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Six Cs of pandemic emergency management: A case study of Taiwan’s initial response to the COVID-19 pandemic

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A R T I C L E   I N F O

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A B S T R A C T

A review of the disaster literature indicates that emergency responses to pandemics are often understudied; the current COVID-19 crisis provides an important opportunity to improve awareness and understanding about this and other contagious and disruptive diseases. With this in mind, this study examines Taiwan’s response to COVID-19 because it was successful in spite of a high probability of contagion. The paper first explores the assertion that cognition, communication, collaboration, and control are vital for effective disaster response; it then indicates the need to consider two additional Cs: confidence (trust of government’s competency) and coproduction (public participation in disaster transmission prevention). The paper also conducts a qualitative descriptive study of the Taiwan government’s response timeline with examples of each of these concepts in action. To further illustrate the need for the two additional Cs, survey data illustrate how public confidence serves as a pivot between government’s COVID-19 response and citizen coproduction in COVID-19 transmission prevention.

1. Introduction

Taiwan has set an example for other countries in how its government has coped with COVID-19 and should be studied comprehensively to improve the understanding of emergency management [1–4]. On January 31, 2020, as the coronavirus disease (COVID-19) began spreading from China, a report, based on air travel between Taiwan and China, predicted Taiwan would have the second-highest case count in the world. However, this prediction did not become reality. By April 27, 2020, from 61,684 tests, there were only 429 confirmed cases (only 55 of which were local, not imported, infections) and 6 deaths in Taiwan (statistics retrieved from the Taiwan Centers for Disease Control (CDC) on April 27, 2020). This brings up two very important questions: What emergency response mechanisms did Taiwan implement to contain the outbreak of COVID-19? How is the emergency response to a pandemic different from other hazard responses?

Using Taiwan’s COVID-19 pandemic response as a case study, this research argues that effective responses to public health emergencies, such as pandemics, require more than just an emphasis on the traditional four Cs of a government’s actions—cognition, communication, collaboration, and control (see Ref. [5] for cognition, communication, and control; see Ref. [6] for collaboration). Instead, citizen coproduction/compliance of disease prevention, and public confidence in government’s competency may be equally as crucial as the traditional four Cs of emergency management. Specifically, the traditional four Cs of emergency management are necessary but insufficient for coping with disasters related to public health. A government needs to utilize the four Cs to carry out necessary steps and cope with the uncertainty, but even then, policies related to the four Cs cannot be executed effectively and efficiently without public confidence and the willingness to coproduce in the process, especially in democratic countries. Several emergency management studies in psychology and sociology have identified citizens’ trust in government as a key determinant for public compliance to emergency policies [7–10]. While emergency management and the four Cs have received significant attention, public confidence and willingness to coproduction/comply are relatively understudied in the field of public sector emergency management compared to psychology and sociology. Most importantly, there are only a few existing studies investigating the interaction between the traditional four Cs (government action) and the two additional Cs (citizen perspective).

With this in mind, the following study seeks to explore the importance of the six Cs (the four traditional Cs plus coproduction and
confidence) in response to a pandemic emergency by focusing on Taiwan’s initial response. Moreover, using evidence collected through an online survey to comprehensively understand how and why people in Taiwan are willing to comply and be confident in the government’s actions, this study highlights how the Taiwanese government’s cognition, collaboration, communication, and control strategies increased public confidence in government, which in turn increased citizens’ willingness to coproduce in non-pharmaceutical interventions and comply with the government’s regulations. Therefore, a qualitative descriptive study will be utilized to discuss how the Taiwanese government used the traditional four Cs of emergency management to contain the spread of COVID-19, while the quantitative analysis of the survey responses will be used to demonstrate the importance of the two additional Cs related to the public perspective.

2. Literature review

The COVID-19 pandemic has incentivized governments around the world to redesign emergency management policy and to redirect resources in order to cope with the rapid, unpredictable spread of the virus. Scholars indicate that governments, in their attempts to contain the outbreak, are adopting many mechanisms to increase public awareness and encourage disaster prevention [11,12]. Countries have adopted public management tools, including open access on COVID-19 cases (all confirmed, suspected, and reported cases can be found on governmental websites); public sanitation education (the importance of handwashing, mask-wearing, and social distancing); and prevention policies through symptom identification and contact tracing, while others focus on promoting and supporting collaboration and resource mobilization to strengthen the capacity and resilience of their own health prevention systems [13,14]. But it is also important to note that citizens should be responsible for following government COVID-19 preventative recommendations [15,16]. Most of the existing COVID-19 literature focuses on the actions initiated by public agents, such as health departments and medical agencies [17], but such an approach largely ignores the important roles the public can play in the governance process of epidemic prevention [18,19].

The public role in governance is crucial because emergency management has an important impact on regional capacity of disaster response, can supplement and complement emergency service delivery, and can hold government accountable for emergency response. For example, in many countries, civil organizations and citizens have been exerting pressure on governments for increased accountability and maintenance of public reports to explain COVID-19 outbreaks [20,21]. Ever-rising public expectations for COVID-19 relief results in an enduring motivation for governments to continually adjust their responses on the basis of assessments of the risks in different locations and situations [22,23]. These pressures reflect public concern, which in turn has encouraged governments to keep responding to contain COVID-19.

Studies on traditional influenza management emphasize communication strategies through social media during high-uncertainty events [24] to provide sufficient information to the public, which enables the public to take personal responsibility for disease prevention. These recent studies also identify citizens’ willingness to accept government recommendations and their compliance with health prevention policies as a significant facilitator of disease prevention [25,26]. The public can contribute to epidemic prevention in several ways, including self-health monitoring and mask use, and as both users and producers of risk information [27,28]. Although the existing studies provide some fundamental public health emergency response strategies for governments to respond to COVID-19 [29–32], and have increasingly focused on the importance of incorporating citizens in influenza preparedness, mitigation, response, and prevention [33,34], these studies do not link together the government-initiated action and the role of the public and are insufficient to help government cope with challenges from COVID-19 [34]. The response to COVID-19 is different from traditional influenza management efforts because the period of a pandemic is significantly more extended than that of other hazards and should be categorized as an extreme context in which several extreme events are likely to occur and result in intolerable consequences. Thus, more research on the role of the public is needed.

Therefore, to comprehensively study the strategies of containing COVID-19, we not only focus on government-initiated action and the public’s role in disease prevention, but we also connect both concepts by investigating how a government’s actions can result in public confidence in government, willingness to coproduce, and compliance with policy.

3. Theory: the six Cs of pandemic emergency responses

As previous studies have illustrated, cognition, communication, collaboration, and control are the four key elements in emergency response both practically and theoretically [5,35]. However, emergency management related to public health emergencies such as pandemics is relatively understudied. The distinction between pandemic emergencies and other hazards can be significant. All disasters require not only government efforts but public participation to increase the probability of success. However, a resilient pandemic response plan requires even further citizen coproduction in transmission prevention because taking non-pharmaceutical interventions and precautionary activity are equally, and in some respects even more, essential [36,37]. Merely relying on government-initiated actions (the traditional four Cs), which has been widely adopted by many countries to cope with COVID-19, may not be enough to generate effective outcomes. All disease control mechanisms and non-pharmaceutical interventions cannot be implemented effectively without public acceptance and coproduction or public confidence. In other words, coproduction and public confidence are essential to coping with public health emergencies such as the pandemic. From the existing literature, we first briefly explain the importance of the six Cs of pandemic response and then state our hypotheses related to the two additional Cs.

3.1. Cognition

Cognition is a “C” that has different manifestations among the public and government. Cognition is defined as “the capacity to recognize the degree of emerging risk” [5]; p.189). From the public’s perspective, being cognizant of public health threats will increase emergency preparedness and encourage the public to use non-pharmaceutical interventions [37,38]. Thus, the level of public cognition of a problem’s severity is positively associated with public compliance and production of disease prevention.

