



## Spread of COVID-19 and policy responses in Vietnam: An overview

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### ABSTRACT

**Objectives:** Despite the proximity and high travel flows with China, Vietnam has been able to contain the spread of coronavirus disease 2019 (COVID-19). This study describes the characteristics of COVID-19 infections in Vietnam and policy responses to identify potential factors contributing to the relative success of Vietnam in containing this pandemic.

**Methods:** Narrative analyses were applied to describe the pandemic and policy responses. Descriptive statistics, generalized linear regression, and a susceptible-infected-recovered model were used to explore the effectiveness of Vietnamese policy responses to COVID-19.

**Results:** To date, Vietnam is one of the few countries that have successfully control the spread of COVID-19. As of 26 October 2020, Vietnam has had 1169 cases of COVID-19, of which 1061 people recovered and 35 people died from the disease. COVID-19 infected patients in Vietnam were relatively younger than those in other countries with an average age of 36. Most of the infected cases were from international travels. Policy responses in Vietnam were implemented early and strictly.

**Conclusions:** Despite the proximity to China, where COVID-19 emerged, Vietnam has experienced a small number of COVID-19 infections and fatalities compared with other countries. Most infected patients were relatively young, and exposure was attributed to international travel. Early policy interventions were the main factors that contributed to the success of Vietnam to date.

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### Introduction

The coronavirus disease 2019 (COVID-19) pandemic has spread rapidly across the globe since December 2019. As of 26 October 2020, more than 43.5 million COVID-19 confirmed cases have been reported, with almost 1.2 million associated deaths (Johns Hopkins University, 2020). Furthermore, the number of confirmed cases is still increasing rapidly in many countries (World Health Organisation, 2020).

Despite sharing a long land border with China, where the COVID-19 pandemic originated (Huang et al., 2020; Zhao et al., 2020; Zhu et al., 2020), and receiving a large number of Chinese visitors, Vietnam has initially contained the spread of COVID-19 (The Vietnamese Ministry of Culture Sport and Tourism, 2020). Since the first confirmed COVID-19 case was reported on 23

January 2020, there have been 268 confirmed COVID-19 cases<sup>1</sup> in Vietnam and no fatalities as of 24 April 2020 (The Vietnamese Ministry of Health, 2020c). Despite limited resources, Vietnam has impressed international communities with its capacity to contain the COVID-19 outbreak to date (Sean, 2020).

There have been a number of papers that focus on the topic of COVID-19 in Vietnam (Hai et al., 2020; Huynh, 2020b; La et al., 2020; Thanh et al., 2020; Trang and Vu, 2020). However, these

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<sup>1</sup> According to Decision No.963/QĐ-BYT issued on 18 March 2020 by the Vietnamese Ministry of Health, a confirmed case is defined as a suspected case or person who has a positive result test for SARS-CoV-2 virus. The test is undertaken by medical centers authorized by the Vietnamese Ministry of Health to use the RT-PCR technique. COVID-19 suspected cases are defined as: People who have at least one of the following symptoms: fever; cough; sore throat; difficulty breathing or pneumonia with unknown cause, with one of the following epidemiological risk factors: - Has a travel history including a country or territory where there has been a COVID-19 case reported by the World Health Organization within 14 days of the day they enter Vietnam. - Has a travel history in areas in Vietnam where there has been a COVID-19 cluster within 14 days prior to symptom onset. - Has had close contact (within two meters) with confirmed cases or suspected cases within 14 days prior to symptom onset.

studies focused on either case reports (Hai et al., 2020; Phan et al., 2020; Thanh et al., 2020), social media (La et al., 2020), or risk perception (Huynh, 2020b, c). To our best knowledge, no previous study estimates the effects of the Vietnamese policy measures on COVID-19. Using detailed disease surveillance data, this paper provides an overview of the spread of the COVID-19 pandemic in Vietnam and estimates the effectiveness of the Vietnamese response to contain the pandemic.

