International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2019): 7.583

Public Health Policies and Global COVID-19 Outbreak

Marina Komaroff[1], Ahmed Amir Belhouchet[2]

[1]Dr. PH, Noven Pharmaceuticals, Inc.100 Town Squre Place, 5th Floor, Jersey City, NJ 07310
genmar2k[at]gmail.com

[2]MD, MPH, University of Paris-Sud, Paris-Saclay, Department of Public health, Paris, France
belhouchet.chem[at]yahoo.com [corresponding author]

Abstract: ***The objective of our observational study is to evaluate the association between public health non-pharmaceutical interventions (exposure) against the COVID-19 outbreak and the incidence of confirmed COVID-19 cases (outcome) from five countries: France, Italy, Japan, South Korea, and the USA, December 31, 2019 through April 12, 2020. The incidence of COVID-19 would be significantly greater without lockdown (1.89 times, p-value <.0001), public health and economic measures (25.17, p-value <.0001), and using masks (11.93, p-value=0.002), assuming that all other public health policies are the same. The effectiveness increases with earlier time of implementation. Among considered countries, South Korea was the most efficacious, where all measures were statistically significantly efficacious. The experience from South Korea should be studied further as the most effective non-pharmacological approach to fight the disease. This paper is the first step to develop the standardized approach utilizing the public health interventions to be applied effectively to the globe population.***

Keywords: COVID-19, Public health measures, Facial mask, Lockdown

1. Introduction

From 31st of December, 2019, COVID-19 is no longer just an Asian problem but rather European, American, and the rest of the world until completely attenuated. It is certain that nobody knows the exact behavior of this virus and less known about the care and actions needed to prevent the growth and control of the disease.

After the first and second world war, public health organizations underscored that the risk of an influenza pandemic was one of the most important infectious threats to humanity. However, when the COVID-19 started spreading around the globe, many countries did not consider the disease as a serious threat. The fact is that the world was not ready to face the pandemic despite of all technological progress.

The disease appeared in Wuhan, Hubei, China around December, 2019 as pneumonia cases of unknown cause, with clinical symptomatology resembling viral pneumonia [1,2]. The series of tests with deep sequencing analysis from lower respiratory tract samples indicated a novel coronavirus, which was named 2019 novel coronavirus (2019-nCoV).

As many early cases of COVID-19 were linked to the Huanan market in Wuhan, the animal origin of COVID-19 was present most likely but remains unconfirmed [3]. Indeed, several theories have been evoked after genetic analysis, namely leaking from a genetic manipulation laboratory [4], but the most likely according to scientists is the zoonotic transfer of bats or pangolins whose coronaviruses have a strong similarity with SARS- CoV-2 [5]. In short time the Chinese authorities have confirmed that the deadly virus has infected more than 200 people in four countries [6], because it can be transmitted via human-to-human contact [7]. The spread is primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes [8]. The clinical signs and symptoms reported are mainly fever, with a few cases of dyspnea, and bilateral invasive pulmonary infiltrates, visible on radiographic images [9]. The national authorities indicated that the patients have been isolated and are receiving treatment in medical establishments in Wuhan.

It is important to know, that the necessary measures to deal with viral pandemic are the government policy, the barrier measures of food hygiene, and social distension. The major actions must be implemented at the right time, and special action must be taken regarding the vulnerable population. Meanwhile the several clinical trials carried out at the moment to find the treatment for this corona virus COVID-19. We are focusing on the public health interventions that were taken by multiple counties to control the spread of the disease. However, the countries around the globe faced the problem with different attitude and level of preparedness that forced them to implement different set public health measures at different time. It is important to compare the patterns of these actions to draw the lessons. The aim of this paper is to evaluate the association between implemented public health measures and COVID-19 outcome across the five countries with the close confirmed date of onset of the disease.

1) Database source

The COVID-19 epidemic outcome data, as well as the various public health interventions/measures taken by the countries from December 31st, 2019 through the April 12, 2020 were extracted from the sources published by the government officials of each country, the World Health Organization (WHO), Johns Hopkins University, Assessment Capacities Project (ACAPS) data reports of notifiable diseases, including media sources regarding the

date of onset of the first cases and the date of confirmed diagnosis (the date of laboratory confirmation of SARS-CoV-2 infection in biological samples). The data has been compared and verified according to at least three official published data sources. The personal identifiable information was not part of used database that follows the protection of privacy laws.

