

Comparative analysis of COVID-19 guidelines from six countries: a qualitative study in the US, China, South Korea, the UK, Brazil and Haiti

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Abstract

Background

On January 30, 2020, the WHO declared the outbreak of COVID-19 a Public Health Emergency of International Concern. Within only a few weeks, the outbreak took on pandemic proportions, affecting over 100 countries. This rapid increase in confirmed cases made the prevention and control of COVID-19 critical on both national and global scales in order to prevent the healthcare systems from being overwhelmed. Government guidelines provide a fundamental resource for communities, as they guide citizens on how to protect themselves against COVID-19, however, they also provide critical guidance for policy makers and healthcare professionals for taking action to slow the spread of COVID-19.

Objective

We aimed to identify the differences and similarities between six different countries' (U.S., China, South Korea, UK, Brazil and Haiti) government provided community and healthcare system guidelines, and to explore the relationship between guideline issue dates and the prevalence/incidence of COVID-19 cases.

Research design and Methods:

To make these comparisons, this exploratory qualitative study used document analysis of government guidelines issued to the general public and to healthcare professionals.

Results

The major differences in the evaluation and testing criteria in the guidelines across the six countries centered around the priority of testing for COVID-19 in the general population, which was strongly dependent on each country's healthcare capacity. However, the most similar guidelines pertained to the clinical signs and symptoms of COVID-19, and methods to prevent its contraction.

Conclusion

In the initial stages of the outbreak, certain strategies were universally employed to control the deadly virus's spread, including quarantining the sick, contact tracing, and social distancing. However, each country dealt with differing healthcare capacities, risks, threats, political and socioeconomic challenges, and distinct healthcare systems and infrastructure. Acknowledging these differences highlights the importance of examining the various countries' response to the COVID-19 pandemic with a nuanced view, as each of these factors shaped the government guidelines distributed to each country's communities and healthcare systems.

Introduction

The recent outbreak of a novel coronavirus disease (COVID-19, previously known as 2019-nCoV) has led to a major concern of increased mortality in the world. In December 2019, the first outbreak of COVID-19 was reported in Wuhan city, the capital of Hubei province in China [1]. Only a few months later, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic on March 11, 2020 and provided guidelines for case management of COVID-19 in the health facility and community. Globally, approximately 3,506,577 confirmed cases of COVID-19 have been reported, including in excess of 247,467 deaths (Johns Hopkins University, May 03, 2020) [2, 3]. The fast spread of the virus reflects how health is connected globally and how it is imperative to invest in global research efforts to explore, clarify, and address the current global health emergency.

When the first COVID-19 outbreak was reported in China, the Chinese government established a guideline that recommended quarantine, social distancing, and isolation of infected populations to contain the epidemic. After a month, South Korea was assailed by a COVID-19 outbreak. Both government's early actions were very aggressive on testing for the virus and contact tracing in an attempt to stop it spreading. The result of the COVID-19 response in China and South Korea has been encouraging for many countries where COVID-19 has just begun to spread. While it was uncertain whether other countries could implement or adapt the stringent measures endorsed by China and South Korea, the heterogeneous nature of the virus worldwide warrants further investigation into the healthcare and community responses from governments across many nations.

The fact that each country had different capacities, risks, threats, political and socioeconomic challenges, as well as different health care systems, made it critically important to look at how different countries addressed the first pandemic of coronavirus. It was clear that each country had responded to this threat with different measures and different timings. Thus, we compared six different countries' guidelines to investigate their guidelines and incidence and prevalence of COVID-19 cases. Additionally, we also explored the relationship between the guidelines issue dates and the prevalence incidence curves of different countries.

Objective

The objective was to compare government guidelines on COVID-19 by six different countries (The United States (U.S.), China, South Korea, The United Kingdom (UK), Brazil and Haiti). This included general public guidelines and healthcare professionals' (medical institutions) guidelines. We aimed to identify differences and similarities between the countries' community and healthcare professional guidelines and additionally to explore the relationship between guidelines issue dates and the prevalence/incidence of the COVID-19 cases. This is significant because we can learn how other countries are responding to COVID-19 and identify best practices. This approach also helps to understand what and how healthcare system and policy capacities shape COVID-19 response and share information to improve response to COVID-19.

Methods

Research design and sample

This exploratory qualitative study used document analysis of government general public guidelines and healthcare professional guidelines from six countries to explore the differences and similarities between COVID-19 guidelines. Document analysis is a qualitative research method widely used in communication, policy and practice research designed to gather and evaluate information [4, 5]. Document analysis includes the following steps: 1) establishing inclusion criteria for documents, (b) collecting documents, (c) articulating key areas of analysis, (d) document coding, (e) verification, and (f) analysis [6]. In this approach, the investigators are the primary means of data selection and analysis. This study used purposive sampling to recruit investigators internationally by email and/or phone. Investigators met the following inclusion criteria in order to be invited to participate in this study: hold a graduate degree, have experience with healthcare material, were fluent in the native language (Chinese, Korean, Portuguese, French/ Haitian Creole and English) of the six countries selected.

Document Inclusion/Exclusion Criteria

Six members of the research team, which consisted of multidisciplinary, cross-cultural researchers, collected the data. The research team only reviewed documents from publicly available government websites for each country (see Additional file 4). Guidelines from government websites were in available in different formats, including action and response plans, healthcare and general population guidelines, prevention measures/recommendation flyers, government memos and webpages. Documents or information from nongovernment websites, social media, online newspapers/editorials, peer-reviewed articles, and health institution guidelines were excluded from the study.

