigned focal points at hospitals and PMCs to facilitate rapid information exchange.** One key factor of success for prompt notification of unusual events has been assigning focal points at hospitals and PMCs. As one hospital staff mentioned:

“One person at PMC is assigned to take care of each hospital or area. This is one favourable factor. They have an administrative landline and mobile to contact when they need. It’s important to have the responsible person to inform. We can report to the leader later. It’s quicker to inform the preventive medicine sector.”

Theme 3 – Potential benefits exist for the curative sector to work with the preventive medicine sector.

Hospital staff reported several potential benefits or factors that could prompt them or encourage them to

report unusual events and work with the preventive medicine sector.

- 1. Outbreak response and containment.** One incentive to work with the preventive medicine sector is the support provided by PMCs during outbreaks. By informing PMCs of suspected outbreaks, hospitals are more likely to experience a timely response and outbreak containment, reducing the burden on hospitals. As one doctor explained:

“It is necessary to have prompt and quick actions to facilitate timely medical consultation and exams for more effective treatments. This would help the occurrence of outbreaks that we could prevent. We can then have a prompt response when an outbreak occurs.”

- 2. Knowledge of the local outbreak situation can increase doctors’ awareness and improve diagnosis, treatment and care.** Knowing the epidemiological situation may help doctors in their clinical practice; however, reporting is often unidirectional, with no or limited feedback received after reporting. The same doctor summed up the reporting direction with PMC in one sentence:

“We only report to them; we do not receive feedback from them.”

- 3. Laboratory confirmation by the preventive medicine network.** Some doctors noted that confirmatory laboratory results help with diagnosis and treatment, and provide external feedback to hone clinical skills. Since hospital laboratory capacities are limited, clinicians benefit from PMC-facilitated laboratory testing through their laboratory network. One doctor explained:

“We are clinical doctors; we want to have experience in diagnosis and treatment. We want to know how accurate our diagnoses are.”

However, laboratory testing in the preventive medicine sector is mainly for surveillance purposes. For diagnostic testing, long delays in receiving results preclude their use in patient diagnosis or treatment. Another doctor said:

“The preventive medicine centre delays the release of test results. I don’t know the reasons why, but they provide results so late that the patients have already been discharged. As a treating doctor, it’s difficult to treat a patient without having a confirmatory diagnosis.”

Theme 4 – Health-care providers face multiple challenges to timely reporting.

Hospital staff reported several challenges that prohibited timely event reporting from the curative sector.

- 1. Reporting is not perceived to be the responsibility of hospital staff.** Many doctors believe their focus should be on treatment and do not perceive reporting to be the task of the curative sector. Some doctors also think they are too busy to do reporting and are not familiar with reporting tasks. One doctor summed it up:

“It’s more appropriate to ask the preventive medicine sector to do reports.”

- 2. Hospital staff do not see the value of reporting.** Many doctors do not see the value or importance of reporting and how it can benefit them. Therefore, they do not prioritize the task of reporting. One doctor explained:

“We have to do all different things; we don’t report straight away if we have too many things.”

- 3. No guidance or formal mechanisms in place.** In the absence of national guidance and formal mechanisms, some hospitals have opted to have their own internal reporting procedure. This may require first getting approval by the Department of Planning before reporting to the preventive sector, which can delay timely reporting of an unusual event. As one hospital staff described:

“We collect cases every day and report to the hospital leaders before 7 PM. At the department level, we need to make a weekly report to send to the planning department; the planning department is in charge of sending it

to the provincial department of health and the preventive medicine centre. They also check if the report is correct.”

- 4. Hesitancy to report unless laboratory confirmation is available.** Many doctors have a fear of being wrong or judged if a reported case turned out to be “not unusual”. Consequently, many doctors only want to report when laboratory confirmation is available. As one doctor explained:

“If later, after we’ve reported, the department of health finds out that the disease is just a normal or a common case, we are afraid that they will turn around and ask us why we could not diagnose an easy case.”

Theme 5 – Extra challenges exist for signal detection and reporting from remote areas and industrial zones.

Hospital and PMC staff reported additional difficulties in remote areas.