2) Objectives and Hypotheses

The "zero" patient (P0) is the first confirmed case. For France, Italy, Japan, South Korea, and the USA, they were men and women travelling from Wuhan, China (where the epidemic started) and back. These countries detected their first cases of COVID-19 on the same month (January) and period (January 16-28), **Table 1**.

Table 1: Counties with the First Confirmed Case of COVID-19 in January, 16-28, 2020

Country	Date First Confirmed Case	Patient P0
China	November 17,2019	A man from Wuhan, China
France	January 24,2020	A 48-year-old French citizen man from China
USA	January 20, 2020	A 35 years-old American citizen man from china travelled to Wuhan to visit his family
Italy	January 28,2020	A Chinese couple tourist, originally from Wuhan
Japan	January 16,2020	A Man 30 years-old from china previously travelled to Wuhan
South Korea	January 20,2020	a 35-year-old woman who had been living in Wuhan, China

At the time of writing this paper (April 4 2020), the number of cases in the U.S. had topped to 368 196. In France and Italy, the number of confirmed cases increased to a total of 74,390 and 132,547 cases, respectively. However, South Korea had less than 10 000 cases and reported its lowest number of new cases since rates peaked at the end of February.

The known public health interventions/measures for air-borne diseases, according recommendations WHO in 2014 were implemented by all five countries, while different set of public health measures were enforced and at different time. For example, Japan and South Korea enforced using masks for the whole population from the first day of epidemic as was implemented in China, but this measure was not adopted by France, Italy or the USA. **The objective of this study was to evaluate the association between the implemented public health measures in five counties with the close onset date of the disease and COVID-19 outcome in those countries. We hypothesized that some public health measures had significant impact on slowing down the spread of the diseases, and the goal was to identify those measures for future outbreak(s).**

2. Study Design and Methods

1) Outcome

The outcome was the incidence of confirmed cases that was assessed every day from December 31, 2019 through April 12, 2020. The data was pooled from the five countries where the first case was reported about the same time (second part of January, 2020): France, Italy, Japan, South Korea, and the USA.

2) Exposure

The exposure was the sets of public health measures implemented in France, Italy, Japan, South Korea, and the USA with the date of implementation.

Table 2: The List of Public Health Measures

No	Category	Measure
1	Lockdown	Full lockdown
		1.2. Partial lockdown
2	Movement restrictions	2.1. Additional health/documents requirements upon arrival
		2.2. Border closure
		2.3. Checkpoints within the country
		2.4. Domestic travel restrictions
		2.5. International flights suspension
		2.6. Surveillance and monitoring
		2.7. Visa restrictions
3	Public Health and Economic measures	3.1. Awareness campaigns
		3.2. General recommendations
		3.3. Health screenings in airports and border crossings
		3.4. Introduction of quarantine policies
		3.5. Psychological assistance and medical social work
		3.6. Strengthening the public health system
		3.7. Testing policy
		4.1. Economic measures
		4.2. Emergency administrative structures activated or established
		4.3. Limit product imports/exports
		4.4. Military deployment
		4.5 State of emergency declared
4	Social Distancing	5.1. Changes in prison-related policies
		5.2. Limit public gatherings
		5.3. Public services closure
		5.4. Schools closure
5	Mandatory Use of Mask	

The number of public health measures were grouped into five categories: Lockdown, Movement restrictions, Public Health Measures, Social (including social distancing) and Economic Measures, and Mandatory Use of Mask. The Lockdown was enforced based on the WHO recommendations; Movement restriction was governments' initiative; Public Health, Social and Economic Measure were based on the Chinese and Asian experience with COVID and SARS, and Social and Economic Measures are known epidemiologic measure. The full set of measures is presented in **Table 2**.

3. Statistical Methods

We hypothesized that implementation of different public health measures is associated with the change in the incident number of COVID-19 cases. The multiple linear regressions were utilized to test the hypothesis, 2-sided with level of

significance 0.05.

Model 1: Multiple linear regression was used to estimate the log-transformed outcome (Y) as dependent variable; and day of the implementation, and the category of public health measures (each coded as No=1/Yes=0) as independent variables. The equation can be presented as following:

$LogY = \alpha + \gamma*day + \beta_i * CategoryPublicHealthMeasure_i + Error$; where i =1 to 5 categories of public health policies.