**Methods**

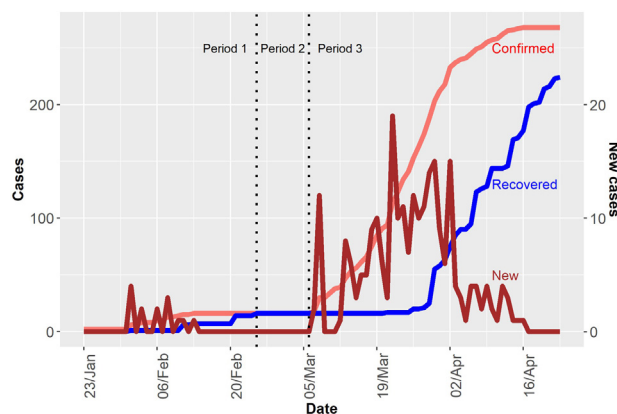
The data used in this paper were collected from the Vietnamese Ministry of Health (The Vietnamese Ministry of Health, 2020c) and the Johns Hopkins University COVID-19 dataset (Johns Hopkins University, 2020). The Ministry of Health dataset includes the number of confirmed cases, deaths, and recovered cases along with information about the age, gender, and locations of confirmed cases. Information about travel history and/or contact or exposure with infected COVID-19 cases by new confirmed cases are also available on the website of the Vietnamese Ministry of Health.

Descriptive statistics were used to summarize the spread of COVID-19. Mean test and Kruskal-Wallis test were used to compare the difference in the mean and median of selected variables by groups. A generalized linear model (Nelder and Wedderburn, 1972) was used to estimate the effects of response policies on the number of new cases. We also applied a susceptible-infected-recovered (SIR) model (Kermack and McKendrick, 1927) to predict the number of infected cases if no policy responses were implemented. We estimated the reproduction number ( $R_0$ ) in Vietnam using observed data for the first 20 days since the first case. Particularly, the  $R_0$  was estimated by choosing the value that minimized the squared differences between the exponential growth curve projected by our SIR model and the observed data in 14 days following the first confirmed case, which is the incubation period of 99% infected cases (Lauer et al., 2020) and is the standard quarantine period in many countries. The effects of policy measures are presented as the difference between the number of cases projected by the SIR model using the estimated  $R_0$  in the first 14 days (proxied for a “do nothing” scenario) and the observed number of confirmed cases (proxied for outcomes of policy interventions). Data were analyzed using R version 3.6.2 (R Core Team, 2019).

**Results**

*The timeline of the COVID-19 transmission*

The daily number of COVID-19 cases in Vietnam can be divided into three main periods (see Figure 1). The first period is from 23 January 2020 (the day when the first case, a 65-year-old man who originated from China, was identified as positive with COVID-19) to 25 February 2020. During this period, there were a total of 16 confirmed COVID-19 cases, of which all 16 were successfully treated and discharged from hospitals (The Vietnamese Ministry of Health, 2020d). The second period is from 26 February to 5 March 2020, during which no new confirmed cases were reported. The third period is from 6 March 2020 onward, during which 252 new infected cases were diagnosed. The main source of infection in this period was from international flights. The predominant countries of origin were England (54), France (18), and the USA (13). As of 24 April 2020, the number of confirmed cases spread to 29 provinces and cities. However, the two biggest cities, including Hanoi (112 cases) and Ho Chi Minh (55 cases), account for the largest number of cases.



**Figure 1.** The number of confirmed, recovered, and new cases of COVID-19 in Vietnam. The number of new cases is on the right axis. Source: Authors’ illustration using data from <https://github.com/CSSEGISandData/COVID-19> (accessed 24 April 2020).

*Characteristics of confirmed COVID-19 cases in Vietnam*

Results from Table 1 below show that the average age of confirmed cases was approximately 36, ranging from 3 months to 88 years. Of the 268 infected cases, 54.5% were female. There was no significant difference in the age profile of infected cases by sexes (p-value = 0.58). As of 24 April 2020, 224 out of 268 infected patients have been discharged from the hospital, and no fatalities have been reported. Again, there were no differences in recovery status between sexes (p-value = 0.096).

Among the reported cases, more than 80% are Vietnamese citizens. Notably, the data also indicate that most of the confirmed cases (60.4%) are imported cases that are either Vietnamese who return to Vietnam or foreigners who visited Vietnam.

