Need for open data on COVID-19 vaccine uptake among pregnant people in the Caribbean: a call to action

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ABSTRACT

Pregnant people with coronavirus disease 2019 (COVID-19) have a higher risk of adverse maternal and fetal outcomes compared with pregnant people without COVID-19. In 2021, large increases in maternal mortality were reported in Jamaica, almost half of which were attributable to COVID-19. COVID-19 vaccination has been shown to reduce these risks, but low- and middle-income countries lack free, publicly available data, known as open data, on COVID-19 vaccine uptake for their pregnant populations. The objectives of this paper were to: review how high-income countries use open data to detect trends in COVID-19 vaccine uptake among pregnant people and develop vaccination distribution strategies; outline barriers to making open data available for maternal COVID-19 vaccination in the Caribbean; and propose a multipronged strategy that would increase the availability of open data on maternal COVID-19 vaccination in the Caribbean. A multipronged strategy to fill the data void would involve: (i) utilizing existing Caribbean maternal immunization data collection entities; (ii) adapting digital software tools to establish maternal electronic immunization registries; and (iii) collaborating with local partners skilled in data analytics. Making open data available for COVID-19 vaccine uptake among pregnant people in the Caribbean could offer substantial benefits, including the development of measurable maternal COVID-19 vaccination goals and the facilitation of vaccine decision-making discussions between providers and pregnant people.

Keywords

COVID-19; vaccination; pregnancy; Caribbean Region.

Pregnant people with coronavirus disease 2019 (COVID-19) are at increased risk of adverse maternal and fetal outcomes compared with pregnant people without COVID-19 (1). Pregnant people with COVID-19 are 15 to 22 times more likely to die compared with pregnant people without COVID-19 (1). Although aggregate mortality data specific to COVID-19 are not available for pregnant persons in the Caribbean, Jamaica, reported a two-fold increase in maternal mortality in 2021, which is the highest it has been in the past 100 years (213 maternal deaths per 100 000 live births) (2).

COVID-19 vaccines are highly effective in preventing severe COVID-19 illness in pregnancy (3). In the USA, a study of 10 092 pregnant women seen between June and August 2021 found that women who were fully vaccinated against COVID-19 had one tenth the odds of developing severe or critical COVID-19 compared with women who were unvaccinated (3). Similarly, in Brazil, a study of 1 609 pregnant women seen between May 2020 and March 2022 found women who were vaccinated against COVID-19 were 60% less likely to die or be admitted to the intensive care unit compared with women who were unvaccinated (4).

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Despite this benefit, epidemiological studies conducted in high-income countries during the early stages of the COVID-19 pandemic found that vaccine uptake was low among pregnant people (5). Low uptake was primarily driven by patient concerns about safety. Since then, several observational studies demonstrating the safety and efficacy of messenger ribonucleic acid (mRNA) (3) and adenoviral-vector COVID-19 vaccines during pregnancy (6) have been published, lessening safety-related vaccine hesitancy. Open data in the USA and United Kingdom of Great Britain and Northern Ireland have subsequently shown relatively high vaccine uptake among all pregnant people with 70% and 66%, respectively, of all pregnant people completing their primary series, as of June 2022 (7). However, in the Caribbean, small observational studies found low levels of COVID-19 vaccine uptake among pregnant people from February to May 2022: 24–35% (8). As of January 2023, it was not known if maternal COVID-19 vaccination had increased over time in the Caribbean because open data on COVID-19 vaccine uptake among pregnant people were largely unavailable.

The objectives of this paper were to: review how high-income countries use open data to detect trends in COVID-19 vaccine uptake among pregnant people and develop vaccination distribution strategies; outline barriers to making open data available on maternal COVID-19 vaccination in the Caribbean; and propose a multipronged strategy that would increase the availability of open data for maternal COVID-19 vaccination in the Caribbean.

BRIEF REVIEW OF OPEN DATA

Open data – or free, publicly available digital data – can play a crucial role in the planning stages of successful public health programs (9). The Open Data Charter was first created at a Group of Eight (G8) summit in 2013 as a way to promote collaboration, innovation, and transparency between governments. From there, the International Open Data Charter formulated six key principles of open data in 2015, including that data should be publicly available, timely, accessible, easy to integrate with other data, and easy for citizens to understand (9). Open data should also abide by the necessary regulations and international data-sharing legislation required for it to be accessed and used by anyone while maintaining individual privacy (9). The ideology of open data has been eagerly adopted by the scientific community, public health organizations, and government entities, all of which cite a wide range of benefits, including the use of these data to detect trends early and to inform public health interventions and policies (9).