The exp (β_i) coefficients will estimate if there is an association of the category of public health measure with the outcome and its significance (level of significance 0.05).

Model 2: Multiple linear regression was used to estimate the log-transformed outcome (Y) as dependent variable; and day of implementation, and the public health measures (each coded as No=1/Yes=0) as independent variables. The equation can be presented as following:

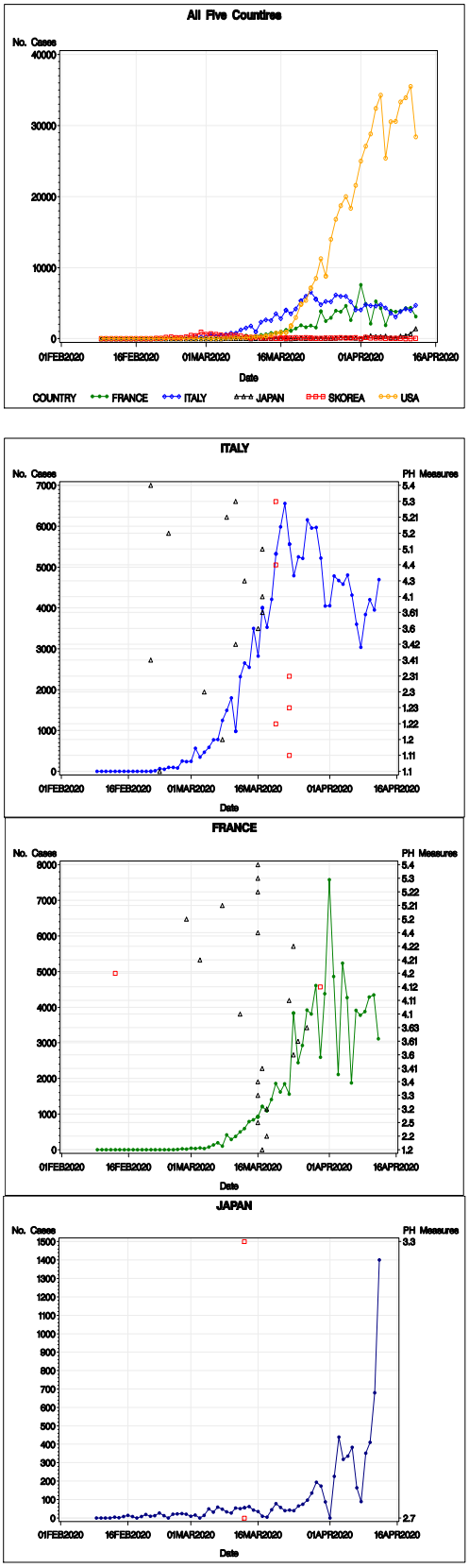
$LogY = \alpha + \gamma*day + \beta_i * PublicHealthMeasure_i + Error$; where i is the number of public health measures.

The exp(β_i) coefficients estimate if there is an association of public health measure with the outcome and its significance (level of significance 0.05). The same model was used to estimate the effect of public health measures in each of five countries.

All statistical analyses were performed using SAS® version V9.4.

4. Results

The incidence of confirmed cases in five countries with the pattern of implementation of public health measures by day is visually presented in **Figure 1**. It is clearly seen that even that the first case happened at the same date, the development of the disease was different across the countries that suggests the difference in effectiveness of implemented public health policies. Overall, the majority of interventions were taken place in March after pandemic was officially announced in 12 of March, 2020. In addition, the mandatory use of mask policy was enforced only in Japan and South Korea from the 31st of December, 2019.