Out of 268 confirmed cases, tracking for transmission path can be identified for 255 cases. Most infected COVID-19 patients (78.8%) are first generation of infection (F0) while second and third generations of infection account for a small proportion based on contact tracing or contact generation. It is notable that the first generation of infection (or F0) is a confirmed case. The second generation of infection (F1) is a confirmed case that became

**Table 1**  
Overall information about the confirmed COVID-19 cases in Vietnam.

Variables	Descriptive statistics
Age (years): mean (SD)	35.9 (15.9)
Sex: count (%)	
Male	122 (45.5%)
Female	146 (54.5%)
Hospitalization	
Still in hospital	44 (16.4%)
Discharged	224 (83.6%)
Nationality	
Vietnamese	220 (82%)
Others:	48 (18%)
- UK	19
- Brazil	6
- France	5
- USA	5
- Others	13
International flights (162)	
- England	54 (33.4%)
- France	18 (11.1%)
- USA	13 (8.0%)
- Others	77 (47.5%)
Transmission path (255)	
First generation of infection (F0)	201 (78.8%)
Second generation of infection (F1)	50 (19.6%)
Third generation of infection (F2)	4 (1.6%)

infected with COVID-19 due to close contact with an F0 case. The third generation of infection (F2) is a confirmed case that became infected with COVID-19 due to close contact with an F1 case.

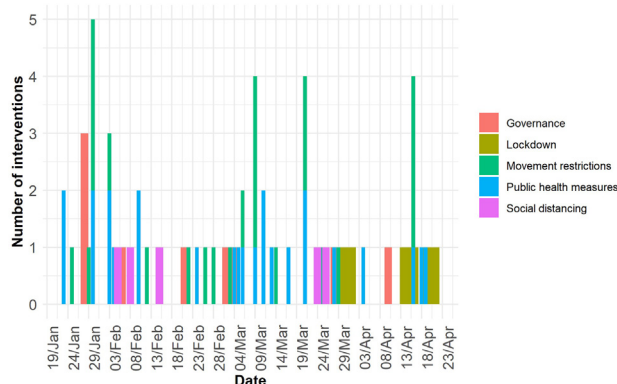
### The Vietnamese government's responses

Despite limited economic and technological advances, Vietnam has applied a number of prevention and control measures from an early stage of the epidemic. These include restrictions on international flights, movement restrictions, contact tracing, quarantine and social distancing, governance (e.g., socio-economic supports), lockdown, and increasing public health awareness. In particular, the most widely covered measure was movement restriction introduced in late January 2020 (Figure 2). Movement restrictions were further intensified in mid-March and mid-April, which coincided with the increase of infection via international flights from Europe and the USA. Lockdown responses, introduced since 29 March 2020, were associated with a reduction of new cases by 55% compared to the previous period (estimated from parameters of a generalized linear model, p-value = 0.003). One day after the first confirmed case arrived in Vietnam from Wuhan on 23 January 2020, all flights from Vietnam to Wuhan and vice versa were cancelled. The cancellation was then expanded to all flights from Vietnam to and from other infected areas in China. Further, all visitors from China were asked to declare their medical status when they entered Vietnam.

From 1 February, all flights from and to China were suspended and all arrivals to Vietnam from countries with COVID-19 were asked to quarantine for two weeks. All schools ranging from kindergarten to universities were closed from the lunar New Year holiday (25 January 2020). From very early on, when COVID-19 was first diagnosed, all social and outdoor activities including festivals, traditional and cultural events, sporting events, national conferences, and outdoor social activities were cancelled.

Community isolation and quarantine were employed early to control the outspread of the infection. For example, on 13 February 2020, a village in Northern Vietnam with a population of 10,000 residents was put into quarantine for three weeks following the identification of six people infected with COVID-19, at which time the total number of confirmed cases in Vietnam was 10 (ASIA, 2020). The use of quarantine measure can be separated into three levels, including self-quarantine at home, quarantine in non-medical establishments, and quarantine in health facilities (The Vietnamese Ministry of Health, 2020a, b). The self-quarantine at home included those who were in close contact with people who had a close contact with confirmed cases and those who had a negative COVID-19 test following release from a health facility. Non-home quarantine were applied for those who had travelled from or transited through an infected or high-risk area or those who had been in close contact with a confirmed case in case health establishments for quarantine were full. Of course, those who had a positive COVID-19 test or had been in contact with an infected case were also required to quarantine. Expenses related to testing COVID-19 in all suspected cases and isolation and treatment costs for infected cases were provided at zero cost to patients (Quach and Thi, 2020).