From the government’s perspective, failing to understand the magnitude of the disaster leads to more serious consequences, such as failing to initiate the necessary response and taking steps for disaster mitigation [5,39–41]. Failure at this early stage may hinder the efforts of emergency response because an early and aggressive response is critical when attempting to contain an epidemic outbreak [42]. Moreover, cognition of a problem’s severity by the government should not be based merely on perception; instead, proper assessment and identification with evidence are needed to build effective communication with the public [43,44]. Thus, without cognition, effective emergency management policy will likely not be carried out. Missing the timing for containing the spread can lead to larger scale disaster.

3.2. Communication

Communication in a pandemic response affects how the public perceives and reacts to the virus because “[r]isk must be well-publicized to inspire personal protective actions” [45]; p.16). Thus, transparent, up-to-date, and accurate information through many communication channels is essential to raising awareness of the problem’s severity and the need for public sanitation. Also, the effectiveness of
non-pharmaceutical interventions and emergency preparedness depends heavily on the success of public education and information communication [38, 46]. In contrast, inadequate communication can lead to anxiety and “public fatigue about respiratory infection communications and a blunting of advice messages on non-pharmaceutical interventions” (44); p.14). Therefore, ensuring information quality (transparency and accuracy) and sufficient quantity (that is frequent and up-to-date) are key elements of pandemic emergency communication.

3.3. Collaboration

The capacity to cope with the uncertainty of disease control and the broader emergency response far exceeds the expectations of what a single agency can deal with or be trained to handle [6]. Thus, intergovernmental, interdepartmental, and intersectional collaboration are essential to combine actors’ capacities in order to create an effective network. Moreover, leaders—including elected officials, political appointees, public managers, civil servants, and leaders from private and nonprofit organizations—need to share the joint goal, support the transboundary cooperation, and grant one another certain levels of autonomy to facilitate effective emergency response collaboration [47, 48]. An effective response to a pandemic requires a government to utilize collaboration within governmental agencies and with other sectors in order to secure and distribute necessary resources effectively and efficiently.

3.4. Control

Bureaucratic control was considered a crucial approach for emergency management early on, but overly bureaucratized control in emergency management has been criticized for having a negative impact on emergency response [31, 49–51]. In the context of this paper, control is not defined as bureaucratic control; instead, it is defined as the capacity to focus on essential tasks and the shared goal of preventing further disaster impacts [5]. From a public health emergency perspective, control includes the initiation and implementation of institutional regulatory policies—social distancing policies, case identifications [52], mass screenings, foreign entry suspension [53], and sanitation product distribution mechanisms—as well as surveillance between community members (non-institutional), to ensure the government and the public health system have the capacity to contain a disease outbreak.

3.5. Coproduction

Although an informed and dedicated governmental approach to emergency management is considered vital, a failure to incorporate the public as a coproducer in public health response is likely to result in social disruption and ineffectiveness of epidemic control [54]. Disease prevention and preparedness cannot be effective if residents refuse to adopt the precautionary strategies [38]. The view of the public as partner is the core of coproduction and emphasizes the importance and functions of the public in service coproduction, which states that citizens can make up for the lack of service-delivery capacity of public organizations [55]. Citizens are expected to have a civic responsibility and a moral imperative to assist government and to follow the guidelines and commands of government. The willingness to comply is the first and most necessary step for a proactive citizen coproduction.

Citizen-initiated coproduction is viewed as a potential source of governmental capacity [56]. Engaging the public as a coproducer to pandemic planning is important for transparency and improving compliance with public health orders [57]. This, in turn, improves government capacity to contain the outbreak of the disease [54]. Moreover, the public can play an important role in emergency management processes because most often the first response to disaster is from citizens, and most citizens are viewed as partners of government and called on as “citizen journalists” to offer information about the places they live to other collaborative participants [58, 59].

In this study we define coproduction as not only the voluntary action taken by citizens as preventive disease control, such as taking non-pharmaceutical interventions, but also the inclusion of the initial and essential element of coproduction—citizen compliance with government policy on COVID-19.

3.6. Confidence

Public confidence is related to the public’s evaluations of the effectiveness of governmental actions and activities, especially whether government would perform its designated role based on the public’s expectations [60, 61]. Public confidence in government competency serves as a pivot point between government’s pandemic response and citizens’ compliance and coproduction behavior. Previous studies have shown that public confidence in government increases compliance and cooperative behavior with emergency response policy initiated by the government [62]. And confidence also increases the public’s willingness to coproduce [53]. Thus, the level of confidence in a government’s competency has a positive impact on citizen compliance and citizen-initiated coproduction (Hypothesis 1).

Because public confidence is hypothesized to be a crucial determinant for citizen compliance and citizen-initiated coproduction, factors that increase public confidence in government are important issues for emergency response. Scholars have indicated that citizens’ satisfaction of perceived government performance is associated with confidence in government’s competency [64]. Catastrophic events regularly affect public confidence in governments. If governments cope with catastrophic events effectively, the public confidence will increase [65]. For example, studies related to the terrorist attack on the World Trade Center in the United States have found that public confidence increased after the terrorist events [66]. On the contrary, if a government does not respond to catastrophes effectively, public satisfaction and confidence in the government’s action will inevitably decrease [67, 68]. Thus, citizens’ satisfaction level of a government’s emergency response performance, including a government’s cognition, communication, collaboration, and control strategies, has a positive impact on public confidence in that government’s emergency response competency (Hypothesis 2).

We use both qualitative and quantitative analyses to comprehensively analyze the Taiwanese experience to test the six Cs. Specifically, the qualitative analysis focuses on thoroughly investigating how the Taiwanese government utilizes the traditional four Cs in their response to COVID-19 strategies, while the quantitative analysis aims to examine the two additional Cs and test Hypotheses 1 and 2.

4. Qualitative case analysis: cognition, communication, collaboration, control and the initial experiences in Taiwan

In this section, we conduct a qualitative descriptive study (a type of qualitative analysis) of the Taiwan government’s COVID-19 response timeline in relation to the global events, using this as evidence to illustrate the presence of these traditional four Cs. All information provided in the qualitative descriptive study was collected from the following agencies’ daily press briefings—Taiwan Centers for Disease Control (CDC), the Executive Yuan, Ministry of Foreign Affairs, the Ministry of Education, and the Presidential Office (see Fig. 1 for a more detailed timeline and Table 1 for how these government actions correspond to the traditional four Cs framework).

4.1. Period 1 (~January 20, 2020): risk recognition and preparedness

Cognition. This study uses the timing of the Taiwan government’s initiation of response actions and the aggressiveness of these actions in comparison with COVID-19 global events to infer the government’s cognition. Drawing lessons from the SARS outbreak in 2003, Taiwan has...
been very careful with its approach to the COVID-19 pandemic [1]. In fact, Taiwan CDC started implementing onboard screenings of all direct flights arriving from Wuhan, China, on December 31, 2019, which was before the World Health Organization (WHO) received the report on the novel coronavirus [69]. Moreover, before the first confirmed case entered Taiwan on January 21, the CDC hosted a meeting of experts on the establishment of testing and reporting criteria, began hosting daily press briefings, organized an advisory committee in preparation for a possible outbreak, reinforced screening practices at the airports and seaports, sent medical experts to Wuhan, China, to obtain more information, announced travel warnings, and activated the Central Epidemic Command Center (CECC) for Severe Special Infectious Pneumonia to coordinate cross-departmental tasks in response to the new virus [70]. Moreover, the president delegated the coordinating power to the commander of CECC to coordinate with other agencies directly [71], which enabled collaboration to be facilitated with fewer bureaucratic procedures.

Although few cases had been confirmed outside China and no human-to-human transmission was evident at this time, the Taiwan government was cognizant of the risk the virus could pose to the public and immediately initiated an aggressive response before most countries and regions [1].

### 4.2. Period 2 (January 21 to February 6): rapid and aggressive response

Most COVID-19 response mechanisms were initiated and mobilized during this period (between the first confirmed cases and first outbreak outside China on February 6) in Taiwan.

