CLINICAL RESEARCH

The Management of the COVID-19 Pandemic: Analytical Studies of 11 Health Systems on Four Continents during the First Wave of the COVID-19 Pandemic

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ABSTRACT

OBJECTIVE

We aimed to develop and deploy draw conclusions from different experiences around the world on the control of epidemics for use in public health system settings.

METHODS

This is a qualitative study. We have opted for a comparative and analytical approach to the different countries strategies to control the COVID 19 pandemic. We compared countries and WHO guidelines and interpreted the challenges to provide evidence-based solutions. The comparison of the different systems is based on the notion of scoring ranging from (1) weak; (2) medium and (3) strong.

RESULTS

Considering the result between process indicators and effectiveness indicators scoring the result of our study is a categorization of the different countries into three categories of pandemic control: Excellent level of control for Germany South Korea, Hong Kong and turkey of a score higher than 15, a medium level with a score that varies between 10 and 15 for China, USA, France, Spain, Italy and Morocco.

CONCLUSION

The present analysis will help political leaders and health authorities to manage epidemics well in the future. To move as quickly as they can, to ensure enough resources, including personnel, hospital beds, and intensive care facilities. Tends to suggest that measures to reduce transmission should be quickly implemented. Interventions to consider include the impacts of quarantine, case and contact isolation, hand hygiene, face masks, public education about personal protection, therapeutics, and future vaccines.

INTRODUCTION

In the past two decades, two highly pathogenic human coronaviruses, responsible for severe acute respiratory syndrome (SARS-Cov) and responsible for Middle East respiratory syndrome (MERS-Cov) have emerged in two separate events [1,2]. A recent emergence, rapid kinetics around the world and a "Severe" Infection noticed on 29 December 2019 in China a clustering of cases of unusual pneumonia with an apparent link to a market that sells live fish, poultry and animals to the public [3]; officially named coronavirus 2 (SARS-Cov-2). The novel coronavirus disease 2019 (COVID-19) presents an important and urgent threat to global health. On 30 January 2020, the World Health Organization declared that the outbreak of SARS-Cov-2 constituted a public health emergency of international concern. The number of patients confirmed to have the disease has exceeded 2 million, and the number of people infected is probably much higher. More than 150000 people have died from COVID-19 infection (upto 20 April 2020). The WHO have emphasized the importance of exit screening at ports in countries showing transmission of the novel coronavirus and have provided guidance for countries implementing entry screening at airports while acknowledging that evidence for the effectiveness of entry screening is equivocal [3]. A global coordination has been active in the novel coronavirus outbreak [3]. WHO's response system includes three virtual groups based on those developed for SARS to collate real time information to inform real time guidelines [3]. All country strategies are based on the WHO strategy with minor modifications, the WHO's strategic objectives for this response are to limit human-to-human transmission including reducing secondary infections among close contacts and health care workers. Preventing transmission amplification events and preventing further International spread from China; to identify isolate and care for patients early, including providing optimized care for infected patients; to address crucial unknowns regarding clinical severity, extent of transmission and infection, treatment options, and accelerate the development of diagnostics, therapeutics and vaccines; to communicate critical risk and event information to all communities and counter misinformation; to minimize social and economic impact through multispectral partnerships [4].

The objective of the various health systems was to break the exponential spread of the virus by limiting the number of cases of contamination over time, so that hospitals would not be overloaded by an influx of patients. The solution involves the containment of the population, which varies from country to country, hygiene measures (hand washing, use of antiseptics and disinfectants), the establishment of social distancing and the wearing of masks, which was only compulsory for health professionals and in some countries, especially in South-East Asia, in addition to screening and case management in the various health system establishments.

METHODS

This is a qualitative study. We have opted for a comparative and analytical approach to the different countries strategies to control the COVID 19 pandemic. We advocated a systems approach (input, process, and output) to describe the health care system. We opted for a targeted content analysis of available policy documents, programs, action plans and reports related to COVID-19 in the literature. A deductive approach was used to extract and analyse data in accordance with the conceptual framework adopted. We compared countries and WHO guidelines and interpreted the challenges to provide evidence-based solutions. Content analysis was used

to extract data in this study, so that the results of the document analysis were coded into categories related to elements of the applied conceptual frameworks.