- 1. Limited resources and experience.** In remote areas, some clinicians found it difficult to recognize uncommon diseases. There is also a lack of local laboratory facilities; thus, treatment decisions were based solely on clinical judgment. For example, a hospital staff described a case of a patient with Cocksackie virus infection in a remote area who was neither referred to the infectious diseases department nor reported.

“The patient was only 4 months old. The patient had respiratory distress, so it was very hard to categorize. The treatment department said that the patient should be in the neurology department; it doesn’t matter if he has an infectious disease or not. We still face difficulties in categorizing patients, so we did not report.”

Another hospital staff reported a cluster of children with pertussis that was misdiagnosed as leukaemia given their unfamiliarity with the condition.

“There were several kids with the same cough and tests. At that time, I didn’t know what pertussis was like. ... We didn’t think of pertussis because we haven’t seen [cases] for a very long time, so it’s very sudden. ... I didn’t know what to do. I explained to their families that it could be leukaemia, so we sent them to the Provincial General Hospital. The hospital did the same thing and sent them to the National Hematology and Blood Transfusion Hospital in Ha Noi. The doctors in the hospital witnessed the cough after two days; they thought it could be pertussis and treated the patient for pertussis. After that we had more and more similar patients coming.”

- 2. Differences in language and culture.** Other issues such as distance, language barriers and cultural barriers can also hinder early detection and timely reporting. One PMC staff mentioned the need to use law enforcement at times to “force” people who resisted medical care due to cultural reasons to go seek health care.

“We have to use law enforcement and follow the law of infectious diseases. The community did special things for the people who died, so people cannot go inside the houses during the three days after death. No one was allowed to go in. They would say, ‘This is my child, not yours, [and] even if they die, I can just give birth again.’ It’s complicated. So for our people’s health, we have to be strong, determined and do law enforcement. Sometimes we even had to ask [the] police to help in forcing them to go to the hospital for treatment.”

DISCUSSION

We found that hospital and laboratory staff were generally aware of what constituted an “unusual event”. Our study further identified facilitators and barriers to timely reporting. Close relationships between hospitals and PMCs facilitated timely reporting and rapid public health response. In addition, instituting focal points at the hospitals and PMCs further clarified roles and

responsibilities and facilitated the reporting process. Key issues that hindered early detection and timely reporting included clinicians not considering reporting as their role; uncertainty regarding the reporting process; a lengthy approval process for reporting in some hospitals; hesitancy to report before confirmatory diagnostic testing; and challenge in recognizing clusters within the hospital. The one-way reporting process with minimal feedback from the preventive medicine sector also discouraged reporting.

Fostering a “win-win” relationship between health-care and public health systems

A common theme seen in this study and previous studies in other contexts was the need to strengthen the relationship between the curative and preventive medicine sectors to ensure two-way communication.³ Although most studies investigating different ways to motivate reporting were for routine reporting through the indicator-based surveillance (IBS) system, we believe it is also applicable to reporting rare and unusual events through the EBS system.

To facilitate reporting from health-care workers to the public health system, health-care workers also need tangible benefits of working with the public health system. In other words, it is important to foster a “win-win” relationship between health care and public health systems. Some study participants believed that information on national and local outbreaks would help their ability to diagnose and treat their patients. Previous studies have recommended generating a feedback report and ensuring they reach reporters, so they see the value in reporting.^{10–12} Other studies have shown that tailoring feedback to focus on the current outbreaks and other information of interest to medical staff can also encourage reporting.¹³ We also believe this may be an important approach that promotes ownership.

Laboratory services at PMCs may also help physicians at health-care facilities with their clinical practice in the diagnosis of infectious diseases. We did note that depending on the province, some laboratory services in the preventive medicine sector were not able to fulfil the physicians' expectations. We believe streamlining preventive medicine laboratory services could contribute to the strengthening of the working relationship of

the health-care and public health systems, and thus, in turn, promote the early detection of outbreaks and public health events.

