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## Article

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# COVID-19 containment in the Caribbean: The experience of small island developing states

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## ABSTRACT

**Background:** Small island developing states (SIDS) have limited absolute resources for responding to national disasters, including health emergencies. Since the first confirmed case of COVID-19 in the Caribbean on 1st March 2020, non-pharmaceutical interventions (NPIs) have been widely used to control the resulting COVID-19 outbreak. We document the variety of government measures introduced across the Caribbean and explore their impact on aspects of outbreak control.

**Methods:** Drawing on publically available information, we present confirmed cases and confirmed deaths to describe the extent of the Caribbean outbreak. We document the range of outbreak containment measures implemented by national Governments, focussing on measures to control movement and gatherings. We explore the temporal association of containment measures with the start of the outbreak in each country, and with aggregated information on human movement, using smartphone positioning data. We include a set of comparator countries to provide an international context.

**Results:** As of 25th May, the Caribbean reported 18,755 confirmed cases and 631 deaths. There have been broad similarities but also variation in the number, the type, the intensity, and particularly the timing of the NPIs introduced across the Caribbean. On average, Caribbean governments began controlling movement into countries 27 days before their first confirmed case and 23 days before comparator countries. Controls on movement within country were introduced 9 days after the first case and 36 days before comparators. Controls on gatherings were implemented 1 day before the first confirmed case and 30 days before comparators. Confirmed case growth rates and numbers of deaths have remained low across much the Caribbean. Stringent Caribbean curfews and stay-at-home orders coincided with large reductions in community mobility, regularly above 60%, and higher than most international comparator countries.

**Conclusion:** Stringent controls to limit movement, and specifically the early timing of those controls has had an important impact on containing the spread of COVID-19 across much of the Caribbean. Very early controls to limit movement into countries may well be particularly effective for small island developing states. With much of the region economically reliant on international tourism, and with steps to open borders now being implemented, it is critical that the region draws on a solid evidence-base to balance the competing demands of economic wellbeing and public health.

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## 1. Introduction

One in five members of the United Nations (UN) are small island developing states (SIDS); 38 countries with a combined population of around 65 million. (Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-OHRLS), 2015) The majority of SIDS are in the Caribbean and Pacific, and in addition to common social, economic and environmental

vulnerabilities they share limitations related to healthcare provision for rapidly aging populations with high burdens of non-communicable disease. (Eldemire-Shearer et al., 2011; Samuels and Unwin, 2018; Suzana, Walls, Smith, and Hanefeld, 2018) In the Caribbean, there are 16 UN recognised SIDS, with a further 13 island territories without UN status and with formal ties to extra-regional UN members (USA, UK, France, Netherlands). Despite this variation in geo-political affiliations, one regional body, the Caribbean Community (CARICOM), includes 20 Caribbean countries and territories as

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members. Serving a combined population of around 16 million people, CARICOM represents the dominant structure for regional cooperation on economic, political, health and disaster response. (Andrewin, Rodriguez-Llanes, and Guha-Sapir, 2015; Samuels, Kirton, and Guebert, 2014) Although many of the island states in the Caribbean are classified as high or middle income – a classification that reduces the available international support - there is now global recognition that SIDS represent a further vulnerable country grouping due to specific economic and climate change disadvantages. (United Nations General Assembly, 2014) They have limited absolute resources to systematically tackle the complexities of their national health burdens, including responding to acute health emergencies.

On March 1st 2020 the first confirmed case of COVID-19 in the Caribbean, an Italian tourist, was reported in the Dominican Republic; one month after the first case in Italy, and three months after patient zero in China. (Huang et al., 2020; Spiteri et al., 2020) By that time, 87 thousand cases in 59 countries had been confirmed, and the Caribbean region, whose economies are heavily dependent on tourist arrivals from Europe and North America, was on high alert. On March 11th 2020, the World Health Organization declared a global pandemic. As of May 25th 2020, there were 5.3 million confirmed cases worldwide, including 2.4 million cases in the Americas. (World Health Organization, 2020) Since March, CARICOM had been actively developing regional public health responses to the COVID-19 pandemic. (CARICOM Today, 2020) At the time of the first identified cases among CARICOM member states, the regional response was in its infancy, and CARICOM members were also relying on local expertise and international evidence.

Implemented measures can be broadly classed as non-pharmaceutical interventions (NPIs). Globally, NPIs are typically introduced as public health responses to outbreaks, and in the case of COVID-19 have been the main method of outbreak control due to the lack of vaccine or pharmaceutical treatment options. (World Health Organization Writing Group, 2006) These containment measures are expected to slow the spread of the virus and reduce the severity of the epidemic peak by reducing physical contact, which in turn can reduce disease transmission, and has an ultimate goal of keeping healthcare demand below health system capacity.

While there have been many similarities in the decisions by CARICOM countries to quickly implement NPIs, there has been distinct variation in the number, the type, the intensity, and particularly the timing of the NPIs. Here we compare national responses across the Caribbean (20 CARICOM and two non-member countries) and explore the potential impact of implemented NPIs. We focus on NPIs affecting human movement. In particular, we examine policies related to movement into countries, movement within countries, and control of mass gatherings, against the dynamics of confirmed cases, confirmed deaths, outbreak growth rates, and population mobility. Understanding how combinations and timing of NPIs work, and in which contexts, can inform the continued response to COVID-19 as well as future virulent outbreaks within SIDS.

## 2. Methods

Our main goal was to present a COVID-19 situation analysis for the Caribbean region during the initial outbreak period (April and May 2020). This period broadly represents the time before governments in the Caribbean began to gently ease their national containment measures. We present confirmed cases and confirmed deaths to describe the extent of the outbreak across the Caribbean. We document the range of containment measures implemented by Governments and explore the time between the start of the outbreak in each country and the start of containment. We describe the temporal association of key containment measures and aggregated information on human movement, using smartphone positioning data.