Noticeably, from 21 March 2020, the Vietnamese authorities imposed a mandatory 14-day quarantine in non-medical establishments for new arrivals from overseas. During the period of quarantine, food and accommodation were supplied for free irrespective of nationality (Quach and Thi, 2020). In addition to isolation and quarantine, intensive tracing and tracking of people who came into contact with infected cases was implemented extensively. When a confirmed case was identified, the authorities would trace contact to the fourth contact level from the confirmed case.



**Figure 2.** Responses of the Vietnamese government to COVID-19. Each bar represents the number of policies, grouped by types, every two weeks. Governance refers mainly to socio-economic supports such as an urgent financial provision to low-income earners during the lockdown period. Source: Authors' illustration using data from <https://www.acaps.org/projects/covid19> (accessed 25/4/2020).

Due to an additional 200 COVID-19 cases reported from 6 March to 31 March, many originating overseas, a national lockdown was introduced on 1 April until further notice to limit the spread of COVID-19. All international flights were suspended<sup>2</sup>, and social distancing regulations were imposed for 15 days from that date. People were advised to stay indoors at their place of residence except for necessities (e.g., buying food, medicine, employment in designated factories, and emergencies). People were also ordered to maintain at least two meters of interpersonal distance, wear masks, and limit gatherings to two people when outside their place of employment, hospitals, and schools. Most non-essential businesses were required to close (The Vietnamese Prime Minister, 2020).

A public health education campaign that taught effective hand washing, face mask use, and enhancing the immune system (e.g., diet and exercises) was conducted using conventional and social media. Approximately 6 billion text messages were sent to mobile users to raise awareness about COVID-19. Particular focus was given to hygiene, self-quarantine, and self-protective measures (Huynh, 2020a). Artists were also engaged to reinforce these public health messages, with one hand washing video gaining popularity outside Vietnam (Billboard, 2020; YouTube, 2020).

Producing and investing in technology for public health management, especially in fighting the pandemic, were encouraged. As a result, within a short period of time, a number of mobile applications (e.g. COVID-19, NCOVI, and Bluezone) were developed and provided free of charge to all citizens (The Vietnamese Ministry of Health, 2020e). Bluezone was used to alert the user if they had been in close contact with a COVID-19 positive individual, thereby identifying potentially infected patients. As of 20 August 2020, Bluezone had been downloaded more than 20 million times (Vietnam Insider, 2020).

### Discussion

COVID-19 has infected 43.5 million people and caused 1.2 million deaths globally. However, the infectivity of COVID-19, expressed as the number of infected cases or death per one million people, differs among countries. Analyzing differences in national

<sup>2</sup> This regulation does not apply to international flights to Vietnam that arrive to Vietnam with special purposes such as diplomatic delegations, high skilled labors, and firm managers who are allowed and approved to enter Vietnam by authorities.

demographics and COVID-19 epidemiology improves the management of the COVID-19 pandemic (Nguyen and Nguyen, 2020).

The results of this study indicate that a cumulative infection rate of 28 COVID-19 cases per 10 million people is low in comparison with other countries such as Spain, UK, Italy, the USA, and other countries in Asia (e.g., Iran, Korea, Singapore). Importantly, no fatality has been confirmed so far, and out of the 268 confirmed cases, 224 have recovered and have been discharged from hospital. The number of new infected cases per day has decreased since 3 April, and no new infected case was identified between 16 April to 24 April.

In Vietnam, the average age of the confirmed COVID-19 cases is 36 years of age, with 75% of infections under the age of 50 years, which is substantially younger than the mean age of 46 years found in other nations. The average ages of COVID-19 infected patients in other countries were 59 years (China) (Li et al., 2020); 42 years (Korea) (Ki, 2020); 40 years (Singapore) (Pung et al., 2020); and 63 years (Italy) (Grasselli et al., 2020).