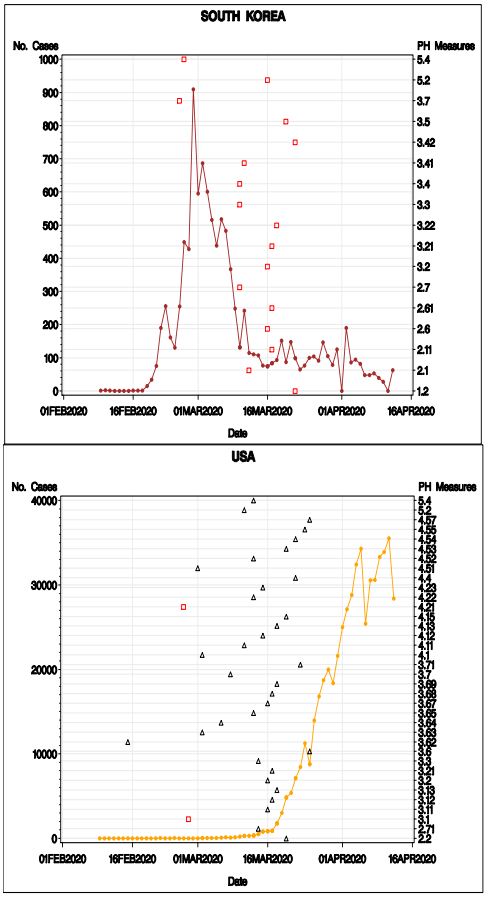


Figure 1: The Incidence of Confirmed COVID-19 Cases from December 31, 2019 through April 12, 2020: France, Italy, Japan, South Korea, and the USA.

The results from Multiple Linear regression model for 5 countries: France, Italy, Japan, South Korea, and the USA is presented in **Table 3** (Model 1), and **Table 4** (Model 2). The model fit for each regression analysis was checked by residuals and the values of R-square. Each model had a good fit with R-square for at least 80, and the variance inflation factor of each predictor variable was at acceptable level which was set below 10.

Table 3: The Association between Categories of Public Health Measures and Outcome

Category of Public Health Measures	Exp (β coeff.)	P-value
Intercept	0.0197	<.0090
Day	1.1119	<.0001
1. Lockdown	**1.8866**	**<.0001**
2. Movement restrictions	0.3974	<.0001
3. Public Health and Economic measures	**25.1719**	**<.0001**
4. Social Distancing	0.1174	<.0001
5. Mandatory Use of Mask	**11.9336**	**<.0001**

The increase in cases was about 11% daily with the implementation of all public health interventions. The incidence would be statistically significantly greater without implementing a policy compared to implementing the policy of *lockdown* (1.89 times, p-value <.0001), *public health and economic measures* (25.17 times, p-value <.0001), and *using masks* (11.93 times, p-value=0.002), assuming that all other public health policies are the same. A policy of *movement restrictions* (p-value < .0001), and *social distancing*. (p-value <.0001) were not effective to control the spread of the disease. It is possible that those policies were not followed in some countries.

The summary of effect of public health measures by counties: France, Italy, Japan, South Korea, and the USA is presented in **Table 4**. Each country had their pattern of policies with the different dates of implementation. The policies with the same implementation day +/- 2 were tested together. If the same measure was enforced second or third time, then 2 or 3 was added at the end to the numbering convention of that measure (for example, 4.22, 4.23 for second and third implementation of 4.2 measure). In **Figure 1**, all public health measures were marked with "triangle" sign, but probable/possible efficacious ones were marked with a "square" sign. The results by counties demonstrated that not all implemented policies were effective.

France: In France, the only *emergency administrative structures activated or established* in February 13, and the *economic measure*s enforced second time in March 30 was possibly efficacious, but not statistically significant. The number of cases would be 2.85 times greater without implementation of *emergency administrative structures activated* (p-value=0.1337). Similarly, the *economic measures* implemented in March 30 started slowing down the disease, if not implemented the incidence would be 1.72 times greater (p-value=0.1287). It may be that the intervention in February 13 slowed down the growth of the disease, and the intervention from March 30 possibly accountable for slight deep down (decrease) in incidence that is seen in the **Figure 1** (France).

Italy: None of implemented public health measures were statistically significant efficacious in Italy. Only in set of measures implemented in March 20-23: *partial lockdown, full lockdown, military deployment, public services closure*, and *checkpoints within the country* possibly started slowing down the disease without which the growth would be 1.25 times greater (not statistically significant, p-value=0.4180). However, the effect observed in **Figure 1** (Italy) coming from those measure may be explained that people finally started following up the restrictions.

Japan: In Japan, the both measures implemented in March 13: *visa restrictions*, and *health screenings in airport and border crossings* were statistically significantly effective without which the growth in incidence would be almost twice greater (p-value=0.017). It could be that those measures delayed the spread of the disease, **Figure 1** (Japan).

