Ten golden lessons from Republic of China (Taiwan), the best country to save lives during 305 days battle against Covid-19

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Abstract

1.82 million lives were officially lost by Covid-19 until last 31st December 2020 (WORLDOMETERS, 2020), a year with an intense global battle against the pandemic, with many countries eagle to learn from benchmark nations able to save lives. A new methodology developed by Silva (2020b), with fifteen phases, showed that among 108 well-evaluated countries, the top six benchmark countries against Covid-19 are from Asia with emphasis on Vietnam, Taiwan, and Thailand. To complement Silva's (2020b) study, this article aims to investigate the performance and the best management practices adopted in Taiwan to save lives, during the first ten months facing the pandemic. The research is descriptive, uses an online questionnaire with bibliographic and documentary approaches. The Fatality Total Index (FTI) developed by Silva (2020b p. 563) was used to compare Taiwan's performance against 43 semifinalist countries. Some results are: 1) Taiwan`s FTI305 is the lowest because of National Government leaders ability to improve the country legal, health care, and industrial systems, as well as integrate and support main actors of the nation to prevent, prepare and control the Covid-19; 2) for 109 respondents living in Taiwan, the ten main policy measures adopted by the National Government that saved lives against the virus are: international travel control, effective public-private collaboration, public information campaigns, integration with mass media, increase the medical and personal equipment capacity, combat fake news, public event cancellations, improve intensive care unit structure, support the expansion of the testing system, and schools closures. At the final, ten golden lessons are provided, from Taiwan Models and 250 policies, measures, programs, projects, strategies, innovative products or services identified, with the majority led by the Public Sector, Corporations, followed by Others, Start-Up and Universities.

Keywords: Best management practices; Covid-19; FTI; Innovation; Lives; Policy; Technologies

1. Introduction

Last 31st December 2020 completed one year of the intense global battle against a virus called by the World Health Organization (WHO, 2020) as Coronavirus disease, a Severe Acute Respiratory Syndrome Coronavirus2 (SARS-CoV-2), known as Covid-19.

Taking into consideration the number of total cases reported, 90 days since the first case, on March 31, 2020, USA, Italy, China, Spain, Germany, France, Iran, UK, Switzerland, and the Netherlands were the 10 most critical nations (SILVA, 2020a). In April/20, Silva (2020a): concluded that b1) Brazil could be among the most-affected country before ending May/20; b2) although no nation is prepared to face epidemics and pandemics (NTI, JHU, and EIU, 2019), among the sixteen countries, investigated, Thailand, Finland, Australia, South Korea, Denmark, and Sweden are cases that Brazil could study so as not to repeat the scenarios of China, USA, Italy, and Spain; b3) the research focused only the number of new cases per day, so it was recommended a study involving **the fatal cases.**

Considering the number of fatal cases, the world surpassed one million reported deaths on 27th September 2020, with the USA, Brazil, India, Mexico, UK, Italy, Peru, France, Spain, and Iran considered the most critical countries. In that time, Silva (2020b) developed a holistic methodology to identify 20 benchmark countries that are saving lives against Covid-19. As a result, the fifteen phases of the methodology, far from perfect, show that among 108 well-evaluated countries, the top six benchmark nations are from Asia (Vietnam, Taiwan, Thailand, China, Malaysia, and Singapore), which suffered from fatal cases from SARS-CoV in 2002/2003, followed by South Korea, New Zealand, Australia, Japan, Hong Kong, Cyprus, Greece, Latvia, Iceland, United Arab Emirates, Czech, Lithuania, Norway, and Estonia. That research did not focus on the policies, measures, programs, projects, innovations, and cultural aspects that were adopted by each country over time, **reason by which further research was recommended to identify, and disseminate them** (SILVA 2020b p. 568).

To complement Silva's (2020a) study, last November/20, another research (GOMES DA SILVA, 2020) was published focused on Thailand's performance and the best management practices adopted to save lives against Covid-19, during the first 180 days facing the pandemic. Besides, this study is part of a research package that is investigating the performance and good practices adopted by each country considered as a benchmark by Silva (2020b).

So, to continue the package research, this article aims to investigate the performance and the best management practices adopted in Taiwan to save lives, during the first 305 days facing the pandemic.

The specific objectives are a) to present WHO models and Taiwan Strategic Preparedness and Response Plan for Pandemic; b) to present Taiwan Models for combating the Covid-19; c) to investigate Taiwan main leaders background; d) to compare Taiwan´s performance against 43 semifinalist countries identified by Silva (2020b); e) to identify the best management practices adopted in Taiwan, taking into consideration cultural practices, main policy measures, programs, projects, strategies, and innovative solutions.

The research is relevant for WHO, Centers for Disease Control and Prevention (CDC), Presidents, Ministers, Managers, Entrepreneurs, since they will know the non-pharmaceutical practices developed by Taiwan during the first 10 months fighting the pandemic. Furthermore, it can be useful to develop strategies for preventing or controlling similar pandemic episodes in the future.

Also, for the academy, it can be useful for the teaching process and the development of new research, especially related to non-pharmaceutical interventions on Covid-19. Although several authors have published relevant information about Coronavirus (COWLING et al., 2020; CUI et al 2003; CHUANG et al, 2020; FLAXMAN et al., 2020; GOMES DA SILVA 2020; HA et al., 2020; LA et al., 2020; KAN et

al. 2005; JIAN et al 2017; JIAN et al 2020; SILVA, 2020a; SILVA, 2020b; PANG 2003; ZAMBRANO-MONSERRATE, RUANO, AND SANCHEZ-ALCALDE, 2020**;** SVOBODA et al. 2004; YEH AND CHENG, 2020; YEN et al 2011; WANG, NG, AND BROOK, 2020), there is a need to compare the performance evolution of a benchmark country against other well-evaluated nations, taking into consideration the real estimated number of Covid-19 fatal cases by one million population during the first 10 months facing the pandemic, as well as to provide a more complete study on the models, cultural aspects, policy measures, programs, projects, strategies, and innovative solutions adopted over time.

2. Best Management Practices (BMP)

Management practice is considered by some authors as an entity of analytical instruments used to support the managers at work during the execution of the selected management concept (DESSLER, 2004; SUTHERLAND and CANWELL, 2004; VAN ASSEN et al., 2009). Others consider the term as tools that are defined as a set of concepts, processes, and exercises (RIGBY, 2001).

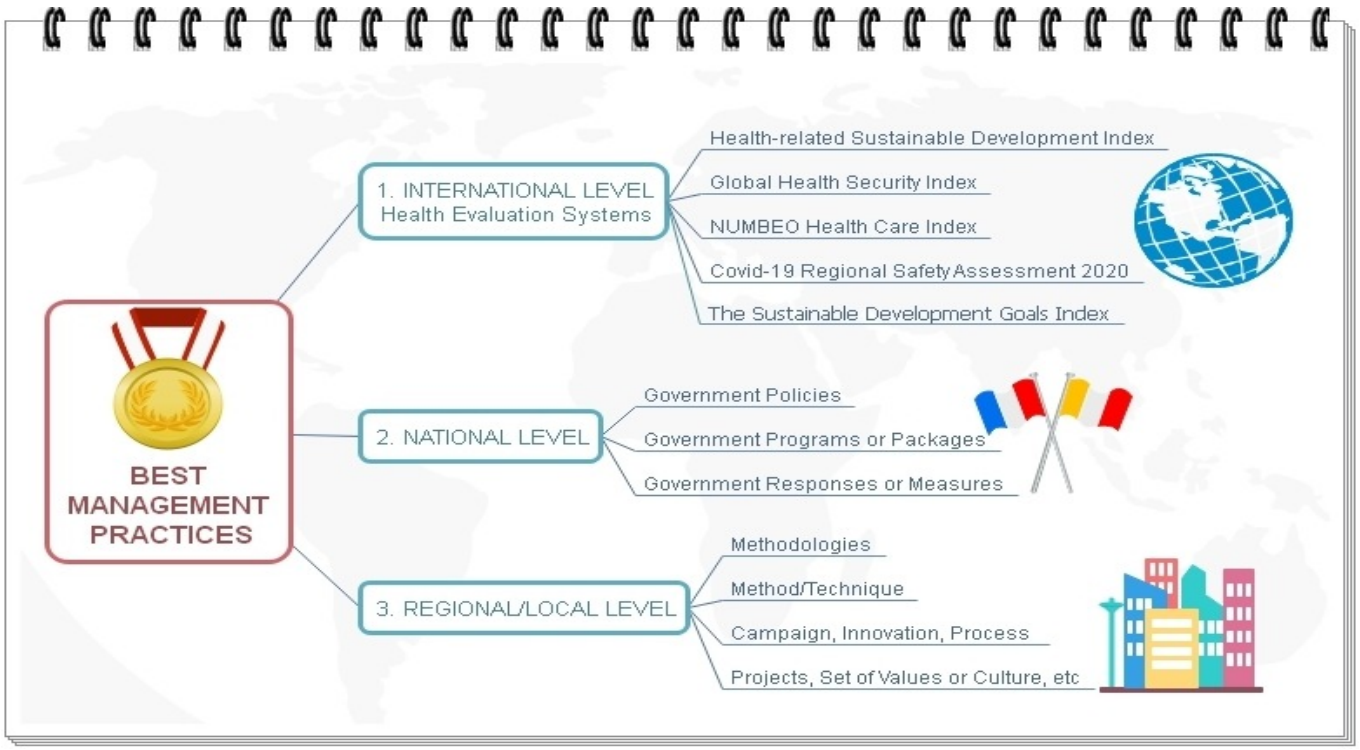

Figure 1: BMP instruments classification related to Health and/or Covid-19
Source: Gomes da Silva (2020 p. 124)

For this research, Best Management Practices (BMP) is defined as those acceptable and effective management instruments able to achieve the goal(s) creatively and sustainably (GOMES DA SILVA 2020 p. 124). The instrument could be classified into 3 levels: International, National, and Regional/Local, as shown in Figure 1.

According to Gomes da Silva (2020 p. 124), at the International level, there are international evaluation systems such as the Health-related Sustainable Development Index (GBD 2017 SDG

COLLABORATORS, 2018), NUMBEO Health Care Index (NUMBEO 2020), Covid-19 Regional Safety Assessment (Deep Knowledge Group (2020), all of them related to Health or Covid-19. At the National level, there are Government or Legislative policies, measures, programs, projects, package, act, law amendment, regulations, and at the Regional/Local level, there is methodology, method/technique, innovation, process, campaign, project, a set of values, or culture developed by Companies, Local Governments, Universities, Startups, and NGOs.

3. Infectious diseases in the last decades before Covid-19

Despite global medical and scientific advances, infectious diseases are still a major cause of mortality and morbidity, disability, and socioeconomic upheaval worldwide (PRILYTSKY et al, 2011).

Infectious diseases are classified in several ways, one way is related to the spatial, temporal distribution of the novel infection disease, as well as the number of people affected, starting from the low level, called endemic until a pandemic.

In simple terms, an endemic is something that belongs to a particular people or country. An outbreak is a greater-than-anticipated increase in the number of endemic cases, if it's not quickly controlled, an outbreak can become an epidemic. An epidemic is a disease that affects a large number of people within a community, population, or region. A pandemic is an epidemic that's spread over multiple countries or continents (INTERMOUNTAIN HEALTHCARE, 2020).

Between 1980 and 2013, 12102 outbreaks of 215 (74% non-vector and 25% vector transmitted) human infectious diseases affected more than 44 million in 219 nations. Concerning the taxonomy of 215 infection diseases, bacteria and virus are more common than parasites, fungi, and protozoans, 80 (37%) are from bacteria which generated 5848 (48%) outbreaks, while 70 (33%) are from the virus which generated 4901 (40%) outbreaks around the world. Finally, at least 150 pathogens that affect humans have been identified as emerging, re-emerging, or evolving since the 1980s (SMITT et al, 2014; BEDFORD, et al 2019).

Data collected from Global Infectious Disease and Epidemiology Online Network (GIDEON) database showed that between 1980 and 2010, the number of outbreaks is growing by a decade, from 991 (1980-1990) to 3420 (2010-2020), with zoonoses related representing a total of 3462 outbreaks, while human-related equal to 2873 outbreaks. In terms of Zoonoses, among the 13 diseases, Salmonellosis (855), Escherichia coli diarrhea (460), Hepatitis A (391), Shigellosis (314), Tuberculosis (271), and Dengue fever (245) were the most representative. When Human-specific cases are analyzed, among the 14 diseases, Gastroenteritis (viral = 536), Measles (467), Cholera (432), Enterovirus infection (350), Legionellosis (249), Meningitis (bacterial=246) were the most representative (SMITT et al 2014).

During last decades, the human being faced several challenges with pandemic and epidemic related to Chikungunya, Crimean-Congo hemorrhagic fever, Ebora virus disease, Lassa fever, MERS-CoV disease, Marburg hemorrhagic fever, Nipah virus infection, Rift Valley fever, SARS-CoV disease, Severe fever with thrombocytopenia syndrome, and Zika virus. All of them were considered as a priority to receive Research and Development by the Workstream1 group that participated at the World Health Assembly realized in May 2016 (WHO, 2016 p.3).

For example, in April 2009, a new influenza virus (H1N1) emerged in the USA and spread quickly around the globe. After two months, on June 11th, 2009, the WHO declared it as the first flu pandemic in 40 years. According to the CDC (2019), between 151,700 and 575,400 fatal cases were estimated during the first year the virus circulated the globe. Another example is the epidemic of SARS-CoV that appeared in Nov/2002 in southern China. According to WHO (2012), from the first day of November 2002 until July 31, 2003, it probably affected 8096 people in 29 countries with a total of 774 fatal cases (9.56%), mostly located in Asia, such as China (5327 cases; 349 deaths), HK (1755 cases; 299 deaths), Taiwan (346 cases; 37 deaths), and Singapore (238 cases; 33 deaths) with an estimated total GDP loss in 2003 for the four economies amounted to about US$13bn (WHO, 2016 p.5).

Since 2003, many progress have been made by organizations such as WHO and CDC to provide guidance, standards to face the pandemics with several authors (HOLMES, 2003; PANG, 2003; WATTS, 2003; BELL, 2004; INSTITUTE OF MEDICINE, 2004; YEN et al, 2011; YEN et al, 2014) providing information about the SARS-CoV and called the attention of the decision-makers about measures necessary to prevent, control, and respond to future global outbreaks.

4. Fast preventive and control responses of Taiwan against Covid-19 pandemic

Despite the advice, guidance, and standards provided by WHO, CDC, and specialists, seventeen years later, on December 31, 2019, a new alert appeared.

From a Taiwanese 25 years old free online platform, called PTT Bulletin Board System (Figure 2), Taiwan Center for Disease Control (TCDC) leaders accompanied a heated discussion and learned that at least seven cases of pneumonia infections on unknown cause had occurred in Wuhan (China).

The hot discussion with documents shared by the participants raised several worries such as the possibility of SARS return again, the need to prepare the mask, the return of Taiwanese businessman from China to Taiwan may cause large infection, the alert of Health Ministry, the explosion of cases, the coming Spring Festival with 130,000 compatriots, the necessary funds, the collapse of house prices, Taiwan prevention measures, etc.

On the same day, using International Health Regulations Mechanism, after contact and receive feedback from WHO, Taiwanese authorities deduced that there was a strong possibility of human-to-human transmission from the Wuhan reported disease, reason by which, from December 31, 2019, the National Government and partners started preventive and control measures, some of them shown in Chart 1.

In other words, Chart 1 shows that before the Covid19 was declared a pandemic by WHO on March 11, 2020, Taiwan leaders adopted several legal, administrative, financial, and technological measures against the virus since December 11, 2019.

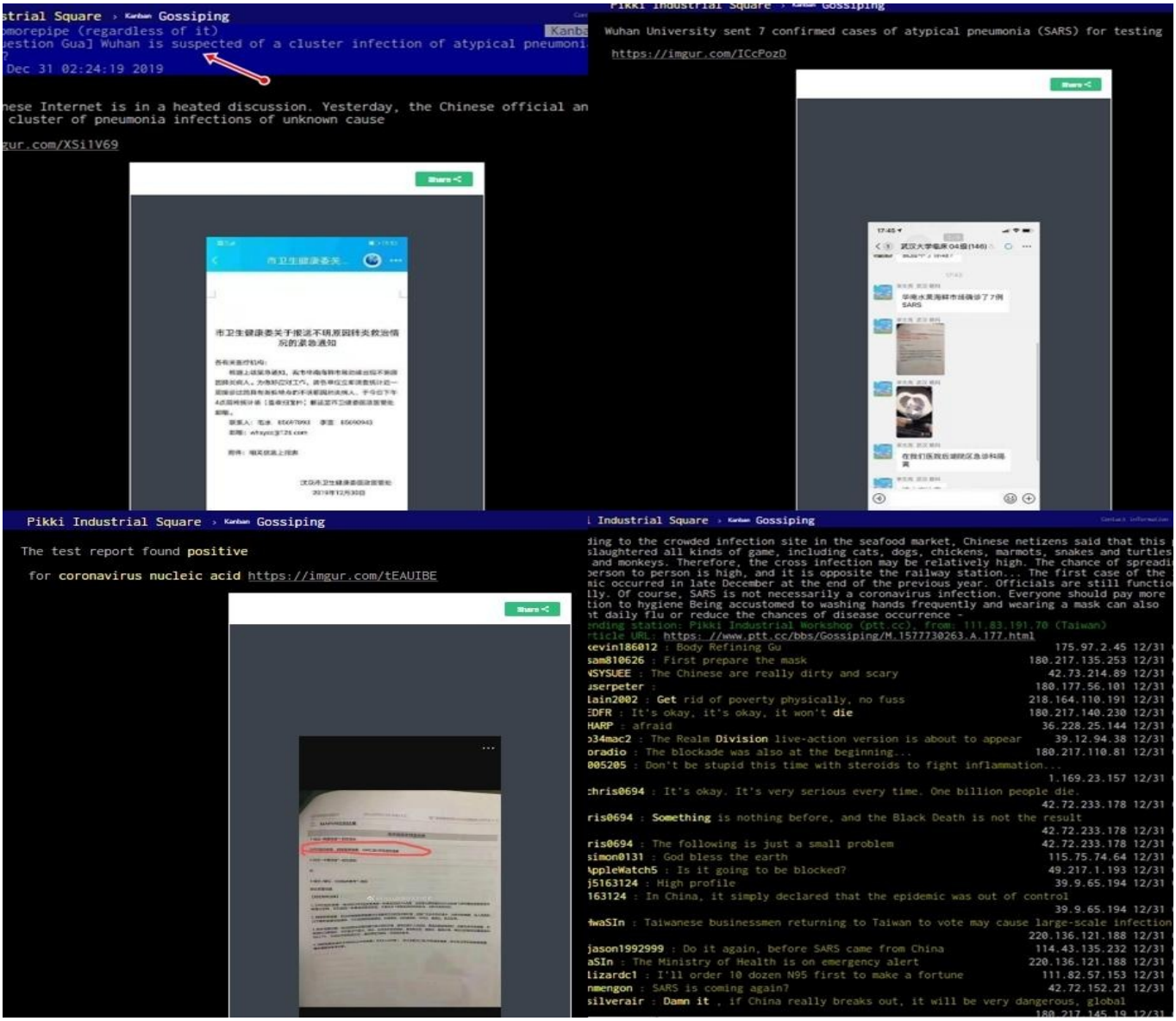

Figure 2: Shared documents and discussion about a suspected cluster infection of atypical pneumonia in Wuhan – Tuesday (02:21:19) December 31, 2019
Source: PPT (2019)