USE OF OPEN DATA TO DETECT EARLY MATERNAL VACCINATION TRENDS

In the USA, open data generated from electronic pregnancy registries and the COVID-19-Associated Hospitalization Surveillance Network (COVID-NET) drew attention to the low COVID-19 vaccine uptake among pregnant people in August 2021 (10). At that time, 52% of pregnant people had completed their primary series (receiving ≥ 2 doses of a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) mRNA COVID-19 vaccine) for the cumulative time period December 14, 2020 to August 28, 2021 (7).

The low percentage of pregnant people vaccinated was freely shared as open data and generated public and media attention (7, 10). The US Centers for Disease Control and Prevention (CDC) issued an urgent health advisory on September 29, 2021, imploring pregnant people, public health jurisdictions, and health care providers to increase vaccination efforts for this group (10). Linked to the advisory were several critical resources, including educational information about the COVID-19 vaccine safety in pregnancy, opportunities for funding of vaccination implementation projects, and best practice guidance on how to partner with community-based organizations, pharmacies, and mobile clinics (10).

Thereafter, vaccine uptake improved (7). Although not solely the result of open data, the public availability of these data, which facilitated early trend detection and public awareness, likely played a role.

USE OF OPEN DATA TO INFORM US VACCINATION DISTRIBUTION STRATEGIES

In the USA, the Behavioral Risk Factor Surveillance System, an open access state-based surveillance system that collects population data on preventive health behaviors, is an example of how open data can be used to inform interventions and policies that affect vaccine uptake (11). For instance, an analysis of the 2018 data from the Behavioral Risk Factor Surveillance System on influenza vaccine uptake showed that individuals who would be considered high-risk for severe-COVID-19 based on their age and comorbidities were more likely to receive their influenza vaccines at doctor's offices and pharmacies rather than in community settings (11), providing critical information for focused COVID-19 vaccine distribution efforts (11). Similar analyses could be performed to identify preferred vaccination sites for pregnant people, reducing the location of vaccination sites as a potential barrier.

WAYS TO GENERATE OPEN DATA IN THE CARIBBEAN

The CDC has highlighted several global digital tools capable of generating open data including CommCare (12), which is currently used by a few of the Caribbean countries (e.g. Belize, Haiti, and Jamaica) to generate COVID-19-related data (G. Stoudemire, personal communication, August 22, 2022), including tracking COVID-19 vaccine administration, vaccine stock monitoring, and COVID-19 contact tracing. CommCare is an open-source, online data collection tool which can be adapted for electronic immunization registries and decision support applications (12). While CommCare is cited here as a practical example, any digital tool capable of generating anonymized open data could be used. Implementation of these digital tools will require substantial training of staff members in data management and analysis (13), as well as operational support for software, internet, and equipment expansion (13).

EXISTING MATERNAL IMMUNIZATION MONITORING SYSTEMS IN THE CARIBBEAN

In 2022, PAHO included 32 Caribbean member and associate member countries and territories, 20 of which were part of the Caribbean Community (CARICOM) (14–16), which is

