

Approaches towards fighting the COVID-19 pandemic in Vietnam

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A thesis submitted for the degree of Master of Philosophy in
Applied Epidemiology of the Australian National University

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Statement of authorship

I herewith assure my authorship of the Master of Applied Epidemiology thesis submitted to the Research School of Population Health, the Australian National University entitled “**Approaches towards fighting the COVID-19 pandemic in Vietnam**”. I certified that all work contained in this thesis has not been and will not be submitted to or published in any other publication before its appearance in the ANU library. All persons who have been made contributions to the work reported in this thesis are named in the Acknowledgement.

Ngoc-Anh Hoang

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Thesis Guide

My placement during the Master of Applied Epidemiology (MAE) program was in the Department of Epidemiology of the National Institute of Hygiene and Epidemiology, Hanoi, Vietnam from February 2020 to October 2021. During this time, I conducted four main projects to meet the MAE requirements. In addition, I contributed to 10 peer-reviewed publications, another one advanced manuscript, which have been submitted for publication, and five presentations at international conferences.

This thesis contains seven chapters dedicated to my work during the COVID-19 epidemic in Vietnam during my MAE fellowship. **Chapter 1** presents an overview of the thesis, providing an overview of all projects and how they relate to MAE requirements. **Chapter 2** discusses the MAE requirement for outbreak investigation. I provide the investigation of the first COVID-19 outbreak in a healthcare setting in Vietnam. I also discuss the application and usefulness of Social Network Analysis in curbing the COVID-19 transmission in the hospital setting. **Chapter 3** discusses the analysis of the public health dataset using the contact tracing data of more than 2,000 passengers on flights with at least one COVID-19 confirmed case during the beginning of the COVID-19 pandemic in Vietnam. **Chapter 4** discuss the evaluation of the COVID-19 surveillance system at Points of Entry. This project used data from a country-led workshop that was designed based on WHO's guidance for Intra-Action Review during the COVID-19 pandemic. **Chapter 5** includes an epidemiological study about the mental health problem among community health workers in Vietnam during COVID-19 pandemic. **Chapter 6** includes a systematic review to assess the robustness of COVID-19 efficacy vaccines trial results. **Chapter 7** includes materials for a lay audience report, lessons from the field, teaching from the field, and a side project.

Chapter 1 – Introduction

This chapter provides an overview of my thesis, describes all my projects and how they relate to MAE requirements, conference presentation, and publications that I have been involved in during my MAE.

Chapter 2 – Investigation outbreak: *Investigating COVID-19 transmission in a tertiary hospital in Hanoi, Vietnam using social network analysis*

The first main project covers the investigation of the COVID-19 outbreak in the largest hospital in Vietnam with the innovative idea of applying social network analysis to investigate

transmission. In particular, I applied network analysis to explore COVID-19 transmission dynamics using contact tracing data. The project shows the importance of non-clinical workers (in particular ancillary support staff) in driving transmission dynamics, a part of the health work force that is often neglected during outbreak containment efforts in hospitals. It also highlights the potential of social network analysis as a method for field epidemiologists to understand SARS-CoV-2 infection patterns in close settings like hospitals.

Chapter 3 – Analyze a public health dataset: *Timeliness of contact tracing among flight passengers during the COVID-19 epidemic in Vietnam*

The second main part applies the epidemiological data analysis methods to real-life data from contact tracing 2,228 passengers on flights with COVID-19 confirmed cases during March 2020, using descriptive analyses, regression models, and survival analyses. My analysis showed the importance of mandatory SARS-CoV-2 testing at arrival to reduce contact tracing duration, and why this testing policy should be considered as an integrated screening tool for flight passengers from high-risk areas when entering low-transmission settings.

Chapter 4 – Evaluate a surveillance system: *Evaluating epidemic preparedness and response to COVID-19: A nation-wide multi-sectorial Intra-Action Review of the Points of Entry surveillance system in Vietnam, January to September 2020*

The third main part provides a fresh eye on the potential of qualitative data to improve COVID-19 surveillance. Data originate from an Intra-Action Review that captured the strengths and challenges of, and provides recommendations to improve the national surveillance system for COVID-19 at Points of Entry in Vietnam. This country-led review followed the WHO's guidance for Intra-Action Review methods with the aim to improve the COVID-19 responses worldwide.

Chapter 5 – Design an epidemiological project: *Assessing the mental effects of COVID-19 related work on depression among community health workers in Vietnam*

The fourth main part covers all crucial steps of designing and conducting an epidemiological study. This part includes not only the scientific advanced manuscript being under revision by Human Resources for Health journal but also shows hands-on experiences throughout conducting the study. It presents important messages to reduce the impact of increased depression symptoms among Vietnamese community health workers during the 2021

Tet holiday COVID-19 outbreak compared to before the pandemic, and reflects on the pervasive influence of COVID-19 on non-clinical front-line healthcare workers.

Chapter 6 – Literature review: *Assessing the robustness of SARS-CoV-2 vaccine efficacy trials: systematic review and meta-analysis*

The project provides an advanced manuscript on assessing the robustness of COVID-19 efficacy vaccines trial results using the fragility score methodology i.e., Fragility Index – FI and Fragility Quotient – FQ. This work highlight the message that COVID-19 vaccine efficacy results are overall very robust though both FI and FQ were in considerable variation. It suggests the need for careful contextualization of results, particularly for trials with small sample sizes and high participants lost to follow-up. With this evidence, I recommend the inclusion of FI and FQ in the Cochrane Handbook for Systematic Reviews of Interventions as an additional measure to improve the interpretation of trial results, in particular for interventions as pivotal as SARS-CoV-2 vaccines in the midst of a global pandemic.

Chapter 7 – Other MAE requirements

The thesis also includes materials of a **Lay Audience Report** on the COVID-19 vaccine tracker updates in Vietnam. Furthermore, it covers the materials of building an online questionnaire on KoBoToolbox for both requirements on the **Lesson from the Field** and **Teaching Experience**. I also include a publication that originated from a side project on the re-positive testing, clinical evolution, and clearance of COVID-19 infection in Vietnam, which was published in the Western Pacific Surveillance and Response journal.

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Chapter 1. Introduction

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List of Abbreviations – Chapter 1

ANU	Australian National University
BCG	Bacillus Calmette–Guérin
COVID-19	Coronavirus 2019
MAE	Master of Applied Epidemiology
NIHE	National Institute of Hygiene and Epidemiology
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
Td	Tetanus-diphtheria vaccine

Introduction to field placement

I began my field placement on 09 March 2020 at the Department of Epidemiology, the National Institute of Hygiene and Epidemiology (NIHE), Hanoi, Vietnam. My field supervisor (Dr. Pham Quang Thai) is a member of the National Steering Committee of COVID-19 Prevention and Response. Very early in my placement, he introduced me to the Rapid Response Team in the Committee, where I spent most of 2020 working in. It was considered my second workplace, apart from NIHE, and where many projects in this thesis were established and conducted.

NIHE was established in 1925 as the first place for studying and developing new vaccines in Vietnam. NIHE is monitored by General Department of Preventative Medicine and Ministry of Health. The institute studies epidemiology, microbiology, immunology, and molecular biology; developed new vaccines and probiotics. This institute have been leading many national programs and provided consultants to the Ministry of Health on the roadmap to prevent and eradicate re-emerging and emerging infectious diseases as well as neglected ones. NIHE also lead in scientific work, postgraduate training, and scale-up the public health network in the national scope.

The Rapid Response Team's primary functions are to provide support for community health workers in contract tracing, data analysis, and epidemic prediction through statistical models. Data for my two projects in Chapter 2 – Investigate an acute public health problem and Chapter 3 - Analysis of a public health dataset was extracted from my work during my time in this team. Through collecting data for my chapter, I also contributed to write COVID-19 daily report to the Ministry of Health.

Summary of field placement activities

NIHE provides an academic and competitive environment for interns to improve their academic career. During my time there, I have learned many practical lessons on how Vietnam's health system operates, especially the interdisciplinary nature of the system. This procedure reflects the culture of multiagency workforce dynamics. These lessons are invaluable for my future career, especially when working in the field.

At NIHE, my field supervisor assigned me to some routine tasks to increase my connection with other people and colleagues in the Department. I was mainly responsible for inputting data for Influenza-like illness/severe acute respiratory infections (ILI/SARI) notifiable system from six Northern provincial hospitals. I also complied and cleaned data for

the COVID-19 dashboard, which included epidemiological, laboratory, and clinical data of COVID-19 cases across Vietnam.

In March 2020, when I came back to Vietnam after completing the first course block at the Australian National University (ANU), my field supervisor introduced me to the Rapid Response Team, the National Steering Committee of COVID-19 Prevention and Control. My cohort colleague – Ms. Ha-Linh Quach and I were in charge of contact tracing, data management, and training activities. We had many opportunities to collaborate with the General Department of Preventive Medicine, the Ministry of Health, the Ministry of Science and Technology, Hanoi Medical University, Hanoi University of Public Health, Hanoi University of Science and Technology, and private IT companies. For contact tracing, I was responsible for interviewing COVID-19 cases and their close contacts. I provided this information for local health officers and community health workers to trace and quarantine. We also contributed to input and clean data for the national epidemiological COVID-19 database. From these hand-on experiences, we helped develop data entry and data management protocols. This database has been used to generate a COVID-19 situation report for the National Steering Committee of COVID-19 Prevention and Control. We also contributed to developing guideline for contact tracing among passengers and close contacts of passengers on flights with COVID-19 confirmed cases. The guidance includes many simulation exercises and mock scripts for remotized contact tracing. The Ministry of Health considered it as a practical reference to build the national guideline for contact tracing in Vietnam. We were also in charge of training new volunteers for contact tracing activities, case investigations, and data management.

Summary of MAE requirements

Presented below are the core requirements of the MAE program.

Requirement	Chapter 2	Chapter 3	Chapter 4	Chapter 5	Chapter 6	Chapter 7
Investigate an acute public health problem or threat	✓					
Analyze a public health data set		✓				
Evaluate a surveillance system			✓			
Design and conduct an epidemiological study				✓		
Literature review					✓	
Report to a non-scientific audience						✓
Lesson from the field						✓
Teaching						✓
Advanced manuscript submission to or publication in an international peer-reviewed journal	✓	✓	✓	✓	✓	✓
Conference presentation	✓	✓			✓	

A. Core requirements

1. Investigate an acute public health problem or threat (Chapter 2)

Investigating COVID-19 transmission in a tertiary hospital in Hanoi, Vietnam using social network analysis

2. Analyze a public health data set (Chapter 3)

Timeliness of contact tracing among flight passengers during the COVID-19 epidemic in Vietnam

3. Evaluate a surveillance system (Chapter 4)

Evaluating epidemic preparedness and response to COVID-19: A nation-wide multi-sectorial Intra-Action Review of the Points of Entry surveillance system in Vietnam, January to September 2020

4. Design and conduct an epidemiological study (Chapter 5)

Assessing the mental effects of COVID-19 related work on depression among community health workers in Vietnam

B. Other requirements

1. Literature review (Chapter 6)

Assessing the robustness of SARS-CoV-2 vaccine efficacy trials: systematic review and meta-analysis

2. Report to a non-scientific audience (Chapter 7)

Hoang NA, Pham QT (2021) “**COVID-19 Vaccine Tracker Updates: where is Vietnam in the technological flow of vaccine evolution?**” (Original title in Vietnamese: “Cập nhật tình hình vắc xin COVID-19 trên thế giới, Việt Nam ở đâu trong dòng chảy công nghệ vắc xin?”), *Suc Khoe & Doi Song Newspaper* – Official press representatives of Vietnam Ministry of Health, Vol 3, Page 10, 5 Jan 2021. Available at: [Việt Nam ở đâu trong dòng chảy công nghệ vắc xin COVID-19? \(suckhoedoisong.vn\)](http://suckhoedoisong.vn).

3. Publications to international peer-reviewed journals (Chapter 2, 3, 4, 5, 7)

- Hoang NA, Van Hoang, N., Quach, H. L., Nguyen, K. C., Duong, L. H., Pham, T. Q.^{*}, & Vogt F^{*}. (2022). **Assessing the mental effects of COVID-19-related work on depression among community health workers in Vietnam**. *Human resources for health*, 20(1), 64. <https://doi.org/10.1186/s12960-022-00760-x>.
- Hoang NA[#], Pham QT[#], Quach HL, Hoang VN, Nguyen CK, Dang DA^{*} & Vogt F^{*}. (2022). **Investigating COVID-19 transmission in a tertiary hospital in Hanoi, Vietnam using social network analysis**. *Tropical medicine & international health: TM & IH*, 10.1111/tmi.13822. Advance online publication. <https://doi.org/10.1111/tmi.13822>
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- Quach HL[#], & Hoang NA[#]. (2020). COVID-19 in Vietnam: **A lesson of pre-preparation.** *Journal of clinical virology: the official publication of the Pan American Society for Clinical Virology*, 127, 104379. <https://doi.org/10.1016/j.jcv.2020.104379>

[#] (shared) first authorship

^{*} (shared) last authorship

[^] (shared) corresponding authorship

4. Conference presentation (Chapter 2, 3, 6)

- (accepted as oral presentation) Hoang NA, Quach HL, Phan QT, Vogt F. “**Assessing the robustness of SARS-CoV-2 vaccine trial results: systematic review and meta-analysis**”. Oral presentation, the European Scientific Conference on Applied Infectious Disease Epidemiology (ESCAIDE) (hybrid conference), 23-25 November 2022.
- Hoang NA, Quach HL, Pham QT, Nguyen CK, Vogt F. “**Investigating COVID-19 transmission in Vietnam's tertiary hospital using social network analysis**”. Oral presentation, Bi-Regional FETP COVID-19 Online Conference (virtual conference), 09-12 November 2020 (*Awarded Second Place Outstanding Presentation*).
- Hoang NA, Quach HL, Pham QT, Nguyen CK, Vogt F. “**Investigating COVID-19 transmission in Vietnam's tertiary hospital using social network analysis**”. Video

presentation, Special Edition - Australasian COVID-19 Virtual Conference (virtual conference), 09 December 2020.

- Hoang NA, Quach HL, Pham QT, Nguyen CK, Vogt F. “**Timeliness of contact tracing among flight passengers during the COVID-19 epidemic in Vietnam**”. Video presentation, The South East Asia and Western Pacific Bi-regional FETP Videoconference, 07-08 September 2021.
- Hoang NA, Quach HL, Pham QT, Nguyen CK, Vogt F. “**Timeliness of contact tracing among flight passengers during the COVID-19 epidemic in Vietnam**”. Oral presentation, The 10th Bi-regional TEPHINET Scientific Conference, 01-05 November 2021.

5. Teaching (Chapter 7)

- **Lesson from the field:** “How to build an online questionnaire on KoBoToolbox”
- **Teaching experience:** “How to build an online questionnaire on KoBoToolbox”

6. Side project (Chapter 7)

Re-positive testing, clinical evolution and clearance of infection: results from COVID-19 cases in isolation in Vietnam

7. Coursework

- POPH8915 (Outbreak Investigation): Semester 1, 2020
- POPH8917 (Public Health Surveillance): Semester 1, 2020
- POPH8913 (Analysis of Public Health Data): Semester 2, 2020
- POPH8916 (Issues in Applied Epidemiology): Semester 1, 2021
- POPH8914 (Methods in Applied Epidemiology): Semester 1, 2021

Other activities

I was included in some COVID-19 epidemiological programs that NIHE was responsible for in 2020-2021. I was also assigned to other immunization projects within the Department.

Project 1: Research Officer at National Immunization Program

I partook in two programs with the Office of National Immunization Program in Northern Region of Vietnam within the Department of Epidemiology, NIHE. My field supervisor involved me in these projects to improve practical experience as well as my relationship with other colleagues in the Department. One project was a Td-vaccination campaign for children under 7-year-old in Yen Bai province, Vietnam. It focused on assessing immune response, implementation process, and post-Td-vaccination response in vaccinated people. The other project assessed the postpartum vaccination system for hepatitis B vaccine in six northern hospitals in Vietnam. I was in charge of literature review and grant proposal. I also contributed to translating protocols from Vietnamese to English and collecting data in Td project.

Project 2: Online Crisis Simulation Workshop

I enrolled myself in the Online Crisis Simulation Workshop on 18-19 March 2021. This workshop was held by Global Health Innovation Policy Program (GHIPP) and USAID. The workshop included participants with diverse backgrounds, from regional affairs, international relations to health and discussed global development and decisions in light of the ongoing COVID-19 pandemic.

Project 3: Capacity building training in Vaccine Economics

This course was held by John Hopkins Bloomberg School of Public Health and Faculty of Pharmacy, Mahidol University from 17 October to 13 December 2020. I have completed 14 sessions, assignments, and exercise simulations for the health economic on COVID-19 vaccine topic under the supervisor of Dr. David Bishai from John Hopkins Bloomberg School of Public Health. At the end of the course, I presented a protocol titled: “The willingness to pay for a COVID-19 vaccination: Perspectives of Community Health Workers in Vietnam”.

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Chapter 3. Analysis of a public health dataset

*Timeliness of contact tracing
among flight passengers during the COVID-19 epidemic in Vietnam*

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List of Abbreviations – Chapter 3

COVID-19	Coronavirus 2019
NIHE	National Institute of Hygiene and Epidemiology
NSCCPC	the National Steering Committee for COVID-19 Prevention and Control
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
RRT	the Rapid Response Team

Prologue

Background

From very early in the COVID-19 pandemic, Vietnam's government established the National Steering Committee for COVID-19 Prevention and Control (NSCCPC) - a multi-ministerial and multi-sectoral committee with representatives from 63 provinces and 707 districts. The committee directed pandemic control and assessed the COVID-19 situation nationwide. In response to the importation of COVID-19 cases from international flights, in March 2020, Vietnam's Ministry of Health required mandatory contact tracing and quarantine for all passengers on flights with COVID-19 confirmed cases. The NSCCPC was in charge of this activity, collaborating with government agencies. During the course of March 2020, Vietnam's government gradually introduced policies for mandatory SARS-CoV-2 tests and a 14-day quarantine for passengers from some designed areas. This included the United Kingdom and 26 Schengen countries on 14 March (1) and was expanded to include the United States, Southeast Asian countries, and Russia on 18 March (2), and expanded again to all international flights on 21 March 2020 (3). During this period, other passengers of the same plane could leave the airport without testing or quarantine if they did not depart from such designated areas and would only be contacted when any co-passengers of their flight were confirmed to be positive for SARS-CoV-2.

My role

In March 2020, my cohort colleague - Ms. Ha-Linh Quach, and I were involved in contact tracing activity within the Rapid Response Team (RRT), NSCCPC.

Contact tracing of flight passengers involved multiple jurisdictions and institutions, from local to national levels. Whenever a laboratory-confirmed polymerase chain reaction test was positive, the testing facility immediately reported it to the National Institute of Hygiene and Epidemiology (NIHE), then the information was channeled to the RRT. The contact tracing team at RRT conducted interviews with these confirmed cases for travel history and related epidemiological data. At the same time, related flight manifests including passenger names, seat numbers, and contact details were submitted by Civil Aviation Administration and airline companies to help with contact tracing for all passengers on the same flight with the confirmed cases.

I conducted contact tracing for both confirmed cases, flight passengers, and other community-exposed high-risk individuals, jointly with provincial CDCs across Vietnam. I was in charge of compiling and inputting these data to the central COVID-19 database, which was

shared amongst public health agencies in Vietnam to update the contact tracing situation. I was also involved in developing protocols for data entry and data storage and trained new members for data entry and extraction. With this experience, I developed a protocol for contact tracing among passengers and crew on incoming flights to Vietnam which contained COVID-19 cases. This protocol included data forms to monitor contact tracing, sample questionnaires in Vietnamese and English, and scripts for contact tracing phone calls. The scripts cover various practical situations, developed for different points of contact such as foreigners, hotel receptionists, embassy. Officials from the Ministry of Health used this protocol to develop the national guidelines for COVID-19 contact tracing.

From the database, I collected the progress of contact tracing for passengers on flights with COVID-19 cases that landed in Vietnam in March 2020. These data were then used to compile into situation reports for the RRT, NSCCP, and Ministry of Health. Afterward, the data were analyzed to assess the timeliness of the COVID-19 contact tracing process among flight passengers in Vietnam.

Achievement

This chapter consists of one published article (Appendix 1) and two conference presentations at South East Asia and Western Pacific Bi-regional FETP Videoconference on 7-8 September 2021 and at the 10th Bi-regional TEPHINET Scientific Conference on 1-5 November 2021 (Appendix 2). The article entitled “Timeliness of contact tracing among flight passengers during the COVID-19 epidemic in Vietnam” was published in BMC Infectious Disease in April 2021 (Appendix 1). The aims of this study are to assess the timeliness of contact tracing among airline passengers arriving in Vietnam on flights with at least one confirmed COVID-19 case on board during March 2020, and explored factors associated with the timeliness of contact tracing.

Abstract

Background:

International air travel plays an important role in the global spread of SARS-CoV-2, and tracing of close contacts is an integral part of the public health response to COVID-19. We aimed to assess the timeliness of contact tracing among airline passengers arriving in Vietnam on flights containing COVID-19 cases and investigated factors associated with timeliness of contact tracing.

Methods:

We included data from 2,228 passengers on 22 incoming flights between 2-19 March 2020. Contact tracing duration was assessed separately for the time between the date of index case confirmation and date of contact tracing initiation (interval I), and the date of contact tracing initiation and completion (interval II). We used log-rank tests and multivariable Poisson regression models to identify factors associated with timeliness.

Results:

The median duration of interval I and interval II was one (IQR: 1–2) and three days (IQR: 2–5), respectively. The contact tracing duration was shorter for passengers from flights where the index case was identified through mandatory testing directly upon arrival (median=4; IQR: 3–5) compared to flights with index case detection through self-presentation at health facilities after arrival (median=7; IQR: 5–8) (p-value=0.018). Cumulative hazards for successful tracing were higher for Vietnamese nationals compared to non-Vietnamese nationals (p<0.001).

Conclusions:

Contact tracing among flight passengers in the early stage of the COVID-19 epidemic in Vietnam was timely though delays occurred on high workload days. Mandatory SARS-CoV-2 testing at arrival may reduce contact tracing duration and should be considered as an integrated screening tool for flight passengers from high-risk areas when entering low-transmission settings with limited contact tracing capacity. We recommend a standardized risk-based contact tracing approach for flight passengers during the ongoing COVID-19 epidemic.

Lesson learned

This project gave me valuable opportunities to have practical experiences as a field epidemiologist. I have acquired many essential contact tracing skills and scientific writing skills that I believe to be helpful in my future public health career.