MEASURES	TYPE	WHEN
Implement onboard quarantine inspection of direct flights from Wuhan, China, and promoted related prevention measures among other travelers.	Prevention	Dec/31/19 Jan/23/20
Set up TCDC team to deal with the mystery pneumonia in Wuhan	Operational	Jan/02/20
Realize surveillance and Laboratory Diagnosis to identify people with fever, cough, or other respiratory symptoms, improving the laboratory diagnosis capacities from 12 laboratories (520 cases/day) to around 50 labs (6K/day)	Prevention	From Jan/02/20
TCDC classified the new coronavirus as Category 5, based on Communicable Disease Control Act (CDCA), to strengthen surveillance and containment of the virus. It helped urge the public and medical facilities to take notice of the disease and take necessary precautionary measures to decrease the risk of transmission.	Legal	Jan/15/20

Continuation of Chart 1

MEASURES	TYPE	WHEN
Use of legal basis of the CDCA to active the Central Epidemic Command Center (CECC), to centralize actions, decide the level, the commander, and other epidemic control actions.	Legal	Since Jan/ 20/20
Establish level 3 of the CECC to integrate resources of the administration, the academic, medical, and private sector, under the leadership of Jih-Haw Chow, Director-General of TCDC.	Operational	Jan/20/20
Confirm the first case of Covid-19 in Taiwan, a 50-year-old woman, who travel to Wuhan, identified at Taipei's International Airport and sent to the hospital.	Prevention	Jan/21/20
After the confirmation of the first case, establish level 2 of the CECC, Shih-Chung Chen, the Minister of Health and Welfare (MOHW) served as the commander to coordinate and mobilize resources from a cross-ministry perspective, including the ministries of interior, transportation, foreign affairs, economics, labor, education, environment, etc. as well as private stakeholders to fight against new coronavirus.	Operational	Jan/23/20
Ban the mask export from Jan/24 to May 31/20.	Prevention	Jan/24/20
Advise citizens abroad against non-essential travel and to those traveling to China to avoid traditional health facilities and market	Prevention	Jan/24, 25/20
Advise people with fever, cough, or shortness of breath to stay at home	Prevention	Jan/24/20
Require new coronavirus contacts to follow preventive health measures	Prevention	Jan/26/20
President Tsai spoke about the new virus potential economic impact, and government contingency measures to fight the pandemic as if fighting a war.	Prevention	Jan/30/20
Require travelers arriving in Taiwan to voluntarily inform the quarantine officer at the airport or port if they have the new covid-19 symptoms, as well as orientation about how to proceed in the case to develop with 14 days the symptoms.	Prevention	Jan/30/20
Develop rigorous isolation and quarantine measures for Taiwanese businessmen returning from Wuhan	Prevention	Feb/03/20
Banned international cruise ships from calling at ports of Taiwan from Feb/06	Prevention	Feb/06/20
Taiwan Machine Tool & Accessory Builders' Association encouraged the companies members to volunteer and help the country to produce masks. The first t"National Mask Team" troop was set up in just five days. Many companies joined on February 21 to support Taiwan's mask equipment manufacturers.	Operational	Feb/06/20
Suspend all flights to China, except to and from Beijing Capital Int. Airport, Shanghai Pudong Int. Airport, Shanghai Hongqiao Int. Airport, Xiamen Gaoqi Int. Airport and Chengdu Shuangliu International Airport.	Prevention	Feb/07/20
Require home quarantine for travelers granted entry into Taiwan that are transiting through China, Hong Kong, and Macau	Prevention	Feb/07/20
Require travelers arriving from areas outside Macau, HK, China to complete a health declaration form, stating their travel and contact history over the previous 14 days. Those who provide inaccurate information or refuse to provide information will be fined up to NT$ 150,000.	Legal	Feb/11/20

Continuation of Chart 1

MEASURES	TYPE	WHEN
WHO announced as a new virus of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) with a popular disease name as Covid-19	-	Feb/11/20
WHO launched a draft of Covid-19 Strategic Preparedness and Response Plan with operational planning guidelines to support countries preparedness and response	-	Feb/12/20
Start the use of a Health Declaration and Home Quarantine E-System (Entry Quarantine System) to facilitate the life of travelers with mobile phone	Operational	From Feb/16/20
The Minister of Economic Affairs created and coordinated the National Mask Team to increase production, and consolidate domestic enterprises including raw material suppliers and manufacturers to assist in producing supplies to prevent disease. The government drew up a budget of NT$200 million (US$6.6 million) to build 60 face mask production lines, they were completed in 25 days, which enabled daily mask production to be increased from 1.88 million to 10 million by Mid-March and 19 million until ending of April 2020.	Financial Aid and Operational	From Feb/21//20
Use smart technologies to track people under home quarantine and inform them those who violate home quarantine requirements will be fined up to NT$150,000	Legal	Feb/24/20
Advises to travelers arriving in Taiwan from Thai, Italy, Iran, Singapore, and Japan, to conduct self-health management of 14 days.	Prevention	Feb/24/20
President Tsai promulgated the Special Act on COVID-19 Prevention, Relief, and Restoration by presidential decree No. 10900021291. It has 19 articles for effectively contain Covid-19, safeguard public health, and cope with associated impacts on the domestic economy and society. The MOHW said a special budget of NT$ 60bi (US$1.97 bi) has been set aside for the act and is pending review by the Legislature.	Legal and Financial Aid	Feb/24/20
Due global epidemic situation getting worse, level 1 of the CECC was established, the Premier appointed Shih-Chung Chen, the Minister of MOHW, as the commander to coordinate and mobilize resources across ministries and from the private sector to fight against Covid-19.	Operational	Feb/27/20
The MOHW published the Covid-19 plan with preparatory and contingency phases in response to the global pandemic	Operational	Feb/28/20
Taipei Mass Rapid Transit refuse entry into metro stations for people with high temperatures (over 38 degrees)	Prevention	Feb/29/20
Taiwan High-Speed Rail canceled non-reserved seats for April 1-6, which includes the Tomb-sweeping Festival holiday, to reduce the number of passengers per train.	Prevention	Mar/04/20
Start to test the Name-Based Mask Distribution System 1.0, the CECC announced that the first round of online orders beginning on March 12 constitute a trial run, with an estimated 7 million face masks (equal to the weekly allotment of 2.33 million people) being made available	Operational	Mar/10/20
The CECC is paying individuals subject to quarantine a stipend of US$33.33 for each day of their 14-day quarantines. Those on paid leave or who violate quarantine regulations are not eligible to receive compensation.	Financial Aid	Mar/11/20
WHO announced Covid-19 as a pandemic	-	Mar/11/20

Chart 1: First measures taken by Taiwan Government and partners against the Covid-19 until 03/11/20

Sources: MOFA (2020), Policy (2020), TCDC (2020) and TCDC (2020b)

5. Fast transmission of Covid-19

According to Silva (2020a), at 18:32 (GMT) on March 29, 2020, the Worldometers pointed out 710,950 confirmed cases with 33,553 deaths. In that time, while Taiwan reported 298 total cases with 3 fatalities, the ten most critical countries were: 1) USA; 2) Italy; 3) China; 4) Spain; 5) Germany; 6) France; 7) Iran; 8) the UK; 9) Switzerland and 10) the Netherlands.

The basic reproductive rate (R_0) of the Covid-19 is considered similar or higher than the SARS-Cov and pandemic influenza (PETERSEN et al, 2020). Due to fast transmission (Figure 3), in one year, since the "first" official case, at 23:59 (GMT) on December 31, 2020, the world officially lost 1.824 million lives, with 1st) USA (354,215), 2nd) Brazil (194,976), 3rd) India (149,018), 4th) Mexico (124,897), 5th) Italy (74,159), 6th) UK (73,512), 7th) France (64,632), 8th) Russia (57,019), 9th) Iran (55,223), and 10th) Spain (50,837) among the ten top critical countries, leading the total number of fatal cases, while Taiwan reported only 7 deaths, located in the 181 position among 220 countries (WORLDOMETERS, 2020).

All | Europe | North America | Asia | South America | Africa | Oceania

#	Country, Other	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	Active Cases	Serious, Critical	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop	Population
	World	83,793,959	+738,738	1,824,915	+13,552	59,320,807	22,648,237	106,365	10,750	234.1			
1	USA	20,445,654	+228,413	354,215	+3,438	12,125,806	7,965,633	29,214	61,588	1,067	253,542,640	763,737	331,976,250
2	Brazil	7,675,973	+56,003	194,976	+1,036	6,747,065	733,932	8,318	35,984	914	28,600,000	134,073	213,316,626
3	India	10,286,329	+19,046	149,018	+244	9,881,786	255,525	8,944	7,417	107	172,049,274	124,063	1,386,789,921
4	Mexico	1,413,935	+12,406	124,897	+1,052	1,066,771	222,267	3,913	10,909	964	3,596,935	27,752	129,609,888
5	Italy	2,107,165	+23,476	74,159	+555	1,463,111	569,895	2,555	34,877	1,227	26,598,607	440,250	60,417,000
6	UK	2,488,780	+55,892	73,512	+964	N/A	N/A	1,847	36,565	1,080	54,892,984	806,479	68,064,964
7	France	2,620,425	+19,927	64,632	+251	194,221	2,361,572	2,634	40,101	989	35,025,374	535,998	65,346,149
8	Russia	3,159,297	+27,747	57,019	+593	2,554,340	547,938	2,300	21,644	391	90,648,889	621,028	145,965,971
9	Iran	1,225,143	+6,391	55,223	+128	988,833	181,087	5,039	14,494	653	7,566,946	89,519	84,529,401
10	Spain	1,936,718	+15,603	50,837	+148	N/A	N/A	2,018	41,415	1,087	27,016,086	577,712	46,763,897

Fig. 3: The ten most critical countries in terms of total deaths cases of Covid-19 on December 31, 2020
Source: Worldometers (2020)

6. WHO and Taiwan Strategic Preparedness and Response Plan for Pandemic

For WHO (2018 p.2), a pandemic is a worldwide spread of a new disease, so the planning and preparation are critical to helping to mitigate the risk and impact of a pandemic, and to manage the response and recovery.

According to The Global Health Security Index 2019 report, no country is fully prepared for epidemics or pandemics, and every nation has important gaps to address. One recommendation of the report is that national health authorities should develop epidemic and pandemic specific preparedness and response strategies as part of routine disaster and broader national security planning efforts (NTI, JHU, and EIU, 2019 p. 15)

Lessons learned from SARs CoV 2002/2003 and 2009 influenza (H1N1) contributed to the WHO development of models to help countries to prepare and respond to epidemic and/or pandemic. For example, they published a Checklist for influenza pandemic preparedness planning (WHO, 2005), a Pandemic Influenza Risk Management (WHO, 2017), a Checklist for pandemic influenza risk and impact management 2018 (WHO, 2018), which replaced the WHO (2005) version and can be used with WHO (2017). Also, since 12 February 2020, they provided a draft with guidance for the Covid-19 Strategic Preparedness and Response Plan (WHO, 2020b).

According to Chung (2017), Taiwan was devastated by the SARS2003 outbreak, many front line healthcare workers became infected while taking care of patients. Also, several hospitals and schools were closed with more than 151,000 people quarantined at home. At that time, Taiwan did not receive timely information on the SARS virus and depend on the expertise experiences shared about the USA CDC guidelines on how to control the outbreak.

Since that time, Taiwan public health and experts started to participate in WHO SARS conferences e developed several strategic measures to improve the preparedness and response processes such as:

1) Established the National Health Command Center (NHCC) in 2004 (WANG, 2020) to address public health emergency and provide disaster information for decision-makers (Figure 4);

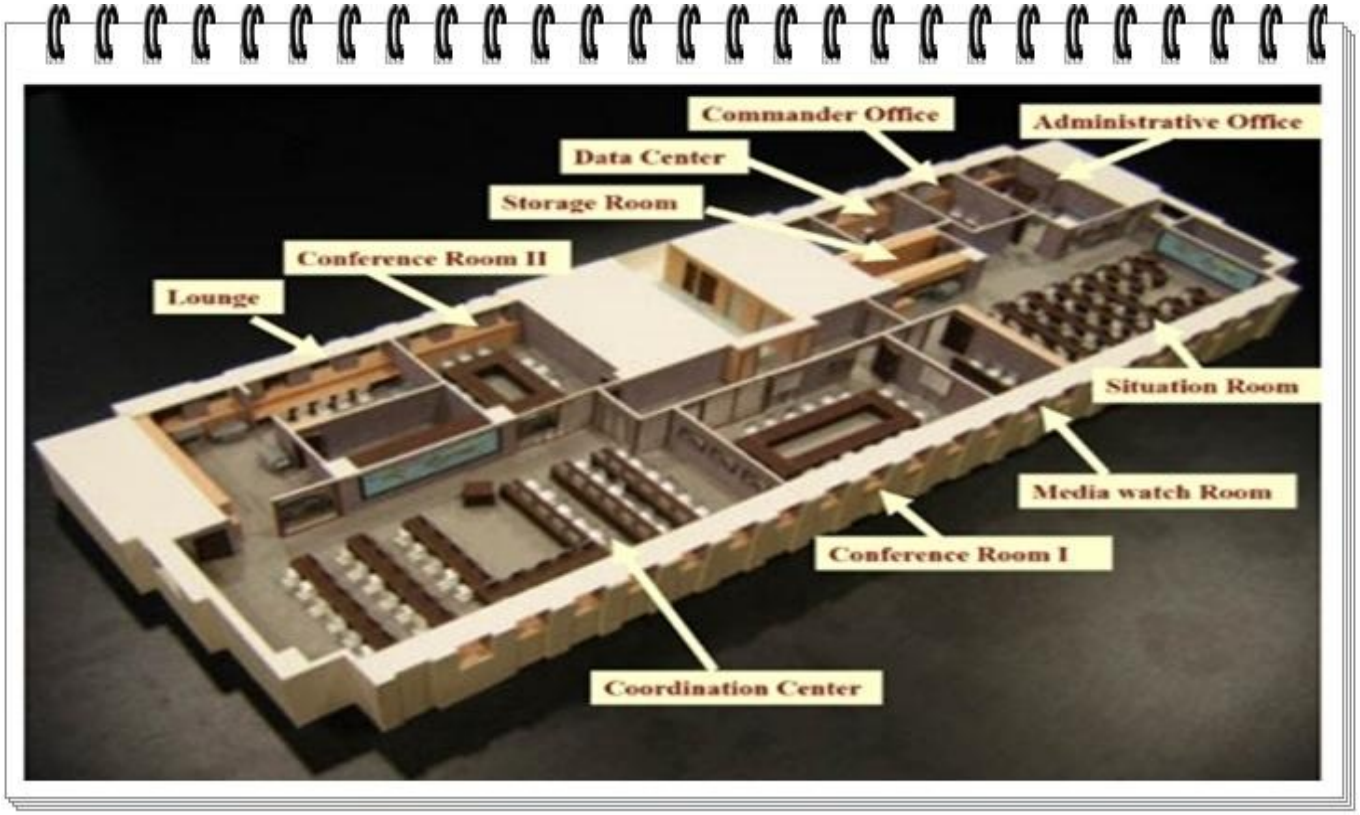

Figure 4: Layout of NHCC
Source: TCDC (2018)

2) Enacted and amended act/laws/regulations to empower government, experts and related managers during epidemic/pandemic; 3) Developed and approved the National Influenza Pandemic Preparedness

and Response Plan in 2005; 4) Developed the Influenza Pandemic Strategic Plan, which first, second and third edition (TCDC, 2012) were approved respectively by Executive Yuan on January 2, 2007, February 20, 2008, and May 18, 2010; 5) Created a pre-pandemic stockpile of A/H5N1 vaccine for human use in 2007; 6) Establish a three-tier preparedness plan that includes efforts by the National and Local Governments, and Healthcare Institutions to maintain a 30-day stockpile of personal protective equipment; 7) in 2020, developed the Preparedness and Contingency Planning in Response to Covid-19 Epidemic.

For example, regarding the establishment of the NHCC in 2004, it is a unified central command system that includes the Central Epidemic Command Center (CECC), the Biological Pathogen Disaster Command Center (BPDCC), the Counter-Bioterrorism Command Center (CBCC) and the Central Medical Emergency Operations Center (CMEOC). It can accommodate 100 persons (Figure 4) at the same time working there (WANG, 2020; TCDC, 2018).

Concerning the act/laws/regulations, in liberal democracies, the law is central to pandemic response and Taiwan has developed a framework for detecting and reporting epidemics following International Health Regulations (LEE, 2020b). According to Taiwan President Tsai, any contingencies against the pandemic can be addressed by existing legislation. Besides, the legal framework is considered part of Taiwan's success in fighting the Covid19 pandemic (CHANG, 2020).

Several acts/laws/regulations have been used (partially or totally) over time to better prepare and respond to epidemic or pandemic in Taiwan, with three enacted during the Covid-19 pandemic. Chart 2 shows nine cases that are playing important role during this pandemic, most (5) was enacted before SARs CoV 2002/2003 and 4 enacted after that. Also it is important to note that most amendments in the norms happened after SARs CoV 2002/2003.