**Communication with the Public.** The CECC continued daily press briefings, provided COVID-19 updates, and corrected misinformation. The CDC also quickly revised its website and collaborated with social media platforms to provide daily updates and correct information. Sanitation education, such as handwashing and mask training, was made available in all public transportation stations [1]. Elected officials

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**Table 1: Chronology of Taiwan Government’s Responses to COVID-19**

| Period 1: Risk Recognition and Preparation | # of Imported Cases | # of Local Cases | Taiwan Government’s Responses | Date | Global Events |
|--------------------------------------------|--------------------|-----------------|-------------------------------|------|--------------|
| CDC implements onboard quarantine (screening) of direct flights arriving from Wuhan. Precautionary measures taken. Passengers with relevant symptoms provided medical treatment. | 0 | 0 | 12/31/19 WHO receives report of 27 pneumonia cases of unknown etiology from Chinese government. |
| Ministry of Health and Welfare Infectious Disease Control and Prevention Advisory Committee holds “Division of Influenza Control and Prevention Meeting in Preparedness to Potential Influenza Outbreak during Chinese New Year Holiday” in response to pneumonia outbreak in China. Government advises travelers visiting outbreak areas to take precautions. (First response-taskforce meeting) | 0 | 0 | 1/1/20 WHO requests further information from national authorities for risk assessment. Wuhan South China Seafood Wholesale Market, identified as a possible point of origin of pneumonia of unknown etiology, closed for disinfection/sanitary procedures. Confirmed cases rise to 40 in China. |
| Convenes experts to establish testing and reporting criteria. Government begins hosting daily press briefings. | 0 | 0 | 1/5/20 Chinese government excludes SARS and MERS as possible causes for the “new pneumonia”. |
| Executive Yuan instructs CDC to reinforce quarantine practices at airports and ports and prepare site visit to investigate ongoing outbreak. | 0 | 0 | 1/6/20 |
| Rases Wuhan, China travel advisory to Level 1 (Watch). | 0 | 0 | 1/7/20 WHO names the new virus 2019-nCOV. |
| CDC announces “Taiwan has made relevant preparedness and response efforts concerning quarantine, diagnostic and testing, as well as medical supplies” and is continuing these efforts. | 0 | 0 | 1/9/20 |
| CDC laboratory develops 24-hour test kits. | 0 | 0 | 1/11/20 First death from 2019-nCOV in Wuhan, Hubei Province, China. |
| CDC laboratory develops 4-hour test kits. | 0 | 0 | 1/12/20 |
| CDC classifies “Severe Pneumonia with Novel Pathogens” as Class-V communicable disease. | 0 | 0 | 1/15/20 |
| Medical experts from CDC and Communicable Disease Control Medical Network visit Wuhan, China to obtain more information about outbreak. Elevates Wuhan (China) Travel advisory for Hubei Province to Level 2. | 0 | 0 | 1/16/20 Japan confirms first imported case. |
| CECC is activated for Severe Special Infectious Pneumonia with Taiwan CDC Director-General Chou Chih-hwa as commander. | 0 | 0 | 1/20/20 Activates U.S. CDC Emergency Operation Center. China confirms third death and over 200 cases. Chinese doctor reports possibility of “human-to-human transmission” cases on television. Korea confirms first imported case. |

Fig. 1. Chronology of Taiwan Government’s responses to COVID-19.
and administrative agency leaders also worked together to ensure information credibility and consistency. Information regarding COVID-19 and public sanitation was given to leaders of the CECC and the vice-president, who was a prominent epidemiologist [72]. Other elected officials and political appointees were responsible for releasing carefully crafted information to decrease public concerns, such as ensuring the supply of essential groceries and personal protection equipment (PPE) and assistance for economic stability [73].

Control (Elevated). The government began evacuating Taiwanese nationals from Wuhan, China, through charter flights and required evacuees to stay at designated sites for a 14-day quarantine. All confirmed cases were required to be hospitalized regardless of the severity of the symptoms and to provide itineraries for the previous 14 days, while an investigation was conducted on the source of infection and contacts were identified. All relevant human contacts of confirmed cases were subjected to 14-day home quarantines. People subjected to home quarantine were required to enroll in a GPS tracking system with local police to ensure the effectiveness of home quarantine [74]. To prevent PPE shortages, the Taiwan government suspended exports of surgical and N-95 masks and centralized the distribution of masks [75,76].

Collaboration (Intersectoral). To distribute masks, the Taiwanese government collaborated with NHI-contracted pharmacies to sell masks under a name-based rationing system on February 6, 2020 [77]. The Digital Ministry also collaborated with citizens to develop "Mask Map" apps to assist in purchasing [78]. On February 5, the Taiwan government collaborated with more than 20 private corporations to recruit a "national mask team" to build 60 surgical mask production lines. Within six weeks, the team assembled 60 production lines, which normally

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**Table 1. Period 2: Rapid and Aggressive Responses**

| Period 2: Rapid and Aggressive Responses | # of Imported Cases | # of Local Cases | Taiwan Government's Responses | Date | Global Events |
|----------------------------------------|-------------------|----------------|-----------------------------|-----|--------------|
| 1 | 6 | 0 | Prime Minister Su Tou-ying called an emergency meeting. The government set 1.8 million N95 masks and 60,000 surgical masks as the daily threshold for purchase. | 15/01 | China confirms 15 medical workers infected with 2019-nCoV | |
| 2 | Elevated Warnings (Elevated) | 0 | Taiwan Health Ministry set Level 2 responses to 2019-nCoV. CECC announced a new surveillance system, which included a 14-day follow-up of returnees from China. | 27/01 | Wuhan, Hubei Province, China is locked down. WHO emergency meeting in Geneva. |
| 3 | 2 | 0 | Subsidized surgical and N-95 mask report for 1 month with masks provided from China; Hong Kong and Macau to compile health declaration card and conduct self-monitoring. Urged travel advisories from China to avoid travel to and avoid public transportation. | 04/02 | UK confirms 1st imported case. France confirms 1st imported case (also 1st European cases), 34 cities in lockdown in Hubei Province, China. |
| 4 | 0 | 0 | Taiwan Changes entry restriction for passengers from China, and add all groups from China to red list. Taiwan and Healthy Minister (CECC Chair) announced Level 2 and other Chinese provinces to Level 2. | 12/02 | Australia confirms the imported case. Malaysia confirms imported cases (8); all patients traveled to Wuhan. |
| 5 | 1 | 0 | Implement limited entry for students and citizens from China. | 04/02 | US confirms 6 cases. Global governments confirm approximately 2,600 cases. |
| 6 | 0 | 0 | Implement number limit for students and citizens from China. | 04/02 | US confirms 6 cases. Global governments confirm approximately 2,600 cases. |
would have taken four to six months to complete [79].

**Collaboration (Intergovernmental).** Most Taiwanese residents enroll in single-payer National Health Insurance (NHI) and carry NHI cards that provide physicians access to a comprehensive medical condition database. The CDC in Taiwan had been collaborating with the National Immigration Agency on entry screening, mandating arriving passengers’ self-reported health information, and the integration of NHI and Custom and Immigration databases enabled doctors to pinpoint