My first hands-on lesson is the importance of building trust between the contact tracers and COVID-19 cases/close contacts. To limit exposure and to save time, all contacts with cases or close contacts were conducted through phone calls or phone messengers. This method made many call receivers reluctant to give out information. Furthermore, in my experience, a completed travel history requires more than one conversation, as people need time and space to reflect on the past few days, especially after they received such shocking information about COVID-19 exposure. At the first contact, my tactic was to introduce clearly and frankly who I was, my purpose of contacting, and the importance of their information to outbreak investigation. I also ensured the confidentiality of their given information.

Through this project, I had a chance to study and practice scientific writing under the guidance of my supervisor – Dr. Florian, who is an accomplished experienced public health researcher. Writing is not always straightforward. The key importance of a good manuscript was a clear aim and meaningful messages you want to convey to your audience. I often start with testing the data, to find an interesting angle or question that the dataset might raise. Whenever I find anything noteworthy, I would take notes and discuss them with Dr. Florian. After having a consensus around the manuscript's key messages, I would conduct the analyses and write up the results, methods, and discussion. Dr. Florian would give me feedback along with any drafts, and reassure my vision for the manuscript is clear and coherent.

I also want to highlight the importance of involving and working closely with both the field supervisor and academic supervisor throughout the project. This is to ensure the project's process is going smoothly and on time, as well as getting timely guidelines on any problems.

Public health impact

One of the major challenges in the COVID-19 pandemic is to prevent the spread of the virus while minimizing adverse consequences on the socio-economic development of a population (4). Our findings suggest that timely contact tracing from the beginning of the pandemic is important to prevent the spread of disease. Contact tracing also has proved its effectiveness in controlling other deadly diseases (5,6), such as the 2014 Ebola outbreak in West Africa (7).

While contact tracing was a crucial component for preventing the spread of SARS-CoV-2 in the community (8), it was important to integrate it with other interventions such as border control and arrival testing. Although contact tracing was timely, a long trail of unreached passengers over time was still recorded, indicating a lengthy process to locate some passengers that can lead to the overstretched tracing system (9,10).

Recommendation

We used contact tracing data to demonstrate that contact tracing among passengers on flights with COVID-19 confirmed cases was timely though delays occurred on days with a high volume of passengers needed to be traced in the early stage of the pandemic in Vietnam. Mandatory SARS-CoV-2 testing at arrival can potentially ease the contact tracing burden, and limit community exposure to imported SARS-CoV-2 risks. Integrating contact tracing with mandatory testing should be considered for passengers from high-risk areas when entering low-risk ones, especially under limited contact tracing capacity. We recommend developing a

general global standardized risk-based contact tracing protocol for flight passengers during the ongoing pandemic. This protocol should be adapted in real situations based on the country/region's contexts, such as the availability of human resources and equipment.

Acknowledgement

I acknowledged important contributions from my academic supervisor, Dr. Florian Vogt, for supporting me throughout the project. I would like to acknowledge Dr. Pham Quang Thai – my field supervisor and the Rapid Response Team to give me this valuable opportunity in contributing to COVID-19 prevention in Vietnam. I am thankful my colleague – Ms. Ha-Linh Quach, for her support in manuscript writing, the peer-review process, and her friendship throughout MAE life. I also thank community health workers from local CDCs and multijurisdictional in Vietnam for their great works in case finding, contact tracing, disease control, and prevention measures.

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Appendix 1. Journal Article.

Pham, T. Q.^{*}, **Hoang, N. A.^{*}**, Quach, H. L., Nguyen, K. C., Colquhoun, S., Lambert, S., Duong, L. H., Tran, Q. D., Ha, D. A., Phung, D. C., Ngu, N. D., Tran, T. A., La, Q. N., Nguyen, T. T., Le, Q., Tran, D. N., Vogt, F.[†], & Dang, D. A.[†] (2021). **Timeliness of contact tracing among flight passengers during the COVID-19 epidemic in Vietnam.** *BMC infectious diseases*, 21(1), 393. <https://doi.org/10.1186/s12879-021-06067-x>

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[†]Florian Vogt and Duc-Anh Dang share last authorship.

RESEARCH

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Timeliness of contact tracing among flight passengers during the COVID-19 epidemic in Vietnam



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Abstract

Background: International air travel plays an important role in the global spread of SARS-CoV-2, and tracing of close contacts is an integral part of the public health response to COVID-19. We aimed to assess the timeliness of contact tracing among airline passengers arriving in Vietnam on flights containing COVID-19 cases and investigated factors associated with timeliness of contact tracing.

Methods: We included data from 2228 passengers on 22 incoming flights between 2 and 19 March 2020. Contact tracing duration was assessed separately for the time between the date of index case confirmation and date of contact tracing initiation (Interval I), and the date of contact tracing initiation and completion (Interval II). We used log-rank tests and multivariable Poisson regression models to identify factors associated with timeliness.

Results: The median duration of interval I and interval II was one (IQR: 1–2) and 3 days (IQR: 2–5), respectively. The contact tracing duration was shorter for passengers from flights where the index case was identified through mandatory testing directly upon arrival (median = 4; IQR: 3–5) compared to flights with index case detection through self-presentation at health facilities after arrival (median = 7; IQR: 5–8) (p -value = 0.018). Cumulative hazards for successful tracing were higher for Vietnamese nationals compared to non-Vietnamese nationals ($p < 0.001$).

Conclusions: Contact tracing among flight passengers in the early stage of the COVID-19 epidemic in Vietnam was timely though delays occurred on high workload days. Mandatory SARS-CoV-2 testing at arrival may reduce contact tracing duration and should be considered as an integrated screening tool for flight passengers from high-risk areas when entering low-transmission settings with limited contact tracing capacity. We recommend a standardized risk-based contact tracing approach for flight passengers during the ongoing COVID-19 epidemic.

Keywords: Timeliness, Contact tracing, COVID-19, SARS-CoV-2, Vietnam

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Background

COVID-19 has spread globally since the beginning of 2020. Within 9 months, SARS-CoV-2 infected over 40 million people and caused over 1 million fatalities worldwide [1]. International air travel plays an important role in the global spread of COVID-19 [2]. Since the beginning of the epidemic, many countries implemented different policies to prevent the importation of COVID-19, including complete closure of borders for international travel [3], systematic passenger testing, and mandatory quarantine at arrival [4].

Vietnam has experienced many infectious disease importations during the last 20 years [5–7], however experience with flight-related contact tracing is limited. Shortly after the first COVID-19 case was reported from Wuhan, China, Vietnam's government implemented a range of policies to screen, detect, and investigate passengers arriving on flights from COVID-19 affected regions. In March 2020, Vietnam saw a surge in COVID-19 cases among returning nationals and tourists, which subsequently triggered a series of public health measures to trace passengers from flights on which an infected passenger had been detected [8].

While contact tracing has proven critical for the containment of COVID-19 transmission in general [9, 10], there is a lack of evidence on contact tracing among aircraft passengers [11, 12]. Timeliness in particular, a key component for effective contact tracing, and factors influencing timeliness in low-middle income settings such as Vietnam, has not been investigated to date. Such evidence is crucial to improve the response to flight-related COVID-19 importations during the ongoing pandemic. We aimed to assess the timeliness of contact tracing among airline passengers arriving in Vietnam on flights with at least one confirmed COVID-19 case on board during March 2020, and explored factors associated with timeliness of contact tracing.

Methods

Setting

Passenger surveillance

In Vietnam, the Government delegated the National Steering Committee for COVID-19 Prevention and Control to implement case finding and contact tracing activities among all passengers of flights where at least one COVID-19 case was detected. This process entailed nation-wide multi-institutional cooperation to contact, test, and quarantine passengers after arrival in Vietnam.

During the course of March 2020, Vietnam's government gradually introduced policies for compulsory SARS-CoV-2 testing and 14-day quarantine for passengers from some designated areas. This included the United Kingdom and 26 Schengen countries on 14 March [13] and was expanded to include the United States,

Southeast Asian countries, Russia on 18 March [14], and expanded again to all international flights on 21 March 2020 [15]. The evolving testing policies are outlined in Additional file 1. During this period, other passengers of the same plane could leave the airport without testing or quarantine if they did not depart from such designated areas and would only be contacted when any co-passengers of their flight were confirmed to be positive for SARS-CoV-2. Consequently, during most of March 2020, flight-associated COVID-19 index cases (the first confirmed cases among flight passengers) were detected either by self-presentation or through mandatory testing in Vietnam depending on the country of departure.

For this analysis, self-presentation was defined as index cases who presented themselves at local health facilities after arrival due to COVID-19 symptoms or due to recent travel history to affected areas following public awareness campaigns. Mandatory testing was defined as index cases who were tested mandatorily for SARS-CoV-2 at immigration points directly upon arrival.

Contact tracing procedures

Contact tracing of flight passengers for COVID-19 in Vietnam during 2020 was a complex operation that involved multiple jurisdictions and institutions, including the Ministry of Health (MoH); the National Institute of Hygiene and Epidemiology (NIHE); the Rapid Response Team (RRT) of the National Steering Committee of COVID-19 Prevention and Control; the Civil Aviation Administration and Immigration Bureau; 63 provincial Centres for Disease Controls and Prevention (CDC); and the local police. The MoH assigned the NIHE as the key institution to manage and store data of contact tracing for flight passengers, including SARS-CoV-2 test results. Whenever a laboratory-confirmed polymerase chain reaction (PCR) test was positive, this was immediately reported by the testing facility to the NIHE. The NIHE then passed on the contact information of confirmed cases to the RRT. The RRT contacted and interviewed all COVID-19 cases for their travel history on international or domestic flights within 14 days from date of first symptom onset or date of first positive test result, whichever came first. The RRT then requested the Civil Aviation Administration and Immigration Bureau to provide flight manifests including passenger names, seat numbers, and personal contact details. The RRT shared this information with provincial CDCs and the local police. Local CDC staff and the local police jointly contacted passengers using email, telephone, or social media accounts if available. If necessary, other information such as residential or workplace addresses, information from tourism companies and embassies (for tourists), temporary/permanent residential registration data from local authorities, police department records, and

immigration bureau data were also obtained. Furthermore, the MoH issued daily public announcements of flight details on mass media to advise all passengers on these flights to self-present immediately at designated facilities (Fig. 1).

All passengers on a flight with a positive case were traced, with their tracing status (tracing ongoing, successfully traced, transited out of the country, lost-to-follow-up) updated daily by local CDC staff on the national COVID-19 Contact Tracing Management System. All successfully traced passengers were instructed to immediately self-quarantine while awaiting health staff to take a nasopharyngeal swab for SARS-CoV-2 PCR testing. All traced passengers were subsequently transferred to designated quarantine areas regardless of their test result. Passengers who had already left Vietnam were instructed to contact respective health jurisdictions at their current location. Contact tracing of a flight was closed 14 days after the last successful tracing attempt occurred; all passengers not reached at that point were declared lost-to-follow-up. For this analysis, contact tracing completion was marked as the date when the last passenger on the flight was successfully traced.

Data collection

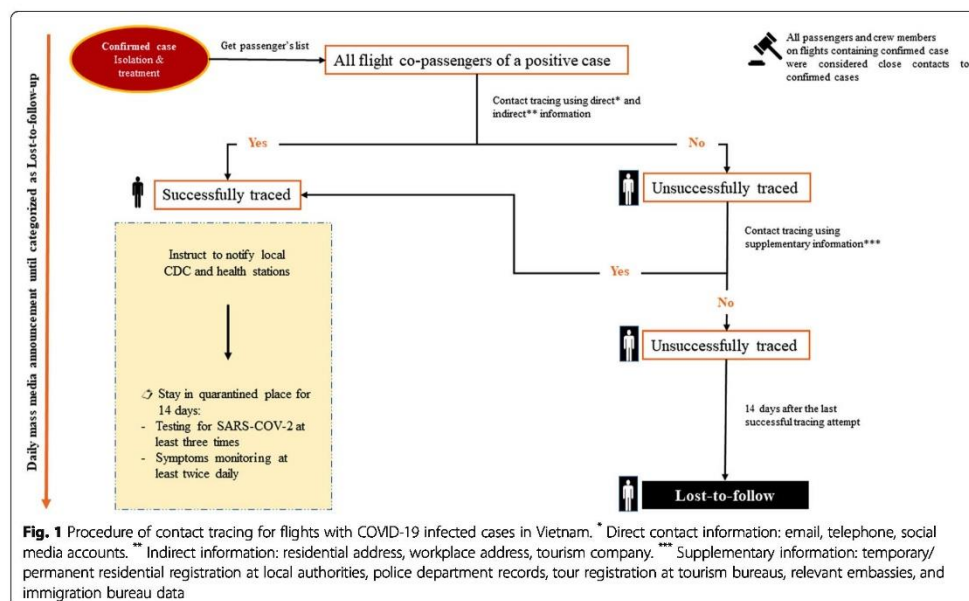
We extracted data for flight numbers, place of departure, arrival dates, total passenger numbers on each flight, passengers' nationalities, the epidemiological index case

detection method of each flight, date of first laboratory confirmation of the index case, date of contact tracing initiation and completion, and final contact tracing status (successfully traced; transited out of the country; lost-to-follow-up) from the national COVID-19 Contact Tracing Management System.

Statistical analysis

We used frequency statistics to describe the total number of passengers needed to be traced and successfully traced each day. We calculated time intervals between the date of index case confirmation and the date of contact tracing initiation (interval I), and the date of contact tracing initiation and date of completion (interval II), both overall and separately by method of index case detection (self-presentation vs. mandatory testing). The outcome of interest was the total duration of contact tracing, defined as time between date of index case confirmation and date of completion (interval I + II).

We calculated Kaplan Meier estimates to plot the probability of unsuccessful tracing (survival probability) over time and used log-rank tests to compare the cumulative hazards of successful tracing between both methods of index case detection (self-presentation after arrival or mandatory testing at arrival), passenger's nationality (Vietnamese vs. non-Vietnamese), and number of passengers per flight requiring tracing (< 50, 50–99, > 100). If a passenger remained untraced at date of analysis



(31 March 2020), the observation period was considered right censored. In addition, we developed a multivariable Poisson regression model to assess the association between index case detection method and timeliness of contact tracing adjusted for passenger nationality and the number of arriving passengers per plane. Data were analyzed using R version 4.0.2 [16].

Results

We included 22 flights arriving to Vietnam between 2 and 19 March 2020 in our analysis, with a total number of passengers of 2228; of these, 25 were index cases (1.1%). Most passengers were successfully traced (80.1%; $n = 1785$), while 1.2% (27 passengers) were lost-to-follow-up. The remaining 391 passengers (17.6%) had already transited to other countries at time of investigation (Fig. 2).

Figure 3 presents the volume of 1812 passengers for which prospective contact tracing was done over time. The median number of passengers successfully traced was 69 (Interquartile range - IQR: 37–162) per day, while the daily median number of new passengers needed to be traced and the total number of passengers needed to be traced was 71 (IQR: 0–165) and 202 (IQR: 66–571), respectively. The total number of passengers requiring tracing was above 400 on each day between 15 March and 21 March. More than 50% of passengers remained untraced during these high workload days.

The percentage of passengers needed to be traced reduced rapidly during the first 2 days of contact tracing (Fig. 4).

A total of 10 index cases from nine flights carrying 1050 passengers were detected by self-presentation, while 15 index cases from 13 flights carrying 1178 passengers were detected by mandatory testing at arrival. Details of the timeline and duration of contact tracing for all 22 traced flights are shown in Additional file 2. There was an overall median delay of 1 day (IQR: 1–2) between index case confirmation and initiation of contact tracing (Interval I), and an overall median delay of 3 days (IQR: 2–5) between initiation and completion of contact tracing process (Interval II). Interval II was longer for flights with an index case detected by self-

presentation (median 5; IQR: 4–7) than for flights with an index case detected by mandatory SARS-CoV-2 testing (median 2; IQR: 2–3) (p -value = 0.005). Similarly, the combined time interval between index case confirmation and contact tracing completion for flights with index case detected by self-presentation (median = 7; IQR: 5–8) was longer than for flights with an index case detected by mandatory testing (median = 4; IQR: 3–5) (p -value 0.018) (Table 1).

Figure 5 illustrates the cumulative hazards of successful tracing over time by method of index case detection, the passenger's nationality, and the number of arriving passengers per plane. Cumulative hazards were higher for passengers on flights with an index case detected by mandatory testing than for passengers on flights with index cases detected by self-presentation (p -value = 0.002) and for Vietnamese passengers than for non-Vietnamese nationals (p -value < 0.001).

Table 2 shows univariate and multivariable analyses assessing the association between method of index case detection and timeliness of contact tracing. The duration of contact tracing was longer for people arriving on flights with large passenger volumes, with an Incidence Rate Ratio (IRR) of 1.36 (95% confidence interval (95%CI): 0.62–2.98) and 1.67 (95%CI: 0.75–3.73) for passengers on flights with 50–99 passengers and with more than 100 passengers, respectively, compared to flights with small volumes (below 50 passengers). After controlling for nationality and passenger volume per plane, the contact tracing duration for passengers where the index case was detected by self-presentation was longer than for passengers on flights where the index case was detected by mandatory testing upon arrival (IRR: 1.94, 95%CI: 1.17–3.21).

Discussion

We evaluated the timeliness of contact tracing and factors associated with timeliness among 22 flights between 2 March and 19 March 2020, shortly before Vietnam's government issued the universal test and quarantine policy for all inbound passengers. Our findings suggest that mandatory SARS-CoV-2 testing at arrival can help to

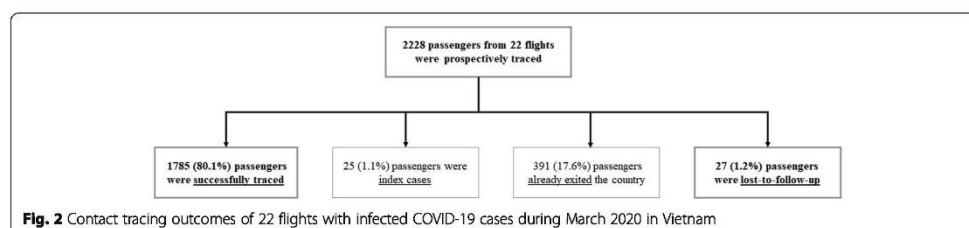
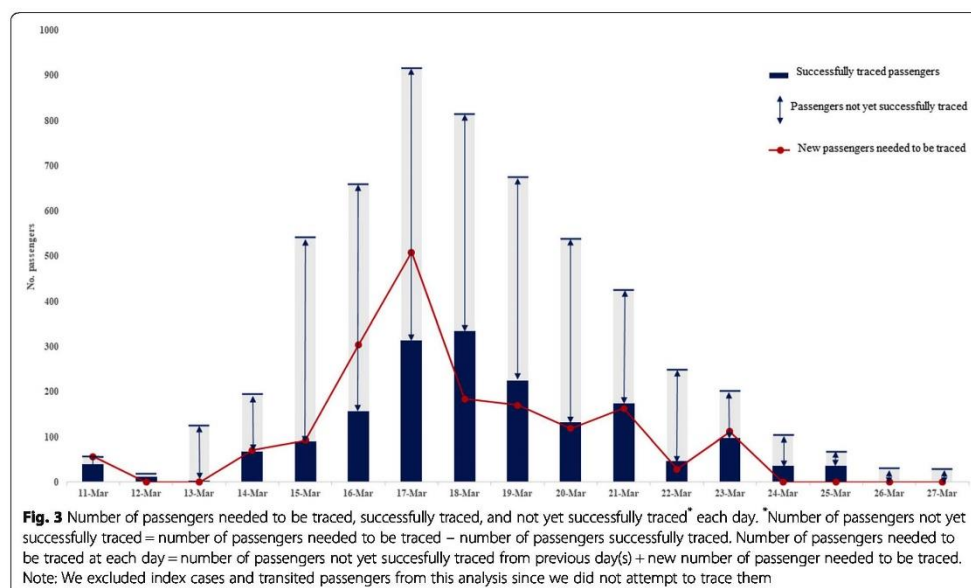


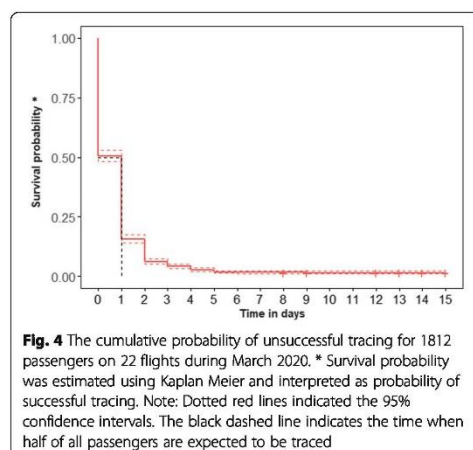
Fig. 2 Contact tracing outcomes of 22 flights with infected COVID-19 cases during March 2020 in Vietnam



reduce the contact tracing duration of passengers upon detection of an index case.

This study provides important evidence on integrated contact tracing of flight passengers in a low-middle income country in the midst of the ongoing COVID-19 pandemic.

The short tracing duration for passengers on flights with index case detection by mandatory testing at the



time of arrival can be explained with the reduced delay in index case detection compared to flights where index cases self-presented, which in turn meant that passengers on these flights had less time to disperse throughout the country and change locations multiple times, which incurred delays. However, this test and quarantine policy by area of departure individually for each passenger (i.e., passengers on the same flight could leave the airport without testing or quarantine if they did not depart from a designated high-risk area and would only be traced if a passenger on the same flight tested positive) was complex to implement. With SARS-CoV-2 increasingly spreading to more and more countries in March 2020 anyways, it was soon replaced by a blanket mandatory quarantine policy for all incoming passengers irrespective of origin.