Acts/Law/Reg.	Dates & amendments	Main parts and some applications
1) Regulations Governing Quarantine at Ports	1930-06-28 13 amendments (6 were made since SARs 2003) 2017-10-17 (last)	42 articles to regulate governance quarantine at ports: general principles, quarantine at conveyances, quarantine of personal, ship sanitation, sanitation of ports, quarantine of domestic ports, supplementary provisions. For example, this regulation was used to quarantine and monitor travelers infected or suspected to carry a communicable virus during the pandemic. Site: http://bit.ly/38IOz9t
2) Communication Disease Control Act (CDCA)	1944-12-05 15 amendments (11 were made since SARs 2003) 2019-06-19 (last)	77 articles to arrest the occurrence, infection, and spread of communicable diseases: general principles, disease control systems, prevention of communicable diseases, disease control measures, quarantine measures, penal provisions, supplementary provisions. Site: http://bit.ly/3aDEBbW

Continuation of Chart 2

Acts/Law/Reg.	Dates & amendments	Main parts and some applications
3) Pharmaceutical Affairs Act	1970-08-17 18 amendments (13 were made since SARs 2003) 2018-01-31 (last)	More than 100 articles for the administration of pharmaceutical affairs: general provisions, management of pharmaceutical firms, management of pharmacies and dispensation of drugs, registration and market approval of drugs, patent linkage of drugs, sales and manufacture of medicament, management of controlled drugs and strongly poisonous drugs, management of advertisements on medical, investigation and interdiction, penal provisions, supplementary provisions. For example, by using Article 48-2 the Taiwan Food and Drug Administration approved, subject to certain conditions, the importation with permission of anti-viral drug Remdesivir for the of patients with severe Covid19 infection. Site: http://bit.ly/3rs77Dm
4) Foreign Trade Act	1993-02-05 10 amendments (8 were made since SARs 2003) 2019-12-25 (last)	More than 37 articles to expand foreign trade and maintaining a sound trade order to enhance the economic benefits of this country in the spirit of liberalization and internationalization and on the principles of fairness and reciprocity. For example, Article 11 was used on 31 January 2020 to ban all export of medical masks. Site: http://bit.ly/2MamRKX
5) Personal Data Protection Act	1995-08-11 2 amendments, all made since SARS 2003 2015-12-30 (last)	56 articles to regulate the collection, processing, and use of personal data to prevent harm on personality rights, and to facilitate the proper use of personal data: general provisions, data collection, processing and use by a government agency, data collection, processing and use by a non-government agency, damage and class action, penalties, supplementary provisions. For example, this law is used when Apps or other technologies are used during Border Control or Quarantine measures. Site: http://bit.ly/3aT8ncO

Continuation of Chart 2

6) Enforcement Regulations Governing the CECC	2004-12-20 1 amendment 2008-01-28 (last)	15 articles to set regulations about the governance of the CEEC. It allows the Ministry MOHW, with the Executive Yuan approval, to establish the CECC to formulate policies, integrate resources, and co-ordinate responses across different government ministries and agencies. Site: http://bit.ly/3pqc11U
7) Medical Devices Act	2020-01-15 No amendments	85 articles to ensure the safety, effectiveness, and quality of medical devices to be used by citizens, to promote the health of citizens, and to improve management of medical devices. This new act separates the regulation of medical devices from pharmaceutical products for the first time. It standardizes the registration of devices, tightens the classification system, and permits rapid approvals for innovative products. Site: http://bit.ly/34VfSwb
8) Special Act for Prevention, Relief and Revitalization Measures for Severe Pneumonia with Novel Pathogens (SAPRRM)	2020-02-25 1 amendment 2020-04-21 (last)	19 articles to effectively prevent and control severe pneumonia with novel pathogens (Covid-19), protect the health of the people and mitigate the impact of the disease on the domestic economy and society. In 2020, a total of NT$ 210 billion was approved as Covid-19 Special Budget to be used by Taiwan Agencies support several Programs, Project and Actions developed under this law. Site: http://bit.ly/3rnvGS1
9) Regulations Governing the Operational Procedures and Compensation for Expropriation of Manufacturing Equipment and Raw Material of Disease Prevention Supplies for Severe Pneumonia with Novel Pathogens	2020-03-10 No amendment	17 articles developed to help government agencies to deal to the shortage of medical supplies such as face masks. These Regulations respect the provisions of Paragraph 2, Article 5 of the SAPRRM described above. Site: http://bit.ly/3hsBjK1

Chart 2: Main Act, Law or Regulation used in Taiwan during epidemic/pandemic

Sources: Taiwan Ministry of Justice

Concerning the Taiwan Preparedness and Contingency Planning in Response to Covid-19 Epidemic (TCDC, 2020b), it has only 12 pages with a legal basis, aims, activation protocol for preparedness and contingency planning, strategies for contingency planning, and assignment of responsibilities.

When this Planning is compared with four WHO models (WHO 2005; WHO 2017; WHO 2018; WHO 2020) it is possible to identify (Chart 3) that Taiwan differently emphasizes the following components: Activation Protocol for Preparedness and Contingency Planning, Implementation of Border Quarantine, Inventory checking of medical supplies and equipment, Tightening border quarantine, Perfecting the Health System, Enhance testing and diagnostic capabilities, Community based epidemic prevention, and Developing International collaboration.

Taiwan PCPRCovid-19 Epidemic`s main components (TCDC, 2020b)	Checklist WHO (2005)	PI Risk Management WHO(2017)	Checklist WHO (2018)	Covid19 SPRP WHO(2020)
12 pages	39 pages	62 pages	44 pages	33 pages
II. Legal Basis	Yes	Yes	Yes	Yes
III. Aim	Yes	Yes	Yes	Yes
IV. Activation Protocol for Preparedness and Contingency Planning	**No**	**No**	**No**	Yes
V. Preparedness Planning in Taiwan: Strategies				
A. Continuous epidemiological surveillance and R.M.	Yes	Yes	Yes	Yes
B. Implementation of border quarantine	**No**	**No**	**No**	Yes
C. Inventory checking of medical supplies and equipment	**No**	**No**	**No**	Yes
D. Strengthening risk communication	Yes	Yes	Yes	Yes
E. Enhance testing and diagnostic capabilities	No	Yes	Yes	Yes
VI. Contingency Planning in Taiwan: Strategies				
A. Continuous epidemiological surveillance and R.M.	Yes	Yes	Yes	Yes
B. Tightening border quarantine	**No**	**No**	**No**	Yes
C. Perfecting the Health System	**No**	**No**	**No**	**No**
D. Allocation and management of medical supplies and equipment	No	Yes	Yes	Yes
E. Enhance testing and diagnostic capabilities	**No**	**No**	**No**	**No**
F. Constant risk communication	Yes	Yes	Yes	Yes
G. Community based epidemic prevention	**No**	**No**	**No**	**No**
H. Epidemiological investigation	Yes	Yes	Yes	Yes
I. Developing International collaboration	**No**	**No**	**No**	Yes
V. Assignment of Responsibilities	Yes	Yes	Yes	Yes

Chart 3: Taiwan PCPRCovid-19 Epidemic`s main components versus WHO models

Sources: WHO (2005, 2017, 2018 and 2020)

7. Fatal Cases Indicators and Fatality Total Index (FTI)

Not only good data is relevant (BALSARI, BUCKEE, AND KHANNA, 2020), but also the indicators. Several organizations are developing indicators and collecting data related to fatal cases of Covid-19, such as a) case fatality rate (CFR); b) deaths per capita; c) tests per confirmed deaths; d) a total number of death cases by age; e) a total number of fatal cases by a total number of cases; f) the total number of fatal cases by 100 confirmed cases; g) the total number of fatal cases by a total number of recovered cases; h) the total number of fatal cases by 100,000 population.

However, one limitation of these indicators is that they don't take into consideration the percentage of symptomatic cases reported (PSCR), and the % of symptomatic cases that have been missed by the surveillance system over time, reason by which Silva (2020b p. 563) proposed a new Indicator called Fatality Total Index (FTI), as shown in formula (1):

$$(1)\ FTI = [\ (TFC / XMPSCRnd) / 1MP / ND)\ ]$$

TFC = Total Fatal Cases

XMPSCRnd = The Average of the Median of PSCR related to the ND

1MP = one million of the population

ND = Nth day facing the Covid-19 since the first official case reported by National Government

The TFC is collected from the worldometer site <https://bit.ly/3dpMErI> and the population of each country was collected from the United Nations Population Fund (2019), which shows the population of each country and other indicators for 2020.

Table 1: Example of Italy Median Percentage of Symptomatic Cases Reported (PSCR)

DATE	COUNTRY	MEDIAN	LOWER_95_CRI	UPPER_95_CRI
2020-02-13	Italy	0,07619631716921	0,063166815916984	0,089605585590268
2020-02-14	Italy	0,073230329695997	0,060871204520831	0,085925137289357
2020-02-15	Italy	0,070426159884898	0,058704300698846	0,082477598273003
2020-02-16	Italy	0,067791120707594	0,056690925216948	0,079220002324427
2020-02-17	Italy	0,065331127805584	0,054809794089387	0,076155309480703
2020-02-18	Italy	0,063050778573396	0,053083941954428	0,073311384509538
2020-02-19	Italy	0,060953458924782	0,051497931974269	0,070683925618618
2020-02-20	Italy	0,059041471795511	0,050068430758611	0,068251532028991
2020-02-21	Italy	0,057316180922205	0,04877654590104	0,066061441790509
2020-02-22	Italy	0,055778163240681	0,047624316273539	0,064117091801045
2020-02-23	Italy	0,054427363337249	0,046618204644091	0,062311604226192
2020-02-24	Italy	0,053263243713593	0,045755917730674	0,060810641060784
2020-02-25	Italy	0,052284925131905	0,045045547058412	0,059549070440637
2020-02-26	Italy	0,051491311932404	0,044480390532982	0,058522931161805
2020-02-27	Italy	0,050881197906485	0,044050973322455	0,057717438663351
2020-02-28	Italy	0,050453349023576	0,043769618789369	0,057131649041495
2020-02-29	Italy	0,050206560022131	0,043624358455376	0,056775873280491

Source: Golding, N. et al. (2020)

The XMPSCRnd was calculated from the data (Table 1) provided by Golding, N. et al. (2020). Since each country was evaluated for 10 months (ND=305), it was used the median of PSCR related to the nth day identified for each country, taking into consideration the delay of 13 days, by using the under-reporting estimates available in the.csv file on the CMMI site <https://bit.ly/30N6qtj>.

8. Methodology

The research is applied, descriptive, with a quantitative and qualitative approach, based on bibliographic and documentary research, involving the study of official sites, articles, technical reports, guidelines, standards, manuals, collected from the internet.

To reach the specific objectives, the collection and data analysis were made in five phases:

Phase 1) to present WHO models and Taiwan Strategic Preparedness and Response Plan for Pandemic

Since the WHO is the world guardian of Health, it was searched and shortly describe four examples of models developed by the organization over time to help countries to prevent and better respond to epidemic/pandemic. Besides, Taiwan's Strategic Preparedness and Response Plan for Pandemic was introduced and compared with WHO models.

Phase 2) to present Taiwan Models for combating the Covid-19

Several Authors (HAN ET AL, 2020; HONG, 2020; SILVA, 2020b; SUMMERS ET AL, 2020; YEH, M.-J. AND CHENG, Y., 2020; WANG, C.J., NG, C.Y. AND BROOK, R.H., 2020) consider Taiwan as a successful country during Covid-19 pandemic, but few explored in detail about the Models adopted by National Government and partners, as well as the country performance over time.

The models were investigated by searching scientific articles, technical reports, and also official sites from Taiwan. As a result, the best sources are official sites created in Taiwan to share their experience with the world, one is from Taiwan External Trade Development Council (TAITRA, 2020) and the other is from the Taiwan Ministry of Health and Welfare (MOHW, 2020b).

From the information of those two sites, it was possible to systematize and explain the models, which part of their components are also described by Hong (2020), Summers et al (2020), Yeh, M.-J. and Cheng, Y. (2020), Wang, C.J., Ng, C.Y. and Brook, R.H. (2020).

Phase 3) to investigate Taiwan main leaders background

The investigation focus on the main background of Taiwan Leaders that occupied the Presidency, Vice Presidency, and the MOHW in the last 20 years. The Taiwan Government sites are the main source and the search is related to Education (Graduation, Master, and Doctor) and main posts occupied by the leaders from 2000 until 2020.

Phase 4) to compare Taiwan performance against 43 semifinalist countries

Silva (2020b) developed a holistic methodology with fifteen phases divided by rankings to identify the best 20 benchmark countries that are saving lives against Covid-19.

It used 13 international raking (5 related to Health, one related to Medical Innovation, 2 related to Sustainability, 2 related to Image, and 3 related to Competitiveness) to identify those countries that were among the 50 top winners in each ranking. As a result, a total of 108 countries were considered as well-evaluated by applying the average, standard deviation, coefficient variation, and median on each nation score, generating a list of 44 semifinalist countries that were present in at least seven of the investigated rankings. And finally, to identify the 20 benchmark countries, for each of the 44 semi-finalists, the Fatality Total Index (FTI180) was used to estimate the real number of fatal cases by the one million population during 180 days facing the pandemic.

Taiwan was in second place and the reason to make a new comparative analysis against the 43 semifinalists, is to check the performance evolution of this country over time when 305 days (10 months) are considered.

The data were collected daily from the worldometers site, from December 31, 2019, until December 31, 2020. For each country, it was identified the official date where occurred the first case of Covid-19, and also the date when completed 305 days facing the pandemic (DTFC305). After that, Formula (1) was applied for each country, and they are ranked in ascending order by using the FTI305 Indicator.

Table 2 (section 9.3) shows the fields: Rank, Countries, Continent, SARS2003_TFC (Total Fatal Case of SARS in 2003)/TC(Total Case), START (Date of first Covid-19 reported), P2020 (Population per Million), PD20 (Population Density 2020), AGE>65 (Percentage of people over 65 years old in 2020), HBED/1K (Number of Hospital Beds per 1000 people), TFC305 (Total of Fatal Cases in 305 days), TFC3051M (Total of Fatal Cases in 305 days per 1M people), FTI305 (Fatality Total Index in the 305th day taking into consideration the delay of 13 days).

Phase 5) identify the best management practices adopted in Taiwan, taking into consideration cultural practices, main policy measures, programs, projects, strategies, and innovative solutions.

In June/20, it was developed an on-line Survey <https://ufam.typeform.com/to/UL7R8M> containing nine questions related to:

Q1) the country of the respondent, with 15 benchmark countries (including Taiwan) listed, selected by the author in that time taking into consideration the FTI100;

Q2) eleven cultural practices that the respondent believes were decisive for the low rate of death, with one option for those that don´t believe culture practice were decisive;

Q3) how much (0-10) the respondent trust in official statistics released by the National Government about the number of deaths cases by Covid-19;

Q4) what are the main policy measures (18 options, multiple choice) adopted by the National Government that saved lives against the Covid-19;

Q5) an opened question to inform (if know), the name of the most innovative product or service that are protecting people against Covid-19. This question aims to identify some tips for the researcher intensify the search on the internet;

Q6) the age;

Q7) if the respondent is native or not;

Q8) an open question to identify how long the respondent is living in the country;

Q9) an open question for suggestions or to inform e-mail, just in case the respondent is interested to receive the scientific article.

Typeform <https://www.typeform.com/> platform was used freely. Other software was used such as Edraw Max editor, Libre Office package, Videorobot, Viddyoze, Piktochart, and Photoscape.

The main aim of this questionnaire is to identify the perceptions of people living in Taiwan, the respondent must have more than 17 years old and living in the country for at least four months.

The pilot test was from June 21st to July 21th, after that, some improvements were to make it easier to answer. The survey continues from the beginning of August until the 9th of November, 2020. Because

he difficulty to collect data, it is worth noting that from 26/October to 09/November, another questionnaire was crated in Traditional Chinese to run together with the English survey.

To invite people, it was paid the Facebook service called "Bost a post", invitations with the link of the questionnaire was written in English and later in Traditional Chinese, and send to the audience of Taiwan.

Due to Covid-19 and cost limitations, it was tried to carry out sampling for convenience, where the researcher depends on the availability of the respondent to contribute in a volunteer way for the survey. As a result, a confidence interval or margin of error was not adopted, but it was hoped to get at least 100 correct answers.

Finally, from June until ending December 2020, parallel to the online questionnaire, several searches on articles, sites of government, universities, journals, startups, associations, and companies of Taiwan were realized to identify the innovative products and services adopted to protect and save lives against the Covid-19.

9. Results

9.1 Taiwan Models to prevent and respond to Covid-19 Pandemic

To share Taiwan's successful experience with the international community, two models were identified, as explained in the next sections.

9.1.1) Taiwan Model according to TAITRA (2020)

Taiwan External Trade Development Council (TAITRA) was founded in 1970, it is a nonprofit trade organization, supported by the industry and government, to assist the enterprise to expand its global reach. It has a team with 1300 specialists, 5 local offices in Taiwan, and 63 branches around the world.

Since 15th June 2020, TAITRA and partners developed, launched, and are updating the Taiwan Global Anti-Covid-19 Pavilion, a website to share information on Taiwan:

a) Epidemic Prevention in Public Health, Smart Health, Disease Control; b) Anti-Epidemic Products Providers; c) Medical Services; d) Business Map; e) Expert Column and Online Seminars; f) Product Launch; g) News with latest technology information; h) and Taiwan Model for Combating the Covid-19.

According to TAITRA (2020), Taiwan Model is composed of six components (Figure 5):

Component 1) Advance Preparations: since the detection of suspected cases identified in China on 31 December 2019, several actions were deployed as explained in Chart 1 and according to Taiwan Preparedness and Contingency Planning in Response to Covid-19 Epidemic (TCDC, 2020b);

Component 2) National Health Insurance (NHI): it was introduced in March 1995, it is a single-payer mandatory for all Taiwan citizens (coverage rate = 99%) except for prisoners and people who have moved out of the country (WU et al, 2010).

It has comprehensive medical coverage including for those suffering from Covid-19. The accessibility of Health Care is provided by 93% of a medical institution (100%=hospital; 92.6%=primary clinics; 79.3%=pharmacies).