Data Collection

To guide document selection among investigators, a codebook was developed which highlighted the information necessary for each theme (see Additional file 5, 6). Each document for each country was reviewed to determine the extent to which the document provided answers to at least one of the pre-identified themes (i.e. areas of analysis). The team reviewed government websites weekly for approximately six weeks from March 2020-May 2020 to obtain information from government guidelines, to ascertain whether any new documents were published, or whether old guidelines had been updated. A total of 52 documents (e.g., government guidelines, flyers, memo, webpages) were reviewed to extract data (10 for the U.S., 3 for China, 10 for South Korea, 8 for the UK, 13 for Brazil, 9 for Haiti) (see Additional file 4). Texts from COVID-19 general public guidelines and government health promotion materials relevant to each pre-identified theme were copied verbatim in their original language and added to an excel spreadsheet. Extracted verbatim texts that written in a language other than English (Portuguese, Chinese, Korean, and Haitian Creole/French) were translated to English by bilingual members of the research team and added to the excel spreadsheet to allow review and analysis of the information as a group (see Additional file 6). Text translation focused primarily on maintaining meaning consistent with

health care language rather than cultural nuances, thus, formal translation procedures (e.g., forward and back translation) were not completed. The authors evaluated translations produced in English providing constructive feedback about the translation and suggestions, justifying them through sources like governmental and professional guidelines, articles, and standardized medical language guides.

Data Analysis

Key areas of analysis were articulated from the codebook, which provided a list of codes (e.g., themes and sub-themes) and included six basic components: the code, a brief definition, a full definition, guidelines for when to use the code, guidelines for when not to use the code, and examples. Explicitly, the codebook helped the research team determine the meanings of themes and provided clarity about what to look for within the text of the guidelines. The adequacy of answers to research questions was assessed in terms of the sensitivity and specificity to the codes. Data analysis entailed appraising and synthesizing texts from guidelines, which were then organized into major themes and sub-categories through content analysis [7]. Content analysis within the research team was facilitated through online meetings, which were convenient and removed geographic barriers. Researchers assessed the data for coding patterns (e.g., *similarity, differences, frequency*) across different countries regarding their government guidelines for the general public and healthcare professionals. All texts from guidelines were allocated deductively to the a priori themes (deductive codes). During the iterative content analysis process, new themes also emerged (inductive codes). When disagreement ensued during data analysis, the research team recoded, or the primary coder sought advice from another team member for verification and clarification [7]. The original data of the confirmed and deaths cases were downloaded from the Johns Hopkins University Center for Systems Science and Engineering [3]. Tableau, which is one of well know website for analyzing big data, cleaned and reshaped the data for sharing with public. The data then converted to excel files and conducted figures (see Additional file 7) [8].

Trustworthiness of the Data

We established trustworthiness of the data by: 1) focusing on government guidelines, as they are a credible source of information (credibility), 2) using information from guidelines, which maintain dependable and consistent patterns over time and are periodically updated to reflected the evolving understanding of the coronavirus (dependability), 3) using government guidelines, which limited the research team's bias at the data collection and interpretation level, and improved accuracy with the use of a well-developed codebook (confirmability), and 4) analyzing the guidelines of six countries experiencing the coronavirus pandemic at the same time but within different contextual realities(transferability) [9, 10].

Results

Theme: Evaluation and testing

Sub-them: Screening criteria

When comparing the different government guidelines on screening for signs and symptoms in suspected COVID-19 cases, all countries listed respiratory symptoms as a criterion and the majority – Brazil being the exception – emphasized fever, as well. Interestingly, the U.S. and UK did not list travel history as a criterion. We also noticed that the U.S. and Brazil did not categorize pneumonia as a screening criterion whereas, South Korea, the UK and Haiti emphasized unknown case of pneumonia, clinical or radiological evidence of pneumonia, and bronchopneumonia.

A major distinction the authors noted was that only China and the UK specified the detection of suspected COVID-19 cases within the hospital through either radiological evidence via chest X-ray and thoracic Computed Tomography (CT) or lymphocyte counts.

Haiti, as of April 20, 2020, expanded the screening criterion from ‘have a fever greater than 38°C within the last 10 days’ to ‘anyone with fever greater than or equal to 38°C (see Additional file 6).’ Haiti’s screening criteria also included body aches, sudden changes in taste (ageusia) or smell (anosmia), possibility of coming in contact with a healthcare professional diagnosed with COVID-19, or being an occupant of a high risk area while experiencing symptoms compatible with COVID-19 (see Additional file 1).

Although information about contact with suspected and/or confirmed cases was vital for screening criterion in most countries, the U.S. and UK did not include this. Furthermore, specifically examining patients aged over 65 with symptoms and patients with underlying conditions was only found to be a criterion in the U.S. guidelines (see Additional file 1). Of note, South Korea created a new category in addition to the suspected cases called the Patient Under Investigation (PUI) on April 03, 2020 (see Additional file 6). A PUI is a person who has an epidemiologic link to a collective outbreak of COVID-19 in an area, or a possible contact to a COVID-19 positive person. The U.S. used the term PUI to describe people who exhibit symptoms, or were otherwise suspected of having COVID-19, but had not yet been confirmed via laboratory testing.

Theme: Evaluation and testing

Sub-theme: Screening center types

Across different countries, we identified three different types of screening centers: healthcare facilities, drive-through screening clinics, and walk-through screening clinics. While walk-through screening clinics were available in South Korea, healthcare facilities were the only screening centers available in Brazil and Haiti. Interestingly, Brazil and China did create other satellite facilities for treatment, even though they did not create separate facilities for screening. The U.S., UK and South Korea conducted drive-through screening clinics.