Pandemic Control Criteria

We have integrated the elements of primary and secondary prevention as process to the health systems and efficiency criteria as output (Figure 1).
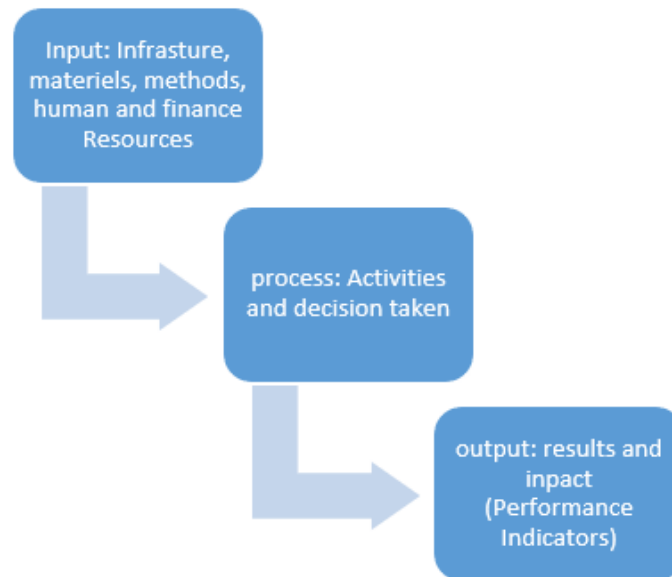

Figure 1: The process of pandemic control.

The Conceptual Framework

Our conceptual framework had three main dimensions. First, health policy triangle was used to analyse the content, context, process and main actors involved in design, agenda setting and implementation of related policies [5]. We also used the Hall Model (legitimacy, feasibility, and political support) to describe the components of agenda setting. Finally, we combined top-down and bottom-up implementation theories (synthetizing approach) [6].

Both the data and the classification philosophy are inspired by the publications of the European Centre for Disease Prevention and Control and the World Health Organization throughout the pandemic period. The Global Health Security (GHS) Index is intended to be a key resource in the face of increasing risks of high-consequence and globally catastrophic biological events and in light of major gaps in international financing for preparedness. The indicators and questions that compose the GHS Index framework also prioritize analysis of health security capacity in the context of a country's broader national health system and other national risk factors. The 140 GHS Index questions are organized across six categories: 1) Prevention; 2) Detection and reporting; 3) Rapid response; 4) Health system; 5) Compliance with international norms; 6) Risk environment [7]. The comparison of the different systems is based on the notion of scoring ranging from (1) weak; (2) medium and (3) strong. Most of the variables are judged with objective and other subjective criteria (Screening; Confinement; Social distancing; Hospital preparation; Critical care Beds/100000 Population; Hospital overcrowding*; Research investment). The different variables were given the same weighting. The scores are then added up and a ranking

is given. We know that this method has limitations (the data sources are not all equally reliable) but remains a way of understanding the subject.

Population Data

Our sample includes countries from Asia, Europe, America and Africa. The selection is based on countries that experienced the epidemic first; countries that experienced a large epidemic; countries with different social and economic levels and geographical distribution among the fourth major continents. The management of the epidemic was very different between the three groups in Asia (group A); the European countries and the USA (group B) and Morocco representing the developing countries (Group C). The criteria for choosing countries were a reasoned choice to encompass different control strategies and the continents most affected by COVID-19. In Group 'A' for East Asian countries (China, South Korea and Hong Kong), which have mobilized effectively against the pandemic, the main taken actions were: Targeted containment not generalized, good hygiene, screening at will, monitoring and geo-localization of contaminated persons wearing a protective face mask is mandatory in public places. In Group 'B' for European countries (Italy, Spain, France, Germany, United Kingdom and Turkey) and United States, most of the containment decisions announced by the governments of these countries were taken late and Group 'C' for Morocco the taken actions were the confinement, social distancing, and others primary prevention.