| Period 3: Capacity Enhancement | # of Imported Cases | # of Local Cases | Taiwan Government’s Responses | Date | Global Events |
|-------------------------------|---------------------|------------------|-------------------------------|------|--------------|
|                               | 0                   | 0                | Suspend entry for visitors who visited China in the past 14 days. CDC investigates the travel routes of Diamond Princess cruise passengers who disembarked on 1/31 in Taiwanese ports and releases these passenger’s detailed footprint through Public Warning System. Individuals who crossed paths are subjected to 14-days self-health management. | 2/7/20 | Japanese government diagnoses largest cluster of COVID-19 cases outside mainland China on a Diamond Princess cruise ship. |
|                               | 1                   | 0                | 128 SuperStar Aquarius cruise ship passengers tested negative for 2019-nCoV and are asked to conduct 14-day self-health management at home. | 2/8/20 | Chinese President Xi Jinping visits Wuhan for first time since 2019-nCoV outbreak. |
|                               | 0                   | 0                | Requires 14-day home quarantine for travelers transiting through China, Hong Kong, and Macau. Enacts temporary ban on flights between most cities in China and Taiwan, except for flights to and from Beijing Capital, Shanghai Pudong, Shanghai Hongqiao, Xiamen Gaode, and Chengdu Shuangliu International Airport. | 2/10/20 | WHO names novel coronavirus disease COVID-19. |
|                               | 0                   | 0                | Suspends entry for visitors from Hong Kong and Macau. Elevates Taiwan travel advisory to Level 1. Singapore to Level 2. Hong Kong and Macau to Level 3, and Philippines to Level 3. Requires all travelers arriving from areas outside China, Hong Kong, and Macau to complete health declaration form and to provide travel and contact history for past 14 days. | 2/11/20 | |
|                               | 0                   | 0                | Conducts retrospective COVID-19 tests for all negative influenza cases reported since 1/13. MOE postpones Joint College Entrance Examination from July 1-3 to July 3-5, 2020. | 2/12/20 | |
|                               | 0                   | 0                | Extends restriction on surgical mask exports and central control of mask distribution to end of April (original restriction date only valid through 2/23). | 2/13/20 | |
|                               | 0                   | 0                | Elevates Japan travel advisory to Level 1. Elevates outbreak levels of Zhejiang and Henan provinces, China to Level 1. | 2/14/20 | |
|                               | 0                   | 0                | Advises asymptomatic travelers with a history of travel to Level 1 or Level 2 outbreak Areas to avoid public transportation. | 2/15/20 | |
|                               | 0                   | 0                | Expands community-based surveillance measure and COVID-19 testing to groups with foreign travel, contact history, or other groups of potential risk. 303 local district public health centers start distributing face masks supplied under the name-based system. | 2/16/20 | |
|                               | 0                   | 0                | CECC announces Taiwanese passengers on Diamond Princess Cruise ship are required to return on charter flight arranged by the CECC and to abide by relevant quarantine measures after release from the ship. | 2/18/20 | |
|                               | 0                   | 0                | EPA and MC collaborate to ensure proper cleaning and disinfection procedures for upcoming school semester. | 2/19/20 | 14-day Dimond Princess ship-based quarantine ends. Passenger disembark in Japan. |
|                               | 0                   | 0                | Increases children’s surgical mask quota to 4 per NHI card per week. Elevates South Korea travel advisory to Level 1. | 2/20/20 | |
|                               | 0                   | 0                | 19 Taiwanese passengers on Diamond Princess arrive in Taiwan on charter flight and are sent to quarantine site for 14 days. Elevates Japan and South Korea travel advisories to Level 2. | 2/22/20 | First major outbreak occurs in Europe (Italy): 10 towns in lockdown. |
|                               | 0                   | 0                | Elevates Iran and travel advisories to Level 1. | 2/23/20 | |
|                               | 0                   | 0                | Elevates South Korea travel advisory to Level 3. Announces foreign nationals entering Taiwan from South Korea between 2/25 and 2/26 must conduct 14-day self-health management. Beginning 2/27, Taiwanese nationals entering Taiwan from South Korea must conduct 14-day period of home quarantine with violators fined up to NT$150,000 (US$5,000). | 2/24/20 | South Korea confirms 763 cases, most due to community spread. |

Fig. 1. (continued).
| # of Imported Cases | # of Local Cases | Taiwan Government’s Responses | Date       | Global Events |
|---------------------|-----------------|------------------------------|------------|---------------|
| 0                   | 1               | Elevates Italy travel advisory to Level 2. Passes Special Act on COVID-19 Prevention, Relief and Restoration. In response to schools reopening, CECC adjusts child-size face mask rationing plan to allow parents to buy masks for children at or under age 13 on any day of the week, with up to 3 NHIC cards at a time, but still only once per week. | 2/25/20    | Iran closes K-12 schools. |
| 0                   | 1               | Elevates Iran travel advisory to Level 2. | 2/26/20    | China reports COVID-19 spreads faster outside of China. Brazil reports first confirmed imported case (is also first confirmed case in Latin America). |
| 0                   | 0               | Elevates Italy travel Advisory to Level 3. Requires passengers arriving from Italy to conduct 14-day home-quarantine. Implements Special Act on COVID-19 Prevention, Relief and Restoration. | 2/27/20    | Italy confirms cases exceed 400 with 12 deaths; infection source unknown for 90% of confirmed cases. Japan confirms 897 cases with 7 deaths. South Korea confirms 595 new cases in 1 day, with a new total case count of 1,766. |
| 1                   | 1               | Requires all recovered patients to be tested 3 times with negative result before release from hospital. | 2/28/20    | COVID-19 cases surge in 14 European Union countries. |
|                    | 1               | A hospital continues to test positive and is believed to have infected 4 other people. Government identifies and contacts all, requires home quarantine. | 2/29/20    | WHO raises assessed risk of COVID-19 spread and impact to very high at global level. Confirmed cases in 97 countries. U.S. confirms first death. |
|                    | 0               | CECC announces NHIC cardholders will be allowed 1 additional face mask per week, beginning 3/5. | 3/2/20     | Japan closes K-12 schools. |
|                    | 1               | Launches Special Taxi service at the airports for passengers subjected to home quarantine. | 3/3/20     | South Korea declares ‘war’ on COVID-19 outbreak. 90,000 confirmed cases with 3,000 deaths, worldwide. |
| 1                   | 2               | Issues Guidelines for Large Scale Public Gatherings to prevent community transmission. Ministry of Economic Affairs (MOEA) announces NT$90 million will be spent to set up another 32 mask production lines. “Team Taiwan” announces completion of supply lines with each line able to manufacture 100,000 masks per day and estimates that the county’s daily mask production ramped from 4 million to 10 million. Raises the mask ration to 3 adult-sized or 5 child-sized masks per week. | 3/5/20     | |
|                    | 0               | Reveals investigation regarding travel itinerary and related contacts of an Australian COVID-19 patient, who visited Taiwan in late February. All close contacts subjected to a 14-day period of home isolation. Other contacts subjected to a 14-day period of self-health management. | 3/6/20     | |
|                    | 0               | Assists Palau in preventing the spread of COVID-19. France, Germany, and Spain travel advisories elevated to Level 2. Government requires all passengers arriving from these countries to conduct self-health management. Passengers of Diamond Princess are released from 14-day mandatory quarantine and asked to conduct self-health management for 14 more days. | 3/7/20     | Globally, confirmed case count exceeds 100,000 (cases in more than 90 countries). |
| 0                   | 0               | CECC implements social distancing and sanitation rules during daily press conference. | 3/8/20     | |
|                    | 0               | CECC announces additional of online ordering mechanism to the name-based rationing system for face masks, beginning 3/12. Second charter flight from Wuhan arrives in Taiwan with 361 evacuees who are immediately subjected to 14-day quarantine at quarantine sites. | 3/10/20    | 27 European countries with confirmed cases. |
| 1                   | 0               | CECC announces travel advisories set at Level 2; all passengers arriving from Taiwan in these countries to be subjected to 14-day, self-health management. CECC announces people subject to 14-day home-quarantine and their caretakers to be eligible for compensation from Taiwanese government; qualified individuals will receive NT$1,000 (US$33.39) per day for up to 14 days; those on paid leave or found to be in violation of related regulations will not be eligible for compensation. | 3/11/20    | U.S. implements 30-day travel ban on 26 European countries. U.S. National Basketball Association suspends season. |
| 1                   | 0               | Launches online name-based face mask ordering mechanism with convenience store pick-up. | 3/13/20    | WHO declares the COVID-19 outbreak to be a pandemic. |

Fig. 1. (continued.)