South Korea: All public health measures implemented in South Korea were significantly effective. The incidence of cases would be 7.23 times greater (p=0.0033) without implementing *testing policy*, and *school closure* implemented in February 27, 28; and *health screening in airports and border crossings, introduction of quarantine policies, and additional health /documents requirements upon arrivals* in March 10-12. The incidence of cases would be 2.2 times greater (p=0.3895) without implementing the efficacy measures in March, 16: *general recommendations*,

limit public gathering, surveillance and monitoring, and additional health/documents requirements upon arrival. The incidence of cases would be 8.54 times greater (p=0.0119) without implementing the *psychological assistance and medical social work, partial lockdown, and introduction to quarantine policies* in March 20, and 22. The decrease in incident cases after implementation of listed public health measures can be seen in **Figure 1** (South Korea).

USA: USA was the country with the highest number of implemented public health policies among considered five countries. However, the significantly effective policies were those that applied earlier. The incidence of cases would be 2.19 (p-value=0.0373), 2.96 (p-value=0.0373), and 4.01 (p=value=0.003) times greater without enforcement the *emergency administrative structures activated or established, strengthening the public health system, visa restrictions, and state of emergency* declared in January 21, and 22; *strengthening the public health system* in February 4th, and *emergency administrative structures activated or established*, and *awareness campaigns* in February 28. The effect of this measure possibly slowed down the spread of the disease, **Figure 1** (USA).

Table 4: The Association between Public Health Measures and COVID-19 Outcome

Date	day	Public Health Measures	FRANCE exp(β) (P-value)	ITALY exp(β) (P-value)	JAPAN exp(β) (P-value)	SOUTH KOREA exp(β) (P-value)	USA exp(β) (P-value)
		Intercept exp(β) (P-value)	4.35 (0.5298)	6151.37 (<.0001)	0.065 (<.001)	0.00014 (<.0001)	7.3066 (0.1040)
		Day exp(β) (P-value)	1.07 (0.0056)	1.00 (0.8035)	1.09 (<.001)	1.154 (<.0001)	1.089 (<.0001)
31/01	22 23 32	4.2 Emergency administrative structures activated or established 3.6. Strengthening the public health system 2.7. Visa restrictions 4.5. State of emergency declared	n/a	n/a	n/a	n/a	**2.1906 (0.0373)**
04/02	36	3.6.1. Strengthening the public health system	n/a	n/a	n/a	n/a	**2.9458 (0.0373)**
13/02	45	4.2. Emergency administrative structures activated or established	**2.85** (0.1337)	n/a	n/a	n/a	n/a
15/02	47	3.6.2. Strengthening the public health system	n/a	n/a	n/a	n/a	0.4381 (0.0279)
21/02	23 24 28 32 53	4.2. Emergency administrative structures activated or established 3.4. Introduction of quarantine policies 3.1. Awareness campaigns 2.5. International flights suspension 4.5. State of emergency declared 2.5. International flights suspension 5.4. Schools closure	n/a	0.20 (0.0064)	n/a	n/a	n/a
23/02	55	1.1. Full lockdown	n/a	0.24 (0.0019)	n/a	n/a	n/a
25/02	57	5.2. Limit public gatherings	n/a	0.29 (<.0001)	n/a	n/a	n/a
28/02	59 60	4.2. Emergency administrative structures activated or established 3.1. Awareness campaigns	n/a	n/a	n/a	n/a	**4.0086 (0.0003)**
29/02	61	5.2. Limit public gatherings	0.169 (0.0001)	n/a	n/a	n/a	n/a
02/03	62 63	4.5. State of emergency declared 3.6. Strengthening the public health system 4.1. Economic measures	n/a	n/a	n/a	n/a	0.1648 (<.0001)
03/03	64	4.2.1. Emergency administrative structures activated or established	0.4839 (0.0730)	n/a	n/a	n/a	n/a
04/03	65	2.3. Checkpoints within the country	n/a	0.30 (<.0001)	n/a	n/a	n/a
06/03	67 69	3.6.3 Strengthening the public health system 3.7. Testing policy	n/a	n/a	n/a	n/a	0.2790 (0.0002)
08/03	69	1.2. Partial lockdown	n/a	0.42 (0.0025)	n/a	n/a	n/a
08/03	69	5.2.1. Limit public gatherings	0.4183 (0.0224)	n/a	n/a	n/a	n/a
10/03	58 59 71 72 73	3.7. Testing policy 5.4. Schools closure 2.7. Visa restrictions 3.3. Health screenings in airports and border crossings 3.4. Introduction of quarantine policies 2.1. Additional health/documents requirements upon arrival	n/a	n/a	n/a	**7.2315 (0.0033)**	n/a