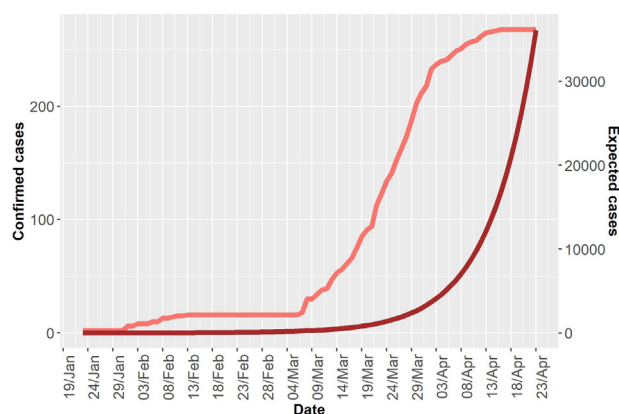
Approximately 60% of confirmed cases were from overseas, being either Vietnamese returnee/oversea students or international visitors/workers. It appears that in the first stage of the pandemic (23 January to 25 February 2020), most of the imported cases were from China, while in the third stage (from 6 March 2020 onward), most of the imported cases came from Europe and North America.

The results also show that the majority (79%) of infections were from the primary infected generation (F0) while the second and third infected generations accounted for a small proportion. This suggests that the current measures and policies were able to control the spread of COVID-19 in Vietnam (Sean, 2020; South China Morning Post, 2020).

Overall, the main characteristics of COVID-19 infection in Vietnam (young people, international flights, and direct contacts) suggested that Vietnam initially contained the pandemic at its early stage. However, this finding also means Vietnam remains vulnerable to the pandemic spread until a vaccine becomes available or the pandemic is also contained across the globe. Thus, to ensure continued success in COVID-19 containment, Vietnam must continue to monitor international travelers closely.

One factor contributing to the success of Vietnam is probably the mindset of its leaders. Vietnamese authorities have recognized that the coronavirus is a deadly infectious disease, not just a seasonal flu. The Vietnamese authorities declared that “*chống dịch như chống giặc*” that can be translated into English as “*fighting the COVID-19 pandemic like fighting the enemy*”. This motto has helped to shape perceptions of COVID-19 in the community. Thus, a combination of measures has been carried out to control the epidemic from very early in the pandemic. These measures have included restrictions on immigration and movement, rigorous quarantine, social distancing, complete tracing and tracking of people who have been in contact with infected people, lockdown, and increasing public health awareness. These measures have been effective for Vietnam, which has limited resources (ASIA, 2020; Sean, 2020). It has been argued that the Vietnamese experience of successfully controlling the outbreak of severe acute respiratory syndrome (SARS) in 2003 provided important lessons for effective management of COVID-19 (Le et al., 2004).

While the number of infections and fatalities caused by COVID-19 has increased substantially in a number of countries in Europe, North America, and Asia, during recent weeks, the disease remains well controlled in Vietnam. This implies that the measures and policies applied have been effective in fighting the coronavirus. As a result, from 16 April to 24 April, no confirmed case has been identified. From 23 April, the application of social distancing has been eased in most provinces in Vietnam except provinces and areas where confirmed cases exist. However, the outbreak of



**Figure 3.** Confirmed vs. expected infected cases in Vietnam. Observed confirmed cases are on the left axis, which is the outcomes of policy interventions; predicted cases using the SIR model are on the right axis (a proxy for “do nothing”); the difference between the two curves represent policy effects.

Source: Authors’ illustration using a SIR model with  $R_0 = 2$ , estimated using observed data of the first 14 days from the first case. Data were downloaded from the John Hopkins COVID-19 Github <https://github.com/CSSEGISandData/COVID-19> (accessed 24 April 2020).

COVID-19 is considered uncertain and complex (Trang and Vu, 2020). Further, the early containment of the pandemic comes with a cost: the country remains vulnerable to the pandemic as most of the population have no immunity against the new coronavirus. For example, Singapore has experienced a second wave of COVID-19 after initial success in the containment of the pandemic. Thus, Vietnam should remain vigilant against the pandemic until an effective vaccine becomes available or the pandemic is controlled globally.

How effective are the early responses to contain the pandemic? We applied a susceptible-infected-recovered (SIR) model using a basic reproduction number ( $R_0$ ) of 2.02 that we estimated using the observed data of the 20 days from the first confirmed cases in Vietnam. Particularly, the  $R_0$  is estimated by choosing parameters of the SIR models that minimized the square of differences between observed and predicted cases in the first 20 days. This estimated  $R_0$  is modest compared to a mean of 3.3 reported elsewhere in the literature (Liu et al., 2020). Figure 3 reports a counterfactual prediction of 35,000 COVID-19 cases if no early policy responses were implemented. Using a case fatality ratio of 1% (Verity et al., 2020), our estimate suggests that Vietnam avoided 350 COVID-19 related deaths due to its timely responses.