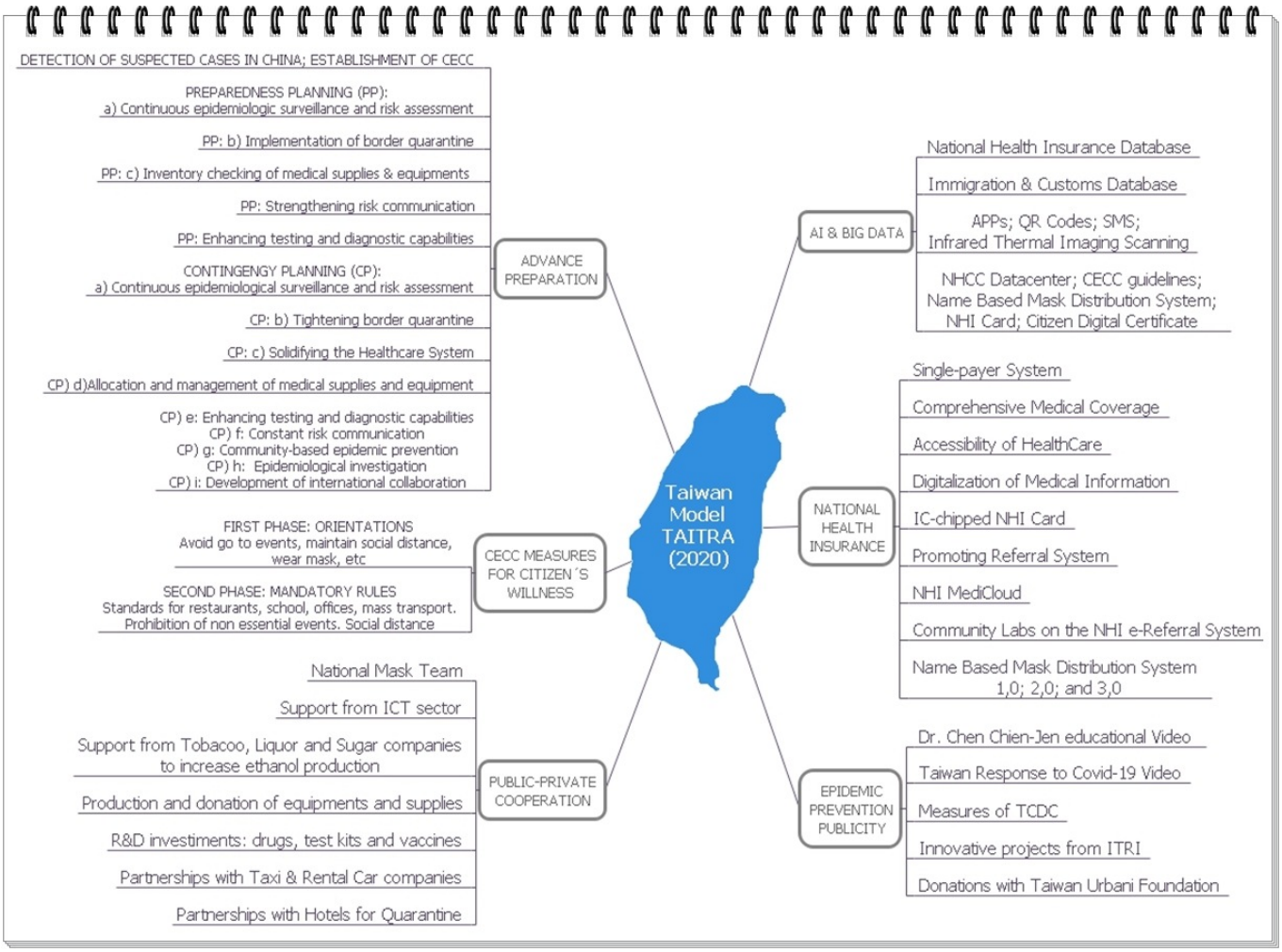

Figure 5: Taiwan Model for Combating the Covid-19
Sources: TAITRA (2020)

The digitalization of medical information contributed to improve the services and make the Taiwan health insurance administrative cost among the lowest in the world. Several smart functions are accessed by IC-chipped NHI Card (Figure 6), which permits to doctor to quickly obtain medical records (last six medical visits, drug prescriptions, examination results, identify patient's information) to prescribe appropriate treatment. Also, this card allows suspected cases to be monitored and detected in real-time.

Since 2016, the Referral System was established into NHI to encourage patients with minor illness to search for care at local clinics, to reduce waste, and overcrowd hospitals or medical centers (CHENG, 2020).

The NHI Administration also established the NHI-MediCloud System (Figure 7) which permitted from 2014 to 2017 the reduction of days repeated medication, saving US$ 9.63 million in expenditure for the six main categories of medication. Besides, among the 20 most common examinations and tests, the cloud sharing process saved around US$ 38.5 million (CHIANG and CHANG, 2019).

The NHI administration set designed community laboratories on the e-Referral System to establish a community screening network for Covid-19 and expand the capacity of medical services, which reduced

suspected cases to rush hospital emergency rooms and lowering the possibility of spreading the coronavirus in hospitals.

Finally, the Name-based Mask Distribution System (1.0 to purchase at pharmacies; 2.0 to realize online purchase; 3.0 to order on Kiosk) was developed and integrated to NHI Card and NHI MediCloud System to permit the authorities to monitor the demand and supply of masks around the country, as well as to guarantee the users to purchase protective masks;

Figures 6 and 7: NHI Card and NHI MediCloud System features
Source: MOHW (2020)

Component 3) Use of Big Data: The NHI Database was leveraged and integrated into the immigration and customs database, which permitted generate real-time alerts during clinical visits bases on patient travel history and clinical symptoms to aid case identification (WANG, 2020). Taiwan also adopted several technologies (Artificial Intelligence, Blockchain, Cloud System, Infrared Thermal Imaging Scanning, QR Code, SMS, UV, etc) to develop products or services to prevent/control the pandemic over time, as shown in Section 9.4.5 and Chart 6 (Appendix).

Component 4) CECC Measures for Citizens Willingness: the main measures were organized in two phases, phase 1 for orientations and phase 2 for mandatory rules.

In phase 1, the CECC oriented people to avoid events no considered essential such as exhibitions, sports, concerts, entertainments. Also, it was recommended to individuals to use a mask properly and keep a distance from others (>= 1.5 m in indoor; >= 1.m in outdoor locations environment).

The second phase starts after the rise in the number of imported Covid-19 cases and focused on mandatory rules, the prohibition of nonessential events, social distance standards several organizations such as offices, schools, restaurants, mass transport, supermarkets, etc.

It is important to highlight: a) the use of digital technologies to communicate with people with fast, fair, and fun strategies led by Ministry Audrey Tang; b) platforms to combat fake news such as Contact

Chatbot, Fact-Checking website; Taiwan FactCheck Center; c) the use of regulations to impose heavy penalties to those who violate mask disposal, quarantine, disseminate fake news;

Component 5) Public-Private Cooperation with some example listed bellow:

a) The government provided a budget of NT$200 million for the National Mask Team to increase production (build 60 face mask production lines), and consolidate domestic enterprises including raw material suppliers and manufacturers to assist in producing supplies for disease prevention. According to Taiwan External Trade Development Council (2020), around 140 people from 29 enterprises, from upstream to downstream, from the machine tool industry and 3 industrial Institutes joined the national team, including managers, factory directors and senior technicians, with an average of 10 years of experience in the industry;

b) Support of ICT Sector to develop several solutions such as Name-based Mask Distribution System, Disease Prevention Mask Control System, Digital Art Fun Coupons, Fight Covid Taiwan Website, Passenger Health Declaration & Home Quarantine Information System;

c) The government coordinate Taiwan Tobacco & Liquor Corporation (TTL), Taiwan Sugar Corporation (TSC) to manufacture hygiene alcohol and distributed them to TTL and TSC retail stores, community pharmacies, cosmetic stores, supermarkets and convenient stores;

d) Tourism Bureau, Ministry of Transportation & Communications is providing financial aid to city and county governments to encourage hotels to participate in the "Epidemic Prevention Quarantine Hotels" program. The program is currently scheduled to run from April 1 to December 31, 2020. Until 14 August 2020, the number of rooms in the epidemic prevention hotel has exceeded 12,000, and the occupancy rate was about 70%;

e) Donations of ambulances, emergency vehicles, protective equipment, infrared thermal imaging cameras;

f) The Academia Sinica, National Health Research Institutes, and Development Center of Biotechnology are conducting R&D on a synthesis of potential treatment drugs, vaccines, and test kits;

g) partnership with taxi and rental car companies to provide services for passengers requiring transportation from airports to home quarantine locations.

Component 6) Epidemic prevention publicity: share videos, guidelines, innovative products and services, donation campaign, etc.

9.1.2) Taiwan Model according to MOHW (2020b)

This model was build from information shared by the Taiwan MOHW (2020b) as part of the Campaign "Taiwan Can Help – Taiwan is Helping".

MOHW (2020b) model components are organized into 3 main parts as shown in Figure 8 and are strongly focused on the main measures taken by the Taiwan Government to combat the Covid-19.

The main parts are:

Component 1) Key Success Factors:

C1a) SARS 2002/2003 experience showed the need to National Government strength collaboration with the private sector to review the regulations, establish NHCC and review epidemic prevention systems and strategies;

C1b) CECC upgrading its level and organizational structure from level 1 to level 3;

C1c) Information Transparency by:

Employing multiple media channels to timely announce information (daily press conferences, outbreak situation and disease survey results, 1922 Communication Disease Report, Consultation hotline, health education materials, videos, etc) to keep public informed; Providing access to the NHI database for public and private sectors to fight the pandemic.

C1d) Good resource allocation for the: inventory and dispatch of epidemic prevention supplies; face masks production and distribution; increasing the availability of epidemic prevention supplies through multiple channels; monitoring health care and testing capacity and reserve sufficient healthcare personnel; affiliation of Hospital on the front line;

C1e) Timely Border Control to immediately prevent Covid-19 spread from China, monitor the international situation, and adjust travel notices;

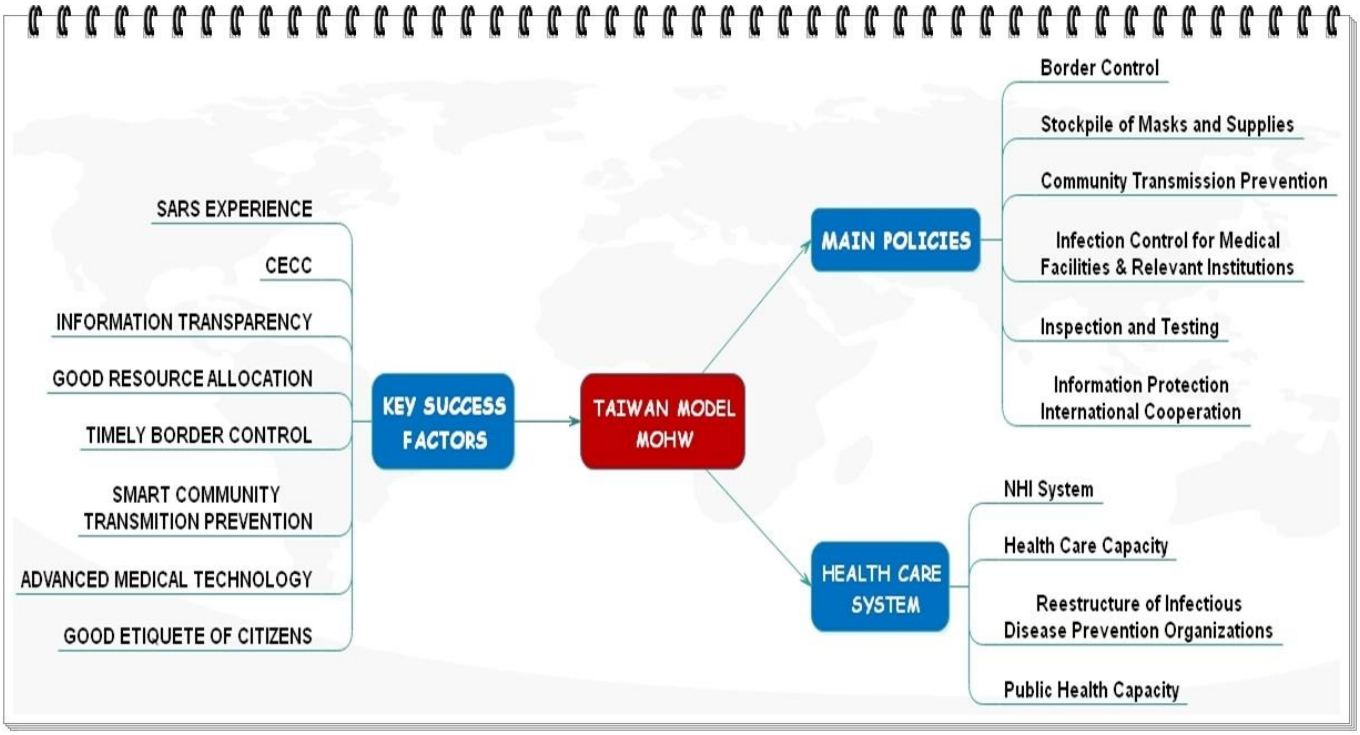

Figure 8: Taiwan Model components for Combating Covid-19
Source: MOHW (2020b)

C1f) Smart Community Transmission Prevention by employing NHI Big Data to help front-line workers to detect cases; adopting technology for isolation and Quarantine; expanding Telehealth care; creating disease prevention network;

C1g) Advanced medical technology by forming a project team to support the development of test kits; establishing laws on green channel and guide major R&D projects; foster the development of test kit; establish technical support platform of Covid-19 to accelerate the development of vaccines, drugs and rapid test kits; collecting resources and cutting-edge technologies for the development of rapid test kits, therapeutics, and vaccine;

C1h) Good Etiquette of Citizen by providing accurate epidemic prevention information to different groups of people; encouraging citizens to develop good personal hygiene habits; teaching elderly how to use their TV for video conferencing and how to use home technology interactive platform, to exercise at home and receive health information.

Component 2) Health Care System

C2a) National Health Insurance System as already explained;

C2b) Restructure of Infectious Disease Prevention Organizations such as NHCC and CECC;

C2c) Monitoring Medical Care Capacity and Guarantee Sufficient Medical Care Human Resources

Component 3) Public Health Capacity

C3a) Definition of roles of local government health departments and public health centers to prevent disease;

C3b) Development of strategies to keep the outbreak under control such as forming health department and public health center combat teams, local government to establish the care service center to ensure that people in-home quarantine and home isolation are cooperating in disease prevention, the realization of drills, increase people knowledge and abilities to use in the outbreak;

C3c) Provide measures for following up on persons wit infection risk;

C3d) Promoting local government home quarantine and home isolation care system Program;

Some products or services developed to prevent/control the pandemic over time are shown in Section 9.4.5 and Chart 6 (Appendix).

9.2 Taiwan Main Leaders Background – 2000 to 2020

Some authors (LEE, 2020; LIN et al, 2020; LO and HSIEH, 2020, WANG et al, 2020) argued that part of Taiwan and other Asian Countries' success during the Covid-19 pandemic is because of the experiences learned from SARS2003. However, no research was developed to study the main Taiwan leaders background.

Before study Taiwan performance against Covid-19, it is important to understand the background of the main leaders (President, Vice-President, Minister of MOHW) that managed the country in the last 20 years, a period by which this nation is monitoring, making investment, reforms, and improvements to better prevent and respond to H5N1, H1N1, SARS2003, MERS and Covid-19.

From 2000 until 2020, Taiwan (Table 2):

a) had 3 presidents, 5 vice presidents, and at least 10 Ministry of Health and Welfare;

b) in general, 100% has graduation, 61% Master Degree and 50% Doctor degree;

c) Law dominate the education background of the 3 Presidents, the last two has excellent education with Doctor Degree got in Harvard Law School and London School of Economics and Political Science;

d) among the 5 vice presidents, 4 (80%) have Master degree (50% related to Law and 50% in Public Health) and one (Dr. Chen) has Doctor degree in Human Genetics and Epidemiology. It is worth to notice that since SARS 2002/2003, Dr. Chen occupied other official posts and is responsible for several reforms to prepare the country for the next outbreaks, epidemic, or pandemic;

e) among the Ministers of MOHW, at least 50% has Master Course and 60% Doctor Course (Dr. Chen was one of them);

Table 2: Background of the Taiwan President, VP and Minister of MOHW (2000-2020)

Pos	Name - Period	Graduation	Master	Doctor/PhD	Professions
	Chen Shui	Law	-	-	Legislator, Mayor,
P	2000-2008	NTU			President
r	Ma Ying-Jeou	Law	Laws - New York	Juridical Science	Deputy, Secretary,
e	(2008-2016)	NTU	University	Harvard Law School	Chairman, Minister,
s.					Mayor, President
	Tsai Ing-Wen	Law	Law - Cornell	Law -London School of	Professor, Chief, Senior
	2016-present	NTU	Univ. Law School	Economics and	Adviser, Legislator,
				Political Science	Chairperson, President
	Lu Hsiu-Lien	Law	Laws – Univ. of		Legislator, Magistrate, VP
	2000-2008	NTU	Illinois & Harvard	-	
V	Vincent Ciew	Diplomacy	Law and		Vice consul, Section
i	2008-2012	NCCU	Diplomacy -NCCU	-	Chief, Dir., Chairman, VP
c	Wu Den -Yih	Arts	-	-	Journalist, Magistrate,
e	2012-2016	NTU			Mayor, VP
P	Chen Chien –	Zoology	Public Health	Human Genetics and	Epidomiologist, Professor,
r	2016-2020	NTU	NTU	Epidemiology - John	Researcher, MoHW, VP.
e				Hopkins University	
s.	Lai Ching	Medical Science	Public Health	-	Physician, Legislator,
	2020 -present	NTU	Harvard University		Mayor, VP.
	Lee Ming	Medicine	-	-	Geneticist, Director,
	(2000-2002)	NTU			MoHW
	Twu Shiing	Medicine	Public Health	(?)	Professor, Secretary,
	(2002-2003)	NTU	NTU	UCLA	Advisor, Director,
					Legislator, MoW
	Chen Chien –	Zoology	Public Health	Similar above	Similar above
	2005-2005	NTU	NTU		
	Hou Shen	Medicine		Clinical Medicine	Physician, Deputy,
	2005-2008	NTU	?	NTU	Director, Vice Sup. and
M					professor, MoHW
O	Yeh Ching	Medicine	Public Health	-	MoHW, deputy
H	2008-2009	NTU	Harvard SPH		
W	Yaung Chih	Health Education	Public Health	Population Planing	Professor, Chairmain,
	2009-2011	NTU	NTU	Univ. of Michigan	Director, MoHW,
	Chiu Wen	Medicine	?	Epidemiology	Professor, Dean,
	2011-2014	CSM University		Univ. of Pittsburgh	Superintendent, MoHW
	Chiang Been	Biology	Food Science	Food Science	Professor, Director, Dean,
	2014-2016	Fu-Jen C.U	Univ. of Illinois	Univ. of Illinois	MoHW
	Lin Tzou	Medicine	-	-	Professor, Superintendent,
	2016-2017	TM College			MoHW
	Chen Shih	Dentistry	-	-	Advisor, Director, Deputy,
	2017 - present	TM College			MoHW
	Total	18	11	9	-

Source: Government of Republic of China - Taiwan <http://bit.ly/37IBjSH and https://bit.ly/3pfccwI >

f) most leaders have a good education and experience background, with Dr. Tsai (President) and Dr. Chen (last Vice President) being globally recognized as an example of leaders able to inspire, prepare and unify the country against the Covid-19 pandemic.

In short, the law and medicine related background of these leaders may have contributed to the development of a society with a strong respect for legal practices, science, and for medical professionals.

9.3 Taiwan Performance against 43 semifinalist countries

Taiwan is close to China, 180 Km from Taiwan Strait and 943 Km from Taipei to Wuhan, with thousand of people traveling between these countries, especially during the Lunar New Year Holiday on January 25, 2020, reason by which, it was a source of high concern for the Taiwan National Government.