high-risk patients during clinical visits [80]. The CDC also collaborated with the Ministry of Foreign Affairs on suspending travelers from and to China, based on the epidemic situation. The CDC also coordinated with the Ministry of Education to defer the start date of the school semester [81]. In addition, to ensure community surveillance, the central government collaborated with local governments (counties and villages) on
Fig. 1. (continued).

| # of Imported Cases | # of Local Cases | Taiwan Government’s Responses | Date  | Global Events |
|---------------------|------------------|-------------------------------|-------|---------------|
| 0                   | 1                | CECC announces the 361 evacuees who returned from Wuhan on charter planes tested negative and remain under quarantine. Official Community Outbreak Prevention work instructions set up official collaboration with local governments, health centers, religious groups, and community volunteer groups. | 3/13/20 | U.S. declares State of Emergency; 5,000 deaths, worldwide. |
| 3                   | 0                | Elevates U.S. states of Washington, New York, and California travel advisories to Level 2. Schengen countries travel advisories set at Level 3. All passengers arriving in Taiwan from these areas are to be subjected to 14-day quarantine. | 3/14/20 | |
| 6                   | 0                | Elevates Egypt travel advisory to Level 2. Import cases again exceeded local cases. | 3/15/20 | U.S. CDC advises no gatherings of 50 or more people over next 8 weeks. |
| 8                   | 0                | Travel advisories for 42 countries and 2 territories in Eastern Europe, Middle East, Central Asia, and Northern Africa set at Level 3. | 3/16/20 | U.S. launches the first human trial of a potential vaccine to protect against COVID-19. |
| 10                  | 0                | Elevates travel advisory for 20 Asian, East European countries, and 3 U.S. states set at Level 3. Symptomatic passengers who arrived from Europe between 3/9 to 3/14 are to be subjected to retrospective testing for COVID-19. | 3/17/20 | European Union looks down its borders with all other nations for 30 days and closes nonessential travel. South Korea postpones the start of spring school semester to 4/6 (5-week delay). Union of European Football Association Euro 2020 Tournament postponed until 2021. |
| 21                  |                  | Retrospective health monitoring for individuals entering Taiwan from Europe, Egypt, Turkey, and Dubai (transits in these regions included) begins in addition to a retrospective testing on symptomatic individuals. Individuals arriving in Taiwan after traveling from Europe between 3/5 and 3/14 are advised to follow home quarantine measures, and to immediately contact their local township/distinct offices to report their travel histories. Local governments arrange local civil affairs personnel to implement home quarantine procedures. Australia, Canada, New Zealand, and U.S. travel advisories set at Level 3, effective 3/6. | 3/18/20 | Confirmed case count exceeds 200,000 worldwide. |
| 7                   |                  | Entry for non-Taiwanese nationals is suspended, except for special provisions. All inbound travelers returning to Taiwan are required to undergo 14-day home quarantine; violators fined up to NT$1 million (US$33,000) and put into designated quarantine facilities. President Tsai issues remarks regarding government response to COVID-19 pandemic, emphasizing proactive measures to maintain economic momentum, stimulate industry, ensure financial stability, control the virus outbreak, and protect citizens. | 3/19/20 | |
| 18                  | 0                | Sale of requisitioned face masks to inbound travelers begins on 3/21 at duty-free sections at airports. Travel advisory elevates for all countries to Level 3. Symptomatic passengers returning from the U.S. and East Asia between 3/8 and 3/18 are to be subjected to home quarantine and tested for COVID-19. MOEA announces travelers who entered Taiwan on or before 3/21 on a visitor visa, a landing visa, or through a visa-waiver program and who have not overstayed legal stay period will be granted an automatic 30-day extension. | 3/21/20 | |
| 20                  | 1                | 90s airline passenger transit through Taiwan | 3/24/20 | India begins lockdown. International Olympic Committee postpones 2020 Tokyo Olympics to 2021. |
| 19                  | 0                | Second round of name-based face mask online ordering commences. CECC recommends suspending indoor gatherings of over 100 people and outdoor gatherings of over 500 people to prevent cluster infections. Government releases 361 Wuhan evacuees from quarantine. | 3/25/20 | |
| 15                  | 0                | CECC urges people to undertake home quarantine/self-isolation and to follow related regulations; violators to be fined up to NT$1 million (around US$33,000) and put in group quarantine. | 3/27/20 | British Prime Minister Boris Johnson tests positive for COVID-19. |
| 14                  | 1                | 153 Taiwanese nationals, who had been stuck in Wuhan, Hubei Province, China, are evacuated through charter flight and subjected to 14-day quarantine at designated sites upon arrival. | 3/29/20 | |
| 7                   | 1                | 254 more Taiwanese nationals are evacuated from China through a charter flight and subjected to 14-day quarantine at designated sites. | 3/30/20 | Tokyo Olympics are officially postponed to 7/23–8/8, 2021. |

Community members’ health condition reporting, correction of misinformation, and public sanitation education [82]. Information transparency through various communication channels, intergovernmental and intersectional collaboration, and effective implementation of control mechanisms facilitated during this period enhanced the government emergency response capacity. Moreover, these mechanisms also created a solid foundation for the following periods.
4.3. Period 3 (February 7 to March 12): capacity enhancement

With outbreaks occurring globally, the Taiwanese government continued to expand and build upon the mechanisms it had already established.

**Control and Communication.** The CECC continued to closely monitor the COVID-19 outbreak worldwide in order to update travel advisories and trace all high-risk groups and their possible contacts. It also expanded the testing criteria to people with foreign travel history or with contact history and provided guidelines for large-scale gatherings. Moreover, quarantine requirements were elevated: asymptomatic travelers arriving from outbreak areas were subjected to strict home-based

| Period 5: Global Pandemic Continued |
|------------------------------------|
| **# of Imported Cases** | **# of Local Cases** | **Taiwan Government’s Responses** | **Date** | **Global Events** |
| 7 | 0 | CECC announces those who violate home quarantine may be fined between NTS200,000 (US$6,700) and NT$1 million (US$33,000) and those who provide incorrect or false personal information on the health declaration form upon entry to Taiwan may be fined between NT$ 10,000 (US$330) and NT$500,000 (US$15,000). CECC announces social distancing measures for COVID-19. People subject to home quarantine are prohibited from traveling by domestic flight or ferry. Donations of 10 million masks to other countries begins. | 4/01/21 | Wimbledon is canceled for the first time since World War II. |
| 6 | 1 | Travelers with symptoms in the past 14 days to be required to undergo quarantine at designated locations. Disease Containment Expert (LINE chatbot system), developed jointly by the CECC, Line Taiwan and HTC Corporation’s healthcare unit (DeepQ), officially launched and used to track people in home quarantine. | 4/03/21 | U.S. death toll exceeds 5,000. Confirmed case count tops 1 million, worldwide. |
| 5 | 0 | In response to tarmac sweeping activities, CECC urges the public to practice social distancing. Refusal to wear face masks on public transportation despite being advised to do so will be fined up to NT$15,000 (US$500). Warning messages sent through Public Warning System. | 4/02/21 | |
| 8 | 2 | Public is urged to wear face masks and to inform physicians of any history of travel, occupation, contact, and cluster (TOCC) in order to facilitate timely diagnoses and prompt case-reporting. | 4/05/21 | |
| 9 | 1 | CECC urges people to conduct 14-day self-health management if they visited crowded places during spring break. CECC begins to send SMS messages every day to track the health status of those in home quarantine and home isolation. Individuals in home quarantine and home isolation can directly reply to these messages to report their health conditions. | 4/04/21 | British Prime Minister, Boris Johnson moved into intensive care. |
| 0 | 1 | Public is allowed to send up to 30 face masks at a time to second-degree relatives living overseas over a two-month period; mask mailing permission can be applied for online. | 4/03/21 | |
| 2 | 0 | Crowd control is imposed at tourist hotspots, night markets and temples. | 4/02/21 | Death toll surpasses 101,000, worldwide. |
| 2 | 0 | 3D face masks for children between ages 4 and 8 are available for online purchase. | 4/15/21 | 91% of the world’s student population is affected by closures due to COVID-19. Confirmed case count tops 2 million with 130,000 deaths, worldwide. |
| 1 | 0 | A cumulative total of 51,603 cases have been reported, among which COVID-19 has been ruled out in 48,680. | 4/17/20 | |
| (3) | 0 | Inbound travelers who visited Europe and the Americas in last 14 days asked to voluntarily present documents for home quarantine requirements before boarding. Inbound travelers from Southeast Asia are asked to notify health officials before boarding; anyone making false health declarations will be fined up to NT$150,000 (US$5,000). More than 744 navy members are called back for COVID-19 tests and subjected to quarantine at designated sites. | 4/18/20 | |
| 1; (21) | 0 | NHRI contracted pharmacies and local health centers stop selling face masks. Releases footprint of all confirmed navy officers through phone messages. All relevant contacts of the confirmed cases are subjected to 14-day home quarantine. All individuals who crossed paths are subject to 14-day self-health management. | 4/19/20 | |