## Conclusions

This study has described the spread of COVID-19 in Vietnam and explored the effectiveness of policy responses. Despite the proximity to China, where the disease emerged, Vietnam has experienced a relatively small number of cases and no fatality (as of 24 April 2020). Most of the active infected cases arrived from Europe and the USA since early March. Most infected patients were relatively young and had a history of international travel. Early policy interventions such as lockdown, movement restrictions, community isolation and quarantine, and intensive contact tracing, among others, were the main factors that contributed to the success of Vietnam to date. These early responses prevented around 35,000 infected cases and 350 deaths from COVID-19.

## Conflicts of interest

We have no conflict of interest to declare.

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## Ethical approval

Ethical approval was not required for this research.

## References

- ASIA. How Vietnam is winning its 'war' on coronavirus. 2020. <https://www.dw.com/en/how-vietnam-is-winning-its-war-on-coronavirus/a-52929967>.
- Billboard. Vietnam's viral coronavirus PSA sparked a TikTok dance challenge & these are 10 of the best videos. 2020. <https://www.billboard.com/articles/news/international/9329174/vietnam-coronavirus-psa-song-best-tiktok-dance-videos>.
- Grasselli G, Zangrillo A, Zanella A, Antonelli M, Cabrini L, Castelli A, et al. Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the Lombardy Region, Italy. *JAMA* 2020;323(16):1574–81, doi:<http://dx.doi.org/10.1001/jama.2020.5394>.
- Hai LT, Nguyen LV, Tran DM, Do HT, Tran HT, Le YT, et al. The first infant case of COVID-19 acquired from a secondary transmission in Vietnam. *Lancet Child Adolesc Health* 2020;4(5):405–6, doi:[http://dx.doi.org/10.1016/S2352-4642\(20\)30091-2](http://dx.doi.org/10.1016/S2352-4642(20)30091-2).
- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;395(10223):497–506.
- Huynh TL. The COVID-19 containment in Vietnam: what are we doing?. *J Glob Health* 2020a;10(1)010338.
- Huynh TL. The COVID-19 risk perception: a survey on socioeconomics and media attention. *Econ Bull* 2020b;40(1):758–64.
- Huynh TL. Data for understanding the risk perception of COVID-19 from Vietnamese sample. *Data Brief* 2020c;105530.
- Johns Hopkins University. COVID-19 dashboard by the center for systems science and engineering (CSSE). 2020. <https://coronavirus.jhu.edu/map.html>.
- Kermack WO, McKendrick AG. A contribution to the mathematical theory of epidemics. *Proc R Soc Lond A* 1927;115(772):700–21.
- Ki M. Epidemiologic characteristics of early cases with 2019 novel coronavirus (2019-nCoV) disease in Korea. *Epidemiol Health* 2020;42:.
- La VP, Pham TH, Ho MT, Hoàng NM, Linh NPK, Trang VT, et al. Policy response, social media and science journalism for the sustainability of the public health system amid COVID-19 outbreak: the Vietnam lessons. *Sustainability* 2020;12(7):2931.
- Lauer SA, Grantz KH, Bi Q, Jones FK, Zheng Q, Meredith HR, et al. The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: estimation and application. *Ann Intern Med* 2020;172(9):577–82.
- Le DH, Bloom SA, Nguyen QH, Maloney SA, Le QM, Leitmeyer KC, et al. Lack of SARS transmission among public hospital workers, Vietnam. *Emerg Infect Dis* 2004;10(2):265–8.
- Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. *N Engl J Med* 2020;382:1199–207, doi:<http://dx.doi.org/10.1056/NEJMoa2001316>.
- Liu Y, Gayle AA, Wilder-Smith A, Rocklöv J. The reproductive number of COVID-19 is higher compared to SARS coronavirus. *J Travel Med* 2020;27(2).