Raising awareness on the value of reporting

Many medical professionals in our study did not perceive that reporting events was their responsibility. In addition, they were not fully aware of what, how and when to report, as we have seen in other countries.^{3,10,11,14} Passive attitudes, lack of knowledge regarding reporting requirements and misconceptions regarding the value of reporting seen in our study have been previously observed.^{3,10,11,14,15} Certain beliefs, knowledge and attitudes held by physicians, such as the ones we saw in our study, are associated with underreporting.¹⁵ These findings point to the need to raise awareness of the value of reporting among medical staff.

For some medical professionals, it may be difficult to recognize the importance of a rare event. One possible strategy is to present scenarios and lessons learnt from past outbreaks such as the 2015 Middle East respiratory syndrome outbreak in the Republic of Korea, which dampened economic growth and impacted the reputation of some hospitals. Describing the role of medical professionals in these past outbreaks may help providers embrace their unique position as the guardians at the first line of defence.^{16,17} A previous study has also suggested the use of financial incentives or a penalty system to encourage reporting.¹¹ Different approaches to motivate reporting among medical staff, specifically in Viet Nam, may need to be explored. With a longer vision in mind, a strong sense of ownership and expanded responsibility of their role as reporters may need to be cultivated during the training and sensitization process.

Creating an enabling environment for reporting

Although raising awareness among medical staff may increase their motivation to report, individual motivation depends on an enabling environment that facilitates reporting. In this study, participants expressed a lack of knowledge of the reporting process. Study participants also revealed that the reporting process could be lengthy, given the layers of approval required at many

Table 2. Proposed key interventions to strengthen hospital event-based surveillance system in Viet Nam based on the key findings from the qualitative study conducted in 2016

Overall recommendations			
1. Develop a legal framework, guidelines and SOPs.	2. Promote feedback from the preventive medicine sector and communication within the curative sector.	3. Streamline preventive medicine laboratory services to support signal detection and timely reporting.	4. Build technical capacity in signal detection, reporting and response through training and on-the-job coaching during monitoring visits.
Proposed key interventions			
<ul style="list-style-type: none"> • Develop clear guidelines and SOPs for both hospital internal reporting and reporting to PMCs. • Engage DOH in encouraging collaboration between the curative and preventive medicine sectors. • Review and identify opportunities to improve existing guidelines and SOPs for the preventive medicine sector. • Improve current feedback reporting template and procedure in the preventive medicine sector to promote two-way communication with the curative sector. • Pilot-test guidelines and SOPs in selected provinces to inform the development and implementation of the national EBS guidelines in Viet Nam. 	<ul style="list-style-type: none"> • Strengthen and implement regular feedback reporting from the preventive medicine sector to the curative sector to demonstrate how reported data are used and to inform disease trends in the locality. • Promote a close relationship and communication between the two sectors by assigning a dedicated focal person and backup focal persons at the hospital (responsible for reporting) and at the PMC (responsible for receiving and responding to reports). • Encourage regular sharing of information on unusual cases in hospitals to identify clusters within the hospital in a timely manner, including during morning meetings, through local e-mail networks or by phone. 	<ul style="list-style-type: none"> • Streamline preventive medicine laboratory services, including defining their roles of referring specimens through their preventive medicine laboratory networks, and clarify their roles to health-care workers. • Review laboratory result feedback systems and identify ways to increase turnaround time to incentivize medical practitioners to send specimens for diagnostic confirmation. • Encourage a proactive follow-up of laboratory results and feedback. • Identify ways for preventive medicine laboratories to provide regular updates to the hospitals regarding existing and new services available and feasible turnaround times. • Review existing signals to be reported by the laboratory to increase the sensitivity of signal detection at the hospital laboratories. 	<ul style="list-style-type: none"> • Conduct training and refresher training for hospital and laboratory staff to sensitize them on the concepts of EBS, list of potential signals and reporting procedures. • Include senior leadership in the training for hospital staff to encourage direct and timely reporting. • Train surveillance staff in the preventive medicine sector on SOPs and epidemiological analysis to improve data analysis skills, and provide technical support as needed to PPMC to generate feedback reports. • Implement periodic monitoring to provide on-the-job coaching to staff to increase their technical capacity in signal detection and reporting at the hospitals. • Conduct additional monitoring visits and on-the-job coaching at hospitals and PMCs for rural areas and industrial zones.