### 2.1. Data sources

We drew on four data sources for this report. To describe the NPIs implemented in our included countries we used the ACAPS COVID-19 government measures database. This database collates measures implemented by

governments worldwide in response to the coronavirus pandemic. It uses a variety of international, national, and media sources and includes a secondary review of collated information. Measures are grouped into 5 broad categories: movement restriction, social distancing, public health measures, governance and socioeconomic measures, and lockdown. (ACAPS, 2020) Information for six of the CARICOM counties, the United Kingdom overseas territories (or UKOTS: Anguilla, Bermuda, British Virgin Islands, Cayman Islands, Montserrat, Turks and Caicos Islands), were not included in the ACAPS database. To complete the CARICOM NPI information, and to generally ensure database accuracy, we systematically searched for missing or inaccurate NPI entries (see Supplement for search protocol). To report the numbers of confirmed cases and deaths, we drew on two data sources. Primarily, we used the European Centre for Disease Control (ECDC) database for the distribution of confirmed COVID-19 cases and deaths worldwide. (European Centre for Disease Control (ECDC), 2020) We supplemented the ECDC numbers using data available each evening from the Johns Hopkins Coronavirus Resource Center. (Dong, Du, and Gardner, 2020) To describe movement of people within their communities we used the Google-generated COVID-19 Community Mobility Reports. (Google LLC, 2020; Aktay et al., 2020) For selected countries (8 Caribbean countries, 8 comparator countries), these data describe the change in the number and length of visits to various grouped locations (grocery and pharmacy, parks, transit stations, retail and recreation, residential, and workplaces). The percentage change in movement for each day is compared to average movement on the same day of the week between 3rd Jan and 6th Feb 2020. Due to privacy concerns (if somewhere isn't busy enough to ensure anonymity), data from the smaller countries of the Caribbean are not publicly available. Data are only collected from users who have opted-in to Google data collection, so the movement data are indicative not representative of a country's population movement.

### 2.2. Included countries and territories

Our Caribbean surveillance work during the COVID-19 outbreak has centred on the 15 CARICOM member states and 5 associate members (See Table 1). We included all 20 members in this review and included 2 further Caribbean countries that have experienced major COVID-19 outbreaks: Cuba and Dominican Republic. Although Belize (Central America) and Guyana and Suriname (north-eastern South America) are geographically separated from the Caribbean islands they each have strong historical and socio-political links to the Caribbean island states. As full members of CARICOM each of these three territories are integrated into the Caribbean political, social, and economic reality. (Girvan, 2001) We included 9 comparator countries from outside of the Caribbean region, which together represent a range of COVID-19 outbreak responses, particularly in terms of response timing and response stringency. Our comparator countries are Germany, Iceland, Italy, New Zealand, Singapore South Korea, Sweden, United Kingdom, Vietnam. In choosing our exemplar countries, we were careful to include examples of good national COVID-19 control (New Zealand, Singapore, South Korea, Vietnam), countries with a range of outbreak responses in Europe (Germany, Iceland, Italy, Sweden, United Kingdom), and island nations with small populations (New Zealand, Iceland, Singapore). See Supplement flowchart and map for further information on how we developed our criteria for Caribbean country inclusions.

### 2.3. Statistical methods

Our analyses are descriptive. We explored the extent of the Caribbean outbreak in two ways. First, we plotted the cumulative cases and deaths across the Caribbean as of May 25th 2020, stratifying into CARICOM and non-CARICOM states. Second, we calculated the growth rate for confirmed cases in each country by using the logarithm of the new daily cases then plotted a 7-day smoothed average growth rate over time for each country on a heatmap. We described the NPIs implemented in each country, grouping measures into those controlling movement into the country (border controls, and border closures), those controlling movement within a

**Table 1**

Selected characteristics of 22 Caribbean territories and 9 international locations.

Country	CARICOM status	(1) Pop (2020)	(2) Pop density (2020)	(3) Land Area (sq km)	(4) Land Border (km)	(5) World Bank Income Group	(6) HDI	(7) % GDP health	(8) GHS Index	(9) (25-May-2020)					
										Total cases	Cases per 100,000	Date 1st case	Total deaths	Date 1st death	Deaths per 100,000
Anguilla	Associate	15,002	165.2	90	0	.	.	.	.	3	20.0	27 Mar	0	–	–
Antigua and Barbuda	Full	97,928	220.7	440	0	High	0.776	4.31	29.0	25	25.5	13 Mar	3	10 Apr	3.1
Bahamas	Full	393,248	38.9	10,010	0	High	0.805	6.38	30.6	100	25.4	16 Mar	11	2 Apr	2.8
Barbados	Full	287,371	667.5	430	0	High	0.813	6.96	31.9	92	32.0	17 Mar	7	4 Apr	2.4
Belize	Full	397,621	17.1	22,810	0		0.720	6.12	31.8	18	4.5	23 Mar	2	6 Apr	0.5
Bermuda	Associate	62,273	1250.2	54	0	High	.	.	.	133	213.6	20 Mar	9	7 Apr	14.5
British Virgin Islands	Associate	30,237	200.2	150	0	High	.	.	.	8	26.5	27 Mar	1	20 Apr	3.3
Cayman Islands	Associate	65,720	270.6	240	0	High	.	.	.	129	196.3	20 Mar	1	21 Mar	1.5
Cuba	Full	11,326,616	106.5	107,400	0	UM	0.777	12.19	35.2	1941	17.1	12-Mar	82	19-Mar	0.7
Dominica		71,991	95.7	750	0	UM	0.723	5.30	24.0	16	22.2	22 Mar	0	–	–
Dominican Republic		10,847,904	222.2	48,310	376	UM	0.744	6.16	38.3	14,442	133.1	1-Mar	458	21-Mar	4.2
Grenada	Full	112,519	329.4	340	0	UM	0.763	5.25	27.5	22	19.6	22 Mar	0	–	–
Guyana	Full	786,559	4.0	196,710	2933	UM	0.670	4.24	31.7	135	17.2	12 Mar	10	12 Mar	1.3
Haiti	Full	11,402,533	408.7	27,560	376	Low	0.502	5.39	31.5	958	8.4	20 Mar	27	7 Apr	0.2
Jamaica	Full	2,961,161	272.2	10,830	0	High	0.725	6.07	29.0	552	18.6	11 Mar	9	25 Mar	0.3
Montserrat	Full	4999	49.9	100	0	–	.	.	.	11	220.0	21 Mar	1	26 Apr	20.0
St Kitts and Nevis	Full	53,192	203.2	350	0	High	0.777	5.67	26.2	15	28.2	25 Mar	0	–	–
St Lucia	Full	183,629	299.7	610	0	UM	0.745	5.31	35.3	18	9.8	14 Mar	0	–	–
St Vincent & the Grenadines	Full	110,947	283.6	390	0	UM	0.728	3.56	33	18	16.2	14 Mar	0	–	–
Suriname	Full	586,634	3.7	156,000	1907	UM	0.723	6.06	36.5	11	1.9	14 Mar	1	4 Apr	0.2
Trinidad and Tobago	Full	1,399,491	271.9	5130	0	High	0.799	6.51	36.6	116	8.3	14 Mar	8	26 Mar	0.6
Turks and Caicos Islands	Associate	38,718	40.2	950	0	–	.	.	.	12	31.0	25 Mar	1	6 Apr	2.6
Germany		83,783,945	239.6	349,130	3714	High	0.938	11.14	66.0	178,570	213.1	28-Jan	8257	10-Mar	9.9
Iceland		341,250	3.4	100,250	0	High	0.938	8.29	46.3	1804	528.6	28-Feb	10	20-Mar	2.9
Italy		60,461,828	205.9	294,110	1836	High	0.882	8.94	56.2	229,858	380.2	31-Jan	32,785	23-Feb	54.2
New Zealand		4,822,233	18.2	263,310	0	High	0.920	9.22	54	1154	23.9	28-Feb	21	29-Mar	0.4
Singapore		5,850,343	8291.9	670	0	High	0.934	4.47	58.7	31,616	540.4	23-Jan	23	22-Mar	0.4
South Korea		51,269,183	526.8	96,460	237	High	0.906	7.34	70.2	11,206	21.9	22-Jan	267	21-Feb	0.5
Sweden		10,099,270	24.5	410,340	2211	High	0.936	10.93	72.1	33,459	331.3	31-Jan	3998	12-Mar	39.6
United Kingdom		67,886,004	279.1	241,930	499	High	0.920	9.76	77.9	259,559	382.3	31-Jan	36,793	7-Mar	54.2
Vietnam		97,338,583	311.1	325,490	4616	LM	0.693	5.66	49.1	325	0.3	23-Jan	0	–	–