- Nelder JA, Wedderburn RW. Generalized linear models. *J R Stat Soc A (Gen)* 1972;135(3):370–84.
- Nguyen HG, Nguyen TV. An epidemiologic profile of COVID-19 patients in Vietnam. medRxiv 2020;., doi:<http://dx.doi.org/10.1101/2020.04.10.20061226>.
- Phan LT, Nguyen TV, Luong QC, Nguyen TV, Nguyen HT, Le HQ, et al. Importation and human-to-human transmission of a novel coronavirus in Vietnam. *N Engl J Med* 2020;382(9):872–4.
- Pung R, Chiew CJ, Young BE, Chin S, Chen MI, Clapham HE, et al. Investigation of three clusters of COVID-19 in Singapore: implications for surveillance and response measures. *Lancet* 2020;395:1039–46.
- Quach HL, Thi NAH. COVID-19 in Vietnam: a lesson of pre-preparation. *J Clin Virol* 2020;104379.
- R Core Team. R: a language and environment for statistical computing URL: <https://www.R-project.org/>. Vienna, Austria: R Foundation for Statistical Computing; 2019.
- Sean F. Viet Nam shows how you can contain COVID-19 with limited resources. 2020. <https://www.weforum.org/agenda/2020/03/vietnam-contain-covid-19-limited-resources/>.
- South China Morning Post. Vietnam fights COVID-19 with limited resources. 2020. <https://www.scmp.com/video/coronavirus/3079756/no-deaths-and-cases-limited-hundreds-vietnams-covid-19-response-appears>.
- Thanh HN, Van TN, Thu HNT, Van BN, Thanh BD, Thu HPT, et al. Outbreak investigation for COVID-19 in northern Vietnam. *Lancet Infect Dis* 2020;20(5):535–6, doi:[http://dx.doi.org/10.1016/S1473-3099\(20\)30159-6](http://dx.doi.org/10.1016/S1473-3099(20)30159-6).
- The Vietnamese Ministry of Culture Sport and Tourism. Tourism statistics: international visitors. 2020. <http://vietnamtourism.gov.vn/english/index.php/statistic/international>.
- The Vietnamese Ministry of Health. Decision No. 878/QĐ – BYT on the circulation of guidelines on quarantine in health establishments Hanoi, Vietnam. 2020.
- The Vietnamese Ministry of Health. Decision No. 879/QĐ – BYT on the circulation of guidelines on quarantine in non-medical establishments Hanoi, Vietnam. 2020.
- The Vietnamese Ministry of Health. 2020c. <https://ncov.moh.gov.vn/>. [Accessed 24 April 2020].
- The Vietnamese Ministry of Health. 2020d. <https://ncov.moh.gov.vn/web/guest/dong-thoi-gian>. [Accessed 24 April 2020].
- The Vietnamese Ministry of Health. 2020e. <https://ncovi.vn/>. [Accessed 24 April 2020].
- The Vietnamese Prime Minister. The Directive No. 16/CT-TTg about the application of necessary measures to combat the COVID-19 Hanoi, Vietnam. 2020.
- Trang HDN, Vu DC. Summary of the COVID-19 outbreak in Vietnam – lessons and suggestions. *Travel Med Infect Dis* 2020;101651.
- Verity R, Okell LC, Dorigatti I, Winskill P, Whittaker C, Imai N, et al. Estimates of the severity of coronavirus disease 2019: a model-based analysis. *Lancet Infect Dis* 2020;20(6):669–77, doi:[http://dx.doi.org/10.1016/S1473-3099\(20\)30243-7](http://dx.doi.org/10.1016/S1473-3099(20)30243-7).
- Vietnam Insider. Bluezone Covid-19 tracking app exceeded 20 million downloads Available online: <https://vietnaminsider.vn/bluezone-covid-19-tracking-app-exceeded-20-million-downloads/>. [Accessed 26 October 2020]. 2020.
- World Health Organisation. Coronavirus (COVID-19). 2020. <https://covid19.who.int/>.
- YouTube. 2020. <https://www.youtube.com/watch?v=BtulL3oArQw>. [Accessed 1 May 2020].
- Zhao S, Musa SS, Lin Q, Ran J, Yang G, Wang W, et al. Estimating the unreported number of novel coronavirus (2019-nCoV) cases in China in the first half of January 2020: a data-driven modelling analysis of the early outbreak. *J Clin Med* 2020;9(2):388.
- Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med* 2020;382:727–33, doi:<http://dx.doi.org/10.1056/NEJMoa2001017>.