11/03	70 72	5.2.1. Limit public gatherings 3.4. Introduction of quarantine policies 5.3. Public services closure	n/a	0.99 (0.9680)	n/a	n/a	n/a
11/03	72	4.1. Economic measures 5.2. Limit public gatherings	n/a	n/a	n/a	n/a	0.5236 (0.0624)
12/03	73	4.1. Economic measures	0.5146 (0.0901)	n/a	n/a	n/a	n/a
12/03	73	2.7. Visa Restrictions 3.3. Health screenings in airports and border crossings	n/a	n/a	**1.97** **0.017**	n/a	n/a
13/03	74 75 76 77 78	3.6. Strengthening the public health system 4.2. Emergency administrative structures activated or established 4.5. State of emergency declared 5.4. Schools closure 2.7. Visa restrictions 3.3. Health screenings in airports and border crossings 4.1. Economic measures 3.1. Awareness campaigns	n/a	n/a	n/a	n/a	0.5522 (0.0994)
13/03	74	4.3. Limit product imports/exports	n/a	0.52 (0.0378)	n/a	n/a	n/a
16/03	77 78	3.6. Strengthening the public health system 4.1. Economic measures 5.1. Changes in prison-related policies	n/a	0.72 (0.2383)	n/a	n/a	n/a
16/03	77 78 79	2.5. International flights suspension 3.3. Health screenings in airports and border crossings 3.4. Introduction of quarantine policies 4.4. Military deployment 5.2. Limit public gatherings 5.3. Public services closure 5.4. Schools closure 1.2. Partial lockdown 3.4. Introduction of quarantine policies 2.2. Border closure 3.2. General recommendations	0.7045 (0.3281)	n/a	n/a	n/a	n/a
16/03	77 78 79	3.2. General recommendations 5.2. Limit public gatherings 2.6. Surveillance and monitoring 2.1. Additional health/documents requirements upon arrival	n/a	n/a	n/a	**2.195** (0.3895)	n/a
18/03	79	3.1 Awareness campaigns 3.6 Strengthening the public health system 4.1 Economic measures	n/a	n/a	n/a	n/a	0.412 (0.0311)
20.03	81 83	3.5. Psychological assistance and medical social work 1.1. Partial lockdown 3.4. Introduction of quarantine policies	n/a	n/a	n/a	**8.538** **(0.0119)**	n/a
20/03		2.2. Border closure 4.1. Economic measures 4.5. State of emergency declared 4.4. Military deployment 3.6. Strengthening the public health system	n/a	n/a	n/a	n/a	0.3709 (0.0115)

5. Discussions

The findings suggest that the following categories of public health measures: *lockdown, public health and economic measure*, and *use of mask* were efficacious during COVID-19 outbreak according to the data for incident confirmed cases from France, Italy, Japan, South Korea and the USA, December 31, 2019 through April 12, 2020. It is possible that significant effect from *movement restrictions* and *social distancing* was not observed because people did not take restrictions seriously and did not follow them, particularly in the beginning of the outbreak; or it is possible that the execution of these policies was different. Moreover, the effectiveness of each particular public health measure differed by country and the time of implementation.

Timely implementation of *health screening in airports and border crossings, introduction of quarantine policies, additional health /documents requirements upon arrivals, general recommendations, limit public gathering, surveillance and monitoring, and additional health/documents requirements upon arrival* in South Korea from February 26 through March 22 steadily and significantly slowed down the spread of the disease. South Korea was the most efficacious county to fight the disease. Early implementation of *visa restriction* and *strengthening the public health system* in March 13 in Japan possibly significantly delayed the spread of the disease which started growing rapidly only from April 1 lacking additional public health measures. The implementation of multiple measures:

emergency administrative structures activated or established, strengthening the public health system, visa restrictions, state of emergency declared, strengthening the public health system, emergency administrative structures activated or established, and *awareness campaigns* from January 21 through February 28 was efficacious in the USA. The other public health measures enforced repeatedly during March in the US were not efficacious and disease rapidly took off to the largest incident cases in the world at the end of March and beginning of April. None of the public health measures implemented in France or Italy statistically significantly slowed down the spread of disease. Yet, it possible that implementation of the measures was not followed, or implementation was not properly enforced. In summary, the experience from South Korea should be studied further as a good example of the most effective non-pharmacological approach to fight the disease.