Although most passengers were successfully traced within 2 days of initiating contact tracing, we still recorded a long tail of unreached passengers over time, indicating a lengthy process to locate some passengers. The reasons for this were manifold and, though reasons for unsuccessful tracing were not recorded systematically, several of them seem to have affected international tourists more than Vietnamese nationals, which might explain the lower cumulative hazards of successful tracing in non-Vietnamese than in Vietnamese nationals. For example, fast-changing locations, lack of local mobile phone contact details, and language barriers were

Table 1 Time interval of contact tracing of passengers on 22 flights arriving Vietnam from 6 March to 21 March by methods of index case detection

Time	Total (n = 22) Median (IQR)	Method of index case detection Median (IQR)		p-value ^a
		Self-presentation (n = 9)	Mandatory testing (n = 13)	
Interval I	1 (1–2)	1 (1–2)	2 (1–2)	0.34
Interval II	3 (2–5)	5 (4–7)	2 (2–3)	0.005
Total time	4.5 (4–6)	7 (5–8)	4 (3–5)	0.018

Note: Interval I is defined as time intervals between date of index case confirmation to date of contact tracing initiation; Interval II is time intervals between date of contact tracing initiation to completion; Total time = Interval I + Interval II

^aInterval I, Interval II, and Total time by method of index case detection were compared using Wilcoxon rank-sum tests

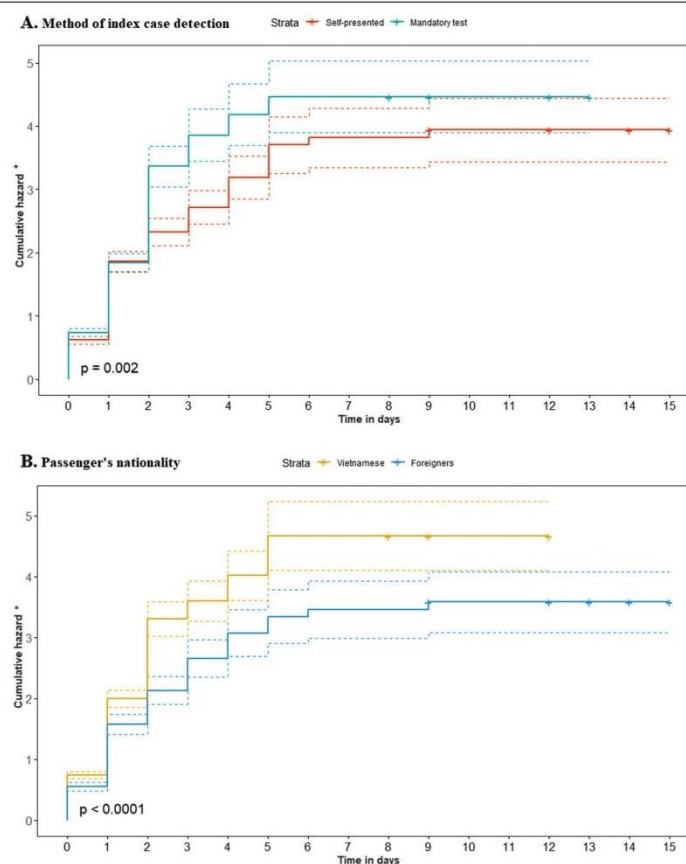


Fig. 5 Cumulative hazard of successful tracing for passengers by method of index case detection (a) and nationality of passengers (b). * Cumulative hazards were estimated using Kaplan Meier and interpreted as probability of successful trace. p-value was calculated from log-rank tests. Note: Dotted lines indicated the 95% confidence intervals

Table 2 Relationship between method of index case detection and timeliness^a of contact tracing for passengers on 22 flights arriving in Vietnam from 6 March to 21 March

	n (%)	Univariate Associations		Model 1		Model 2		Model 3	
		IRR	95%CI	IRR	95%CI	IRR	95%CI	IRR	95%CI
Method of index case detection									
Mandatory testing	9 (40.9)	Ref	–	Ref	–	Ref	–	Ref	–
Self-presentation	13 (59.1)	1.61	1.11–2.34	1.86	1.18–2.92	1.59	1.07–2.34	1.94	1.17–3.21
Percentage of foreigners per flight									
≤10%	7 (31.8)	Ref	–	Ref	–			Ref	–
10.1–20%	4 (18.2)	0.9	0.51–1.59	1.12	0.61–2.04			1.15	0.61–2.14
20.1–30%	4 (18.2)	1.1	0.65–1.87	0.96	0.56–1.65			0.89	0.51–1.56
> 30%	7 (31.8)	1	0.63–1.60	0.77	0.47–1.28			0.74	0.44–1.24
Number of passengers per flight^b									
< 50	2 (9.1)	Ref	–			Ref	–	Ref	–
50–99	13 (59.1)	1.36	0.62–2.98			1.07	0.48–2.42	0.91	0.38–2.17
100+	7 (31.8)	1.67	0.75–3.73			1.34	0.58–3.06	1.18	0.49–2.83

Model 1: Timeliness by method of index case detection adjusted for percentage of foreigners per flight

Model 2: Timeliness by method of index case detection adjusted for number of passengers per flight

Model 3: Timeliness by method of index case detection adjusted for percentage of foreigners per flight and number of passengers per flight

^a Total time between date of index case confirmation to contact tracing completion (Interval I + II)^b Total number of passengers per flight for who contact tracing was performed

obstacles often experienced by the contact tracers according to our anecdotal experience. Some of these passengers were successfully reached via email, their social media accounts, or tourism companies, while for others the involvement of their embassies or the Vietnamese immigration bureau was required, which added to the delay. Although the MoH issued information of flights with confirmed cases on mass media in both Vietnamese and English, this might not have reached all international tourists, which can explain further delays in this group. Incorrect or missing contact information added complexity and challenges to trace passengers. All inbound passengers from international flights had to complete a health declaration form either via a paper-based or web-based version, which was not always done correctly and completely. While the web-based data was directly linked to the passengers' management system, paper-based forms had to be entered manually by the Civil Aviation Administration and Immigration Bureau. Due to the large daily volume of paper-based records at that time, data entry errors might have occurred more frequently during high workload days.

Our results suggest that contact tracing was more time-consuming with increasing passenger volume of that flights, which makes sense in light of the sudden overload of the system through large volume flights. Furthermore, all flights with medium and high volumes were international connections carrying large numbers of non-Vietnamese nationals. Collecting passenger details from foreign airlines also took longer because of differences in time zones and the need to convince the

airline companies to hand over passenger lists, which often required to issue official request letters.

Challenged by a surge of passengers needed to be traced, the contact tracing process in Vietnam adapt, as shown by the increasing number of passengers successfully traced. However, this adaptation did not seem to have been enough during days with a high workload, since more than half of the passengers needed to be traced were not reached during these days. While contact tracing was a crucial component for preventing the spread of COVID-19 in the community [17], it is important to integrate contact tracing with other public health interventions such as border control and arrival testing. The high number of imported cases due to international travel has prevailed over time in many countries leading to overstretched contact tracing capacities [18, 19]. With the early recognition of this possible challenge, the Vietnamese government decided on 21 March 2020 to mandatorily test and quarantine all inbound passengers to reduce the workload for contact tracing, even though only 94 confirmed cases had been recorded at that time [20].

We acknowledge several limitations of this study. Firstly, available data were recorded in days instead of hours, which adversely impacted the accuracy of our estimates. Secondly, for flights with index cases detected by mandatory testing, some passengers were already tested and quarantined upon arrival at the same time as the index cases. However, we could not exclude such passengers from our analysis due to data unavailability but we estimate the number to be relatively low since

the list of designed high-risk areas, which required direct quarantine upon arrival only of those passengers who started their journey from a high-risk area but not of all passengers on that plane, was only gradually expanded (see Additional file 1). Since we treated such contacts as successfully traced at the first day of contact tracing initiation, any effect of this would have contributed to an underestimation of the observed difference in timeliness between the two methods of index case detection. Thirdly, our analysis did not explore contextual factors that may have impacted the contact tracing duration and contact tracing evolution over time such as overall daily capacity of the contact tracing system, organizational structure, administrative delays, information distribution, number of jurisdictions, availability of human resources, and skill levels of contact tracers. Future mixed-methods research is needed to answer these questions. Fourthly, no data on the causes of delay or loss to follow up was systematically recorded and were thus not available for our analysis, which would have enriched the interpretation of our findings.

Conclusion

Contact tracing among flight passengers in the early stage of the COVID-19 epidemic in Vietnam was timely, although delays occurred on high workload days. Mandatory SARS-CoV-2 testing at arrival may reduce contact tracing duration and should be considered as an integrated screening tool for flight passengers from high-risk areas when entering low-transmission countries with limited contact tracing capacity. We recommend a standardized risk-based contact tracing approach for flight passengers during the ongoing COVID-19 epidemic.

Abbreviations

RRT: Rapid Response Team; NIHE: National Institute of Hygiene and Epidemiology; PCR: Polymerase chain reaction; CDC: Centres for Disease Controls and Prevention; MoH: Ministry of Health; IRR: Incidence Rate Ratio; IQR: Interquartile range

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12879-021-06067-x>.

Additional file 1. Public health interventions to prevent transmission from flights in Vietnam.

Additional file 2. Timetable from arrival to contact tracing completion for 22 tracing flights, March 2020, Vietnam.

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Experiments on humans and/or the use of human data

All methods were carried out in accordance with relevant guidelines and regulations.

Authors' contributions

NAH, TQP, and FV are responsible for conceptualization and methodology. NAH, HLQ and KCN collected and cleaned data. NAH and TQP validated and did formal analyses. TQP, KCN, SC, SL, DHL, QDT, DAH, DCP, NDN, TAT, QNL, TTN, MQL, DNT, DAD did data curation and data visualization. NAH, and FV wrote original draft preparation. NAH, TQP, HLQ, KCN, SC, SL, FV review and editing manuscript. DHL, QDT, DAH, DCP, NDN, TAT, QNL, TTN, MQL, DNT, DAD did supervision and project administration. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author (Ha-Linh Quach) or the first author (Ngoc-Anh Hoang) on reasonable request.

Declarations

Ethics approval and consent to participate

This was a secondary data analysis using existing routinely collected de-identified data. This research was reviewed and approved by The Science and Medical Delegated Ethics Review Committee of the Australian National University (decision No. 2020/419), and waived for ethics approval by the board of directors of the Vietnam National Institute of Hygiene and Epidemiology as it was part of regular public health activities in Vietnam. Informed consent was waived by The Science and Medical Delegated Ethics Review Committee of the Australian National University and the board of directors of the Vietnam National Institute of Hygiene and Epidemiology.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Appendix 2. Conference presentation

Conference presentations at the South East Asia and Western Pacific Bi-regional FETP Videoconference on 7-8 September 2021 and at the 10th Bi-regional TEPHINET Scientific Conference on 1-5 November 2021.

The slide features a dark blue background with a grid of lighter blue squares on the right side. At the top left, there are logos for Australian National University and the WHO Epidemiology Training Institute of Applied Epidemiology. At the top right is the logo for the National Institute of Hygiene and Epidemiology (NIHE). The title is in large, bold, yellow text. Below the title, the conference details are in white text. The presenter's name is in white text, followed by their affiliations in smaller white text.

Timeliness of contact tracing among flight passengers during the COVID-19 epidemic in Vietnam

the South East Asia and Western Pacific Bi-regional FETP Videoconference,
7 - 8 September 2021

Hoang Thi Ngoc-Anh

Master of Applied Epidemiology Scholar, Research School of Population Health,
Australian National University, Canberra, ACT, Australia

Department of Communicable Disease Control, National Institute of Hygiene and
Epidemiology, Vietnam

The slide has a light gray background. At the top, the section title is in blue. Below it, there are two red-bordered boxes. The left box is titled 'What's known' and contains a list of four bullet points. The right box is titled 'What's new' and contains a list of two bullet points. A dashed double-headed arrow connects the two boxes.

Section A: Background

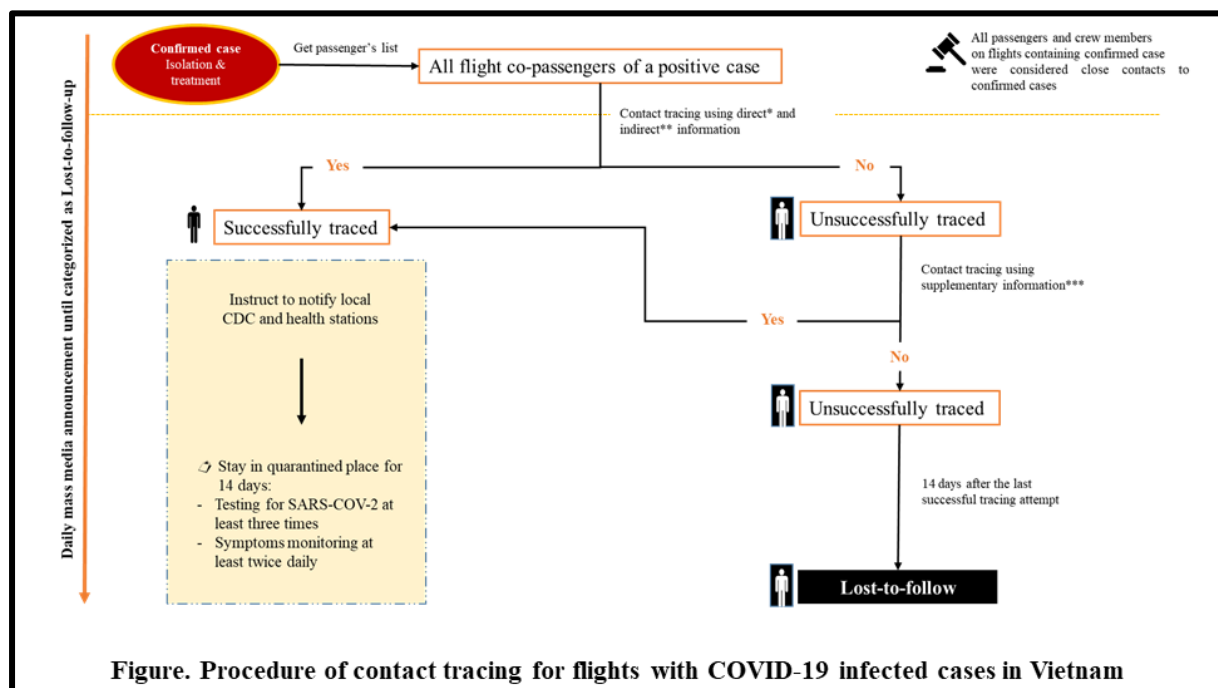
What's known	What's new
• International air travels spread COVID-19 • Increase cases among returning nationals and tourists in Vietnam • Contact tracing contribute to the containment of transmission • Timeliness - a key for effective contact tracing	• Timeliness on contact tracing among aircraft passengers? • Factors influencing timeliness?

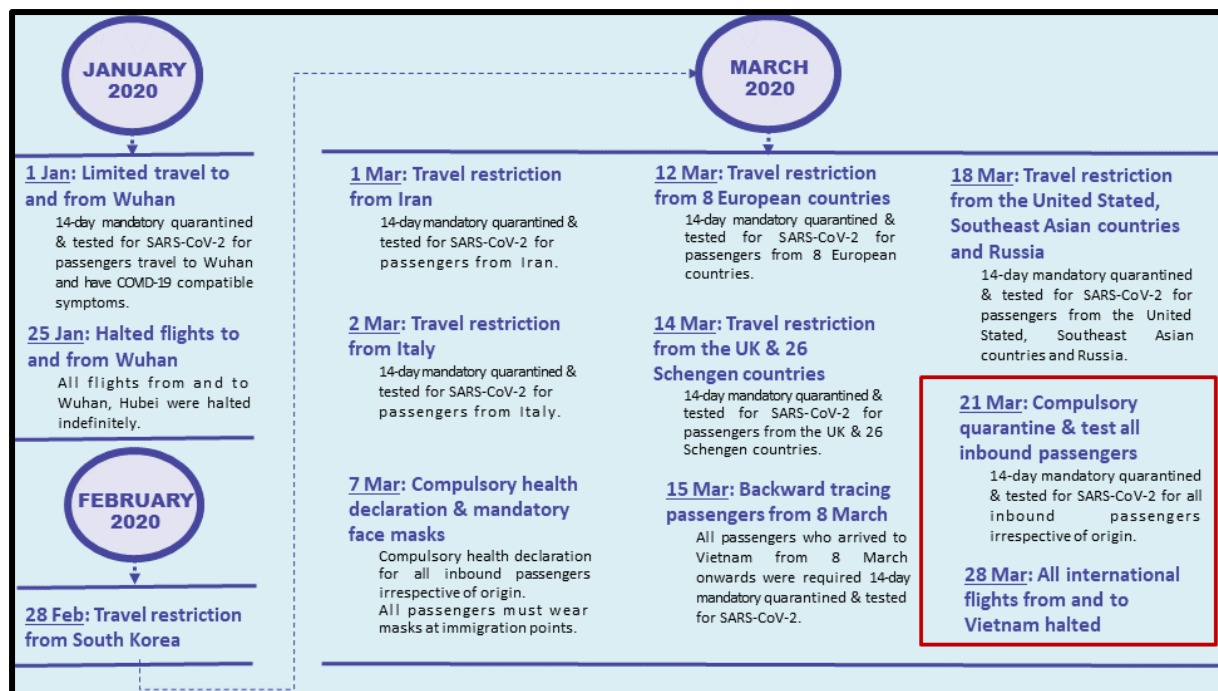
2

Section A: Aims of this study

- Assess timeliness of contact tracing among passengers on flights with COVID-19 cases on board in March 2020 in Vietnam
- Explore factors associated with timeliness of contact tracing

3

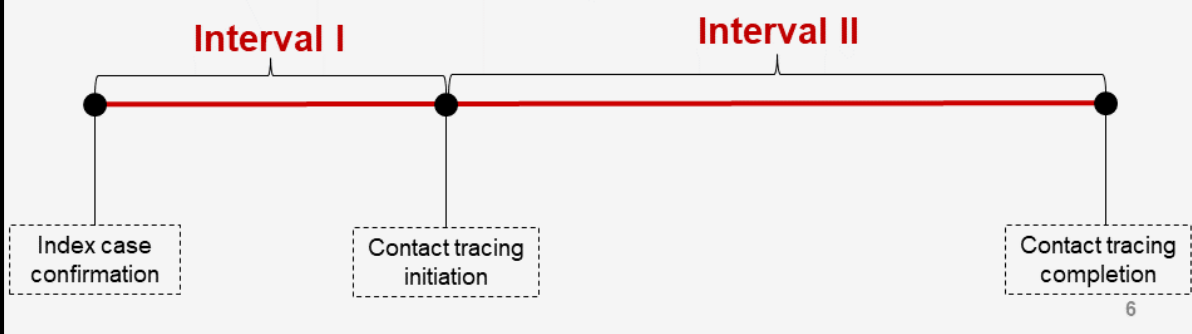




Section B: Methods

Where data we collected:

- The national COVID-19 Contact Tracing Management System
- Civil Aviation Administration (flight manifest and passenger detail)



Section C: Results

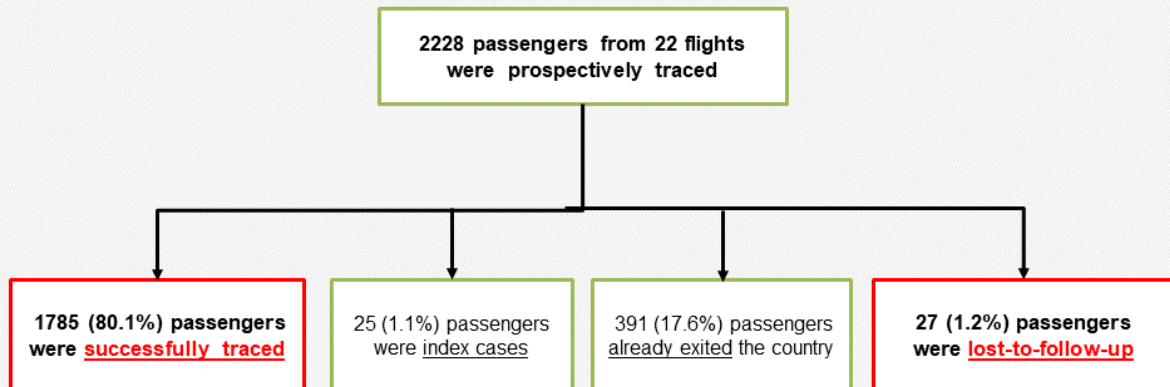
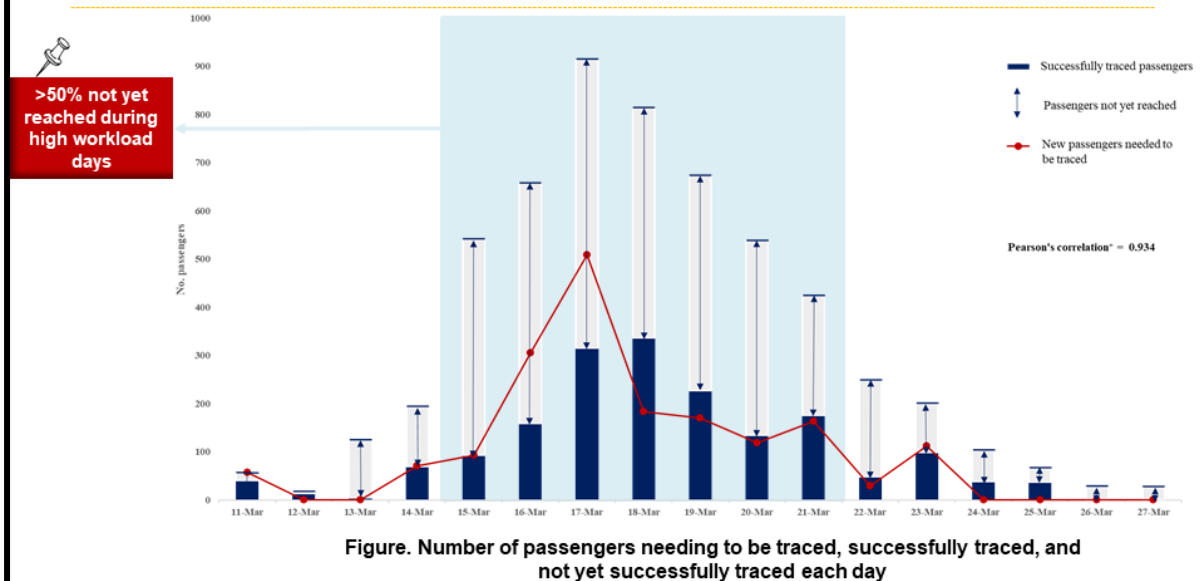


Figure. Number of passengers needing to be traced, successfully traced, and not yet successfully traced each day

7

Section C: Results



Section C: Results



The number of passengers needed to be traced reduced rapidly during the first two days