Among the 44 semifinalist countries identified by Silva (2020b), the first countries that reported the cases of Covid-19 were: 1st) China (31th/Dec/19); 2nd) Thailand (13th/Jan); 3rd) Japan (16th/Jan); 4th) SK (20th/Jan); 5th and 6th) Taiwan and USA (21th/Jan); 7th and 8th) Vietnam and Singapore (23th/Jan); 9th) France (24th/Jan),10th and 11th) Malaysia and Australia (25th/Jan/2020).

During nine months facing SARS2002/2003, Taiwan reported 37 deaths cases (10.7%) from a total of 346 cases (WHO, 2003). However, in terms of Covid-19, during 10 months (305 days), it reported 7 (9,4%) fatal cases from 742 total cases. The number of 7 fatal cases in Taiwan during ten months facing the pandemic is the lowest when compared with the similar period of the 43 countries. The five best are Taiwan (7), New Zealand (25), Singapore (28), Iceland (28), and Vietnam (35). On the other hand, the USA (261772), UK (59051), Italy (56361), France (50237), and Spain (45511) are the most critical countries.

Tables 3 and 4 show the basic profile and performance (FTI305 in ascending order) of the 44 countries, taking into consideration the real estimated number of Covid-19 fatal cases by one million population during the first 10 months facing the pandemic.

The main results are:

a) Taiwan is the best country, with FTI305 equal to 0.0019, followed by Vietnam (0.0035), Thailand (0.0036), China (0.0131), Singapore (0.0168), New Zealand (0.0295), Malaysia (0.0385), SK (0.0431), Japan (0.0862) and HK (0.1180), all considered the top ten benchmark countries, 90% from Asia and 10% from Oceania. Here is important to note that except Japan (no case), South Korea (0), and New Zealand (0), the seven other countries reported at least two fatal cases of SARS2003, with the highest cases reported in China (349), HK (299 fatal cases), Taiwan (37), and Singapore (33), which indicates that those countries have learned from the past lessons and are more prepared to respond for the pandemic.

b) On the other hand (Table 4), Spain (FT305=29.0983), Hungary (13.6797), Italy (12.1514), Slovenia (11.5379), UK (11.1674), Belgium (9.3295), France (5.5491), Czech (5.2733), Sweden (5.1175), and USA (5.1172) were the ten most critical countries with the highest number of FTI305. In this group, most countries (90%) is from Europe and only the USA (10%) is from North America. Besides, among these countries, 40% (Czech, Belgium, Slovenia, and Hungary) did not report any case of SARS2003, and only France reported one fatal case of that pandemic, which indicates that most countries did not have experience in dealing with a high number of SARS2003 disease cases.

Table 3: twenty best countries profile & performance in ascending order of FTI305

R	COUNTRIES	CONTINENT	SARS2003_TD/TC	START	P2020 (Mil)	PD20	AGE>65(20)	HBED/100K	DTFC305	TFC305	FTI305
1	TAIWAN	Asia	37 / 346 = 10,7%	21/01/20	23,82	673,00	14,00	6,98	21/11/20	7	0,0019
2	VIETNAM	Asia	5 / 63 = 7,93%	23/01/20	97,34	308,13	7,90	2,60	23/11/20	35	0,0035
3	THAILAND	Asia	2 / 9 = 22,2%	13/01/20	69,80	135,13	13,00	2,10	13/11/20	60	0,0036
4	CHINA	Asia	349 / 5327 = 6,55%	31/12/19	1439,32	147,67	12,00	4,34	31/10/20	4634	0,0131
5	SINGAPORE	Asia	33 / 238 = 13,87%	23/01/20	5,86	7915,73	13,40	2,40	23/11/20	28	0,0168
6	NZ	Oceania	0 / 1 = 0%	28/02/20	4,82	18,21	16,40	2,61	29/12/20	25	0,0295
7	MALAYSIA	Asia	2 / 5 = 40%	25/01/20	32,38	96,25	7,20	1,90	25/11/20	345	0,0385
8	SK	Asia	0 / 3 = 0%	20/01/20	51,28	527,97	15,80	12,27	20/11/20	501	0,0431
9	JAPAN	Asia	NO CASE	16/01/20	126,49	347,78	28,40	13,05	16/11/20	1885	0,0862
10	HK	Asia	299 / 1755 = 17,04%	23/02/20	7,50	7039,71	18,20	-	24/12/20	135	0,1180
11	AUSTRALIA	Oceania	0 / 6 = 0%	25/01/20	25,50	3,20	16,20	3,84	25/11/20	907	0,1581
12	UAE	Asia	NO CASE	27/01/20	9,90	112,44	1,30	1,20	27/11/20	567	0,1993
13	ICELAND	Europe	NO CASE	28/02/20	0,34	3,40	15,60	2,91	29/12/20	28	0,3090
14	QATAR	Asia	NO CASE	27/02/20	2,89	227,32	1,70	1,20	28/12/20	244	0,3214
15	FINLAND	Europe	NO CASE	29/01/20	5,54	18,14	22,60	3,28	29/11/20	393	0,3349
16	NORWAY	Europe	NO CASE	26/02/20	5,42	14,46	17,50	3,60	27/12/20	421	0,3457
17	CYPRUS	Asia	NO CASE	09/03/20	1,21	127,66	14,40	3,40	08/01/21	141	0,4796
18	DENMARK	Europe	NO CASE	27/02/20	5,79	136,52	20,20	2,50	28/12/20	1204	0,9637
19	ESTONIA	Europe	NO CASE	27/02/20	1,33	31,03	20,40	4,69	28/12/20	213	0,9970
20	GERMANY	Europe	0 / 9 = 0%	27/01/20	83,80	237,01	21,70	8,00	27/11/20	16172	1,0026

Source: Author (2020)

Table 4: 24 countries profile & performance in ascending order of FTI305 (Continuation of Table 3)

R	COUNTRIES	CONTINENT	SARS2003_TD/TC	START	P2020 (Mil)	PD20	AGE>65(20)	HBED/100K	DTFC305	TFC305	FTI305
21	ISRAEL	Asia	NO CASE	21/02/20	8,67	402,61	12,40	2,99	22/12/20	3136	1,4307
22	CANADA	North America	43 / 251 = 17,13%	27/01/20	37,74	4,04	18,10	2,50	27/11/20	11894	2,2037
23	LATVIA	Europe	NO CASE	02/03/20	1,89	31,21	20,70	5,57	01/01/21	644	2,2646
24	GREECE	Europe	NO CASE	26/02/20	10,43	83,48	22,30	4,21	27/12/20	4606	3,2335
25	AUSTRIA	Europe	NO CASE	25/02/20	9,00	106,75	19,20	7,37	26/12/20	5843	3,2415
26	MALTA	Europe	NO CASE	07/03/20	0,44	1454,04	21,30	4,49	06/01/21	227	3,3753
27	PORTUGAL	Europe	NO CASE	02/03/20	10,20	112,37	22,80	3,39	01/01/21	6972	3,4596
28	LUXEMBOURG	Europe	NO CASE	29/02/20	0,62	231,45	14,40	4,51	30/12/20	495	3,7333
29	NETHERLANDS	Europe	NO CASE	27/02/20	17,13	508,54	20,00	3,32	28/12/20	11042	3,7487
30	LITHUANIA	Europe	NO CASE	28/02/20	2,73	45,13	20,60	6,56	29/12/20	1347	3,7622
31	CHILE	South America	NO CASE	03/03/20	19,11	24,28	12,20	2,11	02/01/21	16724	4,0224
32	IRELAND	Europe	0 / 1 = 0%	29/02/20	4,94	69,87	14,60	2,96	30/12/20	2226	4,3753
33	SWITZERLAND	Europe	0 / 1 = 0%	25/02/20	8,68	214,24	19,10	4,53	26/12/20	7193	4,6400
34	POLAND	Europe	NO CASE	04/03/20	37,85	124,03	18,70	6,62	03/01/21	29119	5,0224
35	USA	North America	0 / 27 = 0%	21/01/20	331,03	35,61	16,60	2,77	21/11/20	261772	5,1172
36	SWEDEN	Europe	0 / 5 = 0%	31/01/20	10,10	24,72	20,30	2,22	01/12/20	7292	5,1175
37	CZECH REP	Europe	NO CASE	01/03/20	10,71	137,18	20,10	6,63	31/12/20	11656	5,2733
38	FRANCE	Europe	1 / 7 = 14,29%	24/01/20	65,30	122,58	20,80	5,98	24/11/20	50237	5,5491
39	BELGIUM	Europe	NO CASE	04/02/20	11,60	315,56	19,30	5,64	05/12/20	17142	9,3295
40	UK	Europe	0 / 4 = 0%	31/01/20	67,90	272,90	18,70	2,54	01/12/20	59051	11,1674
41	SLOVENIA	Europe	NO CASE	04/03/20	2,09	102,62	20,70	4,50	03/01/21	2803	11,5379
42	ITALY	Europe	0 / 4 = 0%	31/01/20	60,48	205,86	23,30	3,18	01/12/20	56361	12,1514
43	HUNGARY	Europe	NO CASE	04/03/20	9,70	108,04	20,20	7,02	03/01/21	9884	13,6797
44	SPAIN	Europe	0 / 1 = 0%	31/01/20	46,76	93,10	20,00	2,97	01/12/20	45511	29,0983

Source: Author (2020)

c) The 44 countries' FTI305 average is 3.6818 (S=5.34; CV=144.98%), and the median equals 2.2341, with twenty-seven countries FTI305 average lower than the 3.6818. The 20 best countries´s FTI305 average is 0.2733 (S=0.34; CV=124.11%), and the median equals 0.13805, with 12 countries FTI305 average lower than 0.2733. The 10 best countries´s FTI305 average is **0.03542** (S=0.039; CV=109.37%), and the median equals **0.02316**, with 6 countries FTI305 average lower than 0.03542;

d) The ten countries with the highest population density are: 1) Singapore (7915.73 people/Km^2), 2) HK (7039.71), 3) Malta (1454.04), 4) Taiwan (673), 5) SK (527.97), 6) Netherlands (508.54), 7) Israel (402.61), 8) Japan (347.78), 9) Belgium (315.56), and 10) Vietnam (308.13). When compared with the 10 best countries' FTI305 average (**0.03542),** special attention should be made to Taiwan (0.0019), Vietnam (0.0035), and Singapore (0.0168) because their FTI305 are lower than 0.0342, indicating that they are the best in facing the pandemic in areas with a high level of people living close to each other;

e) The ten countries with the highest percentage of people over 65 (2020) are: 1) Japan (28.4%), 2) Italy (23.3%), 3) Portugal (22.8%), 4) Finland (22.6%); 5) Greece (22.3%), 6) Germany (21.7%), 7) Malta (21.3%), 8) France (20.8%), 9) Latvia (20,7%), and Slovenia (20.7%). When compared with the 10 best countries' FTI305 average (**0.03542),** only Japan (FTI305=0.0862) has the FTI305 lower than 0.03542, which indicates that this country is the best to protect older people against the Covid-19.

RANK	FTI60-2M	FTI91-3M	FTI121 – 4M	FTI152 – 5M	FTI182 – 6M	FTI213 – 7M	FTI243–8M	FTI274-9M	FTI305-10M
1	VIETNAM	VIETNAM	VIETNAM	VIETNAM	VIETNAM	TAIWAN	TAIWAN	TAIWAN	TAIWAN
2	THAILAND	TAIWAN	TAIWAN	TAIWAN	TAIWAN	VIETNAM	VIETNAM	VIETNAM	VIETNAM
3	TAIWAN	THAILAND	THAILAND	THAILAND	THAILAND	THAILAND	THAILAND	THAILAND	THAILAND
4	UAE	HK	HK	CHINA	CHINA	CHINA	CHINA	CHINA	CHINA
5	SINGAPORE	SINGAPORE	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	SINGAPORE	SINGAPORE
6	JAPAN	JAPAN	CHINA	HK	SINGAPORE	SINGAPORE	SINGAPORE	MALAYSIA	NZ
7	AUSTRALIA	CHINA	SINGAPORE	SINGAPORE	AUSTRALIA	SK	NZ	NZ	MALAYSIA
8	MALAYSIA	MALAYSIA	AUSTRALIA	AUSTRALIA	SK	NZ	SK	SK	SK
9	HK	AUSTRALIA	SK	SK	NZ	JAPAN	JAPAN	JAPAN	JAPAN
10	USA	SK	NZ	NZ	JAPAN	CYPRUS	HK	HK	HK
11	SK	NZ	JAPAN	JAPAN	HK	HK	CYPRUS	AUSTRALIA	AUSTRALIA
12	CHINA	UAE	CYPRUS	CYPRUS	CYPRUS	AUSTRALIA	ICELAND	UAE	UAE
13	FINLAND	QATAR	UAE	UAE	ICELAND	ICELAND	UAE	CYPRUS	ICELAND
14	CANADA	CYPRUS	LATVIA	ICELAND	LATVIA	LATVIA	AUSTRALIA	NORWAY	QATAR
15	QATAR	LATVIA	ICELAND	LATVIA	UAE	UAE	NORWAY	ICELAND	FINLAND
16	GERMANY	ICELAND	MALTA	MALTA	GREECE	NORWAY	LATVIA	FINLAND	NORWAY
17	NZ	GREECE	GREECE	GREECE	CZECH REP	LITHUANIA	FINLAND	QATAR	CYPRUS
18	CYPRUS	ISRAEL	ISRAEL	CZECH REP	MALTA	GREECE	QATAR	ESTONIA	DENMARK
19	LATVIA	MALTA	QATAR	ISRAEL	NORWAY	QATAR	ESTONIA	GERMANY	ESTONIA
20	CHILE	CZECH REP	CZECH REP	NORWAY	LITHUANIA	FINLAND	LITHUANIA	DENMARK	GERMANY
21	MALTA	FINLAND	NORWAY	QATAR	QATAR	CZECH REP	GREECE	LATVIA	ISRAEL
22	ISRAEL	LITHUANIA	LITHUANIA	LITHUANIA	FINLAND	ESTONIA	AUSTRIA	ISRAEL	CANADA
23	GREECE	POLAND	POLAND	FINLAND	ESTONIA	AUSTRIA	DENMARK	LITHUANIA	LATVIA
24	CZECH REP	NORWAY	FINLAND	ESTONIA	POLAND	POLAND	GERMANY	GREECE	GREECE
25	ICELAND	ESTONIA	ESTONIA	POLAND	ISRAEL	DENMARK	POLAND	AUSTRIA	AUSTRIA
26	POLAND	CHILE	CHILE	CHILE	AUSTRIA	GERMANY	MALTA	CANADA	MALTA
27	FRANCE	AUSTRIA	SLOVENIA	DENMARK	DENMARK	ISRAEL	ISRAEL	MALTA	PORTUGAL
28	LITHUANIA	GERMANY	DENMARK	SLOVENIA	SLOVENIA	MALTA	LUXEMBOURG	PORTUGAL	LUXEMBOURG
29	NORWAY	SLOVENIA	GERMANY	GERMANY	GERMANY	SLOVENIA	PORTUGAL	LUXEMBOURG	NETHERLANDS
30	SWEDEN	DENMARK	PORTUGAL	HUNGARY	HUNGARY	LUXEMBOURG	SWITZERLAND	SWITZERLAND	LITHUANIA
31	ESTONIA	CANADA	HUNGARY	LUXEMBOURG	PORTUGAL	PORTUGAL	CZECH REP	NETHERLANDS	CHILE
32	AUSTRIA	PORTUGAL	LUXEMBOURG	PORTUGAL	LUXEMBOURG	HUNGARY	SLOVENIA	POLAND	IRELAND
33	DENMARK	HUNGARY	SWITZERLAND	SWITZERLAND	SWITZERLAND	SWITZERLAND	CANADA	CHILE	SWITZERLAND
34	SLOVENIA	LUXEMBOURG	CANADA	CANADA	CANADA	CANADA	NETHERLANDS	CZECH REP	POLAND
35	UK	USA	CHILE	NETHERLANDS	NETHERLANDS	NETHERLANDS	HUNGARY	FRANCE	USA
36	HUNGARY	SWITZERLAND	USA	CHILE	CHILE	CHILE	CHILE	IRELAND	SWEDEN
37	PORTUGAL	NETHERLANDS	NETHERLANDS	USA	USA	FRANCE	FRANCE	SWEDEN	CZECH REP
38	LUXEMBOURG	SWEDEN	FRANCE	FRANCE	FRANCE	USA	IRELAND	USA	FRANCE
39	SWITZERLAND	FRANCE	SWEDEN	IRELAND	IRELAND	IRELAND	USA	SLOVENIA	BELGIUM
40	BELGIUM	IRELAND	IRELAND	SWEDEN	SWEDEN	SWEDEN	SWEDEN	BELGIUM	UK
41	NETHERLANDS	BELGIUM	BELGIUM	BELGIUM	BELGIUM	BELGIUM	BELGIUM	HUNGARY	SLOVENIA
42	IRELAND	UK	UK	ITALY	ITALY	ITALY	ITALY	ITALY	ITALY
43	ITALY	ITALY	ITALY	UK	UK	UK	UK	UK	HUNGARY
44	SPAIN	SPAIN	SPAIN	SPAIN	SPAIN	SPAIN	SPAIN	SPAIN	SPAIN

Chart 4: Position of each country over time by FTI ascending order

Source: Author

When the evolution of FTI of each country is investigated over time (Chart 4 and 5) since the second month facing the pandemic (FTI60=2 Months, FTI91=3M, FTI121=4M … FTI305=10M) it was noted that:

a) Taiwan, Vietnam, and Thailand are the best country with the lowest FTI value, they were able to keep the top 3 positions over time. Among them, Taiwan was the best (Chart 4) to reduce the FTI value,

from FTI60 = 0.0028 to FTI305 = 0.0019 (Chart 5);

b) On the other hand, Spain, Italy, and the UK are the countries with the highest FTI over time;

c) New Zealand FTI evolution during 10 month is considered outstanding, since this country continually reduces the FTI, going from FTI60 = 0.1140 (17th position in the 2nd month) to FTI305=0.0295 (6th position in the 10th Month). Another good example are Iceland and Norway;

d) USA FTI evolution is considered inferior since this country's position dropped significantly from 10th position in the second month (0.0374) to 35th position in the 10th month (FTI305 =5.1172). USA is an example of how a nation with a good Health Security Index (NTI, JHU, and EIU, 2019) can lost millions of lives during a pandemic due to lack of leadership and bad behaviors of the President, as shown by Silva (2020b p. 137).