DOH, Department of Health; EBS, event-based surveillance system; PMC, preventive medicine centre; PPMC, Provincial Preventive Medicine Centre; SOP, standard operating procedure.

hospitals. Hospitals that empower their staff to report immediately to the PMC are the minority. We believe that creating an enabling environment is critical for the success of an EBS system. An enabling environment includes clear guidelines that designate a responsible focal person, describe the roles and responsibilities and lines of reporting, and establish goals and expectations.

In addition, staff should be provided with the means needed to report and have leadership support to ensure that the responsible person has protected time allocated for reporting activities. Finally, training of new staff and regular re-training of existing staff may be an important way to continually sensitize the medical staff.¹⁸

Promoting a simple and flexible reporting process

Developing a process for event reporting that is appropriate for all 63 provinces in Viet Nam is challenging, given their differences in resources and workforce capacity. Therefore, keeping the system flexible, and having the ability to tailor the system to the capability of each province, may be one of the key factors for success. Previous studies have shown that the simplicity of the reporting system is one of the most important factors to encourage reporting from clinicians.^{10,11,13,14}

Limitations

The findings in this study represent only the views of the purposefully selected hospital and preventive medicine staff in four provinces in Viet Nam; therefore, the generalizability of the findings may be limited. In addition, this was an exploratory study carried out for public health practice, which we focused on obtaining in-depth insights and synthesizing the information from all sources into key themes that were actionable instead of a comparative analysis study. Therefore, we did not present on the differences between the provinces, or the responses from key informants who were in different roles or at various levels of the organization. For the same reasons, a certain level of flexibility was required in sample selection; depending on facility size and availability of staff, in rare occasions, focus group discussions also had fewer than five participants.

CONCLUSIONS

In this study, we showed that an enabling environment is critical for timely event reporting. This encompasses multiple components such as having leadership support, a good relationship between the two sectors, clear guidance on the process of reporting, and focal points to streamline reporting. However, we believe the fundamental key to success for both IBS and EBS is cultivating a “win-win” relationship between the curative and preventive medicine sectors, where both sides can see the value and benefits of this synergistic collaboration. Moving forward, as outlined in [Table 2](#), we believe there are priority actions that can be taken to strengthen this important relationship further and ultimately to improve the overall health security system in Viet Nam.

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Conflicts of interest

The authors have no competing interests or financial conflicts.

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A programme to treat chronic hepatitis B in Kiribati: progress and challenges

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Problem: Over 290 million people worldwide suffer from chronic hepatitis B (CHB), with the highest prevalence in the Pacific islands. Mortality attributable to this disease exceeds that from HIV, tuberculosis and malaria combined in this region.

Context: CHB is a major health problem in the Pacific island nation of Kiribati. Medical care is complicated by vast expanses of ocean separating population centres in its constituent islands. Birth-dose hepatitis B immunization rates need improvement. High rates of obesity, metabolic syndrome, and co-infection with hepatitis B and hepatitis D in Kiribati make treatment less effective. Staff allocation, training and retention are difficult. Limited infrastructure creates challenges in training, communications, laboratory testing and record-keeping.

Action: We have established a CHB treatment programme in Kiribati based on World Health Organization (WHO) guidelines and local needs. It includes direct patient care; laboratory, radiology and pharmacy support; public education; training; and data management. Thousands of individuals have been screened, and 845 hepatitis B-positive patients have had blood sent to Australia for molecular testing. Patient education pamphlets, medical training programmes and treatment protocols have been developed. Seventy-nine patients have started treatment. Regular onsite visits by technical experts are scheduled throughout the year.

Lessons learnt and discussion: This is the first national CHB treatment programme established in the Pacific islands region. Unique challenges exist in Kiribati, as they do in each nation affected by CHB. Close engagement with local partners, knowledge of the barriers involved, flexibility, advocacy, and support from WHO and volunteer technical experts are key attributes of a successful treatment programme.