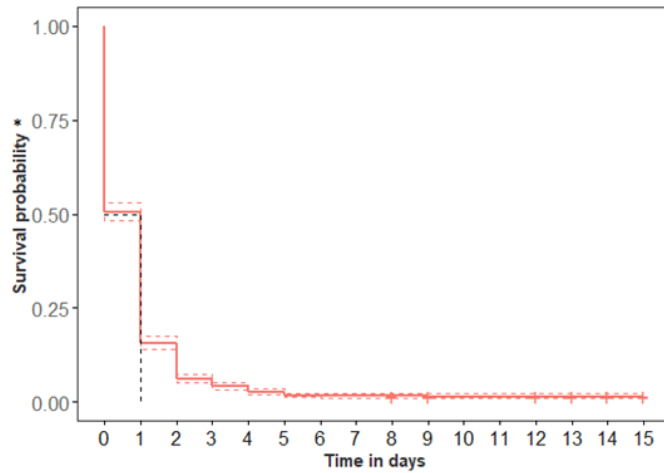
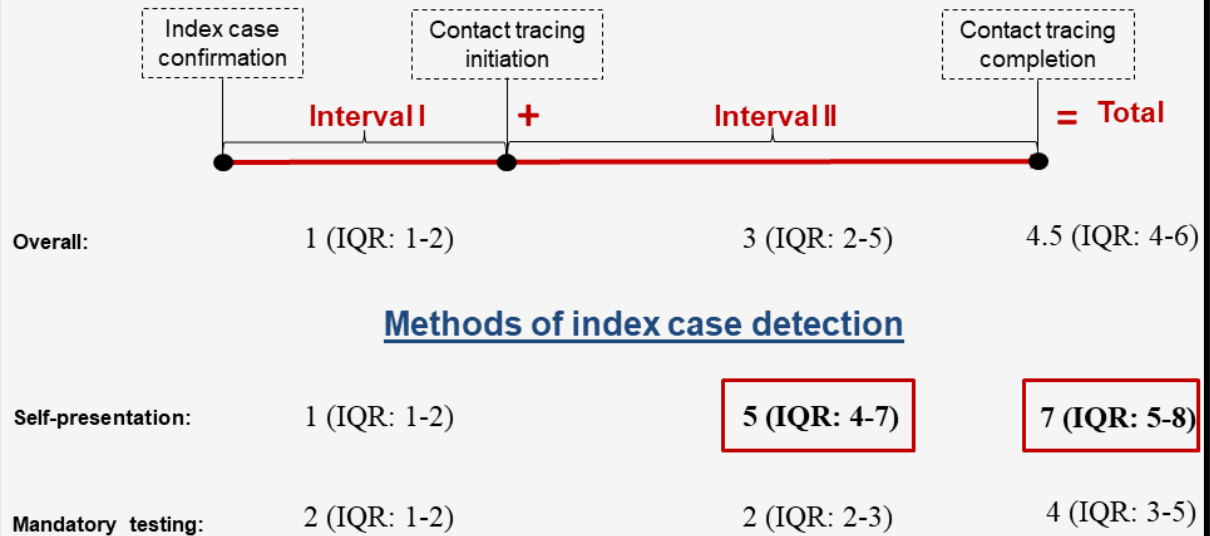


Figure. The cumulative probability of unsuccessful tracing for 1,812 passengers on 22 flights during March 2020

9

Section C: Results



10

Section C: Results

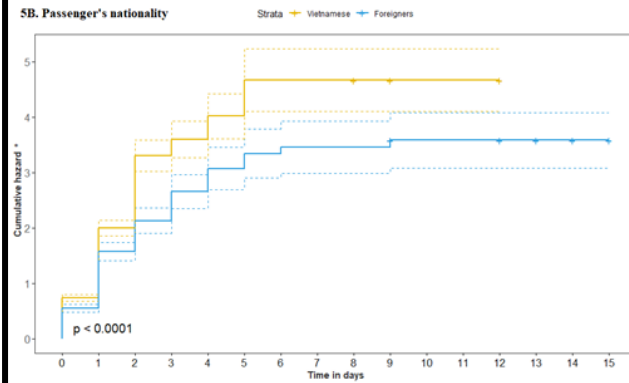
Tracing time:

Mandatory testing < Self-presentation

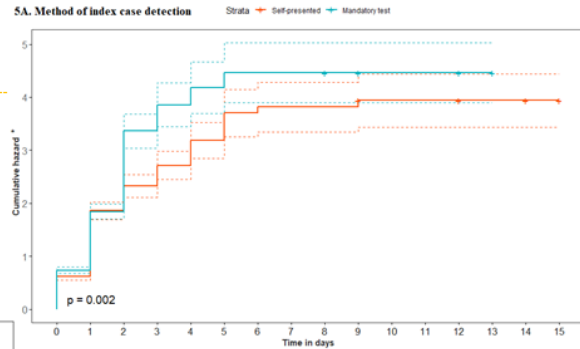
Vietnamese < Non-Vietnamese

Small planes < Large planes

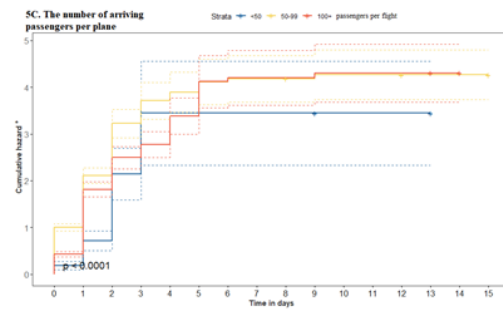
5B. Passenger's nationality



5A. Method of index case detection



5C. The number of arriving passengers per plane



Section D: Conclusions

- Contact tracing was timely overall, but delayed if index case was detected by self-presentation
- Delays on high workload days
- Mandatory SARS-COV-2 testing at arrival should be considered

RESEARCH

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Timeliness of contact tracing among flight passengers during the COVID-19 epidemic in Vietnam



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Link: <https://doi.org/10.1186/s12879-021-06067-x>

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- Dr. Thai Quang Pham, NIHE
- Ms. Ha-Linh Quach, ANU
- ASEAN-Australia Health Security Fellowship Program, Commonwealth Department of Foreign Affairs and Trade
- Vietnam National Steering Committee for COVID-19 Prevention and Control

Chapter 7. Other MAE Requirements

Lay audience report: “COVID-19 Vaccine Tracker Updates: where is Vietnam in the technological flow of vaccine evolution?”

Lesson from the field: “How to build an online questionnaire on KoBoToolbox”

Teaching: “How to build an online questionnaire on KoBoToolbox”

Side project: “Re-positive testing, clinical evolution and clearance of infection: results from COVID-19 cases in isolation in Vietnam”

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List of Abbreviations – Chapter 7

CDC	Center for Disease Control and Prevention
COVID-19	Coronavirus 2019
LFF	Lesson From the Field
MAE	Master of Applied Epidemiology
NIHE	National Institute of Hygiene and Epidemiology
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
WHO	World Health Organization

1. Lay audience report

Prologue

Background

In very early 2021, several vaccines against SARS-CoV-2 have been and are being developed, and the scientific evidence about their efficacy is growing rapidly. There are now several SARS-CoV-2 vaccines administered at scale around the world for which good efficacy profiles have been reported. The world is witnessing the fastest race to develop a safe and effective vaccine against SARS-CoV-2.

My role

Since vaccines against SARS-CoV-2 are now the single most important public health intervention around the world against the ongoing COVID-19 pandemic, it is of utmost importance to make lay people understand what is COVID-19 vaccine, how it can prevent the disease, and the progress of developing COVID-19 vaccines around the world and in Vietnam. Under the supervision of Dr. Thai, I compiled data in the literature to write a lay audience report titled “COVID-19 Vaccine Tracker Updates: where is Vietnam in the technological flow of vaccine evolution?”. The aim of this report was to introduce lay people to acquire with COVID-19 vaccine, update COVID-19 vaccine progress in Vietnam and worldwide, and address some questions about COVID-19 vaccines.

Lessons learned

MAE brought me many first times and this is the one I wrote up a lay audience report. Throughout my journey at MAE, I prepared some manuscripts submitted/published in peer-review journals. I had a chance to compare and contrast between two types of writing: scientific writing vs. writing for the lay audience. For scientific writing, the audiences are researchers, policymakers, or anyone they had basic information on the issues that the manuscript rise. Therefore, the methodology should be detailed at the level that makes the article producible. In contrast, I need to avoid technical words in writing for lay people. I tried to keep the messages short, simple, clear, and refined to avoid confusion. For example, in scientific writing, I wrote “Median depression levels among CHWs in Vietnam doubled from 3 (Interquartile ranges = 2-7) before COVID-19 to 6 (Interquartile ranges= 3-9) on the PHQ-9 scale during the Tet holiday outbreak”. This sentence needs to be revised in the lay audience report “the prevalence of depression among community health workers doubled during the COVID-19 Tet holiday outbreak compared to before COVID-19”.

Public health impact

COVID-19 vaccines are important to protect vaccinated people by creating an antibody response without having to develop potentially severe symptoms. COVID-19 can cause severe illness or death in everyone, even in children. Using the COVID-19 vaccine to control this pandemic is not merely dependent on vaccine efficacy and safety. Vaccine acceptance plays a key role in the successful control of the pandemic. The factors behind vaccine hesitancy are complex, including the messages spread by the media.

My article received a critical review from my field supervisor, a Vietnamese expert in vaccines before being published in a credited magazine of Vietnam's Ministry of Health. After one year of publishing, the article received more than 2,000 online accesses which indicated that it attracted many social concerns. My article, along with other articles on COVID-19, could help people understand how vaccines work, why we should take vaccines, and what we need to care for before, during, and after taking the COVID-19 vaccination. I tried to help people increase their beliefs on the COVID-19 vaccine then increased their willingness to take vaccines, and reduce vaccine hesitancy.

Recommendation

This article is one in thousand articles about COVID-19 in Vietnam. At the time of writing, no channel in Vietnam updated the COVID-19 vaccine situation in the country and worldwide. The Ministry of Health built a specific website to update the number of COVID-19 vaccines rolled out every day but no details on the progress of COVID-19 vaccines. Only some articles, like from myself, reviewed and updated the COVID-19 vaccines. Given the importance of COVID-19 vaccines in controlling this pandemic, I recommend periodically publishing articles to update the COVID-19 vaccine situation in Vietnam and worldwide. It might help lay people, especially those who cannot update information in English, can update the vaccine situation quickly, therefore, reducing their vaccine hesitancy.

Appendix 1. Web version

Available at: [Việt Nam ở đâu trong dòng chảy công nghệ vắc xin COVID-19?](http://suckhoedoisoing.vn)
(suckhoedoisoing.vn)

8/1/2021

Việt Nam ở đâu trong dòng chảy công nghệ vắc xin COVID-19?

Chủ Nhật, 01/08/2021 06:02 (GMT+7)

SỨC KHỎE & ĐỜI SỐNG

CƠ QUAN NGÔN LUẬN CỦA BỘ Y TẾ

f

Hà Nội 28°C / 26-30°C

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Y tế

Sức khỏe TV

Dược

Y học cổ truyền

Y học 360

Phòng mạch online

Khỏe - Đẹp

Dinh dưỡng

Giới tính

Thị trường

Nhịp cầu Nhân ái

Y HỌC 360

>

Bệnh người cao tuổi

Bệnh thường gặp

Bệnh phụ nữ

Bệnh nam giới

Bệnh trẻ em

Sức khỏe tâm hồn

Ung thư

Việt Nam ở đâu trong dòng chảy công nghệ vắc xin COVID-19?

05-01-2021 3:00 PM | Y học 360

SKDS - Thế giới vẫn đang trong tâm dịch COVID-19 với số người mắc và tử vong không ngừng tăng lên từng ngày. Do đó, việc phát minh ra một loại vắc xin an toàn và hiệu quả để chống lại dịch bệnh này là nhiệm vụ cấp bách hàng đầu của mỗi quốc gia.

BỘ TRƯỞNG Y TẾ: HOẠT ĐỘNG CHỈ ĐẠO VÀ ĐIỀU HÀNH

TIN Y TẾ, SỨC KHỎE 63 TỈNH THÀNH

Vắc xin cứu sống hàng triệu người mỗi năm bằng cách chuẩn bị khả năng phòng vệ tự nhiên của cơ thể để từ đó nhận ra và chống lại tác nhân gây bệnh. Thế giới đang ở giữa đại dịch COVID-19 và thực sự đang tồn tại một cuộc chạy đua về phát triển vắc xin an toàn và hiệu quả chống lại căn bệnh này.

Tình hình sản xuất vắc xin COVID-19 trên thế giới

Theo Theo Tổ chức y tế Thế giới (WHO), vắc xin phải chứng minh được tính hiệu quả ở ít nhất 70% số người tham gia; còn theo Cục Quản lý Thực phẩm và Dược phẩm Mỹ (FDA), con số này là 50%. Hiện nay đã có hơn 50 quốc gia tham gia sản xuất và tiến hành thử nghiệm lâm sàng vắc xin COVID-19, bước đầu đã đạt được những kết quả nhất định.

Nga là nước đầu tiên phê duyệt vắc xin COVID-19 và đã bắt đầu tiêm chủng cho người dân từ tháng 8 năm 2020 và đã triển khai trên hơn 100 000 người. Ngày 24 tháng 11, vắc xin COVID-19 của Nga, Sputnik V do Viện Gamaleya phát triển báo cáo có hiệu quả lên tới 91,4%. Ngày 30 tháng 11, công ty dược phẩm Moderna của Mỹ đã công bố dữ liệu thử nghiệm vắc xin COVID-19, cho thấy có hiệu quả là 94,1%. Công ty dược phẩm AstraZeneca của Anh cũng đang nộp đơn xin phê chuẩn vắc xin của mình sau khi công bố dữ liệu thử nghiệm về tỷ lệ hiệu quả trung bình 70% và nhiều nhất là 90% đối với một nhóm nhỏ những người tham gia thử nghiệm được tiêm nửa liều lần 1 và đủ liều lần 2. Hai nhà sản xuất dược phẩm Mỹ, Johnson & Johnson và Novavax, lên kế hoạch công bố dữ liệu thử nghiệm đầu năm 2021.

Y tế



Trưa 1/8, Hà Nội ghi nhận thêm 39 ca bệnh mới

Y tế - 4 giờ trước

SKDS - Trưa 1/8, Sở Y tế Hà Nội thông tin, từ 6h - 12h thành phố Hà Nội ghi nhận 39 ca mắc mới, trong đó, 4 ca phát hiện tại khu cách ly và 35 ca phát hiện tại cộng đồng.



11 chuyên gia của Bệnh viện K chỉ viện Đống Nai phòng chống dịch COVID-19

<https://suckhoedoisoing.vn/viet-nam-o-dau-trong-dong-chay-cong-nghe-vac-xin-covid-19-169185031.htm>

1/8

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Có hơn 50 ứng cử viên vắc-xin COVID-19 đang được thử nghiệm và đạt những bước tiến nhất định.

Ngày 3 tháng 12 năm 2020, Vương quốc Anh cho phép lưu hành vắc xin do hãng Pfizer và BioNTech phối hợp phát triển để phòng ngừa COVID-19. Đây là quốc gia phương Tây đầu tiên triển khai tiêm chủng đại trà vắc xin này. Tiếp sau đó, Mỹ, Canada, Singapore, Baren, Mexico, Pháp và Ủy ban châu Âu cũng đã phê duyệt cho phép sử dụng loại vắc xin này. Tuy hiệu quả cao hơn 90%, vắc xin này gây khó khăn trong quá trình vận chuyển khi đòi hỏi các phương tiện bảo quản có hệ thống làm lạnh âm sâu (-70 đến -80 độ C).

Tại Trung Quốc, kết quả thử nghiệm lâm sàng giai đoạn 3 được công bố ngày 30 tháng 12 cho thấy, vắc xin COVID-19 được phát triển bởi công ty China National Biotec Group Co. thuộc tập đoàn dược phẩm Sinopharm có hiệu quả 79,34% chống lại COVID-19. Vắc xin này cũng đã được thử nghiệm trên 31 000 tình nguyện viên ở tiểu vương quốc Ả Rập Thống Nhất. Kết quả cho thấy hiệu quả lên tới 86% và không gây có biến chứng nghiêm trọng nào. Vắc xin có thể được vận chuyển và bảo quản ở nhiệt độ tủ lạnh bình thường. Kết quả này đáp ứng các yêu cầu về tiêu chuẩn kỹ thuật của Tổ chức Y tế Thế giới và các tiêu chuẩn do Cục Quản lý sản phẩm Y tế Quốc gia Trung Quốc quy định. Hiện sản phẩm vắc xin này đang chờ phê duyệt từ Cục Quản lý sản phẩm Y tế Quốc gia Trung Quốc để phân phối trên thị trường.

Việt Nam trong dòng chảy công nghệ vắc xin COVID-19

Tại Việt Nam, các nhà sản xuất vắc xin COVID-19 trong nước đang nỗ lực đẩy mạnh tiến độ phát triển vắc xin. Ba đơn vị IVAC, VABIOTECH và NANOGEN đã hoàn thiện quy trình sản xuất quy mô phòng thí nghiệm và hiện đang đánh giá tính an toàn, tính sinh miễn dịch của vắc xin trên động vật. Ngày 10 tháng 12 năm 2020, vắc xin Nano Covax - vắc xin COVID-19 sản xuất bởi công ty NANOGEN, đã thử nghiệm lâm sàng giai đoạn 1 trên tình nguyện viên. Để khẳng định tính an toàn và tìm liều lượng thích hợp, giai đoạn 1 dự kiến sẽ được triển khai trên 60 tình nguyện viên với 3 liều: 25 mcg, 50 mcg và 75 mcg. Sau đó, giai đoạn 2 dự kiến sẽ được triển khai trên 400 - 600 người và giai đoạn 3 cần tối thiểu 3 000 người cho tới 30 000 người. Song song với việc triển khai giai đoạn 1, các đơn vị liên quan đang chuẩn bị cho thử nghiệm vắc xin Nano Covax giai đoạn 2 và 3. Thủ tướng giao Bộ Y tế chủ trì việc theo dõi và thúc đẩy tiến độ thử nghiệm lâm sàng vắc xin Nano Covax nhằm sớm có vắc xin trong nước, đặc biệt là trong việc tìm kiếm đối tác nước ngoài chuẩn bị thử nghiệm lâm sàng giai đoạn 3 cũng như chuẩn bị phương án cho sản xuất quy mô công nghiệp. Tính tới cuối năm 2020, không ghi nhận bất kỳ phản ứng bất thường nào trên tất cả các tình nguyện viên tiêm vắc xin Nano Covax giai đoạn 1.



Y tế - 4 giờ trước



Chiến dịch tiêm 1 triệu liều vaccine ngừa COVID-19 ở Bình Dương

Y tế - 7 giờ trước

Y học cổ truyền



Vị thuốc tử xơ mướp trị môi gối, nhức cơ

Y học cổ truyền - 4 giờ trước

SKDS- Xơ mướp được sử dụng trong Đông y và kinh nghiệm dân gian từ lâu đời. Xơ mướp được cấu tạo bằng những sợi nhỏ, chất dai, kết chặt vào nhau. Xơ mướp khô sạch trắng, không còn sót vỏ và hạt lấy tên thuốc là ty qua lạp.



Chuối - Thực phẩm bổ dưỡng, vị thuốc hay trị nhiều bệnh

Vị thuốc quanh ta - 5 giờ trước



Vai trò của tạng phế và bài thuốc phế khí thũng

Thầy giỏi - thuốc hay - 8 giờ trước

Blog thầy thuốc



"Làm nghề y ấy là lúc nào cũng phải nghĩ đến người bệnh"

Blog thầy thuốc - 9 giờ trước

SKDS- Bà ngoại khuyên tôi như vậy kh. quyết định thi vào Đại học Y Hà Nội



Bệnh viện vào trưa ngày giãn cách xã hội

Blog thầy thuốc - 2 ngày trước



Những chiến binh áo xanh trong khu cách ly

Blog thầy thuốc - 6 ngày trước



Vắc xin Nano Covax do Việt Nam sản xuất đã đưa vào thử nghiệm giai đoạn 1 bước đầu đạt kết quả khả quan.

Dự kiến trong tháng 1 năm 2021 này vắc xin Covivac - vắc xin COVID-19 thứ 2 của Việt Nam do Viện Vắc xin và sinh phẩm (IVAC) nghiên cứu cũng được tiến hành thử nghiệm trên người.

Những vấn đề đặt ra

Bên cạnh những thành công ban đầu trên đường đua vắc xin COVID-19 này, các câu hỏi được đặt ra là "Liệu tính an toàn của các loại vắc xin này có được duy trì khi tiêm vắc xin đại trà cho hàng triệu và có thể hàng tỷ người không? Có thể các tác dụng không mong muốn sẽ xuất hiện khi tiêm nhiều người và thời gian lâu hơn?". "Việc triển khai một loại vắc-xin yêu cầu hai liều có phù hợp không khi một số lượng lớn người nhận có thể bỏ lỡ liều thứ hai?". "Vắc xin sẽ có hiệu lực trong bao lâu?". "Liệu vắc xin có thể ngăn ngừa sự lây truyền từ các ca bệnh không triệu chứng không?" hoặc "Liệu vắc xin có an toàn đối với một số nhóm người dễ bị tổn thương như trẻ em, phụ nữ mang thai và bệnh nhân suy giảm miễn dịch không". Tất cả những câu hỏi đó đang cần được giải đáp trong thời gian sắp tới nhưng có một điều mà tất cả các quốc gia đều thừa nhận, vắc xin chỉ là một trong các biện pháp can thiệp khống chế dịch, tất cả các biện pháp khác nhằm đảm bảo hạn chế lây lan như hiện nay chúng ta đang thực hiện tốt vẫn rất cần thiết bởi vì rút biến đổi không ngừng, nếu để chúng tự do phát triển sẽ có rất nhiều biến chứng được tạo ra và nỗ lực trong việc sản xuất vắc xin sẽ mất tác dụng.

CN. Hoàng Thị Ngọc Anh - TS. BS. Phạm Quang Thái (Viện Vệ sinh dịch tễ Trung ương)

Chia sẻ facebook

Like 0



Appendix 2. Printed version

IO

THÔNG TIN Y DƯỢC

Số 3 - Ngày 5/1/2021 **Sức Khỏe & Đời sống** Thứ ba

Vắc-xin cứu sống hàng triệu người mỗi năm bằng cách chuẩn bị khả năng phòng vệ tự nhiên của cơ thể để từ đó nhận ra và chống lại tác nhân gây bệnh. Thế giới đang ở giữa đại dịch COVID-19 và thực sự đang tồn tại một cuộc chạy đua về phát triển vắc-xin an toàn và hiệu quả chống lại căn bệnh này.

Tình hình sản xuất vắc-xin COVID-19 trên thế giới

Theo Tổ chức Y tế Thế giới (WHO), vắc-xin phải chứng minh được tính hiệu quả ở ít nhất 70% số người tham gia; còn theo Cục Quản lý Thực phẩm và Dược phẩm Mỹ (FDA), con số này là 50%. Hiện nay đã có hơn 50 quốc gia tham gia sản xuất và tiến hành thử nghiệm lâm sàng vắc-xin COVID-19, bước đầu đã đạt được những kết quả nhất định.