an intergovernmental organization that promotes economic integration and foreign policy coordination among Caribbean countries/territories, and operates as a single market with a single economy (Figure 1). The Caribbean Public Health Agency (CARPHA) is the public health arm of this organization and typically reports pooled health data from participating CARICOM countries/territories. As of January 2023, PAHO and CARPHA websites did not have open data on maternal COVID-19 vaccination coverage for CARICOM countries/territories. PAHO entities that currently monitor non-COVID-19 maternal vaccination coverage (15) could be expanded to create open data on maternal COVID-19 vaccination in the region.
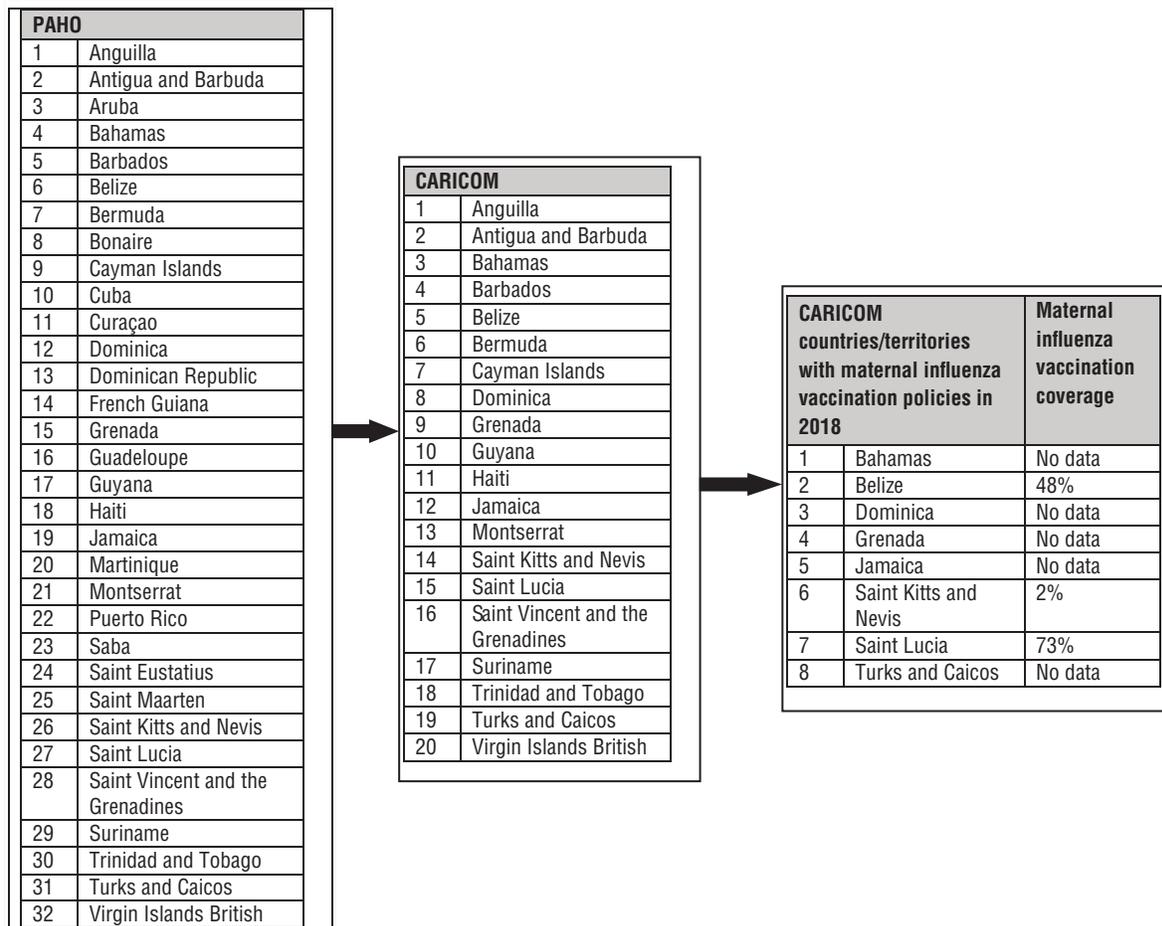
As of January 2023, the Caribbean Immunization Technical Advisory Group (CITAG) (15) was the main entity that used data from the PAHO Caribbean subregional office to make policy recommendations for non-COVID-19 maternal vaccination coverage in CARICOM countries/territories. CITAG was created in 2017 in response to PAHO's regional immunization action plan, which urged member countries/territories to establish a national immunization technical advisory group by 2020 (14–16). CITAG maternal immunization policy recommendations included increasing the number of member countries/

territories with national electronic immunization registries and increasing influenza vaccination coverage for pregnant people (15, 16). However, by 2020, only six (30%) of all CARICOM countries/territories had electronic immunization registries (17), eight (40%) had maternal influenza vaccination in their national immunization schedule (16), and three (15%) had data available for influenza vaccine uptake among pregnant people (2–73%) (Figure 1) (16).

TRANSFORMING MATERNAL VACCINATION DATA COLLECTED BY PAHO TO OPEN DATA

The 2017–2019 data on maternal influenza vaccination in the Caribbean were not open as they could only be accessed through special requests to individual health ministries or through journal publications with a pay wall (16). PAHO identified several barriers to obtaining regional data on maternal influenza vaccination coverage (15, 16), which would affect the availability of open data. These challenges included: tracking pregnant people vaccinated during national vaccination campaigns; difficulty in merging vaccination records from private and public facilities; absence of pregnancy status as a field in

FIGURE 1. PAHO member and associate member countries and territories in the Caribbean, CARICOM member countries and territories, and influenza vaccine uptake in pregnant people, January 2023