Interestingly, South Korea took a distinctly different approach to managing suspected COVID-19 cases. Patients with respiratory symptoms that fit the COVID-19 suspected case criteria were blocked from

entering the designated healthcare facilities (called the Public Relief Hospital System) and were redirected to other COVID-19 screening/test centers, or if the hospital was a screening center itself, the patient suspected of having COVID-19 was directed to use a specific entrance for COVID-19 screening before entering the main hospital building. The purpose of establishing the Public Relief Hospital System was to provide safe hospital environments protected against COVID-19 spread. In other words, this was an attempt to block patients with COVID-19 from spreading the virus to general patients who did not have COVID-19.

Theme: Infection control

Sub-theme: General outpatient guidance

Outpatients are patients outside of the hospital who need periodical medical attention due other morbidities (hypertension, cancer, HIV/AIDS, etc.). In South Korea, outpatients, who require healthcare service due to non-COVID-19 diseases, were directed to the Public Relief Hospital for follow-up or to see a doctor. These outpatients were strictly separated from patients with any respiratory symptoms.

In Brazil and the U.S., outpatients were advised to call ahead of their appointment time and were asked whether they had experienced respiratory symptoms. The UK, and Haiti avoided treating outpatients in their healthcare facilities. Still, the UK continued with outpatient appointments either through video or phone clinics. Chinese patients, on the other hand, could make an appointment via phone or online and could then complete their appointment in the hospital as long as the patient made the appointment with a specialist, and avoided using the emergency room (ER) or fever clinics where COVID-19 patients had been treated. Haiti did not provide recommendations regarding whether outpatients should make appointments with clinics, and outpatient services were unavailable to the general population. However, Haiti did provide some guidance for those with HIV/AIDS, as Haiti has a high number of individuals suffering from HIV/AIDS. The U.S. updated their guidelines in April 13, 2020, advising healthcare facilities to implement alternatives to face-to-face triage and visits, as well as instructing patients to utilize cloth face coverings regardless of symptoms upon entry to a healthcare facility. However, the guideline did not specify what alternatives were implemented.

Theme: Cost Support

Sub-theme: Cost support

Financial support for testing and treatment was provided mainly or totally by the government in South Korea, the UK, and Brazil. In Haiti, the Haitian government and the World Bank's Board of Executive Directors, in conjunction with several international and private organizations, donated money to cover the cost of the country's COVID-19 response. In China, an individual's medical cost was subsidized based on

the subsidy policy of the local area if the patient was suspected of having COVID-19. However, once the patient received confirmation of COVID-19 infection, the medical cost was subsidized by the authorities. The cost of the clinic visit and testing was made free for all U.S. citizens regardless of insurance status, per The Families First Coronavirus Response Act, which required private and federal insurance to pay for Food and Drug Administration (FDA)-approved testing, and for testing to be free to those who are uninsured. The extent to which the COVID-19 treatment was covered differed between insurance companies.

Theme: Evaluation and testing

Sub-theme: Confirmation of COVID-19

All six countries performed real time PCR to confirm COVID-19 cases. Uniquely, the UK did not provide testing for COVID-19 to the community (at the time of writing), and instead reserved testing for National Health Service (NHS) staff, their relatives and – later in the pandemic – select essential workers. Some unique types of confirmatory lab tests were via virus isolation in South Korea, virus gene sequencing in China, and serological examination in Brazil, Haiti, and the U.S.

Brazil made the decision to include epidemiological criteria, meaning a confirmed case could be included if the individual met clinical criteria and epidemiological evidence, despite a lack of confirmatory laboratory testing for COVID-19. The U.S., however, made the distinction that an individual who met those guidelines was considered a probable case. Another probable case situation the U.S. described was if a person met the presumptive laboratory evidence and either the clinical criteria or the epidemiological evidence. Finally, an individual could be considered a probable case by the U.S. if their vital records, as in their death certificate, indicated the person died of causes related to COVID-19, despite not having a confirmed laboratory test result.

Theme: Triage protocols

Sub-theme: Hospital admission criteria

All countries' hospitalization decisions were made on a case-by-case basis. While Haiti's hospitalization criteria were not specified by the government, Brazil relied on post-collection medical evaluation for hospitalization decisions. The Chinese guideline did not indicate hospital admission criteria. The US recommended hospitalization of severe cases: pneumonia, hypoxemic respiratory failure/Acute Respiratory Distress Syndrome, sepsis, septic shock, cardiomyopathy, etc. The UK required either clinical evidence of pneumonia or radiological evidence with a high suspicion for COVID-19, with Acute Respiratory Distress Syndrome-like, or influenza-like symptoms for hospitalization.

Uniquely, South Korea created three different categories, ranging from moderate, severe, to extremely severe for hospitalization. Asymptomatic COVID-19 positive individuals or those with mild symptoms were sent to the Living Treatment Center, a facility that monitored symptoms twice a day and transferred support to the hospital in the event of a worsening of symptom severity.

Theme: Infection control

Sub-theme: Healthcare triage isolation

All six countries developed an isolated area for screening and follow up for symptomatic patients in order to isolate suspected cases. Brazil and the US advised healthcare facilities to place suspected cases in well ventilated spaces that allowed sufficient space between patients. South Korea, Haiti, and China organized their healthcare facilities into different levels of care according to the absence or presence of respiratory symptoms. More specifically, China categorized triage isolation areas into those for confirmed, suspected, or non-COVID-19 patients.