Chronic hepatitis B (CHB) is one of the leading causes of morbidity and mortality in the world. An estimated 2 billion people globally have been infected with hepatitis B sometime during their lives, and almost 300 million people suffer from CHB.¹ Nearly 900 000 chronically infected patients die each year, mainly due to liver failure, complications of cirrhosis such as variceal bleeding, and hepatocellular carcinoma.² A strategy to eliminate viral hepatitis as a public health threat by 2030 was adopted by the World Health Assembly in 2016.³ Low- and middle-income countries (LMICs) face a particularly daunting task and are unlikely to reach this goal without significant effort, support and funding.

Highly effective antiviral treatment for CHB has been available for over 20 years, but it remains inaccessible in

most resource-poor areas. Barriers include the high cost of drugs, the need for lifelong therapy in most patients (unlike hepatitis C therapy), the lack of infrastructure such as laboratory facilities, and a dearth of trained medical personnel. Furthermore, HIV, malaria and tuberculosis (TB) programmes compete for available resources, both global and domestic.

Pacific island nations have among the highest prevalence of hepatitis B infection in the world, in some places in excess of 20%.⁴ The human suffering and economic costs associated with this disease are considerable and often underestimated. One of the first CHB treatment programmes in the Pacific islands was facilitated beginning in 2018 through a collaboration among the Kiribati Ministry of Health and Medical Services (MHMS), the World Health Organization (WHO), the Victorian Infectious

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Disease Reference Laboratory (VIDRL), and Hepatitis B Free (an Australian nongovernmental organization, known as HBF) and its partners, with the support of Australian Aid. We describe the progress made and the barriers encountered and addressed, and conclude that successful CHB treatment programmes in Pacific island countries, such as Kiribati, are challenging but achievable.

LOCAL CONTEXT

Kiribati is a Pacific island nation of 116 000 people stretching across 3000 km of ocean approximately halfway between Australia and Hawaii. Distances between its islands make accessibility to services challenging. Half of the population lives on the island of South Tarawa. The lack of both arable land and dietary diversity result in high rates of diabetes, hypertension and obesity.⁵

In Kiribati, free health care is provided by MHMS. However, there is a shortage of health-care professionals, with fewer than 0.4 physicians per 1000 population, most of whom practise in South Tarawa.⁶ Tungaru Central Hospital (TCH) on South Tarawa is the central referral facility. Health centres in the outer islands, staffed by nurses who receive additional training, offer primary care, midwifery services and medications. These services are supplemented by outreach clinics from TCH. Traditional medicine is also used, with practitioners providing local remedies and midwifery.⁷

Hospital laboratories performed over 10 000 hepatitis B surface antigen (HBsAg) tests per year between 2012 and 2014, with a seropositivity rate of 14–15%.⁷ Nearly half of HBsAg-positive patients in Kiribati also have detectable hepatitis D virus (HDV) co-infection, which is problematic as co-infected patients are at higher risk for rapid progression to liver failure and have a poor response to antiviral therapy.⁸

ACTION

In Kiribati, alarmingly high rates of CHB motivated the inclusion of antiviral treatment into a national hepatitis strategy. Based on an assessment by the WHO Regional Office for the Western Pacific, MHMS, with assistance from HBF and VIDRL, began developing a treatment programme.

HBF is composed of volunteer health professionals and non-medical personnel who have worked in the Pacific and Asia since 2013. It has addressed gaps in hepatitis B care through prevention, public education and advocacy initiatives; health-care worker training; and test-and-treat programmes in underserved communities. VIDRL is a public health and reference laboratory in Melbourne, Australia, that provides molecular diagnostic testing and local laboratory systems support. It holds the designation of a WHO Collaborating Centre for Viral Hepatitis and is the Regional Reference Laboratory for hepatitis B and D.

A memorandum of understanding to begin a treatment programme was signed by MHMS, TCH and HBF in 2017. Using experience gained from the development of CHB programmes in other countries, HBF developed a treatment protocol, and donations to provide medications were secured. Shortly thereafter, an import license was issued, and the antiviral medication tenofovir disoproxil fumarate (TDF) arrived in country. In January 2018, the first cohort of patients was examined and assessed for treatment eligibility, and staff were trained. In March 2018, the first patients began treatment. Within one year, 79 patients in Kiribati were receiving TDF, and hepatitis B and D viral load testing was performed on over 800 CHB-positive individuals.