COUNTRIES	FTI60-2M	FTI91-3M	FTI121 – 4M	FTI152 – 5M	FTI182 – 6M	FTI213 – 7M	FTI243–8M	FTI274-9M	FTI305-10M
TAIWAN	0.0028	0.0055	0.0049	0.0039	0.0032	0.0028	0.0024	0.0021	0.0019
VIETNAM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0035	0.0044	0.0039	0.0035
THAILAND	0.0003	0.0081	0.0085	0.0070	0.0058	0.0050	0.0044	0.0039	0.0036
CHINA	0.0412	0.0313	0.0330	0.0263	0.0219	0.0187	0.0164	0.0146	0.0131
SINGAPORE	0.0061	0.0241	0.0348	0.0313	0.0272	0.0232	0.0203	0.0187	0.0168
NZ	0.1140	0.0870	0.0655	0.0521	0.0435	0.0423	0.0370	0.0328	0.0295
MALAYSIA	0.0113	0.0366	0.0323	0.0271	0.0230	0.0200	0.0186	0.0284	0.0385
SK	0.0411	0.0680	0.0570	0.0483	0.0427	0.0378	0.0408	0.0428	0.0431
JAPAN	0.0065	0.0291	0.0804	0.0848	0.0755	0.0713	0.0833	0.0840	0.0862
HK	0.0178	0.0117	0.0132	0.0281	0.1128	0.1290	0.1152	0.1051	0.1180
AUSTRALIA	0.0097	0.0467	0.0448	0.0364	0.0423	0.1310	0.1883	0.1756	0.1581
UAE	0.0036	0.0966	0.2259	0.2193	0.2032	0.1902	0.1813	0.1886	0.1993
ICELAND	0.5610	0.3699	0.2782	0.2215	0.1850	0.1580	0.1662	0.3194	0.3090
QATAR	0.0670	0.1457	0.3652	0.4414	0.4305	0.4037	0.3803	0.3475	0.3214
FINLAND	0.0477	0.5884	0.6745	0.5609	0.4699	0.4088	0.3680	0.3358	0.3349
NORWAY	0.8390	0.6468	0.5154	0.4202	0.3633	0.3175	0.2876	0.2888	0.3457
CYPRUS	0.2593	0.2052	0.1629	0.1297	0.1254	0.1169	0.1195	0.2575	0.4796
DENMARK	1.7373	1.5237	1.2186	0.9845	0.8370	0.7438	0.7123	0.7270	0.9637
ESTONIA	1.1897	0.9884	0.7433	0.5917	0.5020	0.4290	0.4289	0.5419	0.9970
GERMANY	0.1106	1.2729	1.3334	1.1228	0.9563	0.8308	0.7417	0.7082	1.0026
ISRAEL	0.4267	0.4266	0.3519	0.3936	0.6185	0.8316	1.3119	1.4001	1.4307
CANADA	0.0518	1.6810	3.1594	3.1661	2.7637	2.4148	2.1539	2.0626	2.2037
LATVIA	0.2860	0.2829	0.2659	0.2258	0.2004	0.1863	0.3134	0.8220	2.2646
GREECE	0.4782	0.4071	0.3380	0.2846	0.2918	0.3780	0.5119	1.5637	3.2335
AUSTRIA	1.5116	1.1956	0.9761	0.7926	0.6815	0.6244	0.6817	1.6470	3.2415
MALTA	0.3779	0.4485	0.3373	0.2685	0.3489	0.8517	1.3064	2.4993	3.3753
PORTUGAL	2.5401	2.3683	1.9750	1.7285	1.5151	1.4048	1.5614	2.5282	3.4596
LUXEMBOURG	3.4122	2.7806	2.0912	1.7252	1.5673	1.3392	1.4200	2.6194	3.7333
NETHERLANDS	7.7970	6.7169	5.2244	4.1861	3.5376	3.0986	3.0433	3.5021	3.7487
LITHUANIA	0.6247	0.6366	0.5491	0.4483	0.4025	0.3679	0.5048	1.4985	3.7622
CHILE	0.3399	1.0834	4.0614	4.6370	4.5631	4.4314	4.3009	4.1332	4.0224
IRELAND	11.7801	10.8041	8.5465	6.9336	5.8368	5.0605	4.6923	4.4896	4.3753
SWITZERLAND	5.2434	3.9523	2.9968	2.4037	2.0313	1.7938	1.7003	3.1544	4.6400
POLAND	0.5945	0.6446	0.6552	0.5994	0.6006	0.6431	1.2719	3.6149	5.0224
USA	0.0374	3.0421	4.8768	4.9091	4.7726	5.0242	5.0171	4.9564	5.1172
SWEDEN	1.1880	6.9507	8.1870	7.7410	6.7379	5.8276	5.1548	4.6896	5.1175
CZECH REP	0.5381	0.4822	0.3946	0.3450	0.3222	0.4269	1.8063	4.2302	5.2733
FRANCE	0.6176	8.2274	7.8912	6.5842	5.5888	4.8286	4.3615	4.2598	5.5491
BELGIUM	5.7102	15.0016	12.9559	10.5451	8.8725	7.7145	6.8611	7.3462	9.3295
UK	2.3312	17.3185	17.8449	15.3648	13.0537	11.2383	10.0033	9.8003	11.1674
SLOVENIA	2.0087	1.5038	1.1517	1.0077	0.9243	0.9136	2.0046	7.2945	11.5379
ITALY	13.6622	20.4542	18.2100	15.1165	12.7523	10.9544	9.7132	9.2680	12.1514
HUNGARY	2.3921	2.4771	2.0513	1.6580	1.4357	1.6092	3.2815	8.2022	13.6797
SPAIN	28.5101	55.1335	46.8179	37.7095	31.5826	27.6013	26.4359	26.5544	29.0983

Chart 5: FTI evolution of each country organized in ascending order of FTI305
Source: Author

9.4 The BMP adopted in Taiwan to save lives against the Covid-19

Between 21st June and 9th November 2020, five Boost Posts run for a total of 70 days with the invitation and link of the questionnaire. The Posts reached 50.721 people living in Taiwan, from which 109 (0.21%) respondents accepted voluntarily to participate in the survey.

9.4.1 Basic profile of the respondent

a) the respondents spent an average of 6min15s to answer the questionnaire;

b) most (104=95.4%) revealed the age, which average is 57 years old, the median age is 60 years old, the youngest respondent has 26 years old, and the oldest has 82 years old. This result indicates that adult and old people are more motivated to participate in the survey;

c) Most respondent (62=57%) is native of Taiwan, while 46 (42%) are foreigners living there. Only one person did not respond to the question. All foreigners accepted to inform the time living in Taiwan, with the average time being 15.7 years. Only 5 foreigners are living there for less than one year, with the lowest time living there being four months.

9.4.2 Cultural practices

Only five respondents (4.59%) don´t believe that cultural practices were decisive to the low rate of Covid-19 in Taiwan, while most (104=95.41%) believe in that.

From the group that believe (Figure 9), the most decisive cultural practices were: first) wear a mask (87.5%), 2nd) wash hands (55.77%), 3rd) cleanliness of public services (45.19%), 4th) not shake hands (38.46), 5th)) not hug in public (37.50%).

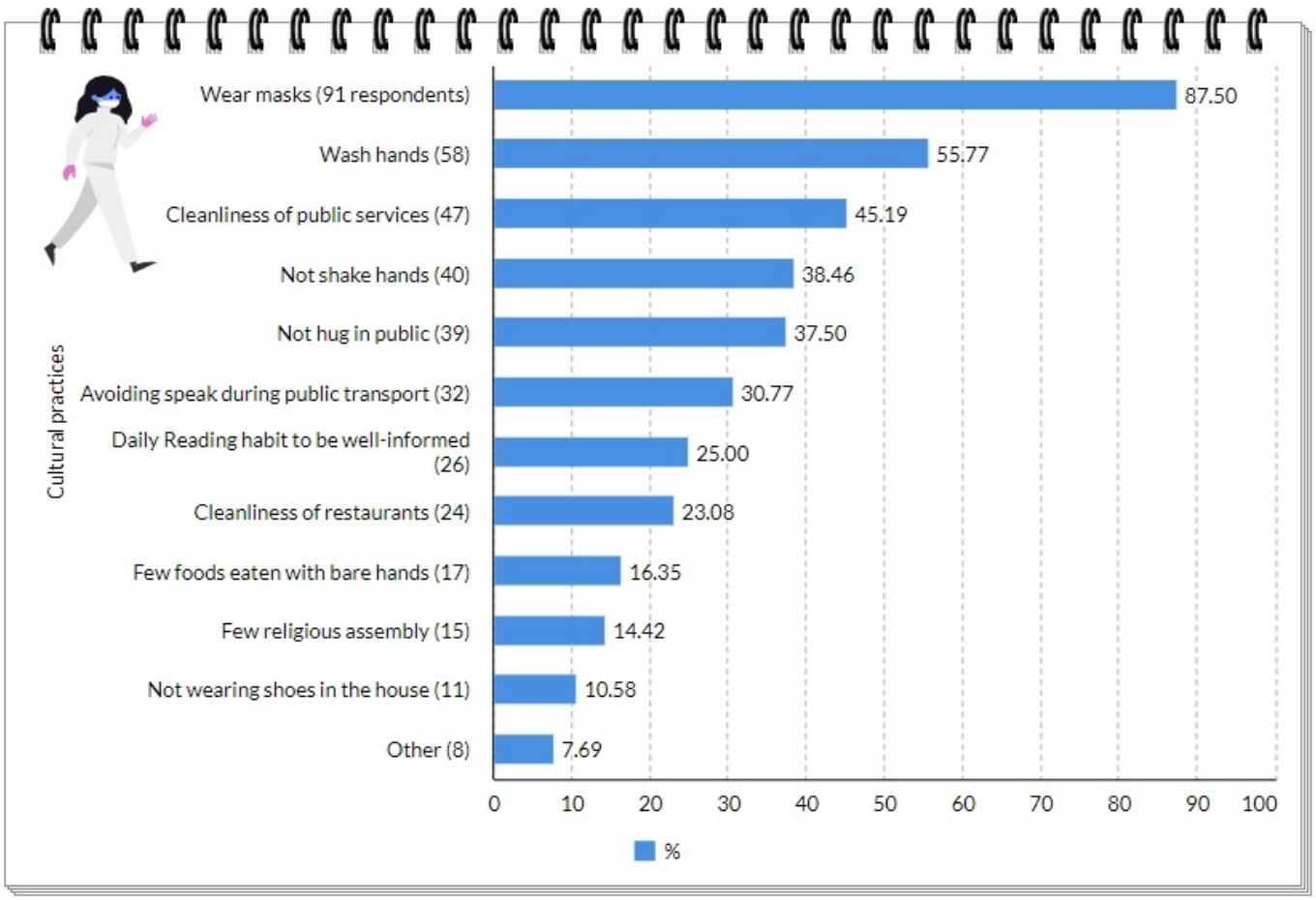

Figure 9: Perception of the 104 respondents that believes that cultural practices were decisive to reduce the rate of Covid-19 deaths in Taiwan

Source: Author (2020)

On the other hand, the less decisive were: 12th) not wearing shoes in the house (10.58), 11th) few religious assemblies, 10th) few foods eaten with bare hands (16.35), 9th) cleanliness of restaurants, 8th) daily reading habit to be well-informed, 7th) avoiding speak during public transport (30.77%). Only 8 (7.69%) responded to the option Others.

9.4.3 Trust in the National Government

Most (108=99%) respondents rated from 0 to 10 the level of trust in official statistics released by the Taiwan National Government about the number of deaths cases by Covid-19.

Figure 10 shows that the average of trust is high (X=9.55; S=1.24; CV=12.98%) and the median is 10, with most (104=96.3%) of them giving a rate equal or over 8 points, and 3.70% giving a rate lower or equal to 7.

When the answers are compared by the foreigners and natives, only 2.17% of foreigners rated equal to or lower than 7, while 4.84% of native did so.

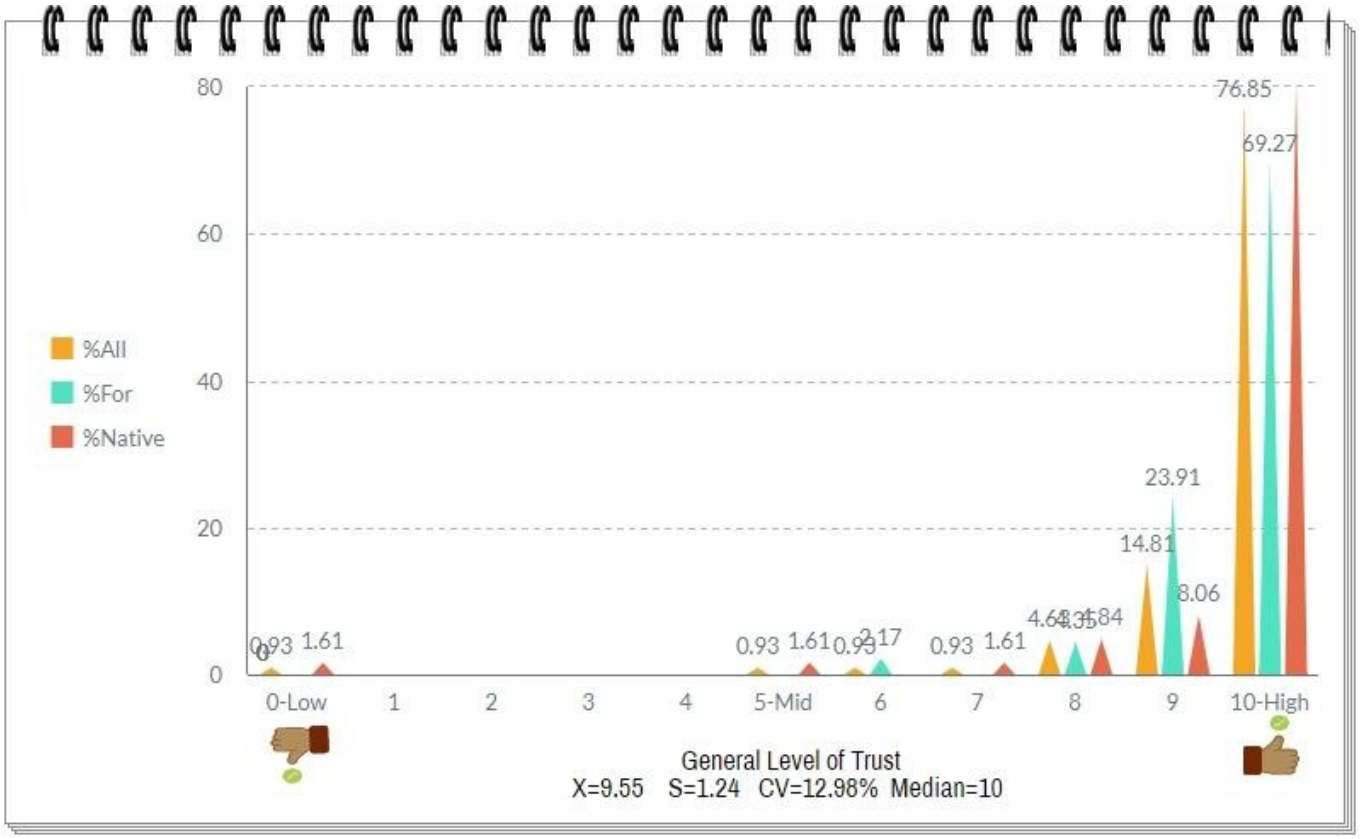

Figure 10: Level of trust of the 108 respondents in Taiwan National Government about the official number of deaths cases by Covid-19

Source: Author (2020)

9.4.4 The perception of the respondents on the main policy measures adopted that saved lives

Several authors and organizations (BALAJEE et al, 2017; HA et al, 2020; IMF, 2020; JONES, 2020; OCDE, 2020; OUR WORLD IN DATA, 2020; PANG, 2003; ROSER et al, 2020; SVOBODA et al, 2004; WHO, 2020c) focused on policies, responses, or measures against the Coronavirus.

In this research, firstly it was aimed to identify the respondent perceptions about the subject, and later, with further research, it was organized the main policies, programs, projects adopted by Taiwan National Government and partners.

Concerning the respondents' perception, all of them selected at least one (multiple choice) of 18 measures provided.

As a result, Figure 11 shows that for the 109 respondents, the ten main policy measures adopted by the Taiwan Government that saved lives against the Covid-19 are:

1st) international travel control (77.98%), 2nd) effective public-private collaboration (60.55%), 3rd) public information campaigns (52.29%), 4th) integration with mass media (51.38), 5th) increase the medical and personal equipment capacity (48.62%), 6th) combat fake news (46.79%), 7th) public event cancellations (44.95%), 8th) improve intensive care unit structure (28.44%), 9th) support the expansion of the testing system (20.18%), and schools closures (15.60%).

On the other hand, the five policies measures considered less voted by the respondents to save people lives are: 18th) low-interest loans (2.75%), 17th) workplaces closure (4.59%), 16th) online training programs (7.34%), 15th) public transport reduction (8.26%), and 14th) Tax relief (9.17%).

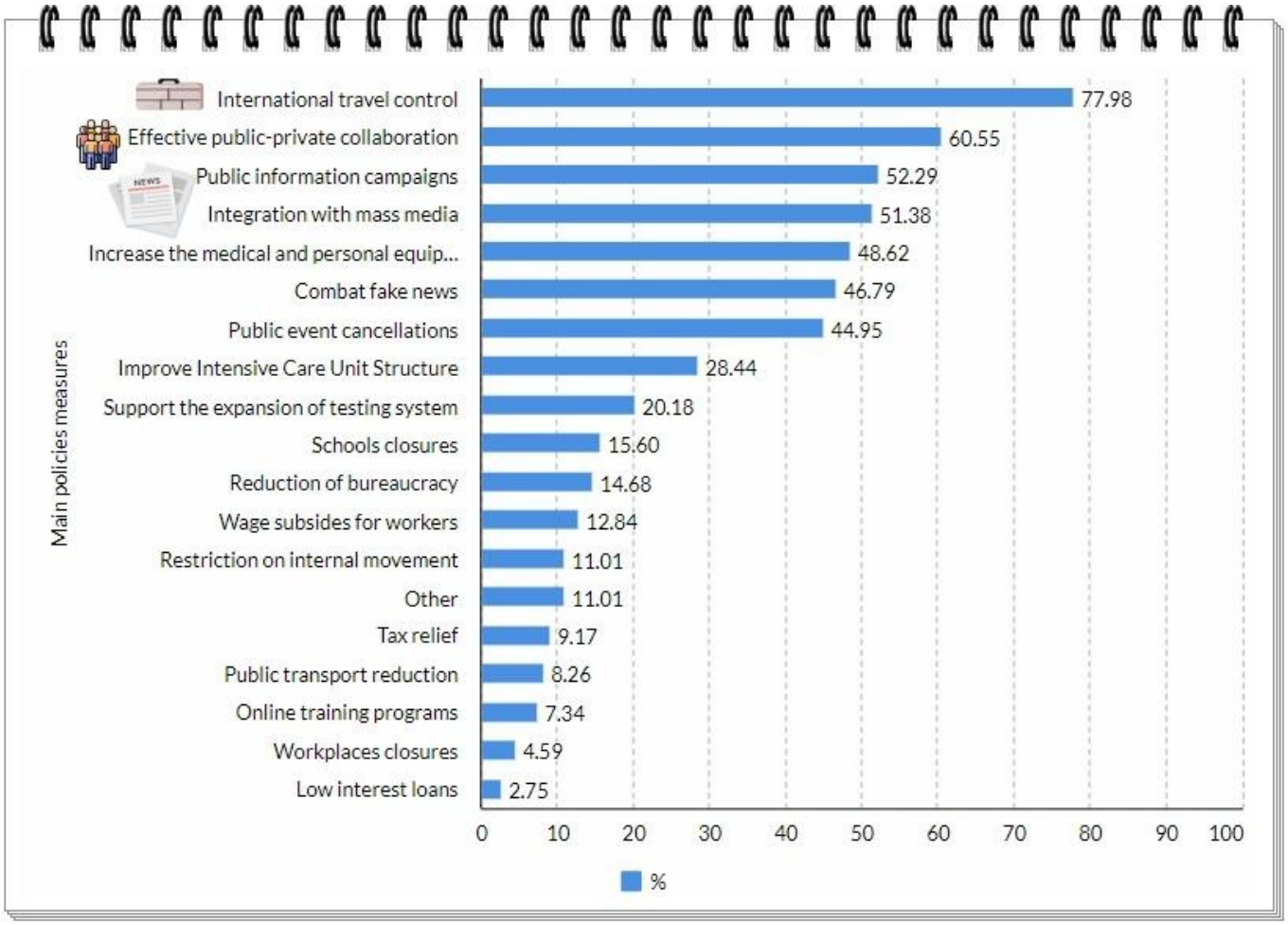

Figure 11: Perceptions of the 109 respondents on the main policies that saved lives in Taiwan
Source: Author (2020)

9.4.5 The most innovative products or services used in Taiwan against Covid-19

For question 5 of the questionnaire, the respondent was asked, if know, to write the name of the most innovative products or services that are protecting people in Taiwan against the Covid-19.