Theme: Infection Control

Sub-theme: Visitor access to healthcare facilities

In China and the UK, visitors were prohibited from accessing healthcare facilities, however, the UK and South Korea made exemptions on compassionate grounds for seriously ill patients receiving end-of-life care, who were allowed one visitor per ward patient. Haiti limited the number of visitors to the minimum amount possible and required that all visitors allowed into the hospital wear a face mask.

Except for China's guidelines, all countries took extra precautions towards visitors, establishing protocols for visitors regarding proper Personal Protective Equipment (PPE) and hygiene. Although the US's Centers for Disease Control and Prevention (CDC) guidelines were not as restrictive as other countries regarding visitor limitations, the US guidelines suggested actively screening visitors for fever and COVID-19 symptoms upon entry to healthcare facilities. If COVID-19 symptoms were present, the guidelines advised that the visitor not be allowed entry to the facility. Similarly, Brazil suggested avoiding entry of visitors with respiratory symptoms. The US CDC and the Brazilian government also recommended posting visual alerts advising visitors to wash their hands frequently, limiting visitors to the most vulnerable patients (i.e. oncology and transplant awards), encouraging the use of videocall applications in place of in-person visits, and recommended visitors leave the patient during aerosol generating procedures or other specimen collection procedures. Brazil and the US instructed visitors to only visit the patient's room, not any other locations in the facility.

Community guidelines

Theme: Prevent getting sick

Sub themes: Prevent getting sick

Most recommendations to the community on preventing getting sick were similar between the six different countries. In order to explore the major differences, the sub-themes were organized according to singular actions (i.e. total time washing hands, covering cough and sneezes, face-cover recommendations, etc.).

Of note, face-cover recommendations changed throughout the pandemic, however South Korea and China recommended the use of face masks in public places from the beginning of the pandemic, even if the individual was not sick. The UK did not indicate clear guidance on this matter. The US, Brazil, and Haiti did not initially recommend wearing a face covering, however, the US CDC updated their guidelines on April 4th, 2020 and Brazilian Health Ministry on April 5th, 2020, and Haiti guideline in the middle of April, 2020 to indicate that all people, regardless of whether they are sick, should wear a cloth face covering in public. However, medical grade face masks were still not recommended for the community, as they were to be reserved for health care workers due to shortages.

South Korea, the US, the UK, and Haiti did not provide guidance on the sharing of personal items in the general community guidelines regarding the prevention of getting sick. However, this guidance was provided by all six countries in the guidelines of what to do if a household member was sick. Additionally, Haiti did not mention cleaning and disinfecting in the general guidelines to the community to prevent getting sick.

Even though most community guidelines on preventing illness recommended maintaining a 1.8-2.0 meters of physical distance between people to avoid viral transmission, Haiti's guidance on physical distancing was to stay two steps away from other individuals.

As of April 8th, 2020, as a unique measure to prevent viral spread, the South Korean government made it mandatory for all Koreans and long-term stay foreigners who enter South Korea to (1) be tested for COVID-19, (2) install an application on their cell phones: the self-quarantine safety protection app, and (3) abide by the guidelines for self-quarantined persons, including conducting self-diagnosis for a period of 14 days (see Additional file 2).

Theme: If you are sick

Sub theme: What to do if you are sick

Based on the guidelines, we were able to extract 8 important terms, including *avoid using public transport and crowded places, isolation days and next steps, face Mask or cloth face covering, use a separate room or bathroom, sharing household items, sick room ventilation, cleaning instructions, call center for COVID-19* (see Additional file 3). These terms were asserted from at least two countries' guidelines.

Five of the countries recommended that people who have respiratory symptoms stay at home for certain periods, whereas the Chinese guidelines advised sick people to immediately go to the designated medical care institution for testing, and to then follow the quarantine protocols requested. Each country designated different isolation periods and procedures. As reported by the US and the UK governments, people with respiratory symptoms were to isolate at home and only stop home isolation under the following conditions, including no fever for at least 72 hours without the use of medications that reduced fever, improvement of other symptoms, and the passage of at least 7 days since symptom onset. Brazil and China advised that, in addition to the person with respiratory symptoms, all family members or fellow residents were to be quarantined for 14 days. In South Korea, any person who had COVID-19 symptoms was mandated to stay at home for at least three to four days and was then called and given advice by the Korea Centers for Disease Control and Prevention (KCDC) call center.

To prevent the spread of the virus between family/household members, the US, South Korea, and Brazil recommended the ill person be confined to a separate room and bathroom and avoid sharing personal household items. Haiti, the UK, and China did not provide guidance on providing a separate room/bathroom or on sharing personal items.

Isolation room ventilation, such as keeping the window open for air circulation or closing the door, were mentioned in the South Korean and Brazilian guidelines. Cleaning instructions for containing the virus were indicated in different ways in each country, except for in the UK and Haiti. Call centers for COVID-19 were conducted in South Korea, Haiti, and Brazil in the very early stages of the pandemic in each country.

Theme: If you are sick

Sub theme: Threshold to contact a healthcare provider

Across the countries examined, the threshold symptoms for when to contact healthcare providers varied. South Korea advised sick people to contact a healthcare provider if the person had a fever (37.5C) or if symptoms worsened. Brazil recommended seeking help if the ill person experienced shortness of breath. The US advised individuals to get medical attention if they experienced persistent pain or pressure in the chest, bluish lips or face, new confusion, or if unable to be awakened. Haiti mentioned contacting a healthcare provider if the individual had respiratory symptoms. Besides the usual respiratory acute signs (fever, shortness of breath), China also mentioned acute digestive tract symptoms as a reason to reach out to a healthcare facility. In the UK, if a person's symptoms worsened to the point where they were

having difficulty breathing, they were advised to go to the hospital by ambulance facilitated by the online NHS service.