The analysis

Descriptive epidemiological indicators were: Case number, death and recovered and (prevalence), Number of new cases (Incidence); Case Fatality Ratio CFR), Attack rate; Basic reproduction rate R0; Generation interval. It will be presented in the form of static and dynamic comparative tables analysing the results of the interventions carried out with the primary prevention indicators process (Avoid touching the eyes, nose, and mouth with unwashed hands; Avoid close contact with people including shaking hands; Practice respiratory hygiene; Seek medical care early if you have symptoms; Stay at home if you are sick; and Clean and disinfect frequently touched surfaces daily Mass screening, the confinement, Social distancing) and secondary prevention (isolate all suspected and confirmed cases, implement recommended infection prevention and control procedures, including standard precautions at all times, and contact, droplet, and airborne precautions while the patient is symptomatic, Hospital preparation) and effectiveness indicators (Deaths/1 million population, Critical care beds/100000 population, Hospital overcrowding, Research investment). The ranking of countries is based on the sum of scores from one to three assigned to each variable.

THE MANAGEMENT OF THE EPIDEMIC

Pandemic Control Criteria

Elements of primary prevention

General prevention measures. The only way to prevent infection is to avoid exposure to the virus and people should be advised to wash hands often with soap and water or an alcohol-based hand sanitizer. Avoid touching the eyes, nose, and mouth with unwashed hands; Avoid close contact with people including shaking hands; Practice respiratory hygiene; Seek medical care early if you are symptoms; Stay at home if they are sick; and Clean and disinfect frequently touched surfaces daily [8].

Facemasks

Recommendations on the use of facemasks in community settings vary between countries. Masks may be worn in some countries according to local cultural habits. The World Health Organization recommends that medical masks should be reserved for healthcare workers. People with symptoms should also wear a medical mask, self-isolate, and seek medical advice as soon as possible. There is currently no evidence that wearing a mask (medical or other types) in the community setting can prevent infection with respiratory viruses, including COVID-19, in a healthy person [9].

Quarantine

Enforced quarantine is being used to isolate easily identifiable cohorts of people at potential risk of recent exposure [10].

Social distancing

Many countries have implemented mandatory social distancing measures in order to reduce and delay transmission. Although the evidence for social distancing for COVID-19 is limited, it is emerging, and the best available evidence appears to support social distancing measures to reduce the transmission and delay spread. The timing and duration of these measures appears to be critical [11].

Screening

Management of contacts of people who may have been exposed to individuals with suspected COVID-19 should be advised to monitor their health for 14 days from the last day of possible contact. A contact is a person who is involved in any of the following from 2 days before, and up to 14 days after.

Elements of secondary prevention

Secondary prevention begins with early detection of new cases followed by immediate isolation of all suspected and confirmed cases. The management of confirmed cases in either outpatient or inpatient settings according to recommended procedures and protocols, with notification of all suspected or confirmed cases and reporting to local and international health authorities [8].

The Pandemic Management Models

There are four options to fight the pandemic. 1) The Chinese model of strict containment, applied by half of the globe; 2) The German and Swiss model, a less strict variant than China's N°. 1 model; 3) The Swedish model, which has not integrated population containment into the control system; 4) The Taiwan-Singapore-Korea-Hong Kong model [12].
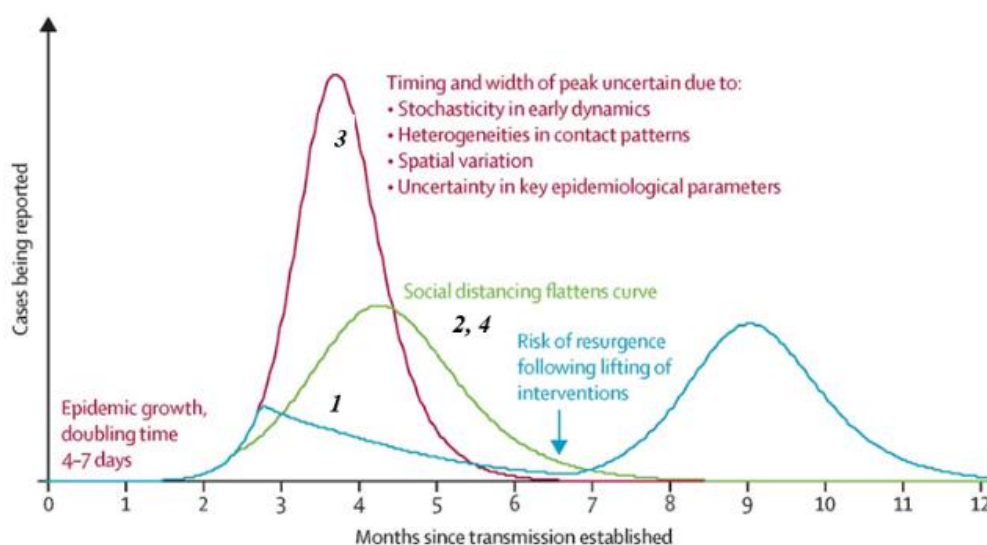
The Chinese model