Nga là nước đầu tiên phê duyệt vắc-xin COVID-19, bắt đầu tiêm chủng cho người dân từ tháng 8/2020 và đã triển khai trên hơn 100.000 người. Ngày 24/11, vắc-xin COVID-19 của Nga, Sputnik V do Viện Gama-leya phát triển báo cáo có hiệu quả lên tới 91,4%. Ngày 30/11, Công ty Dược phẩm Moderna của Mỹ đã công bố dữ liệu thử nghiệm vắc-xin COVID-19, cho thấy có hiệu quả là 94,1%. Công ty Dược phẩm AstraZeneca của Anh cũng đang nộp đơn xin phê chuẩn vắc-xin của mình sau khi công bố dữ liệu thử nghiệm về tỷ lệ hiệu quả trung bình 70% và nhiều nhất là 90% đối với một nhóm nhỏ những người tham gia thử nghiệm được tiêm nửa liều lần 1 và đủ liều lần 2. Hai nhà sản xuất dược phẩm Mỹ, Johnson & Johnson và Novavax, lên kế hoạch công bố dữ liệu thử nghiệm đầu năm 2021.

Ngày 3/12/2020, Vương quốc Anh cho phép lưu hành vắc-xin do hãng Pfizer và BioNTech phối hợp phát triển để phòng

Việt Nam ở đâu trong dòng chảy công nghệ vắc-xin COVID-19?

> CN. HOÀNG THỊ NGỌC ANH - TS. BS. PHẠM QUANG THÁI
(Viện Vệ sinh dịch tễ Trung ương)

Thế giới vẫn đang trong tâm dịch COVID-19 với số người mắc và tử vong không ngừng tăng lên từng ngày. Do đó, việc phát minh ra một loại vắc-xin an toàn và hiệu quả để chống lại dịch bệnh này là nhiệm vụ cấp bách hàng đầu của mỗi quốc gia.



Vắc-xin Nano Covax do Việt Nam sản xuất đã đưa vào thử nghiệm giai đoạn 1.

trình sản xuất quy mô phòng thí nghiệm và hiện đang đánh giá tính an toàn, tính sinh miễn dịch của vắc-xin trên động vật. Ngày 10/12/2020, vắc-xin Nano Covax sản xuất bởi Công ty NANOGEN, đã thử nghiệm lâm sàng giai đoạn 1 trên tình nguyện viên. Để khẳng định tính an toàn và tìm liều lượng thích hợp, giai đoạn 1 dự kiến sẽ được triển khai trên 60 tình nguyện viên với 3 liều: 25mcg, 50mcg và 75mcg. Sau đó, giai đoạn 2 dự kiến sẽ được triển khai trên 400-600 người và giai đoạn 3 cần tối thiểu 3.000 người cho tới 30.000 người. Song song với việc triển khai giai đoạn 1, các đơn vị liên quan đang chuẩn bị cho thử nghiệm vắc-xin Nano Covax giai đoạn 2 và 3. Thủ tướng giao Bộ Y tế chủ trì việc theo dõi và thúc đẩy tiến độ thử nghiệm lâm sàng vắc-xin Nano Covax nhằm sớm có vắc-xin trong nước, đặc biệt là trong việc tìm kiếm đối tác nước ngoài chuẩn bị thử nghiệm lâm sàng giai đoạn 3 cũng như chuẩn bị phương án cho sản xuất quy mô công nghiệp. Tính tới cuối năm 2020, không ghi nhận bất kỳ phản ứng bất thường nào trên tất cả các tình nguyện viên tiêm vắc-xin Nano Covax giai đoạn 1.

Dự kiến trong tháng 1 năm 2021 này vắc-xin Covivac - vắc-xin COVID-19 thứ 2 của

Những vấn đề đặt ra

Bên cạnh những thành công ban đầu trên đường đua vắc-xin COVID-19 này, các câu hỏi được đặt ra là "Liệu tính an toàn của các loại vắc-xin này có được duy trì khi tiêm nhiều người và thời gian lâu hơn?", "Việc triển khai một loại vắc-xin yêu cầu 2 liều có phù hợp không khi một số lượng lớn người nhận có thể bỏ lỡ liều thứ 2?", "Vắc-xin sẽ có hiệu lực trong bao lâu?", "Liệu vắc-xin có thể ngăn ngừa sự lây truyền từ các cá thể không triệu chứng không?" hoặc "Liệu vắc-xin có an toàn đối với một số nhóm người dễ bị tổn thương như trẻ em, phụ nữ mang thai và bệnh nhân suy giảm miễn dịch không?". Tất cả những câu hỏi đó đang cần được giải đáp trong thời gian sắp tới. Nhưng có một điều mà tất cả các quốc gia đều thừa nhận, vắc-xin chỉ là một trong các biện pháp can thiệp không chế dịch, tất cả các biện pháp khác nhằm đảm bảo hạn chế lây lan như hiện nay chúng ta đang thực hiện tới vẫn rất cần thiết, bởi virus biến đổi không ngừng, nếu để chúng tự do phát triển sẽ có rất nhiều biến chủng được tạo ra và nỗ lực trong việc sản xuất vắc-xin sẽ không còn tác dụng. □

Appendix 3. Translated version

"The impact of vaccination on the people health of the world's people is hard to exaggerate. With the exception of safe water, no other modality, not even antibiotics, has had such a major effect on mortality reduction and population growth".

Susan Plotkin and Stanley Plotkin had stated in the first edition of the major textbook Vaccines in 1988.

In fact, vaccines save millions of lives every year by working with the body's natural defenses to build protection. The key element makes vaccines effective is the memorial ability of immune systems. Once exposed to one or more doses of a vaccine, the body typically remains diseases' protection for years, decades, or even a lifetime. In the midst of the COVID-

19 pandemic, we are witnessing a race to develop safe and effective vaccines against SARS-CoV-2.

According to <https://clinicaltrials.gov> - a website that constantly updates COVID-19 vaccine clinical trials and their results, more than 50 COVID-19 vaccine candidates have been or are being developed. Once safe and effective vaccines are found, the COVAX alliance - an international organization aimed to improve access to new and underused vaccines for the world's poorest countries, facilitated access and equitable distribution of COVID-19 vaccines to protect people in all countries. This alliance is co-led by The World Health Organization (WHO), the Global Alliance for Vaccines and Immunizations (GAVI), and the Coalition for Improved Epidemic Preparedness (CEPI). COVAX also assure that susceptible groups such as healthcare workers and older people are given priority for the vaccination. By the end of December 2020, COVAX has purchased about 2 billion doses of the COVID-19 vaccine for low-income and middle-income countries worldwide.

Until December 2020, there is no vaccine in the world that has been shown to be truly effective against the infection of SARS-CoV-2. However, from August 2020, some countries such as Russia have approved the COVID-19 vaccine for use under the emergent situation. In December 2020, publications in the leading journal of medicine - New England Journal Medicine, confirmed the early success of the COVID-19 vaccine in some countries. According to WHO, the vaccine must have proven to be effective in at least 70% of participants; this figure is 50% as stated by the US Food and Drug Administration (FDA).

Russia was the first country to approve the COVID-19 vaccine and has started mass vaccination since August 2020. So far, they vaccinated more than 100,000 people in their country. On November 24, the Russian COVID-19 vaccine - Sputnik V developed by the Gamaleya Institute, reported 91.4% efficacy. On November 30, Moderna - the US pharmaceutical company, released COVID-19 vaccine test results of 94.1% efficacy. UK pharmaceutical company - AstraZeneca, is also applying for its vaccine approval after releasing findings of 70% to 90% from a trial on the small number of volunteers. They were given a half-dose for the first time and a full dose for the second. Two US pharmaceutical manufacturers - Johnson & Johnson and Novavax, plan to release results of trial data as early as 2021.



Figure 1. More than 50 COVID-19 vaccine candidates have been or are being developed

On 3 December 2020, the UK approved to circulate the COVID-19 vaccine named Pfizer and BioNTech as action in an urgent circumstance. It marked as the first Western country launched the mass vaccination. Following that, the United States, Canada, Singapore, Baren, Mexico, France, and the European Commission also approved the use of Pfizer and BioNTech in their countries. Although results showed >90% effectiveness, this vaccine challenges mass distribution since it requires cold-storage at -70 to -80 degrees C.

In China, the results of Phase III of a clinical trial published on December 30 showed that the COVID-19 vaccine was developed by China National Biotec Group Co. (under the pharmaceutical group Sinopharm) had ~80% effectiveness against SARS-CoV-2. The vaccine has also been tested outside China i.e., on 31,000 volunteers in the United Arab Emirates and it shows prominent results with 86% effectiveness and did not cause any serious complications. Therefore, this vaccine meets the WHO's effective requirements of the COVID-19 vaccine (>70%). Moreover, it can be transported and stored at normal refrigerator temperatures. At the end of 2020, this vaccine is awaiting approval from the China National Health Product Administration for mass vaccination.

In Vietnam, manufacturers are making efforts to speed up the progress of COVID-19 vaccine development. Three companies i.e., IVAC, VABIOTECH, and NANOGEN, have completed them in the laboratory. Vaccines of IVAC and VABIOTECH are evaluating the safety and immunogenicity in animals. Nano Covax vaccine manufactured by NANOGEN went a step further. On 10 December 2020, the company has conducted Phase I of a clinical trial on volunteers to confirm safety and find the appropriate dose. The proposed sample size of Phase I is 60 volunteers with three doses: 25 mcg, 50 mcg, and 75 mcg. Phase II is expected on 400-600 people and this figure increases to a minimum of 3,000 people to phases III.

Materials and people for Phases II and III are being prepared while Phase I is implementing. The Prime Minister assigned the Ministry of Health to monitor and accelerate the progress of clinical trials. As of the end of 2020, no complications have been reported among all volunteers receiving the Nano Covax vaccine in Phase I.



Figure 2. Nano Covax vaccine has conducted Phase I of a clinical trial on volunteers to confirm safety and find the appropriate dose

Some questions arise with the successes of the COVID-19 vaccine. “Will the safety of these vaccines be maintained when mass vaccination of millions and billions of people? Maybe complications will appear after monitored time?”; “The appropriateness of deploying two-doses vaccines since a large number of recipients may miss the second dose?”; “How long will the effective protection of vaccine last?”; “Can vaccines prevent transmission from asymptomatic cases?”; or “Is the vaccine safe for certain vulnerable groups such as children, pregnant women, and immunocompromised patients?”. Researchers and scientists are making efforts to discover these questions. However, we should acknowledge that vaccine is one of the COVID-19 public health interventions; it will not work alone to cover all effects of COVID-19. We need to incorporate the number of containments to control the pandemic effectively.

Ngoc-Anh Hoang, Thai Quang Pham

Department of Epidemiology, National Institute of Hygiene and Epidemiology

2. Lesson from the field and teaching from the field

Prologue

Background

The rapid development of technology had a significant impact on survey methodology. In the traditional method, we are faced with the abundance of “junk” mail that renders postal mail surveys ineffective; and for many researchers, the cost of face-to-face survey administration is prohibitive. The increasing use of smartphones, low-cost computing, and the rapid growth of the Internet makes online surveys a promising way to deal with many of these issues. Like all research methods, online survey research has benefits and drawbacks; the method works well for some research projects but is by no means an appropriate data collection tool for all.

My role

I prepared one lesson for both requirements “Lesson from the field (LFF)” and “Teaching from the field (TFF)”. The aim of both sections were to address the benefits and drawbacks of the online questionnaire, to develop and conduct an online survey on KoBoToolbox’s web, and to develop and conduct an online survey by importing Excel data into KoBoToolbox (Optional).

My audience at LFF is my MAE cohorts while my audience at TFF is my colleagues in the field placement. Both LFF and TFF lasted more than one hour. This was the first time I presented to my cohorts and colleagues as a “lecturer”. I received a lot of comments from participants in both sessions, not all of them were positive but very contributable. I also received lots of encouragement from my supervisors and other teachers at NCEPH. Even having two years of experience with Kobotoolbox, I updated many new things when preparing this section.

Lessons learned

One important lesson from both LFF and TFF is careful preparation and always knowing about the audience before each section. Even though both LFF and TFF contained similar content, the concentration is different. In my LFF, the audience is my cohorts. I spent more time explaining the coding which I used to create an online questionnaire by importing excel data into Kobotoolbox. On the other hand, in my TFF, my audience is experienced field epidemiologists and public health; they cared much about the application of the Kobotoolbox for their current work. Therefore, my presentation focused on how to operate the tool, what is

its capacity (the maximum of forms that can be received per day), and how to manage the form when the survey was conducted offline.

Public health impact

Learning by teaching is a good way to learn how to carefully prepare materials for the right audience. In my lesson, I did compare the advantages and disadvantages of both online survey vs. traditional paper survey. Although online questionnaire showed many advantages, it limited target audience to those who have e-mail and internet access. Some respondents can easily quit in the middle of a questionnaire. Furthermore, there are numerous choices of software packages and online survey companies. The products vary greatly in cost, ease of use, and flexibility. The novice may find the choices daunting. For some projects without funding, choosing a software for online survey placed under a careful consideration. I also did introduce a helpful and free software to create and manage online survey – Kobotoolbox. It is a free suite of tools used for digital field data collection on mobile devices or laptop computers. Data can be collected without an internet connection, making it compatible with challenging environments.

Recommendation

For an online survey, choosing software to employ the survey is depended on many factors, such as the experience of researchers, funding of projects, etc. I did introduce free online software to create and manage online surveys in small and medium scope. Although having some limitations, such as limiting the number of received forms per day to under 1000, and freezing if constrain the large volume of uploaded forms, I recommend using this tool for small to medium surveys, especially for projects without funding.

Appendix 1. Lesson from the field

1.1. Pre-reading material

Ngoc-Anh Hoang (u7062793)
Master of Applied Epidemiology's Scholar, ANU

Lessons from the field: How to build an online questionnaire on KoBoToolbox

Created by Ngoc-Anh Hoang

With input from Dr. Florian Vogt

Background

The rapid development of technology had a significant impact on survey methodology. In the traditional method, we faced with the abundance of “junk” mail that renders postal mail surveys ineffective; and for many researchers, the cost of face-to-face survey administration is prohibitive. The increasing use of smartphones, low-cost computing, and the rapid growth of the Internet makes online survey is a promising way to deal with many of these issues. Like all research methods, online survey research has benefits and drawbacks; the method works well for some research projects but is by no means an appropriate data collection tool for all.

Objectives

By the end of this LFF you should be able to:

- Address the benefits and drawbacks of the online questionnaire
- Develop and conduct an online survey on KoBoToolbox's web
- Develop and conduct an online survey by importing Excel data into KoBoToolbox (*Optional*)

Instructions

- Prior to the online session, please read Part 1 and complete the associated exercises as well as try to build an online questionnaire on KoBoToolbox.
- Please bring this document to the online session (Part 2) to revisit the content and discuss the answers as a group.

At any time, please feel free to contact me via email (ngoc-anh.hoang@anu.edu.au) or via WhatsApp (+84 86 577 0967) if you need to discuss any further questions.

Lesson Overview

Part 1: Build an online questionnaire on KoBoToolbox (complete individually)

This is to be completed in prior to our session together

- 1.1. Introduction to online questionnaire
- 1.2. Steps to build an online questionnaire on KoBoToolbox
- 1.3. Create an online questionnaire on KoBoToolbox's web
- 1.4. Create an online questionnaire by importing excel data into KoBoToolbox
(optional)

Part 2: Online LFF session (complete as a group)

This will be completed together as a group on the April 2021 via zoom

- 2.1. Revisit and discuss Part 1's content and answers
- 2.2. Discuss possible ways to create an online survey
- 2.3. Evaluate the LFF

Lesson

Part 1: Build an online questionnaire on KoBoToolbox

1.1. Introduction to an online questionnaire

Please read the attached reference for the introduction to using online questionnaire and the knowledge from the Stephanie Main's LFF and complete questions:

Q1. Apart from the online survey, what are the "traditional methods" for administering surveys?

Mail
Telephone
Face-to-face interview

Q2. What are the benefits and drawbacks of the above traditional methods?

Survey type	Advantages	Disadvantages
Mail	- Low cost - Wide geographic reach - No interviewer bias - Anonymity allows sensitive questions	- Low response rate - Lengthy response period - Contingency questions not effective - Don't know who is responding to the survey
Telephone	- Limited coverage bias - Speedy responses - Can ask complex questions - Wide geographic reach	- Confuse with sales calls - Intrusive - Call screening - No visual support
Face-to-face interview	- Good response rates - Can ask complex questions - Long interviews tolerated	- Limited geographic reach - Time-consuming - Expensive - Interviewer bias - Sensitive topics difficult to explore

Q3. What are the advantages and disadvantages of the online questionnaire?

Advantages	Disadvantages
Speed: If posted on a popular Web site, a questionnaire has the potential to gather thousands of responses within hours.	Limited target audience: limited to those who have e-mail and/or Internet access
Audience: You can post the link on numerous Web sites with the permission and cooperation of the site's owner. This could broaden your audience as you could have the link located on sites whose audience consists of researchers, teachers, children, students, and so on.	Abandonment of the survey: Respondents can easily quit in the middle of a questionnaire
Economy: Web surveys are the most economical means by which to collect data from	Dependence on software: There are numerous choices of software

large numbers of respondents who may be geographically dispersed. After the initial set-up costs (software, Web hosting, etc.), it costs no more to target large samples than small ones. Moreover, direct data entry eliminates the need for data-entry personnel, thus further reducing costs.	packages and online survey companies. The products vary greatly in cost, ease of use, and flexibility. The novice may find the choices daunting.
Added content options: Many Web survey hosts and software packages offer the facility to embed images, audio, and video files. This may increase the time it takes for the Web page to load, so these options should be employed judiciously.	
Expanded question types: Web page questionnaires can include a wide variety of question types and can be programmed to skip questions when necessary, ensuring more accurate data than when respondents are asked to skip questions in an e-mail questionnaire.	
The ability to ask sensitive questions: Web surveys are similar to other forms of self-administered surveys in that there is no researcher present and participants complete the questionnaire at their own pace. This type of self-administered format has been shown to be optimal for inquiring about sensitive or embarrassing information.	

Ngoc-Anh Hoang (u7062793)
Master of Applied Epidemiology's Scholar, ANU

Anonymity is preserved: There is no e-mail address linked to a Web survey response.	
--	--

Q4. In your opinion, which methods bring better quality of data? Traditional or Online Surveys? And Why?

Because its question on opinion, I leave it to yours.

1.2. Step to build an online questionnaire on KoBoToolbox

What is the KoBoToolbox?

- A free suite of tools used for digital field data collection on mobile devices or laptop computers
- Created by researchers at Harvard University for use by field researchers and humanitarian organizations
- Data can be collected without an internet connection, making it compatible with challenging environments

Why KoBoToolbox?

- User-friendly:
 - Easy to use
 - Forms can be translated into any language
 - Compatible with Excel
- Increased efficiency:
 - Faster than pen and paper data collection
 - One-step submission process
 - Data can be sent immediately to the office for faster turn-around time
- Produces better data:
 - Reduces human error in transferring data from paper to computer
 - Uniform response styles make it easier to compare and analyze data

Steps in the survey process

The basic steps in the survey process are the same for all types of surveys:

Step 1: Define objectives

- Determine what you want to know and why
- Think about who will look at the results
- Consider the influence of external funding sources

Step 2: Define the population and choose a sampling frame

- Look for an existing sampling frame or create a sampling frame
- Consider probability and nonprobability sampling strategies

Step 3: Design a data collection strategy

- Evaluate time and budget constraints
- Estimate available resources
- Choose a survey administration method

Step 4: Develop a questionnaire

- Write the questions
- For the online questionnaire on KoKoToolbox:
 - + Create a free account on KoBoToolbox website (will be detailed in section 1.3)
 - + Build the online questionnaire via web or importing from Excel
 - + Pretest the questionnaire for technical issues
- Pilot the questionnaire for content
- Adjust the content based on pilot findings

Step 5: Collect data

- Monitor responses
- Employ follow-ups as needed

Step 6: Manage the data

- Create a codebook
- Input data (for traditional methods) or export data (for online questionnaire)
- Clean data
- Transform data

Step 7: Analyze the data

Step 8: Disseminate the results; for example, write a report or give an oral presentation.

1.3. Create an online questionnaire on KoBoToolbox's web

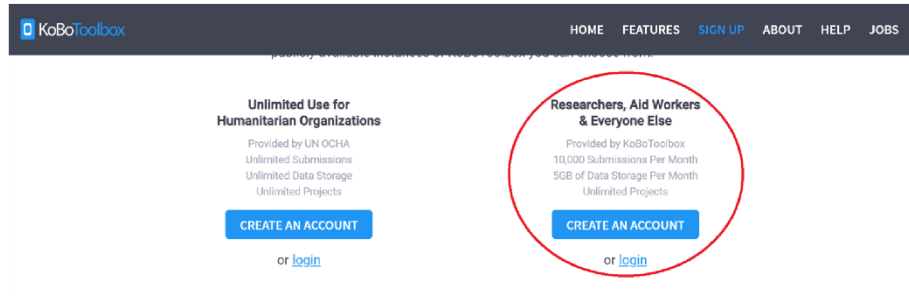
In this section, please find the supplement for the questionnaire.

Step 1: Sign up for a free account and login

- Go to the website: [KoBoToolbox | Data Collection Tools for Challenging Environments](#)

Ngoc-Anh Hoang (u7062793)
Master of Applied Epidemiology's Scholar, ANU

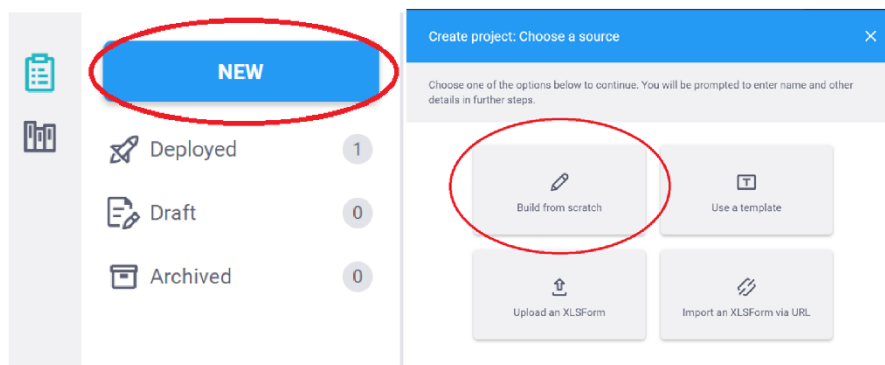
- Choose Sign up section -> Create an account for researchers, aid workers and everyone else



- Login to the account

Step 2: Create a project

Click on the “New” button -> Choose “Build from scratch” -> Enter the Project Name, Description, Sector, Country-> Click on “Create Project button”



Create project: Project details

Project Name
Sample Survey Questionnaire

Description
Example in the lesson from the field

Please specify the country and the sector where this project will be deployed.

Sector
Humanitarian - Health

Country
Viet Nam

☐ Help KoboToolbox improve this product by sharing the sector and country where this project will be deployed. All the information is submitted anonymously, and will not include the project name or description listed above.