Fig. 1. (continued).
Table 1: Example Taiwanese government strategies corresponding to traditional four Cs.

| 4Cs          | Time                           | Example Strategies                                                                 |
|--------------|-------------------------------|------------------------------------------------------------------------------------|
| Cognition    | Period 1 (–January 20, 2020)   | The government’s cognition, drawing lessons from the SARS outbreak in 2003.          |
| Control      | Period 1 (–January 20, 2020)   | Taiwan CDC started implementing onboard screenings of all direct flights arriving from Wuhan, China, on December 31, 2019. |
|              | Period 2 (January 2 to February 6) | (1) The government began evacuating Taiwanese nationals from Wuhan, China, through charter flights and required evacuees to stay at designated sites for a 14-day isolation. |
|              |                               | (2) All confirmed cases were required to be hospitalized regardless of the severity of the symptoms, and all relevant human contacts of confirmed cases were subjected to 14-day home quarantine. |
|              |                               | (3) Taiwanese residents were required to enroll in single-payer National Health Insurance (NHI) and carry NHI cards linked to comprehensive medical condition database. |
|              | Period 3 (February 7 to March 12) | Asymptomatic travelers arriving from outbreak areas were subjected to strict home-based quarantine. |
|              | Period 4 (March 13 to March 31) | (1) After the WHO declared COVID-19 a pandemic, the Taiwanese government suspended entry for non-Taiwanese nationals and banned airline transit through the island nation. |
|              |                               | (2) All returning travelers were required to conduct 14-day home quarantines, and recommended suspending large indoor and outdoor gatherings to prevent cluster infections. |
|              |                               | (3) The punishment for quarantine violators increased. |
|              | Period 5 (April 1 to May 1)    | (1) The CECC imposed social distancing measures. A new policy on mask wearing in public transportation was issued; violators to be fined up to NT$15,000 (US $500). |
|              |                               | (2) Inbound travelers from Europe and the Americas after April 4 must voluntarily present documents for home quarantine requirements before boarding. |
|              |                               | (3) All businesses on the footprint list were asked to conduct two-day disinfection procedures. |
| Communication| Period 1 (–January 20, 2020)   | On January 21, the CDC hosted a meeting of experts on the establishment of testing and reporting criteria, began hosting daily press briefings, and organized an advisory committee in preparation of a possible outbreak. |
|              | Period 2 (January 21 to February 6) | (1) The CECC continued daily press briefings and collaborated with social media platforms to provide daily updates and to correct misinformation. |
|              |                               | (2) People subjected to home quarantine were required to enroll in a GPS tracking system to enable local police to ensure the effectiveness of home-quarantine. |
|              |                               | (3) Emphasis was placed on information transparency through multiple communication channels and intergovernmental and intersectional collaboration. |
|              | Period 5 (April 1 to May 1)    | (1) Warnings are sent out through the Public Warning System to people who have been in contact with suspected COVID-19 cases. |
|              |                               | (2) SMS messages are sent every day to track the health status of people quarantined through the Public Warning System. |

Table 1 (continued)

| 4Cs          | Time                           | Example Strategies                                                                 |
|--------------|-------------------------------|------------------------------------------------------------------------------------|
| Collaboration| Period 1 (–January 20, 2020)   | The Central Epidemic Command Center (CECC) for Severe Special Infectious Pneumonia was activated to coordinate cross-departmental tasks in response to the new virus. |
|              | Period 2 (January 21 to February 6) | (1) Elected officials and political appointees were responsible for releasing carefully crafted information to decrease public concerns. |
|              |                               | (2) The Taiwanese government collaborated with NHI-contracted pharmacies to sell masks under a name-based rationing system on February 6, 2020. |
|              |                               | (3) GPS tracking system was adopted for reporting citizens’ home quarantine. |
|              |                               | (4) The Digital Ministry also collaborated with citizens to develop ‘Mask Map’ apps to assist in purchasing. |
|              |                               | (5) The central government collaborated with local governments (counties and villages) on community member’s health condition reporting, correction of misinformation, and public sanitation education. |
|              | Period 3 (February 7 to March 12) | (1) Special taxi services were launched at the airports for passengers subjected to home quarantine. |
|              |                               | (2) The mask production collaboration among chain suppliers boosted Taiwan’s production capacity from 4 million to 10 million masks daily. |
|              | Period 4 (March 13 to March 31) | The official Outbreak Prevention Works Instruction enhanced collaboration among public agencies and private corporations. |
|              | Period 5 (April 1 to May 1)    | The CECC collaborated with Line Taiwan and HTC Corporation’s healthcare unit to launch a Disease Containment Expert system. |

Additionally, recovered patients could not leave the hospital until passing three health tests [83].

**Collaboration.** The mask production collaboration boosted Taiwan’s production capacity from 4 million to 10 million masks daily, which increased the name-based mask purchasing quota; 303 local district public health centers joined the distribution of the name-based mask rationing system. Moreover, the CECC launched the Mask Online Ordering System and began collaborating with convenience stores for online order pickups. Relief and Restoration was implemented by other government agencies to address the economic impact caused by COVID-19 under the Special Act on COVID-19 [84]. The Ministry of Education also collaborated with the Environmental Protection Administration to disinfect schools for the new semester [85].

During this period, the COVID-19 outbreak occurred in other countries, such as South Korea, Iran, and Italy. These continuing response actions effectively kept the confirmed cases under 400 in Taiwan.
4.4. Period 4 (March 13 to March 31): control mechanism elevation

After the WHO declared COVID-19 a pandemic, several control mechanisms were elevated in Taiwan. The Taiwanese government suspended entry for non-Taiwanese nationals and banned airline transit through the island nation.

**Control.** In response to the global outbreak, the CECC began conducting retrospective COVID-19 testing for travelers arriving in Taiwan from March 3 to March 14, requiring all returning travelers to conduct 14-day home quarantines, and recommended suspending large indoor and outdoor gatherings to prevent cluster infections. The punishment for quarantine violators went up to a NT$1 million (US$33,300) fine with mandatory quarantine at designated sites [86].

**Collaboration.** To ensure effective quarantine practices, the Taiwanese CDC [87] released the official Outbreak Prevention Works Instruction to formalize the collaboration between the central government, local governments, religious groups, community volunteer groups, health centers, and schools to correct misinformation and arrange local civil affairs personnel to implement home quarantine procedures. This increased the implementation of formal control and generated non-institutional control mechanisms, such as community surveillance, in undertaking non-pharmaceutical interventions. The collaboration on mask distribution remained ongoing: in mid-March, 15 more private corporations joined the production, which continued to increase the mask purchasing quota for NH holders [73].

As the result of the pandemic declaration, the number of returning Taiwanese nationals rapidly increased, as did confirmed imported cases. Yet, because of the early preparedness, no mass community transmission occurred in Taiwan.