Public health actions to COVID-19 outbreaks around a world aimed to limit or even stop the evolution of national and international transmission of this virus, which requires total transparency on the situation and real-time sharing of all relevant information. This paper is the first preliminary report that describes the effectiveness of public health measures modeling data from five countries that were severely contaminated about the same time with COVID-19 but faced the problem with a different attitude and level of preparedness. The rational to choose these five countries was based on the fact that they had the close date of onset of the disease (January 16-28), but acted differently. We want to note that certain public health measures were implemented alone while others in a grouped manner. The implementation of certain measures alone cannot be effective or ineffective, so the concomitant implementation of the measures effectively at the same time and in early spread of the disease is important to set up the first barrier and stop the transmission of the virus. Regarding the measures that were not statistically significant effective, we can speculate that they possibly have not been applied correctly or were not applied at the right time (too late in the development of the disease). All these facts suggest that there was no consensus or strategy previously existing on the best public health measures. Thus, results from this study can be valuable in the current common efforts to counteract the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which was a cause of coronavirus disease 2019, now the global pandemic of COVID-19.

6. Strength and Limitations

The strength of this study is a robust database with five diverse counties reporting incidence of confirmed cases every day from December 31, 2019 through April 12, 2020 without missing values. Having the dates of public health measures implementation, it became possible to address the research question.
The public health system remains the most important force to fight the COVID-19 pandemic. According current information, there is no validated therapy or vaccine to stop the transmission of COVID-19. The results from this paper is the first step to develop the standardized approach where the effective public health measures can be applied effectively to the whole population in order to stop the spread of the pandemic.

The limitation of this study is that the number of incident cases might have been underestimated. Because transmission of the disease was not clear, the people at risk and mild symptoms were not tested. According to WHO publications, the COVID-19 virus is mainly transmitted between people through respiratory droplets and contact routes [10]. In an analysis of 75,465 cases of COVID-19 in China, none of airborne transmission was reported [11]. Recently the ocular transmission was reported by the American Academy of Ophthalmology (AAO) when the virus can cause conjunctivitis and possibly be transmitted by aerosol contact with conjunctiva and there is a low risk of spreading COVID-19 through tears [12]. Finally, some studies have suggested that COVID-19 may be spread by people who are not showing symptoms [13]. In addition, the incidence of home confirmed cases was not counted by any of five counties; and probably a high proportion of cases was not detected and/or not tested because the test was reserved only for severe cases with confirmed symptomatic clinical involvement. Yet, adding underreported cases would not have changed the findings of identified efficacious public health measures but only had strengthen the results. However, it is possible that some efficacious measures were overlooked due to this underestimation.

The serious limitation in this study is the absence of clinical data, such as the time of hospitalization of the patients, the treatments taken by these patients before hospitalization as well as the time of discharge, the medical treatment strategies, etc. Thus, further research is needed to confirm the results.

7. Conclusions

As the COVID-19 epidemic spreads dramatically and rapidly around the world, but the global understanding of this disease is not yet clear. Because no therapeutics have emerged, it is important to understand what public health measures are capable of stopping or at least slowing down the spread.

This paper had a novel goal to evaluate the association between the incidence of confirmed COVID-19 cases and the implementation of public health measures based on the data from France, Italy, Japan, South Korea and the USA from December 31, 2019 through April 12, 2020. It identified the overall efficacious policies, as well as measures that worked for each particular country according the pattern and time of their implementation. The results may inform the public health policy makers and politicians about the most effective measures to control the COVID-19 outbreak and the future outbreaks of respiratory disease.
We hope that this paper will be enriched by the other studies in order to build a standard strategy to enforce the effective measures of public health at right time of the evolution of the epidemic.