Analyzing the answers, it was noted that: most (75=68.8%) respondent tried to inform what they believed as innovative products or services, while 28 (25.69%) respondents did not answer the question, 4 (3.67%) respondents informed that they did not know, and only 2 (1.83%) informed that there was no innovative products or services.

In technical terms, from the 75 respondents that tried to explain the innovative solutions, fourteen (19%) informed the name of the products or services.

However, the main aim of this question was not to evaluate the respondent ability in innovation issues but to find tips of products or services that respondents perceived as new during the pandemic, and from them, to search on the internet the details of the organization, solution name, goal, technologies adopted.

For the 75 respondents, the perceptions about the most innovative products or services are related to: Face Masks (18=24%), Apps for contact tracing or electronic fencing (13=17.33%), Adequate National Supply System of Masks (7=9.33%), App (e-Mask Ordering System) for Mask Purchase (7=9.33%), Public health daily information (7=9.33%), Public cooperation (6=8%), Telehealth equipment (6=8%), National Health Care System (6=8%), CDC Management System supported by Central Government (4=5.33%), Temperature (Thermometers) check in shops, workplace, etc (4=5.33%), Wash hands products (alcohol, soap or sanitizers; 4 = 5.33%), Test Kits (4 = 5.33%), Entry Quarantine System during entry inspection (3=4%), Quarantine (3 = 4%), Social distance (2=2.67%), Websites (2=2.67%), Early restrictions (2=2.67%), School closures (2=2.67%), Anti-epidemic battle campaign (1), Crisis Awareness (1), Disease Management Agency (1), Isolation of positive cases and those exposed to them (1), law enforcement such as mandatory use of masks in public transport (1), QR Code solutions (1).

From these tips, a spreadsheet was developed to insert new data from the complementary research on the internet to identify the innovative solutions, with the following fields: 1) organization and solution, which describes the name of the organization and the solution developed; 2) type, divided into Corporation, Public Sector, Start-Up, University, and Other; 3) contact, informing the e-mail or link for contact; 4) site; 5) city where it was developed or applied; 6) stage, divided into In Preparation, Pilot/Demo/Trial, or Ready; 7) category, that classifies the solution as Prevention, Diagnostic, Treatment, Grants & Support Initiatives, Information, and Life & Business Application, by using the criteria of the Start-Up Blink (2020); 8) subcategory with subtopics for each category, by using the criteria of the Start-Up Blink (2020); 9) technology used; 10) resume, which describes the main information of the solution.

As a result, from June until the middle of December 2020, it was found 250 responses in Taiwan, with the majority led by Public Sector (149=59.6%), Corporation (67=26.8%), followed by Others (14=5.6%), Start-Up (10=4%), and University (10=4%).

Concerning the location, the most solution comes from the capital of Taiwan (Taipei) or New Taipei (205=82%), followed by the other cities (Hsinchu=4%, Taichung=2%, Changua=1.6%, Taoyuan=1.6%, Kaohsiung=1.2%, and others).

Concerning to stage, during the period of data collection, most (233=93%) response is Ready, 14

(5.6%) are in Pilot/Demo/Trial (including vaccines), and 3 (1.2%) are in Preparation.

The policies, measures, programs or projects identified are strongly related to Financial Aid (54 responses), followed by Electronic guidelines (16), Act/Law/Regulations (9), Training (9), Quarantine (9), Consumption Stimulus (8), Suspension of events (5), Employment incentives (5), NHI System (5), Fine/Penalties (5), Temporary Ban (5), Donation (3), Refund (3), Delay/Postponed payment (3), Partnerships (3), Daily Press Conferences (2), Adjustment in Production Structure (2), Digital Trade (2), Fuel Subsidy (2), Flexible work hours (2), Insurance (2), Rent deferral or reduction (2), Repair or Maintenance (2), Audits (2), Border Control (2), Campaign (2), Temperature check (2), National Mask Team (1), Preparedness & Contingency Plan in Response to Covid-19 Epidemic (1), National Laboratory System (1), Free Influenza Vaccines (1), Social Distance (1), R&D Team (1), Smartlabs (1), Hackathon (1), Ban export of mask (1), Relax advertisement time (1), National Inspection Network (1), Community collection and inspection network (1), Food kit (1), Investment in new structure (1), Labor pension (1), Grants for work allowances (1), Lift export mask ban (1), National mask team (1), Hotel Subsidy (1), Care Centers (1), Stockpiling framework (1), System unification (1), Technical exchange (1), Customs assistance (1), Suspend group tours (1), Disinfection Task Force (1), Entrepreneurial consulting (1), and Volunteers (1).

In terms of Products or Services, most is related to the development or improvement of Test Kits (17), Robots (15), Apps (14) and Masks (10), followed by Thermal imaging cameras (4), Vaccines (4), Name-based Mask Distribution System 1.0, 2.0 and 3.0 (3), Thermometers (3), Sprays (3), Gowns (3), Wipes (2), Ventilators (2), Reagents (2), Laboratory System Network (1), Medical image analysis equipment (2), Drugs (2), Alcohol (2), Smart Mirror (1), Epidemic Prevention Supplier System (1), National Infectious Disease Statistic System (1), Flu Forecast Map, National & Regional Forecast platform (1), Taiwan Nosocomial Infections Surveillance System (1), PTT Bulletin Board System (1), Single-payer System (1), Servo controlled flow generator (1), Sales Model System (1), Respiratory humidifier (1), Protective clothing (1), Nasopharyngeal Swabs (1), Music Platform (1), Mobile phone visitation software (1), Lung auscultation (1), iodines (1), Intensive care ward (1), Intelligent management system (1), Glasses (1), Face Shield (1), Electrochemical sensing devices (1), Electric motorcycles (1), Drug inventory system (1), Door with automatic detection (1), Digital door sign (1), Breathing tube made by silicon (1), and Blood collection device.

Concerning to the technologies or method used to develop the products or services, it is important to notice that the use of internet is present in all of them, followed by the use of Artificial Intelligence (14), QR Code (11), Cloud System (8), Data center-data mining, database (8), UV (8), IoT (6), ID Chip Cards (6), e-commerce (5), Nucleic acid amplification technology (5), Mobile payment (5), Nano technologies (5), Video Technologies (5), Bluetooth (4), Antibody rapid detection test methods (3), SMS (3), GPS (2), iiPCR technology (2), Telephones (2), Fiber optic (2), Face recognition technologies (2), Chat Bot (2), Ultrasonic sensors (2), 3D technology (2), IR camera technology (2), Modular Assembly Design (2), Remote consultation or monitoring technologies (2), TV satellite or platform (2), KFVirus RT-qPCR Master Mix, In Vitro Diagnostic Device methods (1), Electronic Bulletin Board System (1), Cartoon printing (1), Biosensor Chip (1), Infrared thermometers technology (1), Citizen Digital Certificate (1), Facial temperature sensor (1), Digital one step RT-qPCR platform (1), Laser guiding technology (1),

Gene detection assay (1), Genome Sequence (1), GGHH Aawrd, Genetically modified Spike protein (1), Electronics forms (1), LFIA method (1), Chest X-ray technology (1), Chemical coverall (1), Cell Broadcast Service (1), Blockchain (1), 4G (1), qPCR (1), TELnet protocol (1), Traffic Bundle Control (1), Microfluidic immunoassay cartridge (1), Machine vision (1), Radio Station (1), RT – qPCR (1), Machine learning (1), Microporous film laminate (1), N gene (1), nFOPT smart care film (1), Optical Radar (1), Triage (1), Oxygen Therapy (1), Otorhinolaryngology diagnosis (1), PCR (RT-PCR) technology (1), RdRP (1).

It is important to notice that the number that appears in parenthesis in each product, service, technology, or method should be much higher because during the collection of data, in many cases, it was not clear the description of the technology or method used by the product or service.

In terms of Category, most the 250 responses is focused on Prevention (91=36.4%), Grants & Support Initiatives (55=22%), followed by Diagnostic (40=16%), Life & Business Adaptation (33=13.2%), Information (24=9.6%), and Treatment (7=2.8%).

Some examples of Prevention responses are Border Control, Plans to protect citizens returning from high-risk regions, Full external gas introduction cycle heat exchange health energy-saving air conditioning system, Mask Map, Disinfection Gateway, Automated dispensed cabinet, iMRobot, eMask Ordering System, Infrared Thermal Cameras in the train stations, suspended group tours, postponed Taipei International Book Fair and protect the rights of the exhibitors and ticket buyers, etc

Some examples of Grants & Support Initiatives are Donation of Non-Contact Forehead Thermometers, Cohak Hackathon, Buy More with Triple Stimulus Voucher Program, Guaranteed Salary Program, GU Talent for Training Program, Upgrade for Innovation and R&D Program, Taiwan Can Help for International Support, Special Act for Prevention, Relief and Revitalization Measures for Severe Pneumonia with Novel Pathogens, Automobile Transport Industry Relief Measures, Aviation Industry Relief 1.0; 2.0 and 3.0, Epidemic Prevention Quarantine Hotels, Hotel industry employee salary subsidy program, Tourism Industry Relief 1.0; 2.0 and 3.0 Program, Art and Literature Relief 1.0 and 2.0, Phoenix loan for micro-entrepreneurship and repayment buffer, etc.

Finally, all the 250 responses are shown in Chart 6 (Appendix)

10. Conclusions and recommendations (Golden lessons)

The main aim of the article is to investigate the performance and the best management practices adopted in Taiwan to save lives, during the first 305 days facing the pandemic.

From the data collection and analysis, the main lessons and recommendations are:

1) Over time WHO developed models to help countries to prepare and respond to epidemics or pandemic. Concerning Taiwan Preparedness and Contingency Planning in Response to Covid-19 Epidemic (TCDC, 2020b), it is shorter with only 12 pages with different emphasis to the following components when compared with WHO models: Activation Protocol for Preparedness and Contingency Planning, Implementation of Border Quarantine, Inventory checking of medical supplies and equipment, Tightening border quarantine, Perfecting (or improving) the Health System, Enhance testing and

diagnostic capabilities, Community based epidemic prevention, and Developing International collaboration. Further research should be done to grasp each component;

2) two basic Taiwan Models for fighting the Covid-19 were found, one provided by TAITRA (2020) which seems to follow the Taiwan Preparedness and Contingency Planning in Response to Covid-19 Epidemic (TCDC, 2020b), it is more broad in scope with the participation of several stakeholders. The other model is provided by Taiwan MOHW, more focused to share the lessons learned from SARS2003 and Public Health Measures adopted by the MOHW over time. The 250 responses found in this research should open the discussion for the improvement of these models or the development of a new model to cover all the aspects of Taiwanese Society, including solutions provided by Universities, SMEs, Schools, Start-Ups, R&D Institutes, and NGOs;

3) over the last twenty years (2000-2020), Taiwan had 3 presidents, 5 vice presidents, and at least 10 Ministers of MOHW. In general, it was found that these leaders have a good education background, all have graduation, 61% Master Degree and 50% Doctor degree, with a strong emphasis on Law or Medicine related areas, which may have contributed to the improvement of legal, educational and scientific structures, as well as the development of a society with a strong respect for legal practices, science and for medical professionals. Besides the educational background, the experience and the leadership by example are crucial to unify the country against any crisis, especially those related to the epidemic or pandemic. Further research should be done to grasp these leaders background and their leadership style to provide management guidance to top public managers;

4) Pandemic preparedness can not be effective only adopting short term measures. Several responses identified in this research were not deployed in 2020, but over time. For example, concerning the act, laws, or regulations, Taiwan has developed a framework for detecting and reporting epidemics per International Health Regulations (LEE, 2020b). At least, nine legal norms have been used (partially or totally) over time to better prepare and respond to epidemic or pandemic in Taiwan, with three enacted during the Covid-19 pandemic. Besides, the Taiwan Constitutional Court recommendations were vital for the improvement of the Communication Disease Control Act, considered the main legal basis to fight the Covid-19 (CHANG, 2020). Other examples are National Testing Network, National Laboratory Influenza Surveillance Network, National Laboratory System, National Notifiable Diseases Surveillance System, Nosocomial Infections Surveillance System, as well as improvement made in Taiwan CDC (NHCC and CECC), Hospitals, Universities, Companies, and Local Governments, which investments and operational best practices should be considered for future research;

5) Concerning the 44 countries performance, when is considered the real estimated number of Covid-19 fatal cases by one million population during the first 10 months facing the pandemic, Taiwan is the best country, with the lowest FTI305 due to the National Government ability to improve their legal, health care and industrial systems, as well as integrate and heavily support main actors of the nation to prevent, prepare and fight against the Covid-19. However, there are some area for improvement in Taiwan, such as criminal penalties for violating quarantine, economic support for quarantined citizens, travel restrictions, legislative efficiency, covid-19 equipment availability (DEEP KNOWLEDGE GROUP, 2020 p. 151), reason by which new research should focus on these areas;

5) to get public support, the government needs to provide information transparently. In Taiwan, it was possible by a) employing multiple media channels to timely announce information to keep the public informed; b) providing access to the NHI database for public and private sectors to fight the pandemic; c) combating fake news; d) using digital technologies to communicate with people with fast, fair and fun strategies. As a result, when the each respondent was asked to rate from 0 to 10 the level of trust in official statistics released by the Taiwan National Government about the number of deaths cases by Covid-19, 108 respondent evaluated as high (X=9.55; S=1.24; CV=12.98%) with the median equal to 10, with most (104=96.3%) of them giving a rate equal or over 8 points;

6) Only five respondents (4.59%) don´t believe that cultural practices were decisive to the low rate of Covid-19 in Taiwan, while most (104=95.41%) believe in that. From the group that believes, the most decisive cultural practices were: first) wear a mask (87.5%), 2nd) wash hands (55.77%), 3rd) cleanliness of public services (45.19%), 4th) not shake hands (38.46), 5th) not hug in public (37.50%). On the other hand, the less decisive were: 12th) not wearing shoes in the house (10.58), 11th) few religious assemblies, 10th) few foods eaten with bare hands (16.35), 9th) cleanliness of restaurants, 8th) daily reading habit to be well-informed, 7th) avoiding speak during public transport (30.77%). Only 8 (7.69%) responded to the option Others;

7) For 109 respondents, the ten main policy measures adopted by the Taiwan Government that saved lives against the Covid-19 are: 1st) international travel control (77.98%), 2nd) effective public-private collaboration (60.55%), 3rd) public information campaigns (52.29%), 4th) integration with mass media (51.38), 5th) increase the medical and personal equipment capacity (48.62%), 6th) combat fake news (46.79%), 7th) public event cancellations (44.95%), 8th) improve intensive care unit structure (28.44%), 9th) support the expansion of the testing system (20.18%), and schools closures (77.98%). On the other hand, the five policies measures considered less voted by the respondents are 18th) low-interest loans (2.75%), 17th) workplaces closure (4.59%), 16th) online training programs (7.34%), 15th) public transport reduction (8.26%), and 14th) Tax relief (9.17%);

8) 250 responses against the Covid-19 were found in Taiwan. Public Sector and Corporations are playing important roles, followed by Others, Start-Up and University. Concerning to stage, during the period of data collection, the most response is Ready, 14 are in Pilot/Demo/Trial (including vaccines), and 3 are in Preparation. In addition, the policies, measures, programs or projects identified is strongly related to Public Financial Aid, followed by Electronic guidelines, Act/Law/Regulations, Training, Quarantine, Consumption Stimulus, Suspension of events, Employment incentives, NHI System, Fine/Penalties, Temporary Ban, Donation, Refund, Delay/Postponed payment, Partnerships, Daily Press Conferences, Adjustment in Production Structure, Digital Trade, Fuel Subsidy, Flexible work hours, Insurance, Rent deferral or reduction, Repair or Maintenance, Audits, Border Control, Campaign, Temperature check, National Mask Team, Preparedness & Contingency Plan in Response to Covid-19 Epidemic, National Laboratory System, Free Influenza Vaccines, Social Distance, R&D Team, Smartlabs, Hackathon, Ban export of mask, Relax advertisement time, National Inspection Network, Community collection and inspection network, Food kit, Investment in new structure, Labor pension, Grants for work allowances, Lift export mask ban, National mask team, Hotel Subsidy, Care Centers, Stockpiling framework, System unification, Technical exchange, Customs assistance, Suspend group

tours, Disinfection Task Force, Entrepreneurial consulting, and Volunteers. New research should be done to investigate the impact of these policy measures on the country economy;

9) In terms of Innovative Products or Services, most is related to the development or improvement of Test Kits, Robots, Apps and Masks, followed by Thermal imaging cameras, Vaccines, Name-based Mask Distribution System 1.0, 2.0 and 3.0, Thermometers, Sprays, Gowns, Wipes, Ventilators, Reagents, Laboratory System Network, Medical image analysis equipment, Drugs, Alcohol, Smart Mirror, Epidemic Prevention Supplier System, National Infectious Disease Statistic System, Flu Forecast Map, National & Regional Forecast platform, Taiwan Nosocomial Infections Surveillance System, PTT Bulletin Board System, Single-payer System, Servo controlled flow generator, Sales Model System, Respiratory humidifier, Protective clothing, Nasopharyngeal Swabs, Music Platform, Mobile phone visitation software, Lung auscultation, iodines, Intensive care ward, Intelligent management system, Glasses, Face Shield, Electrochemical sensing devices, Electric motorcycles, Drug inventory system, Door with automatic detection, Digital door sign, Breathing tube made by silicon, and Blood collection device;

10) Internet and digital solutions are playing important roles to save lives during the Covid-19 pandemic. The main technologies and methods related to the 250 best management practices found in this research are: Artificial Intelligence, QR Code, Cloud System, Data center-data mining, database, UV, IoT, ID Chip Cards, e-commerce, Nucleic acid amplification technology, Mobile payment, Nano technologies, Video Technologies, Bluetooth, Antibody rapid detection test methods, SMS, GPS, iiPCR technology, Telephones, Fiber optic, Face recognition technologies, Chat Bot, Ultrasonic sensors, 3D technology, IR camera technology, Modular Assembly Design, Remote consultation or monitoring technologies, TV satellite or platform, KFVirus RT-qPCR Master Mix, In Vitro Diagnostic Device methods, Electronic Bulletin Board System, Cartoon printing, Biosensor Chip, Infrared thermometers technology, Citizen Digital Certificate, Facial temperature sensor, Digital one step RT-qPCR platform, Laser guiding technology, Gene detection assay, Genome Sequence, GGHH Aawrd, Genetically modified Spike protein, Electronics forms, LFIA method, Chest X-ray technology, Chemical coverall, Cell Broadcast Service, Blockchain, 4G, qPCR, TELnet protocol, Traffic Bundle Control, Microfluidic immunoassay cartridge, Machine vision, Radio Station, RT – qPCR, Machine learning, Microporous film laminate, N gene, nFOPT smart care film, Optical Radar, Triage, Oxygen Therapy, Otorhinolaryngology diagnosis, PCR (RT-PCR) technology, and RdRP.