BACK CREATE PROJECT

Step 3: Enter the question

- Click on the '+' sign to add questions

This form is currently empty.
You can add questions, notes, prompts, or other fields by clicking on the '+' sign below.

- Enter the question and choose "+ add question"

A1. Participant ID

+ ADD QUESTION

- Define the type of answer for the question: For question A1 (participant ID), participants will enter integer with the range from 1000 to 9999 -> choose "Number".



A1. Participant ID:

Select One

Select Many

abc Text

123 Number

1.0 Decimal

Date

Time

Date & time

Point

Photo

Audio

Video

Line

Note

Barcode / QR Code

Acknowledge

Area

Rating

Question Matrix

Ranking

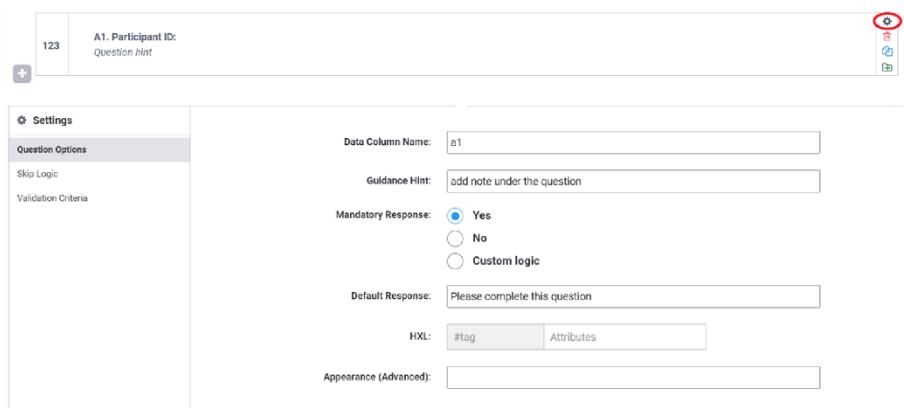
1+1 Calculate

Hidden

File

1..1 Range

- Change variable name to manage data for analysis: Click on the setting symbol -> change automatic variable name *A1_Participant_ID* to *a1* in the "Data Column Name".
Optional: Enter "Guidance Hint" if you would like to add a hint under the question.
Choose "Mandatory Response" as Yes if this question is required to answer. Respondent cannot submit when leaves it blanks. Enter "Default Response" to add a messenger alert if the respondent skip the mandatory question.



123 A1. Participant ID:
Question hint

Settings

Question Options

Skip Logic

Validation Criteria

Data Column Name: a1

Guidance Hint: add note under the question

Mandatory Response: ☒ Yes
☐ No
☐ Custom logic

Default Response: Please complete this question

HXL: #tag Attributes

Appearance (Advanced):

- Define the condition of ranging from 1000 to 9999: In the settings, choose "Validation Criteria". Add the condition for the question as follows.

- Click on the setting again to complete the question

Repeat to this step for each question.

Q5. Use the information below to create Question A2 to B2

Question	Answers' types
A2. Collect GPS of the place	Point
A3. Do you want to participate in our survey?	Select One ☐ Yes ☐ No
A4. Collect participant Photo	Photo
A5. Date of birth of participant	Date
A6. Address	Text
A7. How many members are there in your family?	Number
B1. Do you fever in past 6 months?	Select One ☐ Yes ☐ No
B1.1. How many day fever persist? (enter 1.5 days if the fever persist one and a half of a day)	Decimal
B1.2. Where do you go for the treatment? <i>Multiple choices with options: Hospital, Polyclinic, Self-treatment</i>	Select Many ☐ Hospital ☐ Polyclinic ☐ Self-treatment

B2. What do you think fever is caused by? <i>Multiple choices with options: Virus, pollution, alcohol, online learning</i>	 Select Many ☐ Virus ☐ Pollution ☐ Alcohol ☐ Online learning ☐ Virus ☐ Pollution ☐ Alcohol ☐ Online learning
--	---

Q6. (Optional) Try to create condition that if B1 = “no”, go to Question B2 and skip Questions B1.1; B1.2.

Hint: Go to setting symbols -> Choose “Skip Logic”

Step 3: Save and deploy

- Click on “Save” and close symbols in the upper right hand side.



- Choose “Deploy”. To copy and open the questionnaire using the options “COPY” and “OPEN” below (these options appear after deploying the questionnaire)

v1 Last Modified : Today at 6:31 PM - 0 questions

REDEPLOY

Languages: This project has no languages defined yet

Collect data

Online-Offline (multiple submission)

COPY OPEN

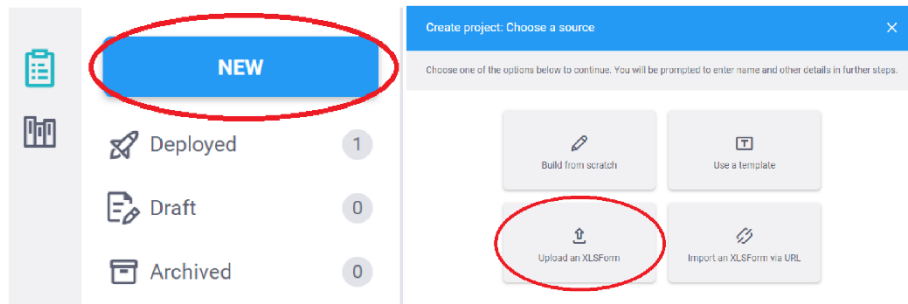
This allows online and offline submissions and is the best option for collecting data in the field.

1.4. (Optional) Create an online questionnaire by importing excel data into KoBoToolbox

Used the supplement “2. LFF_KoBoToolbox_xmlform”

Click on the “New” button -> Choose “Upload an XLSForm” -> Enter the Project Name, Description, Sector, Country-> Click on “Create Project button”

Go to **Step 3**



Part 2: Online LFF session

- 2.1. Revisit and discuss Part 1's content and answers (45')
- 2.2. Discuss possible ways to create an online survey (10')
- 2.3. Evaluate the LFF (5')

Supplement: Sample Survey Questionnaire

They are not real questionnaire. They are only for the lesson from the field presentation

A. GENERAL INFORMATION

A1. Participant ID: _____

(range of Household for our survey is from 1000 to 9999)

A2. Collect GPS of the place:

A3. Do you want to participate in our survey? Yes/No

A4. Collect participant Photo:

A5. Date of birth of participant (manual date entry):

A6. Address:

A7. How many members are there in your family?

B. FEVER

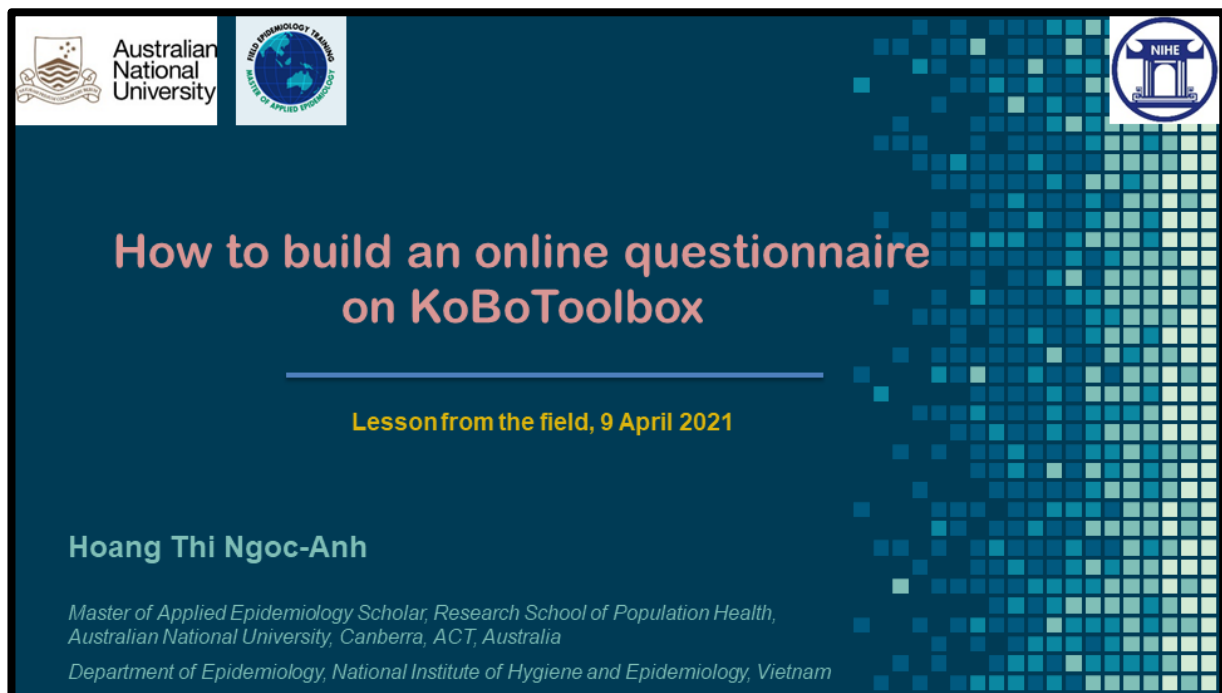
B1. Do you fever in past 6 months? Yes/No **(Condition: If no, go to B2)**

B1.1. How many day fever persist?

B1.2. Where do you go for the treatment? Options: Hospital, Polyclinic, Self-treatment

B2. What do you think fever is caused by? Options: Virus, pollution, alcohol, online learning

1.2. Lesson presentation



 Australian National University

 NIHE

How to build an online questionnaire on KoBoToolbox

Lesson from the field, 9 April 2021

Hoang Thi Ngoc-Anh

Master of Applied Epidemiology Scholar, Research School of Population Health, Australian National University, Canberra, ACT, Australia
Department of Epidemiology, National Institute of Hygiene and Epidemiology, Vietnam

Acknowledgement

- Dr. Florian Vogt, my academic supervisor at Australian National University
- The Commonwealth Department of Foreign Affairs and Trade, the ASEAN-Australia Health Security Fellowship Program
- National Centre for Epidemiology and Population Health, Research School of Population Health, College of Health and Medicine, the Australian National University
- National Institute of Hygiene and Epidemiology
- My family and friends

2

Outline

Section A: Introduction (15 mins)

Section B: Steps to build an online questionnaire (10 mins)

Section C: Create a questionnaire on KoBoToolbox's web (20 mins)

Section D: Create a questionnaire by importing excel data into KoBoToolbox (10 mins)

Section E: Evaluation and Feedbacks (5 mins)

3

Section A: Introduction to online survey

Types of “traditional” survey methods?

[PollEv.com/ngocanhhoang791](https://www.poll-ev.com/ngocanhhoang791)

4

Section A: Introduction to online survey

Survey type	Advantages	Disadvantages
Mail	- Low cost - Wide geographic reach - No interviewer bias - Anonymity allows sensitive questions	- Low response rate - Lengthy response period - Contingency questions not effective
Telephone	- Speedy responses - Can ask complex questions - Wide geographic reach	- Confuse with sales calls - Intrusive - No visual support
Face-to-face interview	- Good response rates - Can ask complex questions - Long interviews tolerated	- Limited geographic reach - Time-consuming - Expensive - Interviewer bias - Sensitive topics difficult to explore

5

Section A: Introduction to online survey

An online survey is a structured questionnaire; target audience completes over the internet generally through a filling out a form

Advantages and disadvantages of the online survey?

[PollEv.com/ngocanhhoang791](https://www.poll-ev.com/ngocanhhoang791)

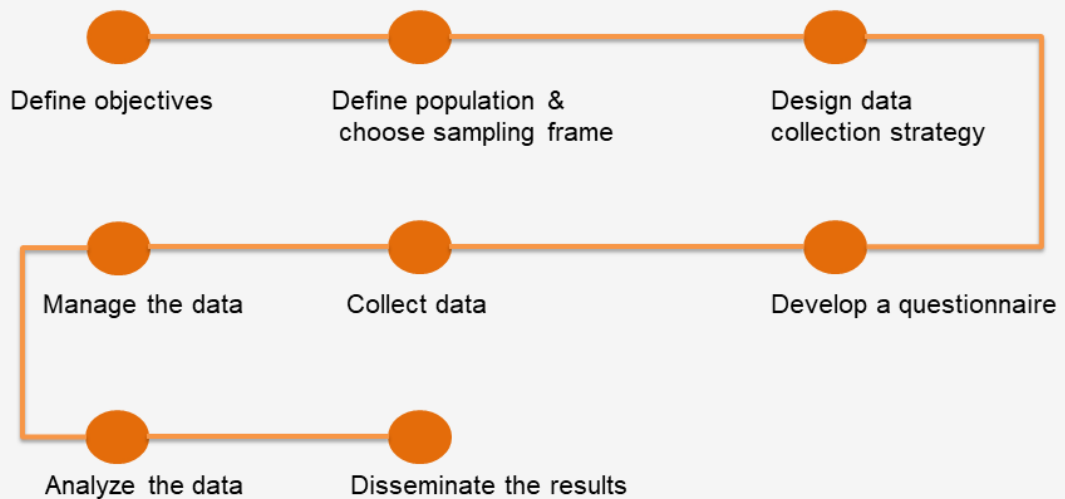
6

Section A: Introduction to online survey

Advantages	Disadvantages
- Speedy - Audience - Economy - Added content options - Expanded question types - The ability to ask sensitive questions - Anonymity is preserved	- Limited target audience - Abandonment of the survey - Dependence on software

7

Section B: Steps to build an online questionnaire



8

Section C: Create an online questionnaire on KoBoToolbox's web

Go to the website: [KoBoToolbox | Data Collection Tools for Challenging Environments](#)

And let practices together

9

Create an online questionnaire on KoBoToolbox's web

A. GENERAL INFORMATION

A1. Participant ID: _____

(range of Household for our survey is from 1000 to 9999)

A2. Collect GPS of the place:

A3. Do you want to participate in our survey? Yes/No

A4. Collect participant Photo:

A5. Date of birth of participant (manual date entry):

A6. Address:

A7. How many members are there in your family?

B. FEVER

B1. Do you fever in past 6 months? Yes/No **(Condition: If no, go to B2)**

B1.1. How many day fever persist?

B1.2. Where do you go for the treatment? Options: Hospital, Polyclinic, Self-treatment

B2. What do you think fever is caused by? Options: Virus, pollution, alcohol, online learning

10

Evaluation

Pollev.com/ngocanhhoang791

11

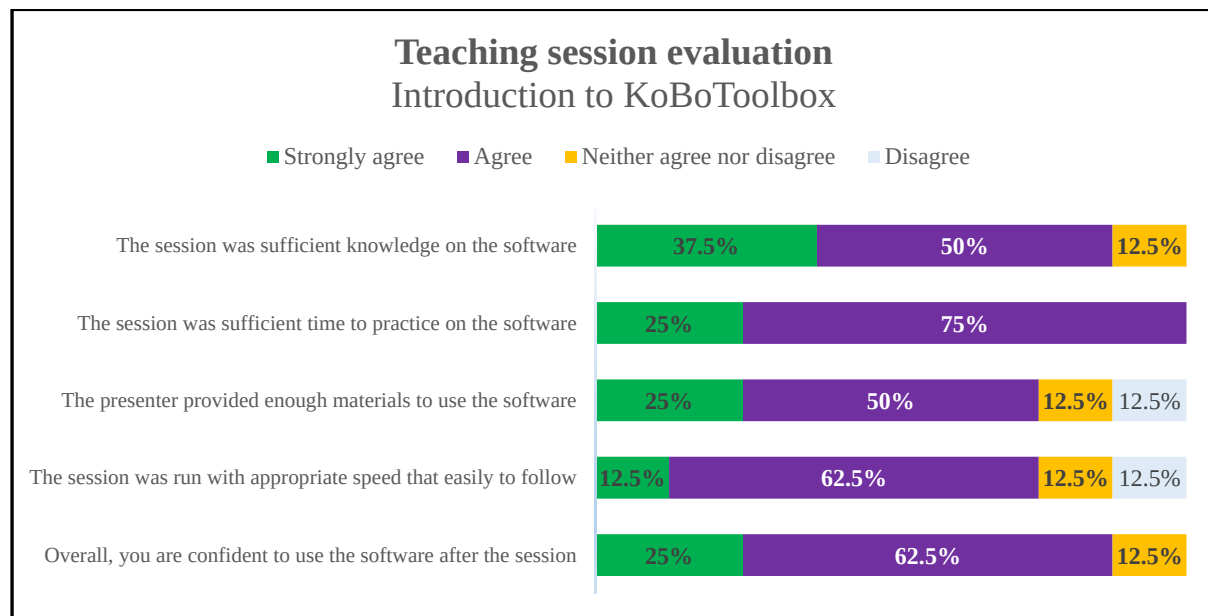
1.3. Practice exercises

type	name	label	required	appearance	relevant	parameters	constraint	constraint_message	guidance_hint
start	start								
end	end								
note	start_note	##### Introduction: Welcome to this practice section. At any time, please feel free to contact me via email (ngoc-anh.hoang@anu.edu.au) or via WhatsApp (+84 86 577 0967) if you need to discuss any further questions	false						
begin_group	group_gi	### __ A. General Information __							
integer	a1	__ A1. Participant ID: __	true				. >= 1000 and . <= 9999	the Participant ID ranges from 1000 to 9999	
geopoint	a2	__ A2. Collect GPS of the place __	true						
select_one a3	a3	__ A3. Do you want to participate in our survey? __	true	quick					
image	a4	__ A4. Collect participant Photo __	false	w2		max-pixels=1024			
date	a5	__ A5. Date of birth of participant __	true	w2					
text	a6	__ A6. Address __	true	w2					
integer	a7	__ A7. How many members are there in your family? __	true	w2					
end_group									
begin_group	group_nq 2xm39	### __ B. Fevers __		w2					
select_one a3	b1	__ B1. Do you fever in past 6 months? __	true	w2 horizontal-compact					
decimal	b1_1	__ B1.1. How many day fever persist? __	false	w2	\$(b1) = '1'				enter 1.5 days if the fever persist one and a half of a day
select_multiple b1_2	b1_2	__ B1.2. Where do you go for the treatment? __	false	w2	\$(b1) = '1'				
select_multiple b2	b2	__ B2. What do you think fever is caused by? __	true	w2					
end_group									

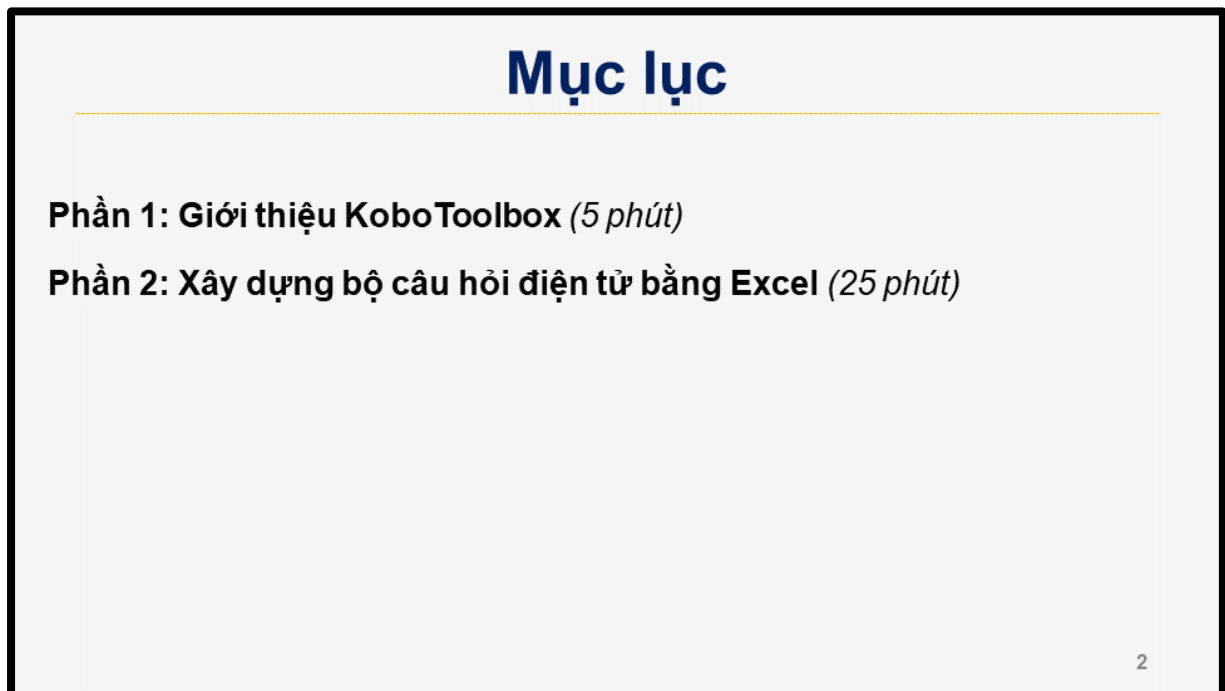
Appendix 2. Teaching from the field

I led a 1-hour teaching session on “Introduction to KoBoToolbox” at the National Institute of Hygiene and Epidemiology (my field placement) on 23 June 2021. There were eight participants attending both online and in-person, who are staff and medical students working/interning at the Department of Epidemiology, NIHE. The main content of this session is similar to the LFF one but all were translated into Vietnamese. I run the exercises together with all participants and conducted a progressive discussion among all attendees. My MAE colleague – Ms. Ha-Linh Quach assisted me to facilitate the Zoom section.

Materials for the teaching session included a PowerPoint presentation and a practice take-home exercise. Below is the evaluation of the session.



2.1. PowerPoint Presentation



Phần 1: Giới thiệu KoboToolbox



- Phát triển bởi Harvard Humanitarian Initiative
- Mã nguồn mở để thu thập và phân tích dữ liệu
- Thu thập số liệu trong trường hợp khẩn cấp và điều kiện khó khăn



Phần 1: Các bước xây dựng BCH điện tử



4

Phần 1: Giới thiệu KoboToolbox

Điểm mạnh	Điểm yếu
- Miễn phí - Hoạt động ngoại tuyến - Thu thập tọa độ GPS - Trích xuất dữ liệu KML, XLS và CSV - Không cần thiết lập máy chủ	- Giới hạn nhóm đối tượng nghiên cứu - Ảnh và tệp ghi âm tải xuống dưới dạng tệp zip riêng biệt, không được liên kết trực tuyến - Giới hạn dữ liệu

5

Phần 1: Giới thiệu KoboToolbox

02 nhóm đối tượng: tổ chức nhân đạo & khác (researchers, aid workers & everyone else)

- Tổ chức nhân đạo: Không bị giới hạn về số lượng phiếu thu thập hàng ngày
- Khác: Giới hạn 1,500 phiếu/tháng. Cần liên hệ với điều phối viên Kobo Toolbox để yêu cầu ngoại lệ nếu trên ngưỡng.