(1) United Nations World Population Prospects, 2019. Population size estimates for 2020. Access date July 10, 2020. <https://population.un.org/wpp/>(2) United Nations World Population Prospects, 2019. Population density estimates for 2020 (persons per square km), Access date July 10, 2020. <https://population.un.org/wpp/>(3) Land Area (sq km). The World Bank. Access date July 10, 2020. <https://data.worldbank.org/indicator/AG.LND.TOTL.K2>(4) Length of country land border. CIA Factbook. Access date May 25, 2020. <https://www.cia.gov/index.html>(5) World Bank Country and Lending Groups. Access date July 9, 2020. <https://data.worldbank.org/>(6) Human Development Index (2019). Access date July 10, 2020. <http://hdr.undp.org/en/content/human-development-index-hdi>(7) % GDP spent on healthcare. World Bank Open Data. Access date July 10, 2020. <https://data.worldbank.org/indicator/SH.XPD.CHEX.GD.ZS>(8) Global Health Security Index. Access date July 10, 2020. <https://www.ghsindex.org/>(9) European Centre for Disease Control (ECDC). Access date July 10, 2020. <https://www.ecdc.europa.eu/en/publications-data/download-todays-data-geographic-distribution-covid-19-cases-worldwide>

country (mobility restrictions, curfews, lockdown), and those controlling gatherings (limiting public gatherings, closing public services, and closing schools). These NPI groups are described in more detail in Box 1. Last, we explored the temporal association of containment measures with outbreak data and with movement data. For each country and for each broad containment group (controlling movement into a country, controlling movement within a country, controlling gatherings), we plotted the number of days between the date of first case and the date of the containment measure. Using Google data on community movements, we plotted the daily movement reduction (see Supplement) and the maximum average weekly movement reduction achieved by each country with available data, linking this timing with the implementation of two key containment measures associated with human movement control (curfews, lockdowns).

### 3. Results

In Table 1 we present the numbers of confirmed cases and deaths in each included country, rates per 100,000 population, along with selected country characteristics. The 22 Caribbean SIDS are generally geographically small, with small populations. In 2020, only 5 Caribbean SIDS have estimated populations over 1 million people (Trinidad and Tobago, Jamaica, Dominican Republic, Cuba, Haiti), and 9 have populations less than 100,000. Fourteen SIDS have land areas less than 100 square kms, leading to high population densities; 15 SIDS have densities in excess of 200 people per square km, against a global average of 59 per square km, and several Caribbean SIDS are among the most densely populated countries in the world (Haiti, Barbados, Bermuda). Although the United Nations Human

## Box 1

Taxonomy of government-initiated non-pharmaceutical interventions (NPIs) 1.

Category	Measure	Description of Measure
Control Movement into Country	Border controls	Any measure to intensify border controls, including health checks at border, visa restrictions or suspensions, and requirements for additional health documents.
	Border closure: full	All points of entry closed including complete suspension of international flights and/or full airport closure
	Border closure: partial	Some points of entry into country closed and/or passengers from certain destinations not permitted entry. This also includes any flight suspensions from specific destinations
Control Movement in Country	Mobility restrictions	Includes domestic travel restrictions with or without structured or ad-hoc security checks.
	Curfews	Government order for people to remain in their home between specified hours (mostly at night).
	Lockdown / stay-at-home order: full	24-h curfew and/or country under emergency "stay at home" order, and closure of public spaces. Only movement of essential workers allowed. Only essential services open.
	Lockdown / stay-at-home order: partial	As full lockdown, except that some public spaces remain open and/or specific businesses remain open, in addition to essential services.
Control Gatherings	Limit public gatherings	Any measure to ban or reduce the number of people allowed at public gatherings (such as weddings, funerals, religious worship) and social occasions.
	Close businesses or public services	Any measure to close or limit public access to non-healthcare public services, and/or private businesses.
	Close schools	Any measure to close an educational facility, including tertiary education

1. Taxonomy of government measures adapted from Assessment Capacities Project (ACAPS) <https://www.acaps.org/projects/covid19-0>

Development Index (HDI) across the Caribbean is generally categorized as "High" (between 0.7 and 0.8), the average expenditure on health is around 6% (5.5% excluding Cuba), compared to a European average of 10%. Crucially, all Caribbean SIDS have a Global Health Security Index (GHS) below 40 (average 32, range 24 to 38) against a global average of 40.2 and an average among high-income nations of 51.9.

In Fig. 1 we visualise the cumulative numbers of confirmed cases and deaths across the Caribbean. As of Monday 25th May, there were 18,755 confirmed cases and 631 confirmed deaths among the 22 Caribbean countries and territories. Confirmed cases were dominated by Dominican Republic (14,422 cases, 76.9% of all cases) and to a lesser extent by Cuba (1941 cases, 10.3% of all cases). The remaining 20 CARICOM countries and territories accounted for 2392 confirmed cases, or 12.8% of all cases. Similarly, confirmed deaths were dominated by Dominican Republic (458 deaths, 72.6% of all deaths) and to a lesser extent by Cuba (82 deaths, 13.0% of all deaths). The 20 CARICOM countries and territories accounted for 91 confirmed deaths, or 14.4% of all deaths.

In Fig. 2 we visualise outbreak growth rates by country. Growth rates varied markedly over time in most countries and territories, reflecting periods in each country when higher or lower numbers of cases were identified. CARICOM countries experienced the outbreak later than comparator countries and have so far maintained lower levels of growth than those seen in comparator countries. As of 25-May-2020, twelve out of 22 Caribbean territories had kept their maximum growth rates below 10% and of the remaining ten Caribbean territories, maximum growth rates ranged between 13% (The Bahamas, Jamaica) and 40% (Dominican Republic). Most Caribbean growth rate trajectories were similar in magnitude to those seen in two Asian comparator countries, Vietnam (13%) and Singapore (16%), indicative of good initial outbreak control. Comparator countries saw higher growth rates and a wider range of growth, between 13% (Vietnam) and 63% (Italy).