Theme: If you are sick

Sub-theme: Transport to healthcare facilities

The US, South Korea, and China recommended using personal vehicles and to avoid using public transportation to reach healthcare facilities, however South Korea and China specified that individuals should cover their face with a face mask before reaching healthcare facilities. Five of the countries allowed ambulance transport, with the exclusion of China.

Discussion

The major differences in evaluation and testing criteria in the guidelines across the six countries centered around the priority of testing for COVID-19 in the population, which strongly depended upon each country's healthcare capacity, including accessibility to healthcare providers, having enough testing kits and reagents, availability of hospital beds, etc. The most similar recommendations in the evaluation and testing criteria from each government were those pertaining to the clinical signs and symptoms, such as fever and respiratory symptoms, as the priority criteria to initiate COVID-19 testing.

There was, at the time of writing, no specific antiviral recommended for the treatment of COVID-19, and no vaccine for COVID-19 available. Therefore, early detection and diagnostic testing for COVID-19 were vital to tracking the virus, understanding epidemiology, informing case management, and suppressing transmission [11]. The government guidelines concerning screening criteria and capacity for screening – including screening centers, and laboratory testing for COVID-19 in suspected or confirmed cases – were crucial factors in protecting the public from the virus. The WHO criticized countries that had not prioritized testing for COVID-19, and Tedros Ghebreyesus, the chief executive of WHO, emphasized the importance of testing by stating, “The most effective way to prevent infections and save lives is breaking the chains of transmission. You cannot fight a fire blindfolded, and we cannot stop this pandemic if we don't know who is infected. We have a simple message for all countries: test, test, test, test” [12]. However, lack of reagents and/or testing capacity for the SARS-CoV-2 virus challenged all nations included in the study, at least at the beginning of the pandemic. The US, UK, Haiti, and Brazil in particular experienced problems with shortages of testing kits for SARS-CoV2 due to rapidly increasing demand compounded by national supply chains under stress and national laboratories with limited experience in COVID-19 virus testing [13, 14]. This had a negative impact by potentially obstructing the expansion of COVID-19 testing criteria, resulting in narrowing the range of people undergoing COVID-19 testing, which may have led to increases in the actual number of cases and overall risk of death by COVID-19, but falsely decreased the number of confirmed cases and deaths reported in the nations' statistics.

According to the UK's National Health Service, (NHS) testing priority was given to 1) patients with suspected COVID-19 in intensive care units (ICU), 2) patients with severe respiratory illness including pneumonia, 3) isolated cluster outbreaks such as care homes, and 4) random testing for surveillance purposes carried out by over 100 general practices [15, 16].

The first 2 confirmed cases occurred in the UK on January 31, 2020 and the first COVID-19 victims died on March 7, 2020 (see Figur 1). After 20 days, although the UK only tested people who were admitted to a hospital, the number of confirmed cases and disease-related deaths dramatically increased (confirmed cases: 14,745, deaths: 1,163) [17]. By April 7, 2020, one month after the first victims died of COVID-19, more than 1000 people were dying every day due to viral infection (see Figure 1). In April 9, 2020, despite the thousands of citizens dying each day due to COVID-19 related causes, the UK government launched massive COVID-19 testing centers prioritized for processing samples from health-care providers who were currently self-isolating, in order to allow them to return to work [16]. Therefore, people who were not considered a priority, such as non-health care providers or community members with mild respiratory symptoms, were never given access to testing. The limited scope of the UK's testing approach for acute respiratory syndrome with COVID-19 was due to a "capacity problem" following a nationwide consolidation in the number of pathology laboratories. Many laboratories were centralized, which resulted in the possibility that each hospital would not necessarily be equipped with a fully functioning lab. This systemic capacity problem may have increased the risk of spread by free movement of people who were suspected of having the disease, since testing was unavailable to those individuals to enforce a stay-at-home order. As of the 24th of March, 90,000 people in the UK had been tested for COVID-19 (around 1300 tests per million people). This was a higher proportion than in some nations such as US (around 74 per million as of the 16th of March) but far behind South Korea (5200 per million as of the 17th of March) [18, 19].

Initially, the US's CDC recommended testing only those who had a fever and/or lower respiratory symptoms and had traveled to China or had been in contact with a suspected or confirmed COVID-19 case. However, in late February, after a patient was infected despite a lack of travel history or known exposure, the CDC modified its testing guidelines to include anyone with a fever who was hospitalized with a respiratory illness. This change broadened the spectrum of patients being tested, which quickly increased the demand for testing.

In February 2020, the CDC acquired, developed, and distributed COVID-19 testing kits to nearly one hundred state and local laboratories. The majority of the laboratories using these kits experienced a number of issues, including the failure of negative controls and receiving inconclusive results. On February 12, 2020, the CDC officially announced that the problem was the result of a faulty reagent. The agency assured healthcare professionals they would solve the problem by re-manufacturing the faulty component and distributing the newly developed reagent to the public health labs. Ultimately, however, the lack of CDC test kits at this crucial time prevented wider-scale testing early in the outbreak.

Furthermore, although the number of confirmed cases and death rate significantly increased each day after March, 20, 2020 in the US (confirmed cases per day around 15,000, deaths per day around 1000), the total number of public health laboratories (PHL) that had completed verification and were offering testing was 97 on May 6, 2020 [20]. As further evidence of inadequate testing capability, the CDC announced that “although supplies of tests are increasing, it may still be difficult to find a place to get tested.”