6

Phần 2: Xây dựng bộ câu hỏi điện tử bằng Excel

[KoBoToolbox | Data Collection Tools for Challenging Environments](#)

XLSForm Reference Table: [XLSForm Reference Table](#)

7

Lời cảm ơn

- TS. Phạm Quang Thái, Th.S. Nguyễn Công Khanh, hướng dẫn thực hành tại Viện vệ sinh dịch tễ TW
- Dr. Florian Vogt, hướng dẫn chuyên môn tại trường Đại học Quốc gia Úc
- The Commonwealth Department of Foreign Affairs and Trade, the ASEAN-Australia Health Security Fellowship Program
- Research School of Population Health, College of Health and Medicine, the Australian National University
- National Institute of Hygiene and Epidemiology

8

2.2. Practice take-home exercise

THÔNG TIN VỀ NGHIÊN CỨU

Lời giới thiệu:

Trân trọng cảm ơn Anh/Chị đã dành thời gian tham gia nghiên cứu về đánh giá thực trạng sức khỏe tinh thần ở cán bộ Y tế tham gia phòng chống dịch Covid-19.

Bộ câu hỏi

A. THÔNG TIN NHÂN KHẨU HỌC

A1. Năm sinh

(Năm sinh dương lịch)

A2. Giới tính

1. Nam

2. Nữ

A3. Tình trạng hôn nhân

1. Độc thân

2. Đã kết hôn

3. Khác (ly thân/ly hôn...)

A4. Số năm Anh/Chị công tác trong lĩnh vực Y tế công cộng

(năm)

A5. Anh/Chị thấy kinh tế gia đình mình đang ở mức nào?

1. Khá

2. Trung bình

3. Trung bình - thấp

4. Thấp

B. TÌNH TRẠNG SỨC KHỎE

B1. Hiện Anh/Chị có đang mắc bệnh lý mạn tính nào không?

1. Có (chuyển B1.2)

2. Không (chuyển C)

B1.2. Anh/Chị đang mắc bệnh lý mạn tính nào?

(Câu hỏi nhiều lựa chọn)

1. Viêm phổi tắc nghẽn mạn tính (COPD)

2. Hen suyễn

3. Viêm khớp mạn

4. Khác (ghi rõ)

B1.2.1. Vui lòng liệt kê tên các bệnh lý mạn tính khác

C. TÌNH TRẠNG CĂNG THẲNG

Vui lòng chọn tần suất Anh/Chị cảm thấy:

	Thường xuyên	Thỉnh thoảng	Hiếm khi	Không bao giờ
C1. Buồn chán vì mọi việc thường xảy ra ngoài dự kiến	1	2	3	4
C2. Không thể kiểm soát được những thứ quan trọng trong cuộc sống	1	2	3	4
C3. Lo lắng và căng thẳng	1	2	3	4
C4. Tự tin về khả năng xử lý các vấn đề cá nhân	1	2	3	4
C5. Mọi việc đang diễn ra đúng dự kiến	1	2	3	4
C6. Không giải quyết được các việc mà trước đây đã từng làm	1	2	3	4
C7. Có thể kiểm soát với mọi tình huống	1	2	3	4
C8. Có thể ứng biến với mọi tình huống	1	2	3	4
C9. Tức giận vì mọi thứ ngoài tầm kiểm soát	1	2	3	4
C10. Các khó khăn chồng chất đến mức không thể vượt qua	1	2	3	4

Anh/Chị vui lòng chọn nút Submit/Gửi lên phía dưới để hoàn thành khảo sát. TRÂN TRỌNG CẢM ƠN!!!

type	name	label	required	appearance	relevant	parameters	constraint	constraint_message	guidance_hint
start	start								
end	end								
note	start_note	#### Introduction: Welcome to this practice section. At any time, please feel free to contact me via email (ngoc-anh.hoang@anu.edu.au) or via WhatsApp (+84 86 577 0967) if you need to discuss any further questions	false						
begin_group	group_gi	### __A. General Information__							
integer	a1	__A1. Participant ID:__	true				. >= 1000 and . <= 9999	the Participant ID ranges from 1000 to 9999	
geopoint	a2	__A2. Collect GPS of the places__	true						
select_one a3	a3	__A3. Do you want to participate in our survey?__	true	quick					
image	a4	__A4. Collect participant Photo__	false	w2		max-pixels=1024			
date	a5	__A5. Date of birth of participant__	true	w2					
text	a6	__A6. Address__	true	w2					
integer	a7	__A7. How many members are there in your family?__	true	w2					
end_group									
begin_group	group_nq 2xm39	### __B. Fever__		w2					
select_one a3	b1	__B1. Do you fever in past 6 months?__	true	w2 horizontal-compact					

decimal	b1_1	__B1.1. How many day fever persist?__	false	w2	\$(b1) = '1'				enter 1.5 days if the fever persist one and a half of a day
select_multiple b1_2	b1_2	__B1.2. Where do you go for the treatment?__	false	w2	\$(b1) = '1'				
select_multiple b2	b2	__B2. What do you think fever is caused by?__	true	w2					
end_group									

2.3. Screenshots from the session



Zoom Meeting You are viewing Ngọc-Anh Hoàng's screen View Options

Phần 1: Các bước xây dựng BCH điện tử

```
graph LR; A[Xác định mục tiêu] --> B[Xác định quần thể & khung mẫu]; B --> C[Thiết kế phương pháp thu thập dữ liệu]; C --> D[Phát triển bộ câu hỏi]; D --> E[Thu thập dữ liệu]; E --> F[Quản lý dữ liệu]; F --> G[Phân tích dữ liệu]; G --> H[Viết báo cáo & công bố kết quả];
```

The flowchart illustrates the process of building an electronic data collection tool (BCH) in seven steps:

- Xác định mục tiêu (Define objectives)
- Xác định quần thể & khung mẫu (Define population & sampling frame)
- Thiết kế phương pháp thu thập dữ liệu (Design data collection method)
- Phát triển bộ câu hỏi (Develop questionnaire)
- Thu thập dữ liệu (Collect data)
- Quản lý dữ liệu (Manage data)
- Phân tích dữ liệu (Analyze data)
- Viết báo cáo & công bố kết quả (Write report & publish results)

4

Zoom Meeting interface showing participants: Khang, Linh Quach, Ngọc-Anh Hoàng (active), and lan anh. The bottom bar includes controls for Unmute, Start Video, Security, Participants, Chat, Share Screen, Record, Breakout Rooms, Reactions, and More. The system tray shows the date and time: 9:40 AM, 6/23/2021.

Zoom Meeting You are viewing Ngoc-Anh Hoang's screen View Options

Recording...

kobocode_ver 1 - Excel

	A	B	
1	type	name	label
2	start	start	
3	end	end	
4	note	batdau_note	Lời giới thiệu: Tr
5	begin_group	group_nhanhauhoc	A. Thông tin nh
6	integer	a1	Năm sinh
7	select_one a2	a2	A2. Giới tính
8	select_one a3	a3	A3. Tình trạng h
9	integer	a4	A4. Số năm Anh/
10	select_one a5	a5	A5. Nhìn chung
11	end_group		
12	begin_group	group_suckhoe	B. Tình trạng sức
13	select_one yesno	b1	B1. Hiện Anh/Ch
14	select_many b1_1	b1_1	B1.1. Anh/Chị đ

Bổ câu hỏi - Word

Trân trọng cảm ơn Anh/Chị đã dành thời gian tham gia nghiên cứu về đánh giá thực trạng sức khỏe tinh thần ở cán bộ Y tế tham gia phòng chống dịch Covid-19.

Bộ câu hỏi

A. THÔNG TIN NHÂN KHẨU HỌC

A1. Năm sinh (Năm sinh dương lịch)

A2. Giới tính

A3. Tình trạng hôn nhân

A4. Số năm Anh/Chị công tác trong lĩnh vực Y tế công cộng

A5. Anh/Chị thấy kinh tế gia đình mình đang ở mức nào?

B. TÌNH TRẠNG SỨC KHỎE

B1. Hiện Anh/Chị có đang mắc bệnh lý mạn tính nào không?

B1.2. Anh/Chị đang mắc bệnh lý mạn tính nào?

(Câu hỏi nhiều lựa chọn)

1. Nam
2. Nữ
1. Độc thân
2. Đã kết hôn
3. Khác (lý do khác...)
1. Khá
2. Trung bình
3. Trung bình - thấp
4. Thấp
1. Có (chuyển B1.2)
2. Không (chuyển C)
1. Viêm phổi tắc nghẽn mạn tính (COPD)
2. Huyết áp
3. Viêm khớp mạn
4. Khác (ghi rõ)

Ngoc-Anh Hoang

Linh Quach

lan anh

LeHa

Unmute Start Video Security Participants Chat Share Screen Pause/Stop Recording Breakout Rooms Reactions More End

Type here to search

Zoom Meeting You are viewing Ngoc-Anh Hoang's screen View Options

Recording...

kobocode_ver 2 | KoboToolbox

https://kf.kobotoolbox.org/#/forms/auv96p3kqzqz35AK5sOX/landing

0 submissions

NEW

Deployed 4

kobocode_ver 2

kobocode_ver 1

Thực trạng sức khỏe tinh thần ở Nhân viên Y tế Dự phòng trong dịch COVID-19

THỰC TRẠNG SỨC KHỎE TINH THẦN Ở NHÂN VIÊN Y TẾ DỰ PHÒNG TRONG DỊCH COVID-19

Draft 1

Archived 0

SUMMARY **FORM** DATA SETTINGS

v1 Last Modified : June 5, 2021 - 25 questions

REDEPLOY

Languages: This project has no languages defined yet

Collect data

Online-Offline (multiple submission)

COPY OPEN

Ngoc-Anh Hoang

Linh Quach

lan anh

tmtmac

Unmute Start Video Security Participants Chat Share Screen Pause/Stop Recording Breakout Rooms Reactions More End

Type here to search

Zoom Meeting You are viewing Ngọc-Anh Hoàng's screen View Options

Recording...

Ngọc-Anh Hoàng

Linh Quach

lan anh

tmtmac

LeHa-NIHE

Thu Ha

LeHa

Unmute Start Video Security Participants Chat Share Screen Pause/Stop Recording Breakout Rooms Reactions More End

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Trung bình
 Trung bình - thấp
 Thấp

B. Tình trạng sức khỏe

B1. Hiện Anh/Chị có đang mắc bệnh lý mạn tính nào không?

☒ Có
☐ Không

B1.1. Anh/Chị đang mắc bệnh lý mạn **lành** nào?

☐ Viêm phổi tắc nghẽn mạn tính (COPD)
☐ Hẹp suyễn
☐ Viêm khớp mạn
☐ Cao huyết áp
☐ Trầm cảm
☒ Khác (ghi rõ)

Vui lòng liệt kê tên các bệnh lý mạn tính khác

C. Tình trạng căng thẳng TRONG DỊCH COVID-19 TẾT TÂN SỬU

Liên với Anh/Chị cảm thấy căng ứng dịch COVID-19 về: Tên tin

3. Side project

From the very beginning of the COVID-19 pandemic in Vietnam, my field supervisor – Dr. Pham Quang Thai, assigned me to collect, compile, and input clinical, laboratory, epidemiological data of COVID-19 patients for supporting other people from the National Institute of Hygiene and Epidemiology and the Rapid Response Team in writing reports for Vietnam’s Ministry of Health and the National Steering Committee of COVID-19 Prevention and Control. After joint conventional meetings among me, my field supervisor, and my academic supervisor, we decided to conduct the project **“Re-positive testing, clinical evolution and clearance of infection: results from COVID-19 cases in isolation in Vietnam”** with the aim were to provide evidence from Vietnam in treating COVID-19 cases to other countries. This manuscript is published in the Western Pacific Surveillance and Response Journal.

Hoang NA*, Pham QT*, Quach, H. L., Nguyen CK, Colquhoun S, Lambert S., Luong DH, Tran DQ, Phung CD, Tran ND, Ngu DN, Tran AT, Nguyen TBH, Dang DA[†], Vogt F[†]. (2021). **Re-positive testing, clinical evolution and clearance of infection: results from COVID-19 cases in isolation in Viet Nam.** Western Pacific surveillance and response journal: WPSAR, 12(4), 1–11. <https://doi.org/10.5365/wpsar.2021.12.4.857>

* Shared first authorship

[†] Shared last authorship

Re-positive testing, clinical evolution and clearance of infection: results from COVID-19 cases in isolation in Viet Nam

Ngoc-Anh Hoang,^{a,b*} Thai Quang Pham,^{a,c*} Ha-Linh Quach,^{a,b} Khanh Cong Nguyen,^a Samantha Colquhoun,^b Stephen Lambert,^b Duong Huy Luong,^a Quang Dai Tran,^d Dinh Cong Phung,^e Tran Nhu Duong,^f Nghia Duy Ngu,^g Tu Anh Tran,^a Hue Bich Thi Nguyen,^g Duc-Anh Dang^{f,h} and Florian Vogt^{b,h,#}

Correspondence to Ha-Linh Quach and Thai Quang Pham (email: linh.quach@anu.edu.au and pqt@nihe.org.vn)

Objective: Asymptomatic infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and test re-positivity after a negative test have raised concerns about the ability to effectively control the coronavirus disease 2019 (COVID-19) pandemic. We aimed to investigate the prevalence of COVID-19 asymptomatic and pre-symptomatic infections during the second wave of COVID-19 in Viet Nam, and to better understand the duration of SARS-CoV-2 infection and the dynamics between the evolution of clinical symptoms and SARS-CoV-2 test positivity among confirmed COVID-19 cases.

Methods: We conducted a cohort analysis on the first 50 confirmed cases during the second COVID-19 wave in Viet Nam using clinical, laboratory and epidemiological data collected from 9 March to 30 April 2020. Kaplan-Meier estimates were used to assess time to clearance of SARS-CoV-2 infection, and log-rank tests were used to explore factors related to time to SARS-CoV-2 infection clearance.

Results: Most cases (58%) had no typical signs or symptoms of COVID-19 at the time of diagnosis. Ten cases (20%) were re-positive for SARS-CoV-2 during infection. Eight cases (16%) experienced COVID-19 symptoms after testing negative for SARS-CoV-2. The median duration from symptom onset until clearance of infection was 14 days (range: 6–31); it was longer in re-positive and older patients and those with pre-existing conditions.

Conclusion: Asymptomatic and pre-symptomatic infections were common during the second wave of COVID-19 in Viet Nam. Re-positivity was frequent during hospitalization and led to a long duration of SARS-CoV-2 infection.

Coronavirus disease 2019 (COVID-19) is a respiratory disease caused by infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The COVID-19 pandemic, first reported in Wuhan, China in December 2019,¹ spread quickly worldwide. As of mid-October 2021, there have been over 240 million confirmed cases and 4.9 million deaths.² The first case of COVID-19 in Viet Nam was recorded on 22 January 2020 in a person who had returned from Wuhan, and that case was linked to a further 15 cases related to Wuhan.³ By the end of February, all 16 cases had recovered and Viet Nam remained clear of COVID-19 for the following 20 days. By early March, the world saw a major shift in the distribution of COVID-19 cases from China to Europe and the United States of America, while China's incidence decreased.⁴ This sparked a second wave of imported COVID-19 cases in Viet Nam, of non-Chinese origin, starting on 6 March

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Published: 13 December 2021

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2020 when an international passenger arriving from the United Kingdom of Great Britain and Northern Ireland tested positive.⁵

Case investigations conducted during the second wave suggested the occurrence of cases without compatible signs or symptoms of COVID-19 at the time of the first positive test, raising concerns about the community spread of COVID-19 in Viet Nam. Some cases remained asymptomatic until discharge, whereas others developed symptom onset after testing positive (pre-symptomatic infections). Also seen at that time was reversion of test results in patients who had tested negative following a positive result, and then returned to positive (re-positivity). As in other settings, pre-symptomatic and fully asymptomatic infections were also recorded but not systematically investigated.^{6,7}

Important evidence gaps remain for asymptomatic and pre-symptomatic cases, and for patients with re-positive test results.^{8,9} In particular, the duration until clearance of infection and the dynamics between clinical symptoms and test positivity are poorly understood.^{10,11} The testing and quarantine policy during the initial phase of the second wave of infections in Viet Nam provided us with a setting to investigate these questions. Using clinical, laboratory and epidemiological data of arriving air travel passengers to Viet Nam and their secondary cases during March and April 2020, we aimed to investigate the prevalence of asymptomatic and pre-symptomatic COVID-19 infections and to better understand the duration of SARS-CoV-2 infection and the dynamics between the evolution of clinical symptoms and SARS-CoV-2 test positivity.

METHODS

Design

A cohort analysis was conducted on the first 50 laboratory-confirmed cases during the second COVID-19 wave in Viet Nam using clinical, laboratory and epidemiological data collected as a part of the national epidemic response between 9 March and 30 April 2020.

Data sources

In Viet Nam, all hospitals reported clinical and treatment information and test results for COVID-19 cases to the

National Institute of Hygiene and Epidemiology and the Medical Services Administration. Data included in this analysis were obtained from the National Institute of Hygiene and Epidemiology.

Case classification and definitions

This study used case definitions from guidelines developed by the Viet Nam Ministry of Health.¹² Case confirmation required a positive polymerase chain reaction (PCR) test for SARS-CoV-2. A symptomatic COVID-19 case was defined as a confirmed case showing any COVID-19 compatible symptom according to Ministry of Health guidelines, including cough, fever, muscle soreness, shortness of breath, sore throat, headache, nausea and fatigue with symptom onset within 14 days before the first positive PCR test result.¹² An *asymptomatic* case was a confirmed case without COVID-19 compatible symptoms throughout the incubation and infection period. This period was counted from 14 days before the first SARS-CoV-2 positive test result until the first negative PCR test, in a series of three negative PCR tests, with at least 24 hours between each test. A *pre-symptomatic* case was defined as a confirmed case without COVID-19 compatible symptoms at the time of the first positive PCR test but who then developed symptoms during the course of infection. A *re-positive* case was defined as a patient who had tested positive, then negative and then returned to positive.

A close contact was defined as a person with direct contact (≤ 2 metres distance) with a confirmed case.¹³ In Viet Nam, if the confirmed case had a flight travel history within 14 days from the date of symptom onset or date of confirmation, whichever came first, all passengers on those flights were categorized as close contacts and were tested for SARS-CoV-2 infection.

As per Ministry of Health guidelines, case severity was categorized as mild, severe or critical.¹³ A *mild* case was a patient with COVID-19 symptoms who was conscious and did not require oxygen support. A *severe* case was a symptomatic patient who was conscious but required oxygen support. A *critical* case was an unconscious patient either being treated with mechanical ventilation or receiving extracorporeal membrane oxygenation. Patients who had a chronic medical condition (e.g. cardiovascular disease, cancer, chronic respiratory diseases or diabetes) were defined as having pre-existing conditions at the time of infection.

Among confirmed cases, the status of being free from SARS-CoV-2 infection began on the date of the first of three consecutive negative SARS-CoV-2 tests before discharge. We used a sampling interval of 1 day between each test.

Case finding and management

Cases were identified through PCR testing at the time of arrival in Viet Nam, during self-presentation at health facilities because of health concerns (due to travel history to regions recording confirmed cases) or through active case-finding measures among passengers and their contacts. All passengers on incoming flights from COVID-19 affected areas were tested for SARS-CoV-2 upon arrival and entered a mandated 14-day quarantine, irrespective of test results or symptoms. (The evolving test and quarantine policies for passengers arriving from affected areas into Viet Nam are included in [Supplementary Table 1](#).) During this period, passengers could leave the airport without testing or quarantine if they did not depart from defined designated areas, and passengers were only contacted when any co-passengers were confirmed to be positive for SARS-CoV-2.

Any person who presented to health facilities with symptoms compatible with COVID-19 and who reported a travel history to COVID-19 affected areas within the past 14 days was directly transferred to a reference hospital for SARS-CoV-2 testing and quarantine. Once SARS-CoV-2 infection was confirmed, an in-depth epidemiological investigation and contact tracing were conducted. All identified close contacts of confirmed cases were advised to self-quarantine immediately at their residence until contacted by local health authorities. They were then tested for SARS-CoV-2 by PCR and were placed into compulsory quarantine at a designated site for 14 days, irrespective of the test result. All quarantined individuals were tested at the start of their quarantine (day 0) and then systematically on days 3–5 and day 14. An additional test was undertaken if an individual developed symptoms. Anyone who tested positive or became symptomatic was transferred to a reference hospital for isolation and treatment.

Statistical analysis

Data were cleaned using Microsoft Excel and exported to the statistical software package R version 3.6.3 for analysis.¹⁴ Frequencies and percentages were used to

describe the number of cases of each type (asymptomatic, pre-symptomatic and symptomatic), demographics and clinical symptoms in the study's time range. Pearson's chi-squared and Fisher's exact test were applied to compare demographic and clinical characteristics between re-positive and non-re-positive cases, and between cases with a negative test presenting with COVID-19 symptoms versus those without COVID-19 symptoms. The Kaplan-Meier estimator was used to assess time to clearance of SARS-CoV-2 infection; that is, the time between the date of symptom onset and the date of the first of three consecutive negative SARS-CoV-2 tests. Asymptomatic cases were excluded from this analysis. Log-rank tests were applied to explore the relationship between time to SARS-CoV-2 infection clearance and patients' age, sex, pre-existing conditions, inconsistent PCR results and clinical severity.

RESULTS

Among the first 50 COVID-19 cases in the second wave in Viet Nam, the proportions of pre-symptomatic, symptomatic and asymptomatic cases were 38%, 42% and 20%, respectively. Male (54%) and female (46%) representation was approximately equal. Vietnamese nationals accounted for 64% of cases. The prevalence of people under 30 years old in pre-symptomatic, symptomatic and asymptomatic groups was 15.8%, 57.2% and 50%, respectively. Most of the asymptomatic and symptomatic cases were less likely than the pre-symptomatic cases to have a pre-existing condition ([Table 1](#)).

Two thirds of cases ($n = 34$, 68%) were international arrivals, with the remaining cases identified locally ($n = 16$, 32%). Among international passengers, 23% ($n = 8$) were detected through airport screening, 56% ($n = 19$) were detected through case-finding activities among flight passengers and 21% ($n = 7$) were detected during self-presentation at health facilities. All 16 local cases were close contacts of international passengers and were detected by case-finding activities ([Supplementary Fig. 1](#)).