In Fig. 3 we present containment measures in our three broad categories: measures to control movement into a country, measures to control movement within a country, and measures to control mass gatherings. Sixteen out of the 22 Caribbean countries implemented a full border closure, compared to 1 of 9 comparator countries (New Zealand). Roughly equal proportions of Caribbean and comparator countries initiated some form of lockdown, but only Caribbean countries implemented strict evening and overnight curfews. All countries implemented measures to control gatherings.

In Fig. 4 we present the timing of NPIs, relative to the date of first confirmed case in each country. Broadly, Caribbean countries and territories tended to implement NPIs earlier, compared to the international comparator countries. Within the Caribbean the order of implementing measures has been control of movement into countries, followed by control of gatherings, and then control of movement within countries. Comparator countries tended to follow the same pattern but waited longer before implementation. When examining the spread of NPI timings across the Caribbean, many Caribbean territories followed similar timings to New Zealand and Iceland. On average, Caribbean countries began controlling movements into countries 27 days before the first confirmed case (inter-quartile range (IQR) 48 to 4 days before). This compares to 4 days before the first confirmed case among comparator countries (IQR 23 days before to 22 days after). Caribbean countries began controlling movement within a country 9 days after the first confirmed case (IQR 2 days to 15 days after), compared to 45 days after among comparator countries (IQR 24 to 55 days after). Caribbean countries began controlling gatherings 1 day before the first confirmed case (IQR 5 days before to 2 days after), compared to 29 days after among comparator countries (IQR 22 to 42 days after).

In Fig. 5 we present the maximum reduction in weekly community movement data in selected Caribbean and comparator countries. With the exception of Haiti (39% maximum reduction) and Jamaica (50% maximum reduction), the largest weekly reductions in movement over a full week were above 60% in all Caribbean countries, over 70% in 5/8 Caribbean countries, and over 80% in 1 Caribbean country (Barbados). In the 8 comparator countries with available movement data, maximum movement

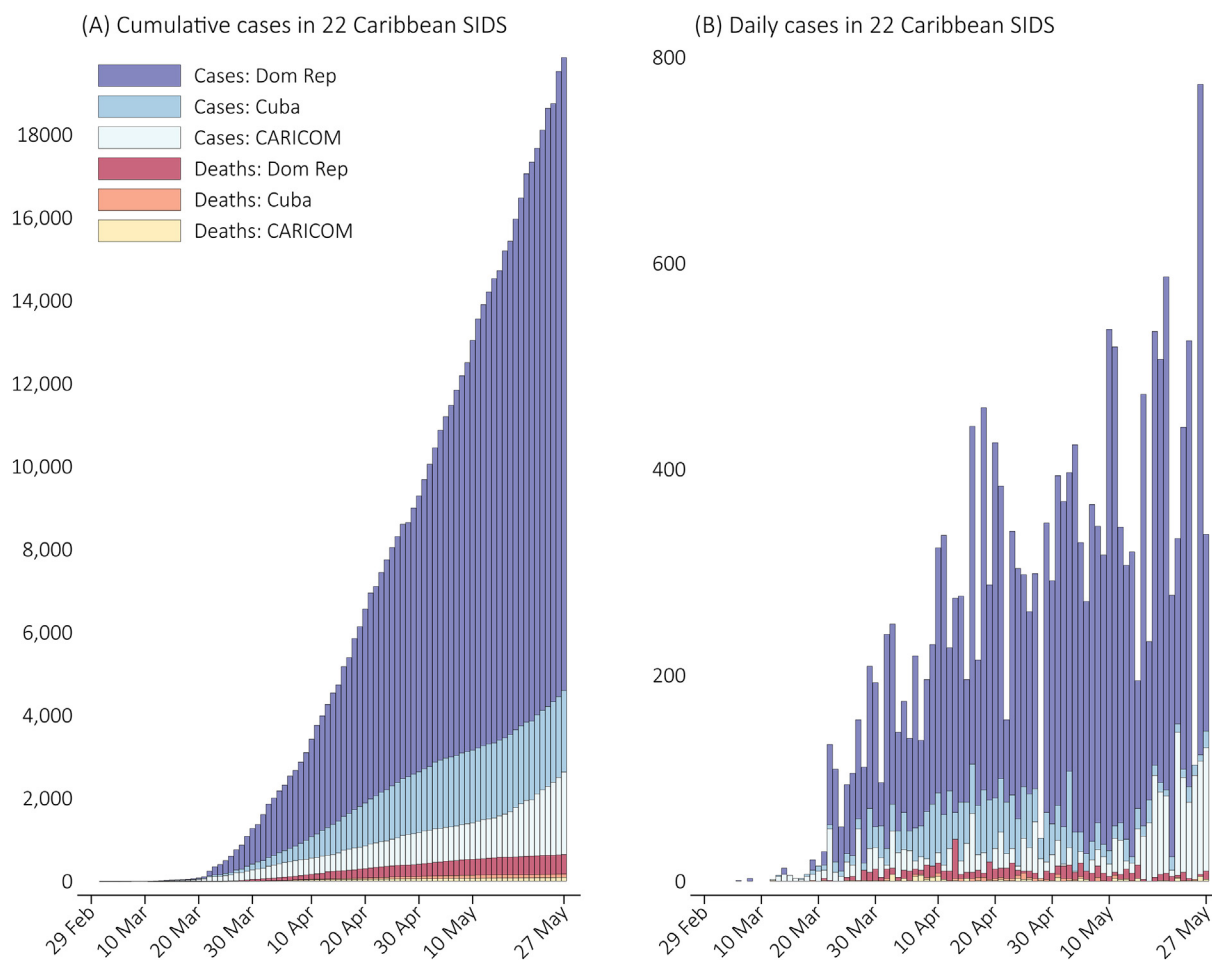


Fig. 1. Numbers of confirmed cases and confirmed deaths from COVID-19 in 22 Caribbean countries and territories up to 25 May 2020.

reductions were over 70% in only 2/8 countries (Italy, New Zealand). The implementation of a major NPI to limit movement (curfews and/or lockdowns) was largely followed by a fall in population mobility, but there was much variation in this effect. Several countries saw a sharp fall in mobility co-incident with the date of either curfew and/or lockdown implementation (Antigua and Barbuda, Barbados, Trinidad and Tobago, New Zealand, Singapore), while for others the decline was either more gradual or less pronounced (see Supplement graphics for country-level details). In Barbados (for example) two drops in movement occurred: a 23 percentage point drop on 29th March, 1-day after a national curfew order, and a further 32 percentage point drop on 4th April, 1 day after a national stay-at-home order. Similarly, stark drops were seen in Antigua and Barbuda, New Zealand and Italy, all of which implemented stringent lockdown conditions (see Supplement for details).