The capacity for widespread testing together with prepared health facilities were key to controlling the spread of COVID-19, as evidenced by South Korea. South Korea reported its first coronavirus case (confirmed 7 cases) on January 31, 2020. In the month following, the number of daily reported cases remained low (confirmed cases: 100, deaths: 1) until a super spreader event was initiated on February 29, 2020. This event led to a daily case number spike for nine days, with each day the country's epidemic curve resembling a steep staircase as infections climbed (see Figure). However, South Korea quickly implemented large-scale COVID-19 testing, which allowed health officials to identify and notify potentially infected people, and to then send them into quarantine as a preventative measure. By March 25, 2020, more than 357,000 Koreans had been tested. The country reported about 10,804 total coronavirus cases and 254 deaths as of May 1, 2020. This was the lowest death rate among the countries examined [3, 21].

Having previously dealt with the 2015 outbreak of the Middle East Respiratory Syndrome (MERS), South Korea continued to refine its response system to better address potential outbreaks of large-scale epidemics, including installing negative pressure rooms in hospitals in 2018. The large-scale availability of COVID-19 testing locations, such as K-Walk-Thru and Drive-thru testing stations, were developed for the first time in the world to quickly and safely collect samples for COVID-19. These centers helped minimize the risk of cross infections at the in-hospital testing centers while maximizing daily testing capacity amid rapidly rising rates of new cases and received international attention and acclaim [22].

Still, exponential escalation in the number of daily confirmed cases placed enormous strain on national medical systems, leaving limited or no beds available for treating COVID-19 patients, even in the hospitals designated for viral treatment. Therefore, the US, the UK, South Korea, Brazil, and Haiti decided that patients with mild to moderate COVID-19 symptoms should be observed at home and remain in “Home Isolation.” This approach was an important alternative to hospital isolation, as it required individual behavior change but no additional infrastructure investment.

Interestingly, the Chinese government decided against Home Isolation of patients with mild to moderate COVID-19. This policy was initiated in Wuhan, the city where COVID-19 emerged in late January 2020 and which accounted for more than 60% of all confirmed cases in China in March 27, 2020 (see Figure 1). The city opened three ‘Fangcang Shelter Hospitals’ on Feb 5, 2020, by converting exhibition centers and stadiums. Over the following weeks, Wuhan opened an additional 13 Fangcang shelter hospitals. Early epidemiological evidence showed that more than half of all Chinese patients with COVID-19 had at least one family member with the disease, with 75–80% of all clustered infections diagnosed within families, suggesting high rates of intrafamily transmission [23, 24]. Quickly emerging alternative hospitals, such as

the Fangcang Shelter Hospitals, for testing and admission of the all COVID-19 patients may have led to a reduction in the spread of the virus into the community, thereby decreasing the number of new cases during the pandemic.

By January 22, 2020, the WHO announced the presence of travel-related cases linked to Wuhan City, human-to-human transmission, and reported that COVID-19 had been observed outside of China. The WHO strongly advised that individuals report their travel history to their health care providers [25]. However, the UK did not track travel history as it was not considered valuable information in the testing criteria. This was problematic since people who traveled to COVID-19 occurring areas could have been potential carriers of the virus to their respective communities and families, which might have had a strong influence on the increasingly steep confirmed case curves. Neither the American, Brazilian nor Haitian governments considered a history of travel to a region or country of high incidence of COVID-19, to be a high priority for testing or to be an important criterion for suspected cases. Those with a travel history to high spread areas were only encouraged to seek testing if they developed a fever or respiratory symptoms. In direct contrast, the Chinese guidelines suggested that any travelers who traveled to a region or country with occurrence of COVID-19 must be tested, regardless of whether they had developed symptoms.

Not enough was known about the epidemiology of COVID-19 to draw definitive conclusions about the full clinical features of disease, but the main clinical signs and symptoms reported in this outbreak include fever ($>38\text{ }^{\circ}\text{C}$), difficulty breathing, and chest radiographs showing bilateral lung infiltrates [11, 26]. For this reason, most countries considered fever, respiratory symptoms, and pneumonia as clinical justification for initiating diagnostic testing. Although there was enough evidence for human-to-human transmission, the US and UK did not include contact with confirmed or suspected cases as screening criteria. The absence of this criteria may have led to an increased risk of spreading the virus. In contrast, South Korea implemented a well-organized contact-tracing program: After laboratory testing confirmed a positive case, officials used interviews, GPS phone tracking, credit-card records, and video surveillance to trace an infected person's travel history. The South Korean government then published anonymized data detailing where each patient went, prior to diagnosis on a public website so others could determine whether they had been near a positive patient. Though effective, there were concerns regarding individual privacy.

Recognizing that the global spread of COVID-19 had dramatically increased the number of suspected cases and the breadth of geographic areas affected, it became increasingly evident that implementing screening criteria to better cope with each country's capacity for screening, and laboratory testing was needed. However, beyond supply chain issues with provision of testing kits, there were significant limitations of the government guidelines for COVID-19 testing in several domains.

National health systems and coverage of COVID-19 medical expenses were vital to fostering a sense of financial certainty and a safe environment for those who were infected. Testing and treatment support came mainly or totally from the government in South Korea, the UK, China and Brazil. All US citizens were

covered for FDA-approved COVID-19 testing, regardless of private or federal insurance status, however, treatment was subject to the insurer's policy. Despite the larger role the governments took in the other countries examined, Haiti's COVID-19 health care response was financially supported primarily by the private sector (60%). Hospitals and newly established screening clinics from the private sector worked together with the Haitian Ministry of Health to screen Haitians, however, health care facilities from the private sector were not regulated by government officials (hence the paucity of government screening guidelines) [27].