Treatment protocols in Kiribati are based on WHO guidelines.⁹ A culturally appropriate booklet that outlines the causes, complications, transmission and treatment of hepatitis B was developed jointly with health-care workers and is given to patients. All patients identified as HBsAg-positive are invited for further assessment at TCH. A history and physical examination are followed by laboratory testing, ultrasound evaluation and transient elastography. The latter is facilitated through equipment hand-carried by HBF volunteers during regular visits. Blood samples are batched for shipment to VIDRL for molecular diagnostics.

Patients with cirrhosis are prioritized for treatment, following identification by laboratory testing, a history and a physical exam (jaundice, variceal bleeding, encephalopathy), and transient elastography >11.0 kPa, or ultrasound. Other priority groups include older patients with elevated alanine aminotransferase

(ALT) and high viral load, patients with a strong family of liver cancer, and health-care workers.

Treatment candidates are counselled on their suitability for therapy versus monitoring. Those qualifying for treatment are asked to sign an informed-consent document and an agreement that states their intention to comply with the programme requirements. Generally, patients are given a 30-day supply of TDF at a time for the first several months of treatment. However, factors that affect adherence such as remote location, family hardship, age or physical disability may require dispensing several months' worth of medication at once. Follow-up visits with laboratory and radiographic monitoring are scheduled according to WHO guidelines.⁹

The baseline characteristics of patients on treatment in Kiribati are shown in **Table 1**. Of note is male predominance (over two thirds), obesity (median body mass index of 31.2), elevated liver enzymes, high rates of co-infection with HDV (46.3%), and a preponderance of patients with cirrhosis, 56 (70.9%), by transient elastography.

PROGRAMME CHALLENGES

Initial successes have been tempered by several challenges, notably staff shortages. High health worker turnover disrupts programme continuity and necessitates frequent retraining. There is a paucity of medical staff, and most doctors are required to attend to multiple duties, which places them under great pressure at work. Regular visits by HBF volunteers are required to support the programme, but entry is difficult due to infrequent and expensive air service. As local medical staff also work on remote islands, attendance during training visits is not always possible. Limited Internet bandwidth has impacted training via teleconference.

Although over 800 patients have had viral load testing, many have yet to be evaluated in a clinic. Patient recall is difficult due to staff and clinic limitations, and many patients lack a mailing address. Patients living on the outer islands must journey by boat to attend clinics at TCH and may lack accommodations. Radio and social media are often used to disseminate clinic schedules and appointments due to lack of other forms of communication, contributing to inconsistent attendance and difficulty maintaining confidentiality.

Patient non-adherence with clinic visits is common. Local physicians note that patients will sometimes stop long-term medications due to family pressures, consultations with local traditional healers or lack of confidence in the local health system.

High rates of obesity complicate patient treatment. Fibrosis from metabolic syndrome and the hepatitis B virus (HBV) mono-infection or HBV/HDV co-infection constitute synergistic risks for the progression of liver disease. Dietary change is difficult given a dearth of arable land, low per capita income¹⁰ and a lack of healthy food choices.

Recent availability of a hepatitis B cartridge for the GeneXpert (Cepheid, Sunnyvale, California, United States of America) machine has made routine access to viral load testing possible, but this has not been introduced in Kiribati. TCH has such technology for HIV and TB testing, but consumable costs, trained personnel, the need for safe disposal and allocated machine time to perform hepatitis B testing are problematic.

Medical documentation is challenging. Records for patients on TDF must be compiled from several different sources, including paper-based clinic records, laboratory results from Kiribati and VIDRL, and pharmacies. Overburdening of local staff and competing priorities delay data entry, making programme oversight challenging.