#### 4. Discussion

As of Monday 25th May, there were 18,755 confirmed cases and 631 confirmed deaths among the 22 Caribbean countries and territories. The maximum growth rate in the Caribbean was 40% in the Dominican Republic, compared to 63% in the comparator country of Italy. Caribbean countries were more likely to implement a full border closure and strict overnight curfews. They were also more likely to introduce NPI measures earlier than comparator countries relative to the date of their first confirmed case. Peak movement reductions were above 70% in 5/8 Caribbean countries, and in only 2/8 comparator countries.

As of 25 May 2020, the Caribbean region had broadly achieved initial COVID-19 containment, with the exception of the evolving outbreak on the island of Hispaniola. Given the struggles some developed comparator

countries have had with containment, and the low GHS scores across the Caribbean, this is a significant success for the CARICOM SIDS. Although Caribbean countries initially developed their NPI implementation strategies using local expertise and international evidence, they nevertheless followed similar initial NPI pathways, focusing first on measures to limit movement into their respective countries. These sensible early precautions were an attempt to block imported cases and may be particularly important in small islands with a limited and manageable number of physical entry points. Several CARICOM member states have long and often remote land borders: Haiti (with Dominican Republic), Guyana and Suriname (with Brazil, Venezuela, French Guiana, each other) and Belize (with Guatemala and Venezuela), and the need to monitor movement across these borders is an additional resource challenge. The significance of early border controls and closures should be placed within the economic context of the region. Tourism is a dominant revenue stream for many Caribbean SIDS, with their reliance on international arrivals, particularly from Europe and North America. Governments were aware that border controls and closures would have severe economic effects. Weighed against this was the known fragility of regional health systems, and governments were keen to avoid their health systems being overwhelmed by a sharp increase in hospitalisations. Using the date of first confirmed case in each country as our indicator, Caribbean SIDS generally implemented NPIs earlier than our chosen comparator countries. For movements into a country, the Caribbean on average implemented controls 23 days before their comparator counterparts. For control of movement within countries, the Caribbean implemented controls 36 days before comparators, and for control of gatherings the Caribbean on average implemented controls 30 days before comparator countries. This three-to-four week 'head-start' by Caribbean countries may be partly attributed to the region having seen the outbreak

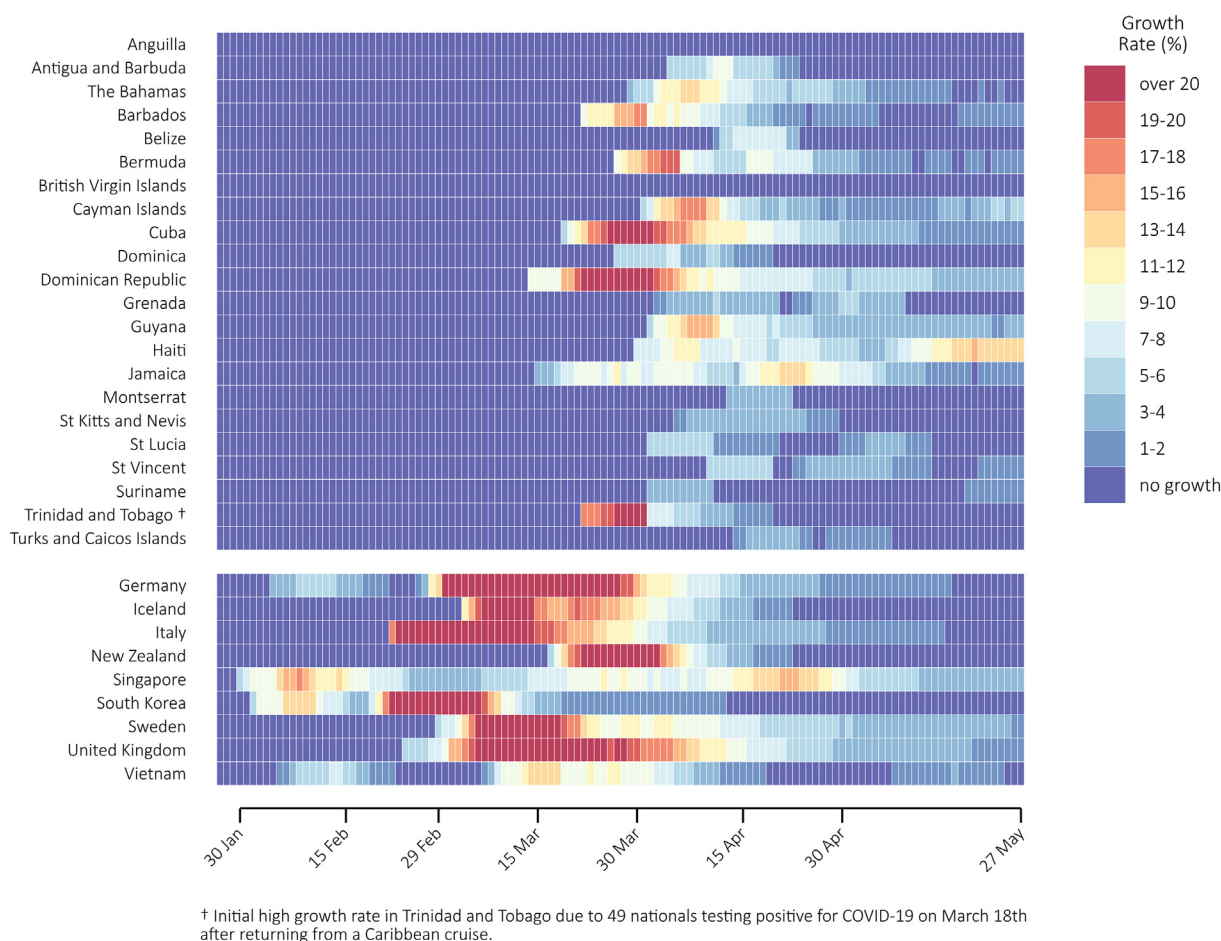
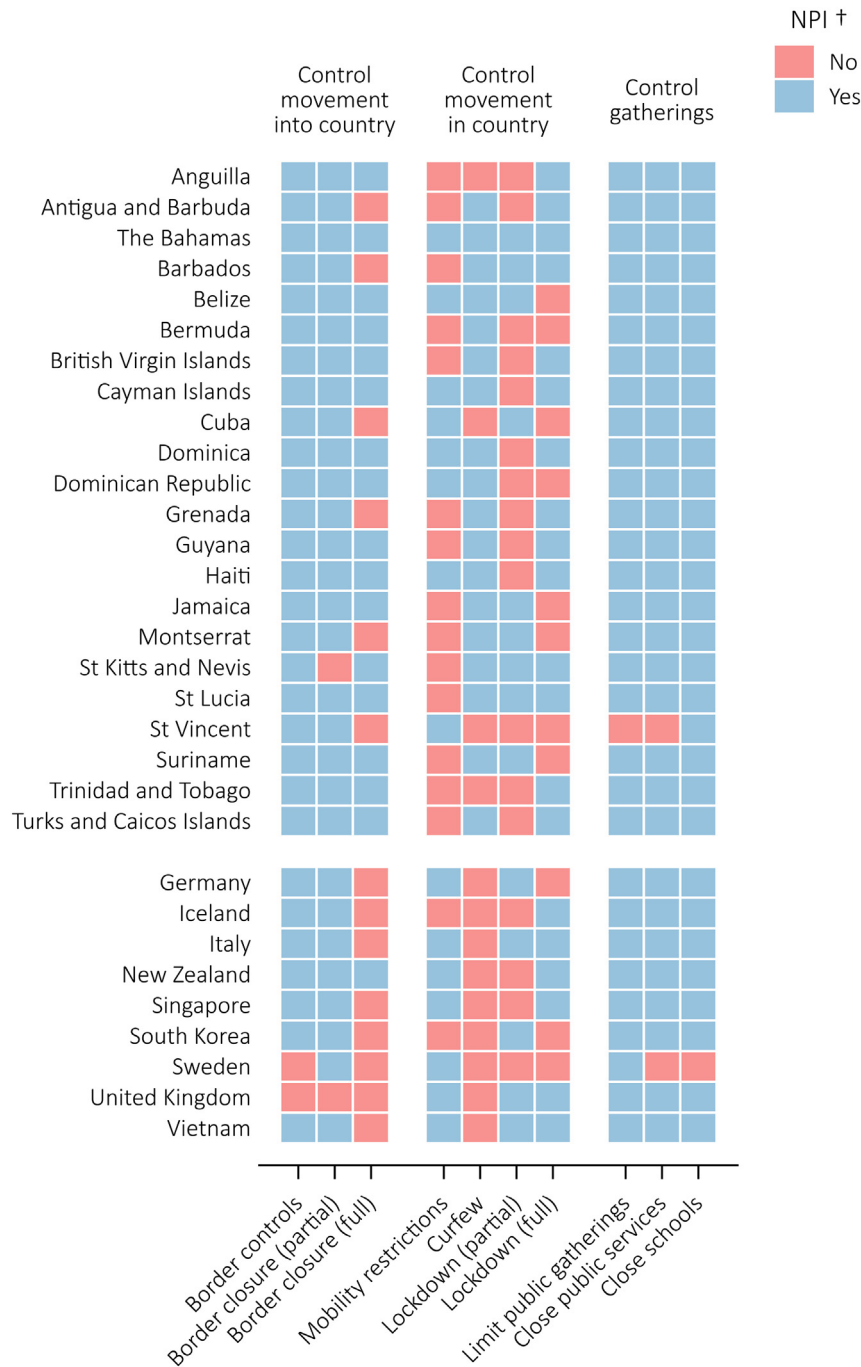