4.5. Period 5 (April 1 to May 1): global pandemic continued

**Control.** To prevent community transmission during the Tomb Sweeping Festival (TSF) a four-day national holiday, the CECC imposed social distancing measures. A new policy on mask wearing in public transportation was issued; violators would be fined up to NT$15,000 (US $500). The CECC also urged people who visited crowded places to conduct 14-day self-health management and sent out warnings through the Public Warning System (also an example of Communication). Moreover, incoming passengers who provided incorrect personal information on the health declaration notice could be fined up to NT $150,000 (US $5000). Inbound travelers who had visited Europe and the Americas after April 4 were to voluntarily present documents for home quarantine [89]. The central government immediately collaborated with county governments, quarantining people they had contacted, and used text messages to release the footprints (tracking) of all confirmed cases. Moreover, Taiwan now not only has the capacity to contain the COVID-19 spread in the country but has also begun to donate nearly 10 million surgical masks to countries in need to cope with the cross-boundary challenges.

5. Quantitative data analysis: determinants of public confidence and coproduction

5.1. Methodology

To explore public satisfaction with the Taiwan government’s response to COVID-19 and test Hypotheses 1 and 2, we conducted an online survey. IRB for the research and the survey was submitted on April 5, 2020 (expedited review) and was approved by the University of Dayton Institutional Review Board on April 6, 2020. The survey was distributed by posting the survey link on social media platforms widely used in Taiwan [90,91], including Facebook, Line, Dcard, and PTT (both Dcard and PTT are similar to reddit in Taiwan) between April 9 and April 17, 2020. Users of these social media took the survey or shared the survey link voluntarily (N = 1792). When survey participants clicked the link, participants were immediately informed that the survey was completely anonymous; it did not gather nor present the respondents’ IP address or location data in the results. Additionally, respondents were informed that this survey was solely for academic research and in no way affiliated with a government agency. Researchers’ university affiliations and the institution granting the IRB approval were also disclosed in the consent form.

Post-stratification was applied to reduce the sample bias. Post-stratification weight was created on the basis of gender and age. The comparison between the weighted and unweighted gender and age distribution is presented in Table 2. Generally, there are more female than male participants; around 50% of the participants were between 30 and 44 years old.

Respondents were asked to rate their level of satisfaction with government actions regarding communication, collaboration, and cognition as well as their preferred level of government control. Respondents were also asked to rate their confidence in the government’s competency, the level of personal responsibilities taken, and their willingness to comply with relevant regulations. Two mediator analyses were conducted through Stata 15 (see Table 3 for survey questions). The first mediator analysis examines the indirect effect of government’s cognition, control, communication, collaboration efforts on the public’s willingness to coproduce in containing COVID-19 with the level of public confidence as a mediator. The second mediator analysis examines the indirect effect of government’s cognition, control, communication, collaboration efforts on the public’s willingness to comply with COVID-19 related regulations with the level of public confidence as a mediator. Control variables included gender, age, income, party affiliation, education level, marital status, and whether the respondent had children. Descriptive statistics for control variables are presented in Table 4.

6. Results

According to the survey, more than 90% of the respondents were
they had engaged in non-pharmaceutical interventions to prevent disease spread and preferred stricter government regulations. Moreover, 99% reported satisfaction with relevant policy (see Table 5).

Table 4
Measurement/indicators.
| Indices/Variables                  | Measurements/Indicators                                      | Cronbach’s Alpha |
|------------------------------------|-------------------------------------------------------------|------------------|
| Communication                      | Daily press briefing                                        | .79              |
|                                    | Public sanitation education                                 |                  |
|                                    | Source of infection                                          |                  |
| Collaboration                      | Mask production                                             | .80              |
|                                    | Mask distribution                                            |                  |
|                                    | Interdepartmental (horizontal)                              |                  |
|                                    | Intergovernmental (vertical)                                |                  |
| Control                            | Travel advisory warning                                      | .79              |
|                                    | Entry limitation                                             |                  |
|                                    | Tracking system                                             |                  |
|                                    | Quarantine (high-risk)                                       |                  |
|                                    | Quarantine (businessperson and students)                    |                  |
|                                    | Quarantine (travel)                                          |                  |
|                                    | Name-based rationing system                                 |                  |
|                                    | Fine                                                        |                  |
| Cognition                          | Aggressive response                                         | .82              |
|                                    | Early warning                                               |                  |
| Confidence                         | Confidence in government competency                         | NA               |
| Public Cognition                   | COVID-19 severity                                            | .65              |
|                                    | Global news                                                 |                  |
|                                    | Confirmed cases in Taiwan                                   |                  |
|                                    | SARS experience                                             |                  |
| Coproduction (Non-pharmaceutical interventions) | Social distancing                                      | .80              |
|                                    | Prevent crowded places                                       |                  |
|                                    | Mask wearing                                                |                  |
|                                    | Handwashing                                                 |                  |
|                                    | Prevent eating out                                           |                  |
| Coproduction (Compliance)          | Comply with regulation                                      | .83              |
|                                    | Comply with quarantine rule                                  |                  |

Table 5
Descriptive statistics for the six Cs.
| Indices/Variables                  | Measurements/Indicators                                      | Percentage of Response |
|------------------------------------|-------------------------------------------------------------|------------------------|
|                                    | Dissatisfied and Strongly Dissatisfied                       | Neutral               | Satisfied and Strongly Satisfied |
| Communication                      | Daily press briefing                                        | 2.80%                  | 3.24%                  | 93.96%                  |
|                                    | Public sanitation education                                 | 3.12%                  | 3.35%                  | 93.53%                  |
|                                    | Source of infection                                          | 8.51%                  | 7.41%                  | 84.88%                  |
|                                    | Mask production                                             | 4.57%                  | 4.68%                  | 90.76%                  |
|                                    | Mask distribution                                            | 8.45%                  | 5.29%                  | 86.25%                  |
|                                    | Interdepartmental (horizontal)                              | 6.46%                  | 9.74%                  | 83.81%                  |
|                                    | Intergovernmental (vertical)                                | 3.36%                  | 27.46%                 | 69.14%                  |
| Control                            | Travel advisory warning                                      | 1.66%                  | 42.83%                 | 55.51%                  |
|                                    | Entry limitation                                             | 1.86%                  | 51.22%                 | 46.94%                  |
|                                    | Tracking system                                             | 1.50%                  | 56.61%                 | 31.89%                  |
|                                    | Quarantine (high-risk)                                       | 1.74%                  | 61.8%                  | 36.45%                  |
|                                    | Quarantine (businessperson and students)                    | 1.49%                  | 47.47%                 | 51.04%                  |
|                                    | Quarantine (travel)                                          | 1.54%                  | 44.63%                 | 53.83%                  |
|                                    | Name-based rationing system                                 | 2.24%                  | 74.39%                 | 3.14%                   |
|                                    | Fine                                                        | 2.02%                  | 3.53%                  | 94.46%                  |
| Cognition                          | Aggressive response                                         | 3.27%                  | 8.41%                  | 88.32%                  |
|                                    | Early warning                                               | 2.61%                  | 4.26%                  | 93.13%                  |
| Confidence                         | Confidence in government competency                         | 3.50%                  | 6.33%                  | 90.18%                  |
| Public Cognition                   | COVID-19 severity                                            | 0.74%                  | 1.85%                  | 97.41%                  |
|                                    | Global news                                                 | 9.46%                  | 11.54%                 | 79.00%                  |
|                                    | Confirmed cases in Taiwan                                   | 0.47%                  | 1.78%                  | 97.75%                  |
|                                    | SARS experience                                             | 1.69%                  | 8.29%                  | 90.03%                  |
| Coproduction (Non-pharmaceutical interventions) | Social distancing                                      | 0.97%                  | 4.12%                  | 94.91%                  |
|                                    | Prevent crowded places                                       | 0.90%                  | 3.87%                  | 95.23%                  |
|                                    | Mask wearing                                                | 0.47%                  | 2.52%                  | 97.01%                  |
|                                    | Handwashing                                                 | 0.29%                  | 2.37%                  | 97.35%                  |
|                                    | Prevent eating out                                           | 5.65%                  | 13.54%                 | 80.82%                  |
| Coproduction (Compliance)          | Comply with regulation                                      | 0.24%                  | 1.84%                  | 97.92%                  |
|                                    | Comply with quarantine rule                                  | 0.00%                  | 1.64%                  | 98.00%                  |