As an example of the increased preparedness the WHO called for, the South Korean government created temporary 'Public Relief Hospitals' which provided segregated treatment for non-respiratory and respiratory patients to ensure safe medical services to general patients and to prevent the viral spread. Public Relief Hospitals were divided into two types: Type A and Type B. Type A hospitals had separate outpatient treatment areas for general patients and respiratory patients, while Type B hospitals did not only provide separate outpatient areas for respiratory patients, but also had testing centers for COVID-19 and dedicated wards for respiratory patients. The Korean government also permitted non-respiratory patients to receive counseling and prescriptions by phone or by proxy, so as to prevent infection within healthcare institutions. This approach was also utilized in the US and UK. Non-respiratory patients, such as cancer patients or patients with heart problems, were directed to the general outpatient area at a Public Relief Hospital. Patients with mild respiratory symptoms were directed to see a doctor nearby or to go to the respiratory outpatient area at a Public Relief Hospital. Suspected patients or PUI who developed COVID-19 symptoms were advised to attend a screening center after receiving guidance from a competent clinic or the 1339 call center. Using this triage workflow, hospital systems were better able to prevent internal spreading of the COVID-19 virus in the hospital setting and potentially reduced a higher infection-related risk of mortality across the population. The South Korean death rate provided evidence to support this hypothesis, showing that although they had a high rate of confirmed cases (10,780), the total number of deaths was only 250. Most of those who died were admitted to the hospital due to chronic health conditions and were infected with the virus during their hospitalization.

Even though the US's federal guidance on hospital visitation seemed more liberal than other countries, especially when contrasted with South Korea, more restrictions were adopted depending on the local circumstances. For example, although limiting visitors was not advised by the US CDC until April, several hospitals in New York city restricted visitor access as early as March.

Community guidelines:

Theme: Prevent getting sick

Despite being consistently recommended for use by symptomatic individuals and those in health-care settings, discrepancies were observed in the recommendations regarding the use of face masks in the general public and community settings. The WHO consistently maintained that the benefits of healthy people using masks in the community setting was not supported by the current evidence, and additionally

could contribute to uncertainties or create critical risks [26]. This advice to decision makers remained in place up until the time of this paper submission in May 2020.

Several nations, such as the US and Brazil, changed their face cover recommendations as new studies were conducted that supported the use of face masks as an effective means to limit viral spread. Some studies may under-estimate their protective effects, while observational studies exaggerate them [28]. However, with the emerging evidence of asymptomatic or presymptomatic COVID-19 transmission, the authors note that the community guidance regarding utilizing a face mask and not sharing personal items could significantly prevent potential asymptomatic or presymptomatic transmission, which corroborates other publications [14]. Mask shortages were prevalent across countries in their early stage of use. For example, in the early stages of the COVID-19 pandemic, masks were in short supply in South Korea as citizens crowded the pharmacies to stock up in preparation. The South Korean government encouraged mask companies to increase their production rates and then ensured the newly manufactured masks were directly allocated to pharmacies, where a limited number of masks could be sold to each citizen. To prevent citizens from lining up outside pharmacies, and violating physical distancing measures, the government and private sector partners created apps to display the number of masks available at nearby locations. The number of masks bought by each citizen was then tracked through the National Health Insurance Service database.

The general guidance across nations about avoiding infection by washing hands or using alcohol-based hand sanitizer frequently, performing respiratory etiquette when coughing or sneezing, and avoiding touching the face corroborated the WHO guidelines [29].

Despite physical distancing being vital to mitigating the spread of coronavirus, political beliefs affected compliance with COVID-19 social distancing orders. In general, in the US, people who held contrasting political beliefs to the resident state governing body were less responsive to stay at home orders. For example, Republican counties were less likely to stay at home after a Democratic state order had been implemented, relative to those in Democratic counties. In a similar fashion, Democrats were less likely to respond to a state-level order when it was issued by a Republican governor [30].

On that point, it is worth noting that although the countries examined all referred to the government issued COVID-19 notices as 'guidelines,' these notices were not enforceable equally across countries. As an example, in the US, the CDC's guidance acted as a framework that could be adapted for use by individual hospitals or by local/state governments for legislative purposes. However, in South Korea the guidelines essentially acted as enforceable legislation with serious financial repercussions.

Another important political development to note occurred in Brazil, when the Ministry of Health included a video on their website focused on clarifying "fake news" about the coronavirus. The video requested that users confirm whether information presented in various medias was true before sharing that information with others. It also suggested individuals consult with an official number via WhatsApp for information clarification and communication.

An additional concern was raised regarding the use of health-tracking apps. Various countries used voluntary health-tracking apps to manage the COVID-19 pandemic either for informational, health vigilance, or contact tracing purposes. However, a unique aspect of the South Korean response was to mandate all Koreans and long-term expatriates install a health tracking app for contact tracing purposes. Privacy concerns were raised by several publications, some of whom referenced the possibility of preserving data protection [31], while others reflected on the legal implications and the need to refine the data into an aggregate, rather than individual-level data, to better deter the misuse of the data [32].