Fig. 2. COVID-19 confirmed case growth rates in 22 Caribbean countries and territories and 9 international locations up to 25-May-2020.

unfold in other parts of the world, and the longer grace period before COVID-19 arrival in the region. It may also reflect Governments' recognising the potential for hospitalisations to overwhelm vulnerable health system infrastructures, spurring them into strong and early outbreak suppression. (Ferguson, Laydon, Nedjati-Gilani, et al., 2020)

Of the 193 countries in the ACAPS database, 96 initiated a curfew order, with 59% of those countries in Africa and the Americas. In the Caribbean, governments quickly passed emergency laws that allowed for enforceable curfews and stay-at-home orders. Curfews were common in the Caribbean, with populations not allowed to leave their homes for any reason except emergencies (or emergency work). Associated punitive measures were regularly significant; in Barbados for example, a fine of 50,000 Barbados dollars (USD 25,000) or 1-year in prison were possible. Curfews were mostly applied during the hours of darkness, and a logic to this would have been to prevent evening gatherings. Movement restrictions are used as a safety measure by Caribbean governments as seasonal storms approach the islands, and a psychological readiness might have contributed to a general willingness among the public to accept similarly stringent government controls applied to the COVID-19 outbreak. (Hambleton, Jeyaseelan, and Murphy, 2020) Although curfews were not officially implemented in any of our comparator countries, this may reflect the semantics of terminology, with curfews possibly seen by some governments as sounding overly authoritarian. Some countries, without using the term "curfew", operated near curfew-like conditions. Italy for example required those leaving their homes to carry movement exemption forms, with fines for breaches of these rules. The stringency of national lockdowns, including curfews seem to impact heavily on community mobility, with countries implementing strict measures seeing stark drops in post-implementation mobility. The extent of a Government's willingness to implement and enforce stringent

movement restrictions will have been a compromise between the desire to limit transmission and the perceived success of the intervention given known societal norms. A full examination of these influences is important, but beyond the scope of this initial work. Among countries for which human mobility data were available (8 Caribbean countries, 8 comparators) curfews and lockdowns were visually associated with marked falls in human movement. For example, Barbados, Antigua and Barbuda, Trinidad and Tobago, and New Zealand saw sustained post-lockdown drops in excess of 30 percentage points (see supplement for details). In the case of Barbados, implementation of curfew followed by lockdown each coincided with clear mobility reductions. It may be that a curfew order acted as a national sensitisation measure for subsequent full lockdown. South Korea is separated from China by North Korea, so is effectively an island with respect to border travel and access. As such it offers one practical alternative to the stringent lockdowns favoured across the Caribbean. The country has not initiated a full lockdown, but has limited the outbreak and maintained a low death rate by implementing – early in their outbreak – one of the highest test-per-capita rates in the world, along with strong technology-aided national contact tracing and messaging campaigns. The approach required a national tolerance for data-sharing and a fast scale-up of technological solutions. (Our World in Data, 2020) For the Caribbean, a priority is to safely but effectively re-invigorate international tourism as Caribbean islands look to reopen their economies for business. Increased tourism from the European and North American markets increases the opportunity for imported cases and subsequent local transmission. Consequently, modified NPIs that minimise the chance of a renewed outbreak without negatively impacting the tourist experience will need to be envisaged. One potential option is the concept of travel corridors allowing free movement between countries or cities that have good containment, but



† NPI: non-pharmaceutical intervention

Fig. 3. Non pharmaceutical interventions (NPIs) implemented by 22 Caribbean countries and territories and 9 international locations, stratified by type of NPI.

restricting movement from higher-risk locations to safeguard public health. As timing of NPIs has emerged as an important factor in containing the outbreak, it should now encourage a proactive approach as countries plan to encourage tourism. National evidence-based risk assessments, drawing on country-level goals and limitations are a priority. Continued outbreak surveillance remains a critical tool to enable swift action following accelerated transmission. As always, it could be sensible to learn from successful models implemented elsewhere.