The Chinese model of strict containment combined with individual protection and prevention measures are among the key strategies that have enabled China to control the epidemic. On 23 January 2020 in Wuhan: The closure of schools and universities, house arrest of the population, restriction of gatherings and the notion of "cordon sanitaire". [12]. The other option is personalized or precision physical distancing, along the lines of Singapore, Hong Kong, Taiwan, South Korea and Japan, have all taken tough decisions on the compulsory wearing of masks by the public. Surveillance for COVID-19 should occur in both community and hospitals. Contact tracing is a core public health measure that plays an important role in the control of COVID-19 [13].

The Germany and Switzerland

The Germany and Switzerland the measures are taken measures that focus on closing airports and door points, differentiated containment and mass screening. The German and Swiss model set objectives at National and level are to: Monitor the intensity and geographical spread of the virus in the population; Identify risk groups for severe disease; Measure the impact on the population and the healthcare system; and Measure the impact of the mitigation measures and identify triggers for measure escalation/de-escalation strategies. The risk of severe disease associated with COVID-19 is currently considered moderate for the general population and very high for populations with defined risk factors associated with elevated risk [14]. The risk of increasing community transmission of COVID-19 is moderate if mitigation measures are in place, and very high if insufficient mitigation measures are in place. The risk of health and social care system capacity is considered high with mitigation measures in place and very high if insufficient mitigation measures are in place [15]. Physical distancing measures have been implemented in all EU/EEA Member States during the COVID-19 pandemic, in different forms and to different degrees.

The Taiwan-Singapore-Korea-Hong Kong

The Taiwan-Singapore-Korea-Hong Kong model that have implemented strict physical distancing measures to interrupt the chain of transmission of the virus, contact tracing will be a major part of the public health response after these measures are lifted, to reduce the risk of further escalation. Before de-escalation measures are implemented, countries should review existing systems to determine the optimal implementation of an effective contact tracing strategy [14]. In East Asia, the compulsory and widespread wearing of facemasks by the population was an effective and essential measure to reduce and limit the spread of the virus. The solution involves: the containment of the population, which varies from country to country, hygiene measures (hand washing, use of antiseptics and disinfectants), the establishment of social distancing and the wearing of masks, which was only compulsory for health professionals and in some countries, especially in South-East Asia, in addition to screening and case management in the various health system establishments.

1) The Chinese model of strict containment, applied by half of the globe; 2) The German and Swiss model, a less strict variant than China's No. 1 model; 3) The Swedish model, which has not integrated population containment into the control system; 4) The Taiwan-Singapore-Korea-Hong Kong model.

Figure 2: The dynamics of the pandemic based on the measures taken (The Lancet 2020 395931-934).

Others

Alternatives include identifying a combination of measures that maintains incidence slightly below hospital capacity [15]; ensuring adequate protection of those most at risk of developing severe disease: The so-called 'cocooning' approach; widespread testing to facilitate the return to work of those who have recovered. Since in many settings measures have been introduced in combination, it is difficult to assess which have had the strongest impact on transmission, morbidity, and mortality. Morocco has taken measures staggered over time with a gradual increase in scope: Closing Airports and Door Points, Progressive Confinement and Practice respiratory hygiene mask faces. The results of pandemic control vary greatly depending on the methods used to control the pandemic (Figure 2).