The research has limitations, it identified the responses considered as best management practices, however, it did not evaluate their costs and effectiveness over time, which can open several opportunities for new research. Also, other research can be done with a higher number of participants in order to get more representative data. Finally, new research can be developed to compare these result against other benchmark countries such as Vietnam, Thailand, Singapore and New Zealand.

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g) all respondents that take their valuable time to answer the questionnaire, without their contribution, this article was not possible;

h) to the authors of the papers mentioned in this article, and also to the reader, for your patience to study this long article, if you know a new solution, please send the information;

i) all public managers, technical, nurses, doctors, professors, researchers, infectologist, drivers, cookers, janitors, donors, public and private managers, volunteers that are bravely fighting the Covid-19, God Bless You.

12. Appendix A – Chart 6

Organization → Solution	Type	Organization → Solution	Type
Addimune Co. & NTU → Vaccine	Co.	Formosa Laboratories → Remdesivir	Co.
Adimmune Co. & Taiwan Government →Vaccine AdimrSC-2f (SARS-COV-2)	Co.	GeneOne → Covid-19 Nucleic Acid Diagnostic Kit	Co.
AFC →Protective Equipment and Antiviral Sprays	Co.	GeneReach → POCKIT™ Central SARS-CoV-2 (orf 1ab) Premix Reagent	Co.
Agnitio Science & Technology → BioIC SARS-CoV2 IgG/IgM Detection Kit	Co.	Genereach Biotechnology → POCKIT™ Micro Series Nucleic Acid Analyzer	Co.
AIPHAS → AIoT healthcare solution	Startup	GGM → Humidoflo HFT System & Nasal high flow oxygen therapy	Co.
Arbor Technology → Portable Temperature Screening Station	Co.	Goodideas-Studio (Howard Wu) → Mask Map	Other
Atom Health →Protective Equipment for medical services	Co.	Heroic Faith Medical Science → AI stethoscope	Co.
Bluesense Diagnostics→ BlueBox	Startup	Honeywld Technology → MyGuardian	Co.
Bluesense Diagnostics→ ViroTrack COVID-19 IgM / IgG	Startup	Huijia → Smart Care System	Co.
Blusense Diagnostics → Rapid Diagnostic Test	Startup	IMedCat & CC Hospital → Disinfection gateway	Co.
Brain Navi Biotechnology → Nasal Swab Robot's assistance	Startup	ImedCat → Automated Dispensing Gabinet; → Digital door sign and iMWard and iMSign; → iMRobot; → Quarantine and Polluted area disinfect Robot; → Telemedical cart in quarantine area; → Vital sign station/kiosk ITRI →Medical grade ventilator prototype; →Nucleic Acid Detection System	Co. Other
BRISE → Brise AI Air Meter	Co.		
BRISE → Brise AI Guardian Angel App	Co.		
BRISE → Multi-shield facemask	Co.		
Cheetah Mobile → Cheetah Greetbot	Co.		
Cofacts Taiwan → Cofact Chatbot to combat fake news	Other		
Cold Spring Biotech Co. → Covid-19 detection reagents	Co.		
CSD → Alcool Prep Pad; → Color Face Mask; Anti Smog Mask; Medical Mask; Children Mask; → Wipes and Iodine Prep Pad	Co.	Instant NanoBiosensors → iNA™ COVID-19 One-Step qPCR/PCR Test Kits	Startup
Delta Electronics → Dagene G1 Automated Nucleic Acid Analysis System	Co.	Kim Forest Co. → SARS-CoV-2 Detection Kit	Co.

Continuation of Chart 6

Organization → Solution	Type	Organization → Solution	Type
Delta Elect.→ Dagene G1 SARS-Cov-2 Test Kit	Co.	Line Corporation → Free content services	Co.
Derekduck Industries Co. → Chemical Coverall ULTITEC series	Co.	LUFTQI→Luft Cube Portable, Filterless Air Purifier	Co.
ELECLEAN → Water to Disinfectant Technology	Startup	MedCheX → COVID-19 diagnostics from Chest X-rays.	Startup
Eternal Materials Co. Ltd → COVID-19IgM/IgG rapid test kits	Co.	Medgen Vaccine Biologics → MVC SARS-Cov-2 qPCR Kit	Co.
FFSI & FIK→FinTechSpace Covid-19 Supporting Plan	Other	Medgen Vaccine Biologics → MVC SARS-Cov-2 Vaccine	Co.
Mediland → Hyper Light Disinfection Robot	Co.	Solomon Tech → Smart Disinfection Robot	Co.
Microlife → Thermometers (Infrared, Digital and Non-contact thermometer NC 200/TEA 2020)	Co.	Students of Linyuan Elementary School → Lego Robot	Other
MiiS →MiiS Telemedicine Solution	Co.	TABP & NHRI & IPM & NDMC → Long Zhun SARS-CoV-2 Rapid Test	Co.
Motex Healthcare Corporation → Surgical face mask with visor, Aroma fragant face mask →Anti-Leak Diamond Shape Face Mask (TEA 2018)	Co.	Tai Doc → Covid-19 Antigen Rapid Test → Donation Non Contact Forehead Thermometer; → Non Contact Forehead Thermometer; → Pulse Oximeter	Co.
Mygopen → Fact-checking to combat fake news	Other	Taipei Mass Rapid Transit → Refuse entry into metro stations	Public
National Cheng Kung University & BAF → QurE Project for Quarantine → QR Code System for Digital Trace in University Campus	Univ.	Taipei Medical Univ & TCDC & Partners → Traffic control bundle to protect Health Workers; → Contact-Free Connected Healthcare Platform; → Healthcare Blockchain Platform	Univ.
National Chiao Tung University & Partners → AllCHECKTM Compositional Electronic Chip Platform → NCTU1 Intelligent Iot Robot	Univ.	Taiwan CIP → Revitalization plan-mobile payment feedback; → Tribal Landscape Optimization Project; → Ayoi 阿优依" e-commerce platform; → Indigenous Peoples Committee's Relief Plan for Severe and Special Infectious Pneumonia	Other
National Chin-Yi University of Technology → Full external gas introduction cycle heat exchange health energy-saving air conditioning system.	Univ.	Taiwan Design Research Institute & partners →The MAC Ward	Other

Continuation of Chart 6

Organization → Solution	Type	Organization → Solution	Type
NKG & partners → 3D printers to fast manufacture Protective Kits → Epidemic Prevention Video Cart → Intelligent Transportation Robot (Specimen Delivery) → Smart Epidemic Prevention Door → Smart Service Robot (Abao) → Sterilization and Disinfection Robot (Disinfection) → Temperature Measuring Smart Mirror → UVC Ultraviolet Disinfection Robot (UVC AMR)	Co.	Taiwan Gov. MOE (Ministry of Education) → Guidance for Colleges and Universities → Guidelines for University and College Preventative Measures against COVID-19 (3rd ed); → EDU Cloud website; → Guidance for Academic who return from Abroad; → Sport Department relief and revitalization measures	Public
NTU & Electronic BBS Research Society → PTT Bulletin Board System	Univ.	Taiwan Gov. & USA Government → Cohak	Public
NTU & NCTU → Fight Covid Taiwan website	Univ.	Taiwan Gov. & Mask Companies → eMask Ordering System	Public
PlexBio Co. Ltda → IntelliPlexTM SARS-CoV-2 Detection Kit	Co.	Singular Wings Medical → BeatInfo-Precaution Management System	Startup
Radica Health → ICU Remote Monitoring	Co.	Smart Ageing Tech → Jubo Long Term Care Solution	Startup
Singtex→Protective Equipment for medical services	Co.		
Taiwan Gov. Ministry of Economic Affair (MOEA) & Partners → National Mask Team to increase production or make emergency procurement to maintain steady supplies → 1988 Relief and Revitalization HotLine → Buy More – Triple Stimulus Voucher → Expand Business Opportunities → GU Talent for training → Guaranteed Salary → Help Transition for business services → Make Up Funds for companies and families → Reduce Burden for householders and companies → Upgrade for Innovation, R&D	Public	Taiwan Gov. MoHW CECC & partners → Crucial policy for combating COVID-19 → Public Warning System (PWS) for transmissible diseases → Regulations to impose heavy penalties (fines) → Fall-Winter COVID-19 Prevention Program → Regulations concerning short-term business travelers; → Border Control → Gradual adjustment of arrival regulations to stop the epidemic to enter in Taiwan → Flu Forecast Map, National & Regional Forecast → Free Influenza Vaccines Program → National Infectious Disease Statistic System → National Laboratory Influenza Surveillance Network	Public

Continuation of Chart 6

Organization → Solution	Type	Organization → Solution	Type
Taiwan Gov. MoHW CECC & partners → National Health Command Center (NHCC) and Central Epidemic Command Center (CECC) → Name-based Mask Distribution System 1.0, 2.0 and 3.0 → Compensation to quarantined individuals → Home quarantine to travelers transiting → Measures to person at Risk of Infection → Orientations to citizens abroad → Preparedness & Contingency Plan in Response to Covid-19 Epidemic → Rigorous isolation & quarantine measures to Taiwanese returning from Wuhan → Create a positive social climate for disease prevention → Plans to protect citizens returning to Taiwan from high-risk regions Taiwan Gov. Ministry of Foreign Affair (MOFA) & MOHW CECC & partners → 14 quarantine for foreigners with valid Taiwan Residence Certificate → Measures with orientations for foreigners wishing to enter in Taiwan → Temporary prohibition to foreigners enter in Taiwan → 14 quarantine for transit travelers from China, HK & Macau → Temporary Ban for some passangers → Corona disease (COVID19) outbreak Updates → International Cooperation → Taiwan Can Help for international support	Public	Taiwan Gov. MoHW CECC & partners → National Laboratory System → National Notifiable Diseases Surveillance System (NNDSS) → Taiwan Nosocomial Infections Surveillance System → Promotion of Local Government Home Quarantine and Home Isolation Care Service Program → Guidelines for Enterprise Planning of Business Continuity in Response to Covid19 → 3-tier Safety Stockpiling Framework of Personal Protective Equipment → 10 strategies for medical responses and preparedness → 8 primary strategies for responses and preparedness at long-term care facilities → Digital Fencing Tracking System → Quarantine System For Entry → Special Act for Prevention, Relief and Revitalization Measures for Severe Pneumonia with Novel Pathogens → Central and Local Government Care Centers → National Health Insurance (IC Chip Card, NHI MediCloud System, etc)	Public

Continuation of Chart 6

Organization → Solution	Type	Organization → Solution	Type
Taiwan Gov. Ministry of Interior (MOI) and CECC → COVID-19 Response Guidelines: Community Management and Maintenance → Introduction of Flexible Working hours to Staff	Public	Taiwan Gov. Ministry of Transport and Communications (MOTC) & CECC & Other Ministries & Partners → Banned international ships cruise → Automobile transport Industry Relief Measures; → Aviation Industry Relief 1.0 and 2.0 Program; → Bailout 2.0 – 50 billion loan for aviation Industry → Epidemic Prevention Quarantine Hotels → Home Quarantine Persons Returning Home Transportation Program from the Airport → Hotel industry employee salary subsidy program → Infrared therm cameras in the train stations → Infrared thermometers in the Ports → Maritime Relief 1.0 and 2.0 → Orientations on Social distance, masks, food and drink in the train → Suspend group tours → Tourism Industry Relief 1.0; 2.0 and 3.0 Program	Public
Taiwan Gov. Ministry of Justice (MOJ) & Legislative & Other Ministries & Partners → Prevention measures in Correctional Institutions against covid-19 → Pharmaceutical Affairs Act → CDCA → Enforcement Regulations Governing the CECC → Foreign Trade Act; → Medical Devices Act → Regulations Governing Quarantine at Ports → Regulations Governing the Operational Procedures and Compensation for Expropriation of Manufacturing Equipment and Raw Material of Disease Prevention Supplies for Severe Pneumonia with Novel Pathogens → Special Act for Prevention, Relief and Revitalization Measures for Severe Pneumonia with Novel Pathogens; → Personal Data Protection Act	Public		
Taiwan Gov. National Communication Commission (NCC) & Partners → Deferred Payment of Communication Fee for general public and corporate users → Relax advertising time for Radio & TV Industries → Resolution for broadcasters to promote epidemic prevention and health education messages → Digital Social Innovation with Fast, Fair and Fun strategies to communicate with people → Guidance to agencies to protect personal data	Public	Taiwan Gov. Env. Protection Administration (EPA) & Other Ministries & Partners → Amend the Low Carbon Sustainable Homeland Program Implementation Guidelines Regarding Loans and Guarantees/Subsidy Regulations for Scrapping and Replacing Large Old Diesel Vehicles → Amend the Subsidy Regulations for Scrapping and Replacing Large Old Diesel Vehicles → National Disinfection Task Force to Fight COVID-19	Public
Taiwan Gov. Academia Sinica → Network to track SARS-CoV-2 variants	Public		
Taiwan Gov. Council of Agriculture (COA) & Other Ministries & Partners → Measures for the Relief and Revitalization of the Agriculture Committee			

Organization → Solution	Type	Organization → Solution	Type
Taiwan Gov. Council of Agriculture (COA) & Other Ministries & Partners → Procedures for the Relief and Revitalization of Industries and Businesses Affected by Severe Special Infectious Pneumonia by the Agriculture Committee of the Executive Yuan for operating difficulties → Reliefs for Agricultural Food → Reliefs for Animal husbandry → Reliefs for Casual; → Reliefs for Fishery → Taiwan Agricultural Products Carnival (on line shopping) → Triple Coupon + Agricultural Tour Coupon	Public	Taiwan Gov. Env. Protection Administration (EPA) & Other Ministries & Partners → Green Life for All Program → Increase subsidy in The Recycling Care Program → Loan to replace old diesel trucks to cope coronavirus → Revised the Mobile Pollution Source Air Pollutant Emissions Standards → Subsidy to replace old motorcycles with new electric motors	Public
Taiwan Gov. Ministry of Culture (MOC) & Other Ministries & Partners → Art and Literature Relief 1.0 and 2.0; → Art Fun Coupon and "Arts FUN ticket" APP; → Artsfungo platform for art stores; → Digital Art FUN Coupons; → Postponed Taipei Fashion Awards and Fashion Week; → Postponed Taipei International Book Fair and protect the rights of exhibitors and ticket buyers; → Shortening the home quarantine rules for arts and cultural groups; → Suspend and Postpone indoor or outdoor gathering activities; → Suspend Taipei International Book Fair and refund the full booth fee paid by exhibitors; → Suspend Taiwan Cultural Expo and refund the booth fees paid by the exhibitors	Public	Taiwan Gov. Ministry of Science and Technology (MOST) & Other Ministries & NCU & SmartLabs → 2020 NCKU International Virtual Forum on Covid-19 → SmartLabs Global Launch Program → Epidemic Prevention Science Research Center → Promote cooperation between domestic and foreign research institutions	Public

Continuation of Chart 6

Organization → Solution	Type	Organization → Solution	Type
Taiwan Gov. Ministry of Finance (MOF) & Other Ministries & Partners → Measures for Covid-19 Epidemic Prevention, Bailout, and Revitalization → Proactively Reducing Tariffs for Raw Materials of Medicinal Alcohol → Measures for Bank, Security and Insurance Sectors; → Financial Relief; → Flexible control of materials; → Stimulate consumption and revitalize → Tax Assistance to overcome difficulties	Public	Taiwan Media Watch & Association for Quality Journalism → Taiwan FactCheck Center	Other
		Taiwan High Speed Rail → Cancellation of no reserved train seats	Co.
		Taiwan Stanch Co. Lid → LAITEST UV Protection Medical Face Mask	Co.
		Taiwan TAITRA & Partners → Taiwan Global Anti-Covid-19 Pavillon	Other
Taiwan Gov. Ministry of Labor (MOL) & Other Ministries & Partners → Additional school subsidies for children of unemployed workers → Employment Measures for Fresh Graduates → Labor relief loan and Interest Subsidy → Measures for Enterprise; → Phoenix loan for micro entrepreneurship and repayment buffer → Real-time work plan with peace of mind → Recharge and Start Training Program (for workers); → Self-employeed workers or workers without a certain employee living allowance → Sheltered workshop and visually impaired massage; → Unemployment benefit Proram	Public	TCI Corporation → QVS-96 Robot	Co.
		Tonyar Biotech Inc → ASK Covid-19 Antibody Rapid Test	Co.
		UniRing Tech Co. Ltd → MAX Robot Floor Scrubber	Co.
		VADI → VH-3000 Respiratory Humidifier and Breathing tube	Co.
		Winnoz → HAIIM	Co.

Char 6: List of Best Management Practices identified in Taiwan used to fight Covid-19

Source: Author (2020)

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