The countries' guidelines on how to care for people infected with COVID-19 experiencing mild symptoms at home aligned with the WHO guidance [33]. According to the WHO, ensuring the sick person used a separate room and bathroom in the home would be essential to containing the virus, however, only the US, South Korea, and Brazil made this recommendation to their respective communities. Haiti, the UK, and China did not mention this recommendation in their guidelines. Although those suspected of having coronavirus were requested to stay at home in the UK, limited information was provided to guide the home care process, such as how to disinfect the ill person's room or how to handle sharing household items in the home. In China, all people suspected of having the coronavirus were instructed to seek testing at a testing center, and were admitted to 'Fangcang Shelter Hospitals.' Therefore, it was not necessary to provide information on how to deal with sick people at home to the community. The decision to advise all people suspected of having the coronavirus to go directly to the hospital is at odds with at least one study, which proposed that instead of guiding the COVID-19 patient to seek healthcare facilities, it would be preferable to provide at-home testing and monitoring [34]. However, while staying at home it is critical to carefully monitor worsening symptoms since medical care is not necessarily immediately available.

The symptom thresholds to contact healthcare providers varied between countries, with a wider array of symptoms (beyond the respiratory types) being included by countries that had dealt with the epidemic for longer periods of time. Clearly there was a great deal of clinical judgement necessary in monitoring the disease progression, which meant acting in a timely manner to differentiate a more serious case of COVID-19, which could be fatal.

Finally, the guidelines on transportation to healthcare facilities varied in emphasis between governments. A publication from China indicated that imported cases via public transportation played an important role in the spread of COVID-19, finding a significant and positive association between the frequency of flights, trains, and buses from Wuhan in the daily, as well as the cumulative, numbers of COVID-19 cases in other cities [35].

Limitations:

These findings are related to the guidelines for healthcare facilities and communities, as updated until April 20, 2020, however some guidelines may have been continuously updated beyond this date. In Haiti, because of the low prevalence of COVID-19 (total confirmed case: 100, deaths: 8 as of May 1, 2020), some information was unable to be obtained from the government guidelines, even though it was

provided by news outlets or other medias, which were not included here. This study only used government guidelines accessible by the public, which may have limited the scope of the study's usable information.

Conclusion

In summary, all six countries updated their guidelines, especially screening criteria, as the incidence of COVID-19 increased to take more aggressive actions against the progression of COVID-19 spread and to help "flatten the curve," thus easing some of the burden on the respective healthcare systems. In the initial stages of the outbreak, certain strategies were universally employed to control the deadly virus's spread, including quarantining the sick, contact tracing, and social distancing. However, these measures would have limited value if the people suspected of contracting the disease were not tested. It is difficult, if not impossible, to identify any one factor that would have the greatest impact on the spread of COVID-19, but by comparing these countries' approaches it is possible to identify multiple factors that contribute to an overall effective strategy. Additionally, there are multiple factors that influence the prevalence and incidence of COVID-19, including population density, differences in healthcare infrastructure, and primary means of transportation. Future studies should focus in more detail on these factors and their influence on the prevalence and incidence of COVID-19.

Abbreviations

COVID-19

Coronavirus disease

CT

Computed Tomography

CDC

Center for Disease Control and Prevention

ER

Emergency Room

FDA

Food and Drug Administration

HIV/AIDS

Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome

ICU

Intensive Care Unit

KCDC

Korea Centers for Disease Control and Prevention

MERS

Middle East Respiratory Syndrome

NIH

National Health Service
PUL
Patient Under Investigation
PPE
Personal Protective Equipment
PHL
Public Health Laboratory
US
United States
UK
United Kingdom
WHO
World Health Organization

Declarations

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Not applicable

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Not applicable

Availability of data and materials

See Additional file 4.

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Figures

Figure 1. COVID-19 Cases in six countries

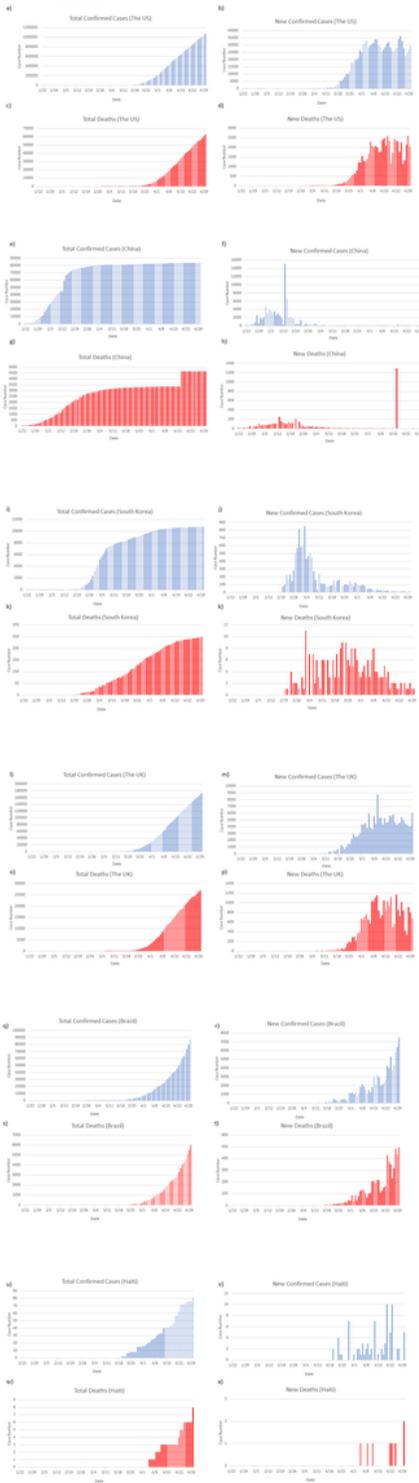


Figure 1

COVID-19 Cases in six countries

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