RESULTS

Massive public health interventions have been implemented nationwide to contain the outbreak. All countries recorded their first confirmed case of acute respiratory infection due to coronavirus disease 2019 (COVID-19) in January 2020 and initially responded by quarantining at-risk individuals to contain the spread of infection [16]. The strategies to prevent or limit transmission in health care settings include the following [8]: Ensuring triage, early recognition, and source control; Applying standard precautions for all patients; Implementing empiric additional precautions for suspected cases of COVID-19; Implementing administrative controls; Using environmental and engineering controls. The key concepts in the recommendations of infection prevention and control are to reduce facility risk, to isolate symptomatic patients as soon as possible, and to protect healthcare personnel [17]. Since then, the outbreak has escalated rapidly, with the WHO first declaring a public health emergency of international concern on 30 January 2020 and then formally declaring it a pandemic on 11 March 2020 [18]. Even assuming masks are not 100% effective in preventing infection, they may reduce severity of infection by reducing viral dosing. Laboratory studies suggest masks may be effective in stopping both exhalation and inhalation of viral particles [19]. Many of the prediction models are published that combine several variables or features to estimate the risk of people being infected or experiencing a poor outcome from the infection could assist medical staff in triaging patients when allocating limited healthcare resources. Models ranging from rule-based scoring systems to advanced machine learning models (deep learning) have been proposed and published in response to a call to share relevant COVID-19 research findings rapidly and openly to inform the public health response and help save lives [20]. A number of actions were integrated into the control system to varying degrees between countries. Primary prevention, Strategic Objectives, Mass screening, social distancing and Secondary prevention, Hospital preparation. There are two possibilities to reduce the number of contacts: population-based physical distancing, which is classic and even archaic if we may say so, albeit effectively, and that its very particular implementation was conceived and invented by the Chinese under the name of "lockdown" [12].

Considering the result between process indicators and effectiveness indicators scoring the result of our study is a categorization of the different countries into three categories of pandemic control: excellent level of control for Germany South Korea, Hong Kong and turkey of a score higher than 15, a medium level with a score that varies between 10 and 15 for China, USA, France, Spain, Italy and Morocco, which we've synthetized into the Table 1.

Table 1: Elements of pandemic control COVID-19 in different countries.

	Mass screening	confinement	Social distancing	Hospital preparation	Critical care Beds/10000 Pop	Hospital overcrowding*	Research investment	Score/21
USA	++	+	+	++	35[2]	+++ (1)	++	12
Spain	++	++	++	++	9.7[2]	+++ (1)	++	13
Italy	++	++	++	++	12.5[2]	+++ (1)	++	13
France	++	++	++	++	11.6[2]	+++ (1)	++	13
Germany	+++	++	+++	+++	29[2]	+_ (3)	+++	20
UK	+	+	++	++	6.6[2]	+++ (1)	++	10
China	+++	+++	+++	+++	4[1]	+++ (1)	+++	17
Turkey	+++	++	++	+++	40	+_ (2)	+++	19
S. Korea	++	++	+++	+++	10.6[1]	+_ (2)	+++	17
Singapore	++	++	+++	++	11[1]	+_ (2)	++	15
Morocco	++	++	++	+	4.82[3]	+_ (3)	+	12

+ Low = 1   ++ Medium = 2   +++ Strong =3
* The score is inversely proportional
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[3] Head of Government Saad Eddine El Othmani on Friday 27 March

DISCUSSION

The ongoing outbreak of the recently emerged novel coronavirus (2019-nCoV) poses a challenge for public health system while there is growing evidence that the outbreak is more widespread than initially thought and international spread through travellers does already occur [21]. Despite public health responses aimed at containing the disease and delaying the spread, several countries have been confronted with a critical care crisis, and more countries will almost certainly follow [22,23].

While there is still doubt about the evolution of covid disease, recent reports suggest that presents a period of viral shedding and spread of mild or even "preclinical but contagious" infection [24]. In the United States the Director of the Institute of Infectious Diseases, reported on Fox News data indicating, "The virus can actually be transmitted when people just talk, rather than just when they sneeze or cough" [25].