This descriptive study has limitations. We focus only on NPIs related to movement and we recognize that other NPIs such as contact tracing, and isolation and quarantine protocols will have also helped to reduce transmission. We have described the type and timing of NPIs implemented and have

inferred their impact on COVID-19 transmission. However, we have not attempted to quantify these effects, nor have we accounted for other factors that may impact transmission, such as the effect of climate on virus longevity. (Eslami and Jalili, 2020) The data we use in this article has been drawn from disparate sources, each of which has limitations. The number of cases we report is based on the number of tests performed, and as population-level testing remains economically impractical, no country currently knows the extent of their underlying outbreak. The NPI data are drawn partly from informal sources such as media reports with implied quality concerns. To counter this we have made systematic efforts to triangulate our NPI information wherever possible. Although we have used two quantitative categories to describe the implementation of lockdowns, in reality

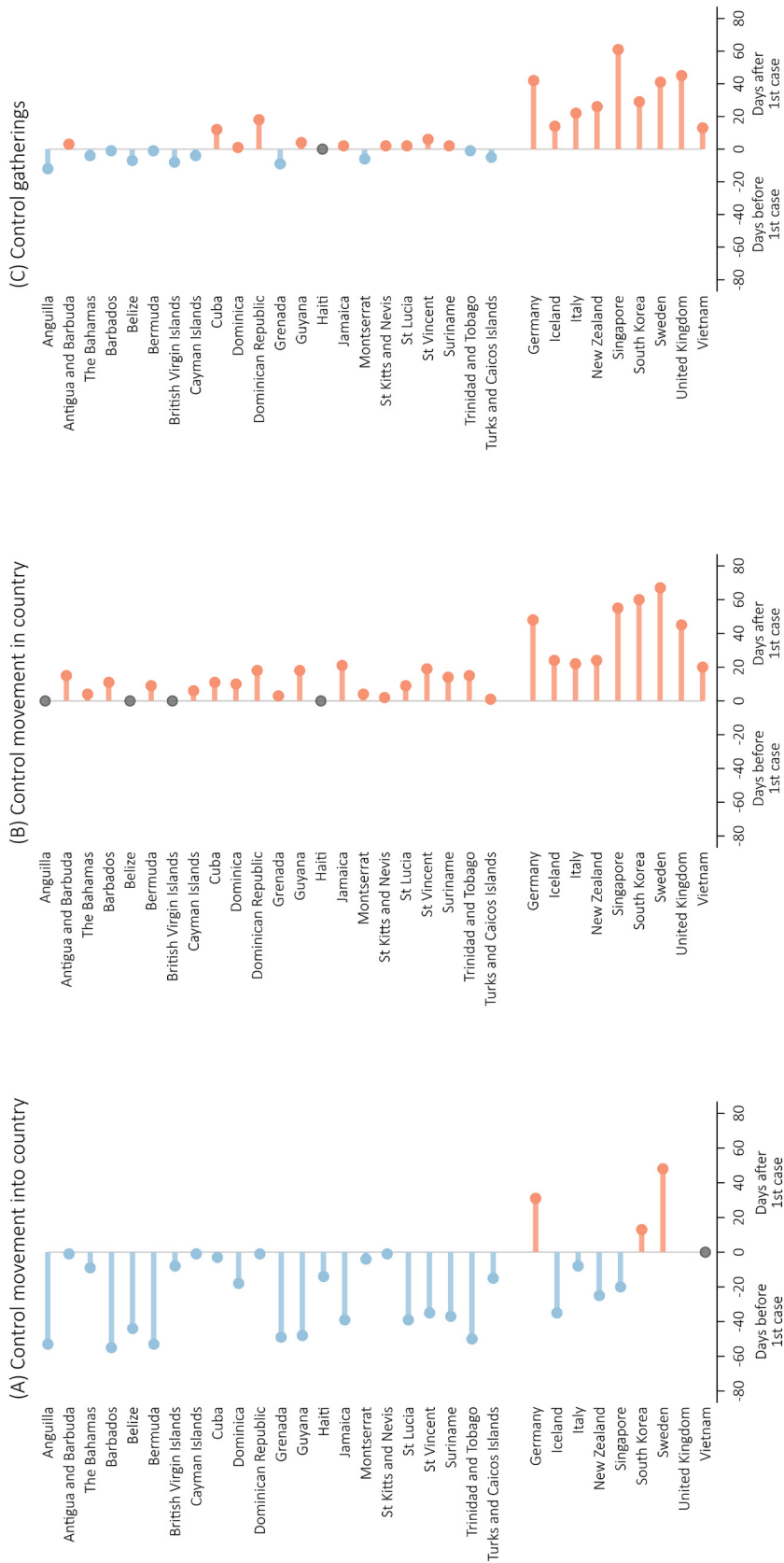


Fig. 4. The number of days between the date of first confirmed case of COVID-19 and the date of introducing the first non-pharmaceutical intervention (NPI), stratified by country and by NPI type.