References

[1] *Novel Coronavirus – China*. Jan. 2020. URL: ttps://www.who.int/csr/don/12-january- 2020-novel-coronavirus- china/en/#.X2YnqbisIsA.100zakladok (visited on 01/12/2020).
[2] C Huang et al. "Clinical features of patients infected with 2019 novel coronavirus in Wuhan". *China Lancet* 395 (2020), pp. 30183–30188.
[3] P Zhou, X Yang, X Wang, et al. "A pneumonia outbreak associated with a new coronavirus of probable bat origin". *Nature* 579 (2020), pp. 270–273.
[4] Jie Cui, Fang Li, and Zheng-Li Shi. "Origin and evolution of pathogenic coronaviruses".
[5] *Nature Reviews Microbiology* 17(3) (2019), pp. 181–192. DOI: 10.1038/s41579-018-0118-9. URL: https://dx.doi.org/10.1038/s41579-018-0118-9.
[6] K.G. Andersen, A Rambaut, W.I. Lipkin, et al. "The proximal origin of SARS-CoV-2".
[7] *Nature Medicine* (2020). DOI: https://doi.org/10.1038/s41591-020-0820-9.
[8] Sky News. Jan. 2020. URL: https://news.sky.com/story/china-confirms-deadly-wuhan- coronavirus-can-be-transmitted-by-humans-11913560 (visited on 01/23/2020).
[9] J Parry. "China coronavirus: cases surge as official admits human to human transmission". *BMJ* 368(236) (2020).
[10] Y Li et al. "Saliva is a non-negligible factor in the spread of COVID-19". *Mol Oral Microbiol* (2020).
[11] T Singhal. "A Review of Coronavirus Disease-2019 (COVID-19)". *Indian J Pediatric* 87 (2020), pp. 281–286.
[12] J Liu et al. "Community transmission of severe acute respiratory syndrome coronavirus 2". *Emerg Infect Dis* (2020).
[13] Swx Ong, Y K Tan, P Y Chia, et al. "Air, Surface Environmental, and Personal Protective Equipment Contamination by Severe Acute Respiratory Syndrome Coronavirus 2
[14] (SARS-CoV-2) From a Symptomatic Patient". *JAMA* 323(16) (2020), pp. 1610–1612.
[15] Ivan Yu Jun Seah et al. "Assessing Viral Shedding and Infectivity of Tears in Coronavirus Disease 2019 (COVID-19) Patients". *Ophthalmology* 127(7) (2020), pp. 977–979. DOI: 10.1016/j.ophtha.2020.03.026. URL:https://dx.doi.org/10.1016/j.ophtha.2020.03.026.
[16] Cdc Usa. "Coronavirus Disease 2019 (COVID-19): How COVID-19 Spreads". In: 2020.

Author Profile

Ahmed Amir Belhouchet MD, MPH is project manager SI unit care consultant deployment at AP-HP France. Medical doctor, started his career as a general practitioner parallel participated in clinical research project whose objective was to set up treatment for craniopharyngioma with bleomycin, then joined pharmaceutical industry, has over 10+ of experience in areas including scientific, research and parallel computing, system information, business development & marketing. he also has a master 2 degree in public health from the prestigious Paris Saclay Paris Sud University France.

Marina Komaroff, Dr.PH, MPH, MS is a Director of Biostatistics department at Noven Pharmaceuticals, which is a partner company of Hisamitsu in Tokyo, Japan. For the past 15 years, she has worked with research physicians and epidemiologists on the development and analysis of randomized clinical trials testing the efficacy and safety of investigational new drugs. Her major responsibility is collaborating with clinicians and regulatory management on statistical strategy and communication with the Federal Drug Administration (FDA) about the research methods and statistical analyses that must be reviewed, monitored and approved by the FDA before a new drug can be licensed for sale. She earned Doctorate Degree in Public Health from State University of New York (SUNY) Downstate Medical Center, Epidemiology and Biostatistics department; Master of Public Health degree from Columbia University Mailman School of Public Health. She is a fluent in Russian and hold a masters in science from Saint Petersburg University (Russia) where she majored in applied mathematics. She is a member of American Public Health Association (APHA) and American Statistical Association (ASA); and has presented posters and papers at many professional conferences. She is a Best Paper winner from Pharma SUG conferences in 2017 and 2018 years.