A number of countries are beginning to catch up in decision-making; the EU/EEA countries and the UK have implemented a series of measures to reduce the transmission of the virus, focusing in particular on physical remoteness to reduce the burden on health services, to protect populations at risk of serious illness and to reduce excess mortality [14]. ECDC recommend that a strong focus should remain on comprehensive testing and surveillance strategies, community measures, strengthening of healthcare systems and informing the public and health community [14]. On 2 April, the French Academy of Medicine issued an opinion recommending that the wearing of a mask for the public be made compulsory for necessary outings during periods of confinement [26].

The results of studies on R0 remain unstable and vary across studies, a recent review of 12 modelling studies indicates that the average basic reproductive index (R0) for COVID-19 is 3.28, with a median of 2.79, and the introduction of mitigation measures has been reported to decrease R0 [27]. Modelling studies have shown that slowing transmission would reduce the overall number of cases and delay the peak of the epidemic, thereby significantly alleviating pressure on national health systems [28].

Hospitalization occurred in 32% of cases reported from 26 countries (median country specific estimate, interquartile range (IQR): 28%, 14%-63%), severe illness (requiring ICU and/or respiratory support) accounted for (2.4%) cases reported from 16 countries (median, IQR: 1.4%, 0%-33%) (ECDC 2020) and Death occurred in (11%) hospitalized cases from 21 countries (median, IQR: 3.9%, 0%-13%) [14]. The mean crude case-fatality from the EU/EEA and the UK by 6 April 2020 was 1.5%. Persons aged 65 years - 79 years accounted for 44% of all deaths and those aged 80 years and above for 46% [14]. In China and the United States (US), hospitalization occurred in 10.6% and 20.7%-31.4% of reported cases [29].

Non-pharmaceutical interventions remain central for management of COVID-19 because there are no licensed vaccines or coronavirus antivirals. The WHO strategy of containment for elimination could need to be adjusted to include mitigation strategies combined with the following activities currently recommended by STAG-IH on the WHO website [30]. Social distancing and behavioural changes are estimated to have reduced COVID-19 spread by 44% in Hong Kong, and a combination of non-pharmaceutical interventions are likely required to limit transmission Up to 86% of early COVID-19 cases in China were undiagnosed, and these infections were the source for 79% of documented cases [31]. Digital and telecommunication providers have also collaborated to generate insights on the efficacy of control measures by analysing mobility data. The culture of wearing the mask reduce this risk by the entire population, obviously combining hygienic precautions (hand washing, use of antiseptics and disinfectants), barrier gestures, social distancing, and targeted early detection. Whereas in Europe and the USA, containment and ordinary hygiene measures were largely insufficient to reduce the spread of the virus. Gao George Believes that the "big mistake" of Western countries was not to have worn masks the European population should wear masks, to further limit the spread of the epidemic [32]. Nicholas et al. show that the wearing of masks in the population leads to a slight reduction in the transmission coefficient of the virus [19].

The difficulties lie in quantifying the effectiveness of each system, after it becomes easier to identify a blended approach that will keep the incidence rate of cases at equilibrium, which is important for minimizing the total number of cases and for planning and optimizing health care personnel and resources [33].

LIMITS

A substantial uncertainty regarding the epidemiological characteristics of COVID-19. A limited epidemiological and clinical information on the cases of COVID-19 identified so far (e.g. efficiency of different modes of transmission, effective preventive measures). The limits of interpretation of the R0, Decrease peak numbers of infected people and Decrease transmission speed.

RESEARCH NEEDS

The following issues require attention (ECDC 2020): Risk factors for development of severe COVID-19 should be identified. The role of children in transmitting the virus. The proportion of asymptomatic cases and their role in transmission. The relative efficiency and relevance of the different modes of transmissions.

CONCLUSION

The present study demonstrates the enormous response capacity achieved through coordination of academic and public health system around the world. We hope that the present analysis will help political leaders and health authorities to manage epidemics well in the future. To move as quickly as they can, to ensure enough resources,

including personnel, hospital beds, and intensive care facilities. Finally, our analysis tends to suggest that measures to reduce transmission should be quickly implemented. Interventions to consider include the impacts of quarantine, case and contact isolation, hand hygiene, face masks, public education about personal protection, therapeutics, and future vaccines.

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