LESSONS LEARNT AND INTERVENTIONS

Sensitivity to the local context has resulted in changes in programme strategies. A volunteer gastroenterologist and project manager from HBF have been designated as coordinators to help provide continuity in the programme. They make regular visits (two to three times a year) that have been extended to a week or more to permit additional training time and visits to outlying islands. Weekly or biweekly teleconferences are scheduled so that they do not disrupt local clinical requirements. A local programme coordinator has been hired to provide physician support and to ensure patients are scheduled at times convenient for them, with appropriate follow-up. Nutritional interventions and educational pamphlets have been developed and distributed to address misconceptions about hepatitis and lessen the stigma associated with it. The provision

Table 1. Characteristics of patients on HBV antiviral treatment in Kiribati, 2018–2019

Number of people on treatment	79
Age in years, median (range)	36.2 (22–58)
Sex, number (%)	54 (68.3%) Male 25 (31.7%) Female
BMI, mean (standard deviation)	31.2 (\pm 5.9)
Transient elastography (kPa), median (range)	15.2 (4.8–74.8)
APRI score, [†] median (range)	2.58 (0.18–33.1)
FIB4 score, [‡] median (range)	3.22 (0.22–29.53)
AST (U/L), median (range)	61.5 (3–1934)
HBV viral load (IU/mL) in patients tested, median (range)	366 (15–3.25 \times 10 ⁸)
Proportion HBsAg-positive with detectable HDV RNA (%)	46.3%

[†] APRI (AST to Platelet Ratio Index) Score = [(AST/ULN AST) \times 100]/Platelets (109/L)]

[‡] FIB4 (Fibrosis-4) Score = (Age \times AST)/(Platelets (109/L) \times (sqrt (ALT)))

of laboratory testing (HDV antibody and both HBV and HDV viral load) by VIDRL is a temporary fix, so there is a focus on laboratory capacity-building, training and skills transfer. Input from local medical personnel has guided the development of data management tools, such as clinical spreadsheets, that greatly improve the efficiency of patient encounters, are much simpler to learn, and minimize the time required to maintain and analyse data.

Co-infection with hepatitis B and D remains a significant problem since there is not yet an effective treatment. Currently, interferon is the only recommended therapy, but it is not practical to use in this setting. There are promising new drugs on the horizon, but they are still undergoing clinical trials.¹¹ Prevention is by far the best strategy to prevent the co-infection with hepatitis B and D. To this end, birth-dose hepatitis B immunization is being prioritized, and a new national plan to treat expectant mothers who have CHB and high viral loads has been approved. The latter strategy has been found to be effective in the prevention of mother-to-child transmission of hepatitis B in other settings.¹² Given the resource limitations of the country, funding to support this programme to reduce the rate of vertical transmission was sought and has been secured.

DISCUSSION

Hepatitis B causes considerable morbidity, mortality and economic loss in the Pacific islands. Although there is not a cure, its effects can be ameliorated by the implementation of proven prevention strategies and national treatment programmes using effective antiviral therapy for those already infected. In the short time since implementation of the treatment programme in Kiribati, patients who remain adherent to therapy have reported an overall improvement in well-being. Progress has been made but has been hampered by the problems described above, each of which is being actively addressed. Remaining cognizant of the local needs, we are optimistic for an acceleration in patient recruitment and treatment.

Kiribati has embraced the need to finally address CHB. There is considerable appetite to establish similar programmes in other Pacific island nations. Working with VIDRL and WHO, HBF is currently providing medications, laboratory support and training to jump-start pilot treatment programmes in other Pacific island countries such as Fiji, Tonga and Vanuatu. Discussions are also under way to implement treatment programmes to interrupt maternal-to-child transmission in these countries.

Lack of infrastructure and training, co-infections, geographic considerations, limited public knowledge and social norms create problems that are likely shared in other low- and middle-income settings, particularly small islands. Nevertheless, there is no one-size-fits-all solution for every country. Treatment programme development has required patience, close engagement with local partners, cultural sensitivities, a significant time investment and attention to the needs of the population served. Programme administrators need to “get their hands dirty” and observe first-hand the work being done on the front lines. With innovative strategies to deliver services, testing and effective treatment of CHB can be provided to LMICs such as Kiribati.

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