Table 6
Descriptive statistics for control variables.
| Marital Status                  | Married            | 50.37% |
| Have Child?                    |                   |   |
| Have at Least One Child        |              |   |
| No Children                    |          |   |
| Have Child?                    |                   |   |
| Have at Least One Child        |              |   |
| No Children                    |          |   |
| Party Affiliation              |                   |   |
| KMT                            |    |   |
| DPP                            |    |   |
| People First Party             |     |   |
| New Power Party                |     |   |
| Taiwan State Building Party    |   |   |
| Taiwan People’s Party          |   |   |
| Others or No Party Affiliation |    |   |
| Income                         |                   |   |
| less than NTD 28,000            |    |   |
| NTD 28,001–39,000              |    | 15.48% |
| NTD 39,001–49,000              |    | 13.42% |
| NTD 49,001–59,000              |    | 13.16% |
| NTD 59,001–69,000              |    | 12.07% |
| NTD 69,001–80,000              |    | 12.57% |
| NTD 80,001–93,000              |    | 6.51% |
| More than NTD 93,000            |    | 16.75% |
| Education                      |                   |   |
| No Education                   |    | 0.59% |
| High School and Under          |    | 23.63% |
| College Degree                 |    | 38.15% |
| Master’s Degree                |    | 29.88% |
| Ph.D. Degree                   |    | 7.75% |

satisfied with the government’s cognition, communication, and collaboration mechanisms; were confident of the government’s competency; and preferred stricter government regulations. Moreover, 99% reported they had engaged in non-pharmaceutical interventions to prevent disease control and were willing to sacrifice personal freedom to comply with relevant policy (see Table 5).

As Table 6 presents, public satisfaction with the government’s cognition, communication, and collaboration mechanisms were positively associated with public confidence in the government’s competency in coping with the COVID-19 pandemic (showing that Hypothesis 2 is partially valid). But this does not directly affect citizen compliance and coproduction. Public confidence in government’s COVID-19 response competence, as hypothesized, has had a positive association with citizen compliance and coproduction (Hypothesis 1 Valid). In other words, public confidence in government has served as a pivot point between government’s COVID-19 response and citizens’ disease prevention efforts. Moreover, public cognition and the public’s preferred level of government control mechanisms also have had a positive impact on coproduction and citizen compliance. However, respondents’ preferences for control level was not associated with their willingness to coproduce and comply.

7. Discussion

Unless there were serious legal consequences for non-compliance, many governments were unable to produce an effective COVID-19 response because they failed to boost citizens’ confidence in their actions [15], which in turn decreased the public’s willingness to coproduce...
and comply. The case of Taiwan’s initial response to the COVID-19 pandemic provides valuable theoretical and practical contributions. In practice, according to the initial COVID-19 pandemic response experience in Taiwan, public health emergencies require more than government-initiated communication, collaboration, and control actions. Effective responses are also based on government and public cognition, public confidence in government, and citizen coproduction.

The results show, to successfully contain the spread of COVID-19, governments need to encourage citizens to have an active role in the COVID-19 pandemic and not just be passive public service consumers. To encourage coproduction and increase public confidence (the two additional Cs), governments first have to utilize the traditional four Cs to increase their emergency management performance and boost public confidence. Moreover, the traditional four Cs can remove barriers to citizen responsibility in disease prevention. For example, if a government does not provide transparent, high-quality, consistent, and up-to-date COVID-19 and public sanitation information, it will be difficult for the public to understand the severity of the pandemic and disease prevention mechanisms or to understand and comply with governmental regulations. In addition, if the government does not collaborate with other sectors to secure non-pharmaceutical interventions, it will be extremely difficult for the public to obtain them. In other words, the traditional four Cs are essential to boost the additional two Cs presented in this study; the additional two Cs are then essential to ensure that the four Cs initiated by government are effective.

This study also provides several theoretical contribution. The Taiwan experience highlights the importance of cognition. Although this study only focuses on the initial stage, it highlights the importance of studying a country’s early action in response to possible large scale catastrophes. Due to the 2003 SARS experience, both the Taiwanese government and the public are more cognizant of epidemic threats [2]. When COVID-19 was discovered but not yet to an epidemic level in late 2019, the Taiwanese government had initiated a series of precautionary actions, which set up the foundation to cope with the threats of this global pandemic. For example, when the first outbreak took place in Taiwan in the middle of May 2021, the daily confirmed cases in Taiwan started to decrease in the middle of June 2021 and continued to drop to around 30 in early July 2021 without full lockdowns or mass vaccinations. The effectiveness of containing the outbreak reveals the resilience of the early infrastructure.

Moreover, this study connects the traditional 4Cs (cognition, communication, collaboration, and control) and the two additional Cs (coproduction and confidence) into a comprehensive theoretical framework. Specifically, Cognition, Control, Communication [5], Collaboration [6], Confidence, and Coproduction were all important concepts in public health emergency management studies. However, the existing studies typically focus on some of these concepts rather than attempting to establishing the connection between these six concepts. Based on these previous theories, we developed a theoretical framework to predict and exam how the government’s action interacts with citizens’ risk preparedness and response behaviors.

8. Conclusion

On the basis of the qualitative descriptive study, the effectiveness of Taiwan’s initial COVID-19 response should be attributed to its cognition that triggered the actions on quality and quantity of communication (transparent information, misinformation correction, daily briefing, and numerous channels), collaboration (mask production, interdepartmental and intersectoral efforts), and institutional control (mask rationing system, strict quarantine, retrospective investigation, and entry suspension). Even though negative and positive incentives are associated with the Taiwan government’s control mechanism, without strict lockdown/social distancing rules, government actions alone are insufficient to contain the spread of COVID-19. Therefore, the Taiwan experience has shown that its citizens’ coproduction on transmission prevention, such as voluntary use of non-pharmaceutical interventions and willingness to comply, and non-institutional control, such as community surveillance, increase the peer pressure for community members to take non-pharmaceutical interventions, and are equally essential. Moreover, while the convenience sample of the online survey creates certain inferential limitations, the evidence collected reveals that the proactive risk-recognized capacity (cognition) and communication and collaboration mechanisms taken by the Taiwan government can indirectly increase citizen production and compliance through the effect of public confidence in government’s COVID-19 response competencies and public cognition among the Taiwanese online users.

As with every study, this research also poses some limitations that can be improved by future research. First, government cognition can be better measured by interviewing core decision makers. Future studies can conduct a series of focus group interviews or semi-structured interviews to obtain direct information from decision makers in the Taiwanese government.

Second, the nonrandom social media sample is not representative of the entire population. Although we have applied post-stratification sampling, the bias of representation cannot be completely eliminated. Specifically, the survey excluded the population that did not use social media; individuals above 65 were underrepresented in the sample. Moreover, participants who opted into the survey might differ from social media users who decided not to opt-in. However, according to recently published studies, a significant number of individuals, especially people under 65 years old, obtain COVID-19 information through social media and also express their opinions on these social media platforms [92-97]. But it is worthwhile to quickly capture public opinions of COVID-19 responses in Taiwan by recruiting participants from social media during the early stage of the pandemic. Future studies can conduct surveys that use random sampling in order to better capture the public’s reaction to COVID-19 and eliminate the possible differences between volunteer respondents and non-respondents. Moreover, through a survey with random-sampling, we can better understand whether non-social-media users are more likely to take preparedness actions or not.
measures. To further understand the interaction between the six Cs, future research can conduct experiments to test how a government’s pandemic response strategies, such as communication mechanisms, increase the willingness of citizens to coproduce. A comparative study that uses the response strategies, such as communication mechanisms, increase the research can conduct experiments to test how a government

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