[Supplementary Table 2](#) illustrates symptoms at onset and total numbers of symptoms during infection (combining symptoms at onset and during treatment or isolation) for the 40 pre-symptomatic and symptomatic cases. The most common symptom at onset was cough (70%), followed by fever (25%) and sputum production

Table 1. Characteristics of COVID-19 cases by symptomatic category (*n* = 50)

	Total		Pre-symptomatic		Symptomatic		Asymptomatic	
	<i>n</i> = 50	%	<i>n</i> = 19	%	<i>n</i> = 21	%	<i>n</i> = 10	%
Age, mean (SD)	40.6 (19.2)		48.6 (18.2)		35.1 (16.7)		36.7 (22.5)	
<20	4	8	2	10.5	1	4.8	1	10
20–29	16	32	1	5.3	11	52.4	4	40
30–39	8	16	2	10.5	4	19	2	20
40–49	3	6	3	15.8	0	0	0	0
50–59	8	16	5	26.3	2	9.5	1	10
60–69	7	14	5	26.3	2	9.5	0	0
70+	4	8	1	5.3	1	4.8	2	20
Sex								
Male	27	54	12	63.2	11	52.4	4	40
Female	23	46	7	36.8	10	47.6	6	60
Nationality								
Vietnamese	32	64	10	52.6	15	71.4	7	70
Other	18	36	9	47.4	6	28.6	3	30
Pre-existing condition								
Yes	12	24	6	31.6	4	19	2	20
No	38	76	13	68.4	17	81	8	80

SD: standard deviation.

(15%). Most cases experienced multiple symptoms, with 70% having more than one symptom and 15% having six or more symptoms.

Fig. 1 presents the clinical evolution and PCR results of SARS-CoV-2 testing during treatment or isolation in symptomatic, pre-symptomatic and asymptomatic cases. Among 40 (80%) patients who experienced symptoms during infection, eight (20%) were clinically classified as severe and four (10%) as critical. Three of the four critical cases had pre-existing conditions, namely, vestibular disorder, type 2 diabetes and hypertension.

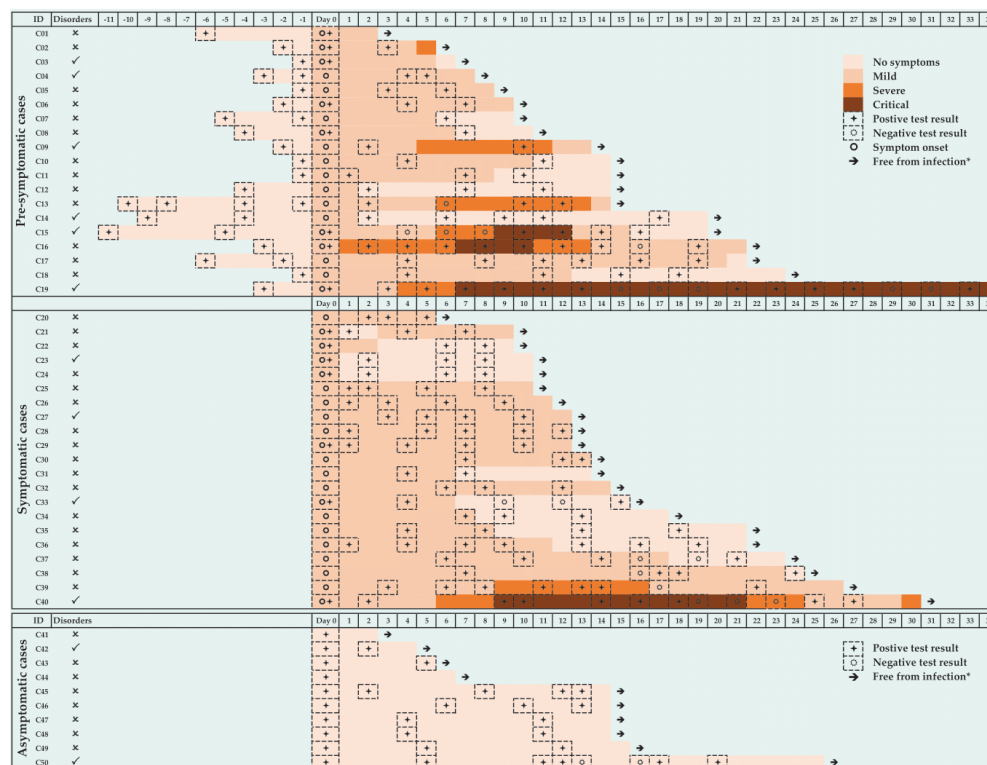
Ten cases (20%) returned a positive SARS-CoV-2 result after returning one or more negative result (re-positivity). The number of re-positive cases who were pre-symptomatic, symptomatic and asymptomatic was four, five and one, respectively. Most re-positive cases (90%) had one loop of reversion (i.e. one positive test after a negative test, then negative test results until being free from SARS-CoV-2). Only one re-positive case (case 19, who was pre-symptomatic at the time of testing) had more than one loop of reversion.

Eight cases (16%) still experienced COVID-19 symptoms after testing negative for SARS-CoV-2, among which four (50%) were symptomatic and four (50%) were pre-symptomatic at the time of testing.

The demographic and clinical characteristics of the 10 (20%) re-positive COVID-19 cases and eight (16%) cases who had COVID-19 symptoms after testing negative for SARS-CoV-2 are shown in Table 2. There was no significant difference in age, sex, nationality, pre-existing conditions and symptoms at onset between re-positive and non-re-positive cases. This was also observed among symptomatic cases who had a negative test versus cases without symptoms. Most re-positive cases and cases with COVID-19 symptoms after testing negative were categorized as severe or critical, and experienced more than two symptoms during infection.

The overall median duration from onset of symptoms to clearance of SARS-CoV-2 infection was 14 days (range: 6–31). Twenty days after symptom onset, 75% (30 cases) were free from SARS-CoV-2 infection (Supplementary Fig. 2).

Fig. 1. The evolution of clinical symptoms and results of SARS-CoV-2 PCR tests during treatment of symptomatic, pre-symptomatic and asymptomatic cases in Viet Nam



Cases are aligned by date of symptom onset for symptomatic and pre-symptomatic cases and date of first positive test for asymptomatic cases.

* "Free from infection" is defined as the date of the first of three consecutive negative SARS-CoV-2 tests before discharge, with a sampling interval of at least 1 day between each test.

Note: In the "Disorders" column, "✓": having at least one pre-existing condition and "✗": free from pre-existing conditions.

The median duration until clearance of SARS-CoV-2 infection was 12 days (95% confidence interval [CI]: 11–20) for males and 14 days (95% CI: 13–22) for females ($P = 0.44$), and was higher in older people (14 days among all those aged 30 years and older, 10 days in those aged 30–44 years, 12.5 days in those aged 45–59 years, 20 days in those aged 60 years or more; $P < 0.001$) (Fig. 2).

The duration until SARS-CoV-2 clearance for re-positive cases was nearly double the duration for those without test conversion (22 days vs 13 days, $P = 0.00034$). Critical cases had a longer time to freedom from infection (26.5 days) than did mild cases (13 days) and severe cases (14 days) ($P = 0.015$) (Fig. 3).

DISCUSSION

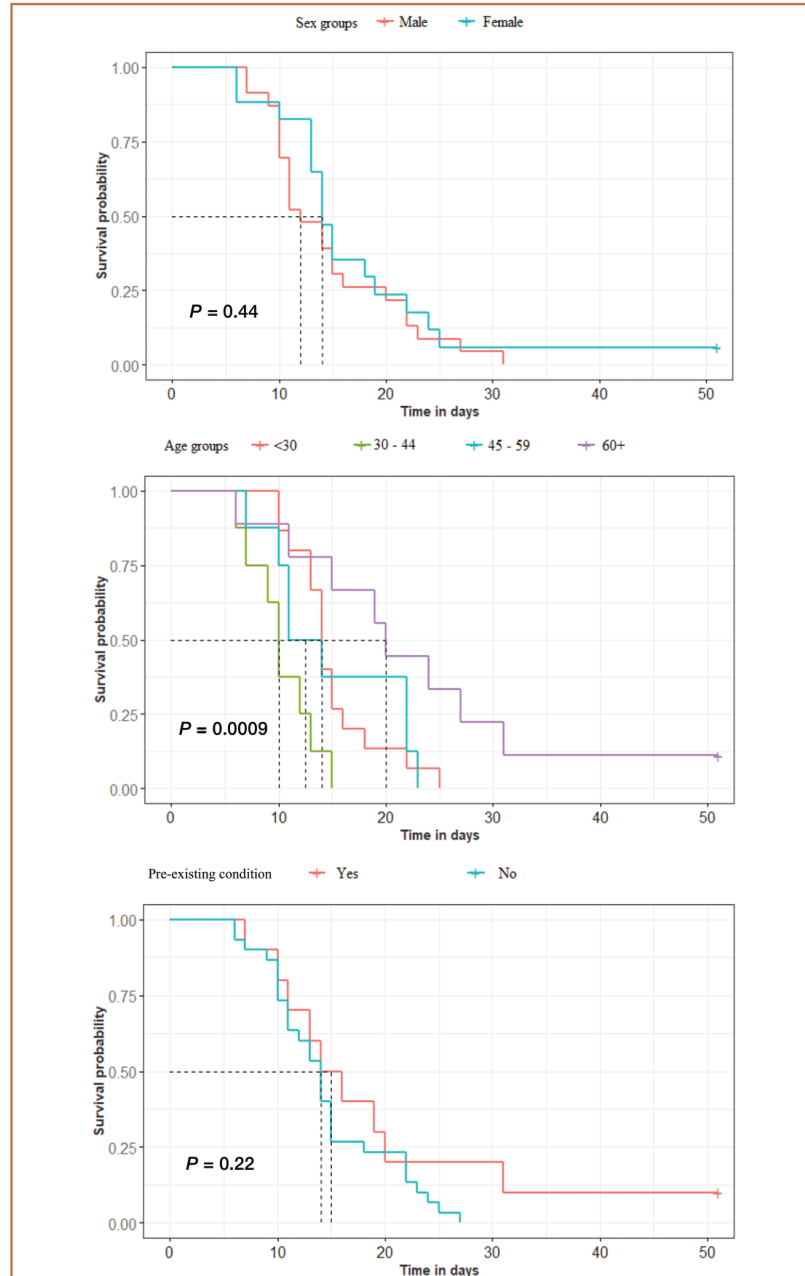
This study examined the clinical and laboratory findings of the first 50 SARS-CoV-2 confirmed cases at the start of the second COVID-19 wave in Viet Nam. There was a high prevalence of cases without compatible signs or symptoms of COVID-19 at the time of the first positive test (i.e. asymptomatic infections and pre-symptomatic infections). We found that 20% of cases tested positive following a negative result, and 16% of patients still experienced COVID-19 symptoms after testing negative for SARS-CoV-2. The median duration until clearance of SARS-CoV-2 infection was 14 days, with the duration being longer in older people, those with pre-existing conditions and re-positive cases.

Table 2. Characteristics of COVID-19 cases with a re-positive PCR test and symptomatic cases with a negative PCR test ($n = 50$)

Characteristics	Re-positive test		<i>P</i> [†]	Negative test with COVID-19 symptoms		<i>P</i> [†]
	No <i>n</i> (%)	Yes <i>n</i> (%)		No <i>n</i> (%)	Yes <i>n</i> (%)	
Demographics						
Age						
<45	26 (65)	3 (30)	0.10	28 (66.7)	1 (12.5)	0.01
45–64	8 (20)	5 (50)		8 (19)	5 (62.5)	
65+	6 (15)	2 (20)		6 (14.3)	2 (25)	
Sex						
Male	23 (57)	4 (40)	0.32	24 (57.1)	3 (37.5)	0.31
Female	17 (43)	6 (60)		18 (42.9)	5 (62.5)	
Nationality						
Vietnamese	25 (63)	7 (70)	0.66	27 (64.3)	5 (62.5)	0.92
Other	15 (38)	3 (30)		15 (35.7)	3 (37.5)	
Pre-existing condition						
Yes	7 (18.5)	5 (50)	0.03	9 (21.4)	3 (37.5)	0.33
No	33 (82.5)	5 (50)		33 (78.6)	5 (62.5)	
Disease characteristics						
Symptoms at onset						
Cough	23 (57.5)	5 (50)	--	23 (54.8)	5 (62.5)	--
Fever	7 (17.5)	3 (30)		7 (16.7)	3 (37.5)	
Headache	4 (10)	0 (0)		4 (9.5)	0 (0)	
Fatigue	4 (10)	0 (0)		4 (9.5)	0 (0)	
Sputum production	3 (7.5)	2 (20)		3 (7.1)	2 (25)	
Sore throat	2 (5)	2 (20)		3 (7.1)	1 (12.5)	
Chill	0 (0)	1 (10)		0 (0)	1 (12.5)	
Nasal congestion	0 (0)	1 (10)		1 (2.4)	0 (0)	
Diarrhoea	0 (0)	1 (10)		0 (0)	1 (12.5)	
Number of symptoms during infection						
1–2	24 (60)	6 (60)	1	26 (61.9)	4 (50)	0.53
>2	16 (40)	4 (40)		16 (38.1)	4 (50)	
Patient category						
Pre-symptomatic	15 (38)	4 (40)	0.66	15 (35.7)	4 (50)	0.3
Symptomatic	16 (40)	5 (50)		17 (40.5)	4 (50)	
Asymptomatic	9 (23)	1(10)		10 (23.8)	0 (0)	
Severity						
Asymptomatic	9 (23)	1 (10)	0.009	10 (23.8)	0 (0)	<0.001
Mild	28 (70)	4 (40)		29 (69)	3 (37.5)	
Severe	2 (5)	2 (20)		2 (4.8)	2 (25)	
Critical	1 (3)	3 (30)		1 (2.4)	3 (37.5)	

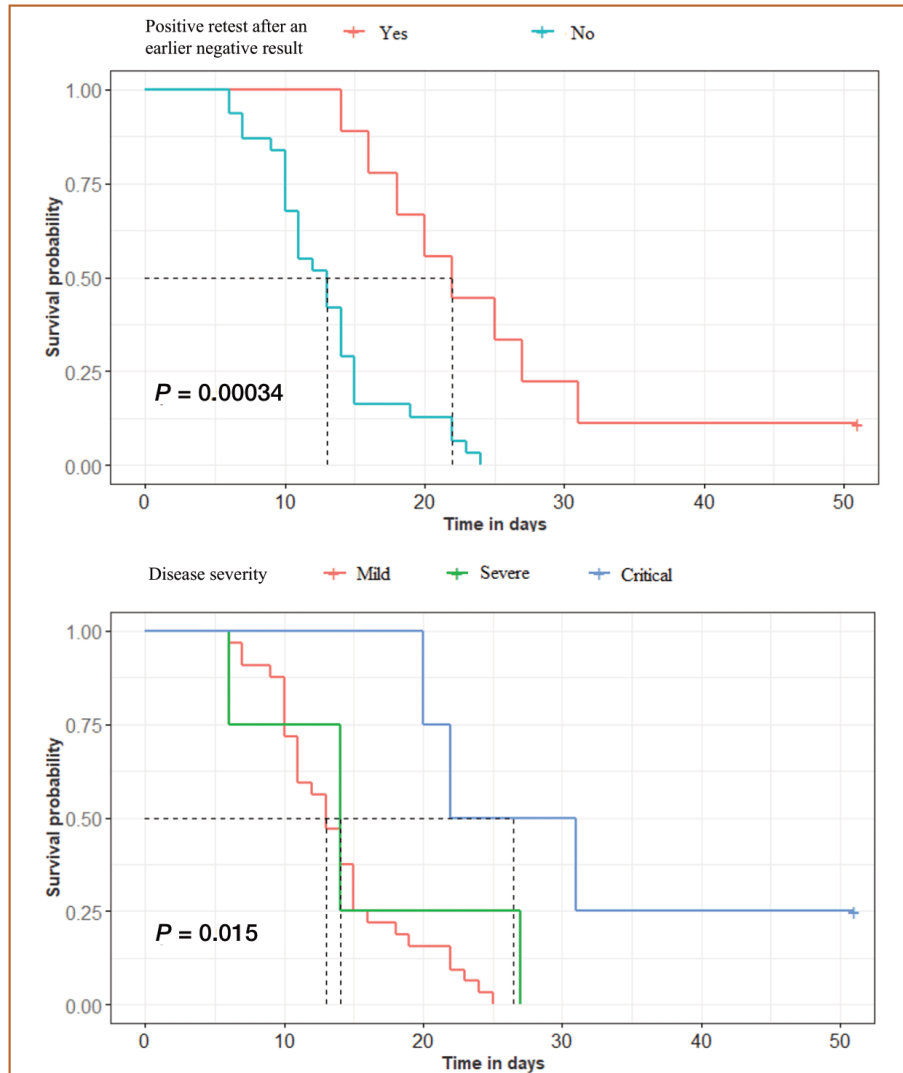
[†] Groups were compared using Pearson's chi-squared or Fisher's exact test.

Fig. 2. Cumulative probability by sex, age and pre-existing condition of clearance of SARS-CoV-2 infection from the day of first positive laboratory test among 40 pre-symptomatic and symptomatic cases



Survival probabilities were estimated using the Kaplan-Meier estimator and interpreted as the probability of clearance of SARS-CoV-2 infection (the probability of having the first of three consecutive negative SARS-CoV-2 tests). P values were calculated using log-rank tests.

Fig. 3. Survival analysis by re-positivity and severity of 40 pre-symptomatic and symptomatic cases



Survival probabilities were estimated using the Kaplan-Meier estimator and interpreted as the probability of clearance of SARS-CoV-2 infection (the probability of having the first of three consecutive negative SARS-CoV-2 tests). P values were calculated using log-rank tests.

The findings showed that 58% of cases did not exhibit compatible signs or symptoms of COVID-19 at the time of the first positive test, although fewer than half remained asymptomatic. This finding aligns with current published evidence of the expression of asymptomatic, symptomatic and pre-symptomatic cases.¹⁵⁻¹⁷ The degree of SARS-

CoV-2 transmission appears to vary among asymptomatic cases. A study in China showed that transmissibility from asymptomatic cases is comparable to that of symptomatic cases.¹⁸ A study in Singapore suggested that people with asymptomatic COVID-19 might be less infectious than symptomatic cases.¹⁹ Meanwhile, the World Health

Organization declared that asymptomatic cases are much less likely to transmit the virus than those who develop symptoms.²⁰ However, there is still a lack of comprehensive studies with representative samples on SARS-CoV-2 transmission during the asymptomatic period.

In our study, 20% of confirmed COVID-19 cases returned a positive SARS-CoV-2 result after one or more negative test result. Findings from China indicated that the prevalence of a positive test following a negative test was about 17% after discharge.^{21,22} Most current evidence about re-positivity focuses on the recovery or post-discharge phase. However, re-positivity during hospitalization might contribute to the need for ongoing admission and repeat testing, and cause distress for both patients and health care staff, which has not been the focus of published studies to date. In this study, all critical cases returned to positivity during SARS-CoV-2 infection. Re-positive cases had a substantially longer duration until viral clearance, which aligned with current evidence.²¹

Although re-positive tests for SARS-CoV-2 in recovered COVID-19 patients are common, there is insufficient evidence about the underlying mechanism leading to a re-positive test.²³ Most reported re-positive results could not be explained as simple viral relapse or secondary infection.²⁴ Some potential reasons included virology (biological characteristics of the virus),²⁵ specimen issues (sample collection, processing, virus at the limit of detection)^{26–28} or patient condition (underlying conditions, degree of infection, treatment methods).²⁹ A study in post-symptomatic individuals showed that persistent positivity is associated with elevated cellular immune responses, and thus the viral RNA may represent replicating virus.³⁰ However, transmission to close contacts was not observed. Other evidence suggested that re-positive cases are not infectious after an initial negative test, indicating that persistent PCR-positive individuals are not infectious at the post-symptomatic stage of infection.^{11,31} However, further work is needed to understand the likelihood of transmission from these patients.

Our findings showed that several cases still experienced COVID-19 compatible symptoms after testing negative for the virus or even after meeting SARS-CoV-2 clearance criteria. Defining and measuring COVID-19 transmissibility should be more sophisticated than only checking for a negative test. It has been suggested that

when determining criteria for discharge and ending isolation, health authorities should consider multiple factors such as symptom resolution, time elapsed since the onset of symptoms, disease severity, immune system response and evidence of viral RNA clearance from the upper respiratory tract.³²

Viral shedding is used as a marker of infectivity when detected via an upper respiratory tract PCR sample a few days before symptom onset.³³ Viral shedding persists for varying periods of time, with a median duration of 11 days.²² In our study, the median duration was 14 days. The viral shedding period in our study was defined as the day of diagnosis to the day of the first of three negative tests, each 24 hours apart; this excludes shedding before diagnosis. Although viral shedding has been identified during both the asymptomatic and symptomatic phases, its relation to transmissibility is unclear. Because real-time PCR cannot distinguish between infective virus and inactive virus, a positive PCR result does not necessarily represent the potential for viral transmission. The amount of viral RNA detected does not necessarily indicate greater infectivity.³³

Older age and having pre-existing conditions have been reported as important independent predictors of worse outcomes in severe acute respiratory syndrome and Middle East respiratory syndrome.³⁴ Our results also confirmed that increased age and pre-existing conditions were associated with longer SARS-CoV-2 infection in COVID-19 patients, which is consistent with other findings.³⁵ Further in-depth studies are encouraged to explore additional factors related to the duration of SARS-CoV-2 infection.

We acknowledge that there were several limitations to this study. First, the relatively small number of cases and specific context might limit the generalizability of our study findings. Second, we acknowledge the lack of cycle threshold (Ct) values (the number of cycles necessary to detect the virus by PCR). Ct is a semi-quantitative value that categorizes the concentration of viral genetic material in a testing sample following PCR testing. This value indicates how much viral genetic material is in the sample: a low Ct indicates a high concentration of viral genetic material, which is typically associated with a high risk of infectivity and vice versa. Knowing this value might have helped us to understand re-positivity tests and to compare symptomatic, pre-symptomatic and asymptomatic

cases over time. Although Ct is important, this single value depends on several factors, including the quantity of specific gene targets and reagent variability, and other factors that do not reflect a person's infectivity in the absence of clinical context.³⁶ Large-scale, multicentre studies that include Ct values are required to explore the importance of this issue.

CONCLUSION

A high proportion of asymptomatic and pre-symptomatic infections were evident in the first 50 confirmed cases during the second wave of COVID-19 in Viet Nam. In this study, re-positive cases were common during hospitalization and had a long duration of SARS-CoV-2 infection. High-quality longitudinal studies to explore the transmissibility of re-positive and asymptomatic COVID-19 patients are needed.

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Conflicts of interest

The authors declare no conflicts of interest.

Ethics statement

The conduct of this analysis was approved by the National Institute of Hygiene and Epidemiology and was exempted by the institute's Institutional Review Board as part of routine outbreak investigation and response activities.

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