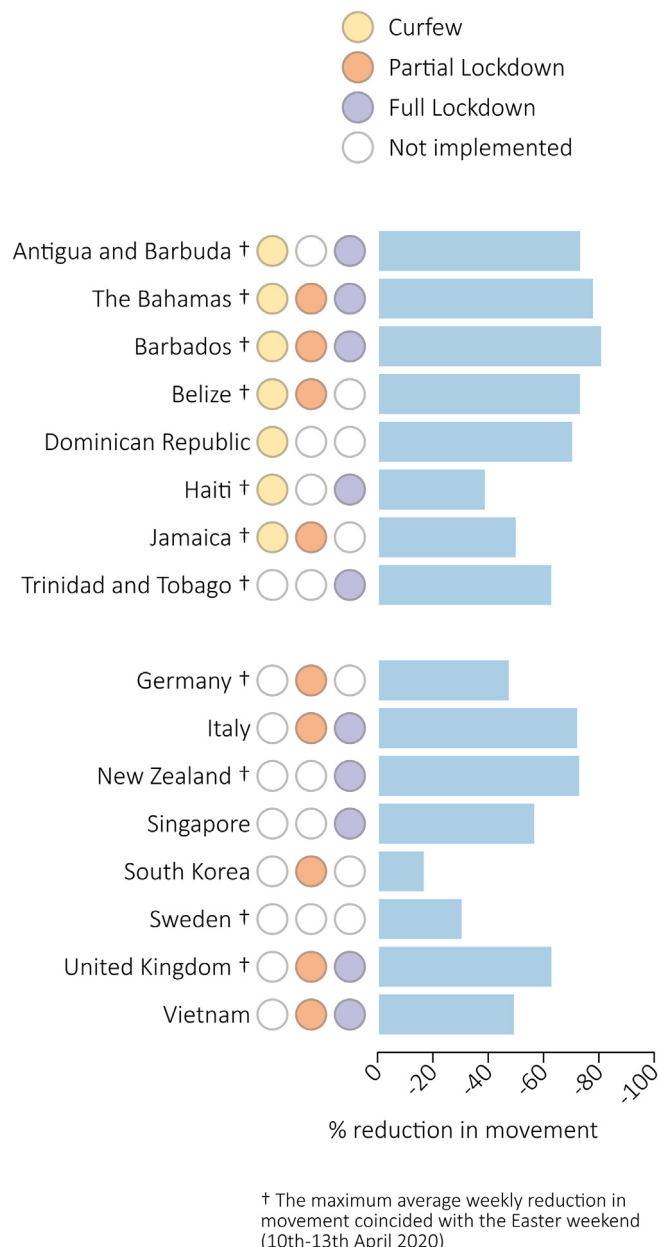


Fig. 5. The maximum average weekly reduction in population mobility among 8 Caribbean countries and 8 comparator countries.

national stay-at-home orders varied markedly in their stringency and geographical reach. This variation in stringency included country-level differences in what constituted essential services.

Stringent controls to limit movement, and specifically the early timing of those controls has had an important impact on containing the spread of COVID-19 across much of the Caribbean. Very early controls to limit movement into the country may well be particularly effective for SIDS. With much of the region economically reliant on international tourism, and with steps to open borders now being implemented, it is critical that the region draws on a solid evidence-base to balance the competing demands of economics and public health.

#### Declaration of interest statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Appendix A. Supplementary data

Supplementary information to this article can be found online at <https://doi.org/10.1016/j.resglo.2020.100019>.

#### References

- ACAPS (2020). COVID-19 Government Measures Database. Available from: <https://www.acaps.org/covid19-government-measures-dataset>.
- Aktay, A., Bavadekar, S., Cossoul, G., Davis, J., Desfontaines, D., Fabrikant, A., Gabrilovich, E., Gadepalli, K., Gipson, B., Guevara, M., & Kamath, C. (2020, April). Google COVID-19 community mobility reports: Anonymization process description (version 1.0). arXiv preprint arXiv:2004.04145.
- Andrewin, A. N., Rodriguez-Llanes, J. M., & Guha-Sapir, D. (2015). Determinants of the lethality of climate-related disasters in the Caribbean Community (CARICOM): A cross-country analysis. *Scientific Reports*, 5, 11972.
- CARICOM Today (2020, March 1st). CARICOM Heads, Ministers Agree On COVID19 Protocol. Available from: <https://today.caricom.org/2020/03/01/caricom-heads-ministers-agree-on-covid19-protocol/>.
- Dong, E., Du, H., & Gardner, L. (2020). An Interactive Web-Based Dashboard to Track COVID-19 in Real Time. [https://doi.org/10.1016/S1473-3099\(20\)30120-1](https://doi.org/10.1016/S1473-3099(20)30120-1).
- Eldemire-Shearer, D., James, K., Morris, C., Holder-Nevins, D., Lawes, H., & Harris, M. (2011). Chronic disease and ageing in the Caribbean: Opportunities knock at the door. *The West Indian Medical Journal*, 60(4), 471–477.
- Eslami, H., & Jalili, M. (2020). The role of environmental factors to transmission of SARS-CoV-2 (COVID-19). *AMB Express*, 10(1), 92.
- European Centre for Disease Control (ECDC) (2020). Daily data download on the geographic distribution of COVID19 cases worldwide. Available from: <https://www.ecdc.europa.eu/en/publications-data/download-todays-data-geographic-distribution-covid-19-cases-worldwide>.
- Neil M Ferguson, Daniel Laydon, Gemma Nedjati-Gilani et al. Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand. Imperial College London (16-03-2020), doi: 10.25561/77482.
- Girvan, N. (2001). Reinterpreting the Caribbean. In B. meeks, & L. Folke (Eds.), *New Caribbean Thought: A Reader* (pp. 3–23). Kingston, Jamaica: University of West Indies Press.
- Google LLC (2020). COVID-19 Community Mobility Reports. Available from: <https://www.google.com/covid19/mobility/index.html?hl=en>.
- Hambleton, I. R., Jeyaseelan, S. M., & Murphy, M. M. (July 02,2020). COVID-19 in the Caribbean small island developing states: lessons learnt from extreme weather events. *Lancet Glob Health*. [https://doi.org/10.1016/S2214-109X\(20\)30291-6](https://doi.org/10.1016/S2214-109X(20)30291-6).
- Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., et al. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan. *China. Lancet*, 395(10223), 497–506.
- Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-OHRLS) (2015). Small Island Developing States in Numbers - Climate Change Edition 2015 Downloaded from: <https://sdgs.un.org/publications/small-island-developing-states-numbers-climate-change-edition-2015-17996>.
- Our World in Data. Emerging COVID-19 success story: South Korea learned the lessons of MERS. 30- June 2020 Available from: <https://ourworldindata.org/covid-exemplar-south-korea>.
- Samuels, T. A., & Unwin, N. (2018). The 2007 Caribbean Community Port-of-Spain Declaration on noncommunicable diseases: An overview of a multidisciplinary evaluation. *Revista Panamericana de Salud Pública*, 42, Article e193.
- Samuels, T. A., Kirton, J., & Guebert, J. (2014). Monitoring compliance with high-level commitments in health: The case of the CARICOM summit on chronic non-communicable diseases. *Bulletin of the World Health Organization*, 92(4), 270 6B.
- Spiteri, G., Fielding, J., Diercke, M., Campese, C., Enouf, V., Gaymard, A., et al. (2020). First cases of coronavirus disease 2019 (COVID-19) in the WHO European Region, 24 January to 21 February 2020. *Euro Surveill*, 25(9).
- Suzana, M., Walls, H., Smith, R., & Hanefeld, J. (2018). Achieving universal health coverage in small island states: Could importing health services provide a solution? *BMJ Global Health*, 3(1), Article e000612.
- United Nations General Assembly (2014). SIDS Accelerated Modalities of Action (SAMOA) Pathway. Resolution adopted by the General Assembly on 14 November. Available from [http://www.un.org/ga/search/view\\_doc.asp?symbol=A/RES/69/15&Lang=E](http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/69/15&Lang=E).
- World Health Organization (2020, May). Coronavirus disease (COVID-2019) situation reports. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>.
- World Health Organization Writing Group (2006). Nonpharmaceutical interventions for pandemic influenza, international measures. *Emerging Infectious Diseases*, 12(1), 81–87. <https://doi.org/10.3201/eid1201.051370>.