PAHO	
1	Anguilla
2	Antigua and Barbuda
3	Aruba
4	Bahamas
5	Barbados
6	Belize
7	Bermuda
8	Bonaire
9	Cayman Islands
10	Cuba
11	Curaçao
12	Dominica
13	Dominican Republic
14	French Guiana
15	Grenada
16	Guadeloupe
17	Guyana
18	Haiti
19	Jamaica
20	Martinique
21	Montserrat
22	Puerto Rico
23	Saba
24	Saint Eustatius
25	Saint Maarten
26	Saint Kitts and Nevis
27	Saint Lucia
28	Saint Vincent and the Grenadines
29	Suriname
30	Trinidad and Tobago
31	Turks and Caicos
32	Virgin Islands British

CARICOM	
1	Anguilla
2	Antigua and Barbuda
3	Bahamas
4	Barbados
5	Belize
6	Bermuda
7	Cayman Islands
8	Dominica
9	Grenada
10	Guyana
11	Haiti
12	Jamaica
13	Montserrat
14	Saint Kitts and Nevis
15	Saint Lucia
16	Saint Vincent and the Grenadines
17	Suriname
18	Trinidad and Tobago
19	Turks and Caicos
20	Virgin Islands British

CARICOM countries/territories with maternal influenza vaccination policies in 2018		Maternal influenza vaccination coverage
1	Bahamas	No data
2	Belize	48%
3	Dominica	No data
4	Grenada	No data
5	Jamaica	No data
6	Saint Kitts and Nevis	2%
7	Saint Lucia	73%
8	Turks and Caicos	No data

PAHO, Pan American Health Organization; CARICOM, Caribbean Community.
Source: PAHO (14,16).

both electronic immunization registries and written pregnancy immunization cards; relocation of pregnant people as a result of natural disasters (e.g. Hurricane Irma and Hurricane Maria in 2017); and difficulty in calculating the pregnant population (denominator), particularly when births occurred in other countries/territories (15, 16).

To address these challenges, PAHO recommended the following approaches: (i) disaggregating pregnant people from other influenza high-risk groups at the time of data collection by recording pregnancy status in national data collection tools (preferably electronic immunization registries); (ii) consolidating data on maternal influenza vaccination from multiple sources, including national vaccination campaigns, public health care facilities, and private health care facilities in a national electronic immunization registry; and (iii) estimating the total number of pregnant people at any given time period, which is essential to establish the denominator needed to calculate vaccination coverage (i.e. all persons with pregnancies in each year) (16). PAHO proposed using the number of live births per year (i.e. crude annual birth rate) as a proxy for the number of pregnant people in a year and dividing the number of live births by 12 to estimate the monthly number of pregnant people (16). For example, the crude birth rate in Haiti was 23.6 per 1000 population in 2020 (18). With a population of 11.5 million (18), an estimated 272 384 live births would occur per year and 272 384 people would be pregnant per year, equivalent to 22 699 pregnant people per month (Table 1). Therefore, a reasonable public health goal would aim for 75% COVID-19 vaccination coverage among pregnant people each month, equivalent to

vaccinating 17 024 pregnant people every month in the case above. Limitations to this method include double-counting multiparous pregnant people and excluding pregnant people who experienced a miscarriage or delivered outside of the country (15, 16).

Overall, the systems created to monitor non-COVID-19 vaccination coverage among pregnant persons in CARICOM countries/territories serve as an ideal starting point to generate open data on COVID-19 maternal vaccination coverage in the region.

BARRIERS TO GENERATING OPEN COVID-19 VACCINATION DATASETS AND ELECTRONIC IMMUNIZATION REGISTRIES IN THE CARIBBEAN

A significant barrier to generating open data in the Caribbean is the lack of maternal electronic immunization registries (14–17). As of January 2023, most COVID-19 vaccination data collection tools in the Caribbean did not have pregnancy status as an input field, thus limiting the ability to generate open data on maternal COVID-19 vaccination.

A few Caribbean countries are in the process of developing separate dedicated electronic immunization registries. In Jamaica and Guyana, Digital Square, a global initiative of the Program for Appropriate Technology in Health (PATH), recently recruited technical consultants to assess the immunization information system and create electronic immunization registries. The proposed electronic immunization registries focus on childhood vaccinations only; however, collaboration

TABLE 1. Estimated number of pregnant people per month in CARICOM countries/territories, calculated using crude annual birth rate

CARICOM country/territory	Total population	Crude annual birth rate/1 000 population	Estimated number of live births/year	Estimated number of pregnant people/month
Anguilla	15 274	12.1	185	15
Antigua and Barbuda	99 509	15.6	1 552	129
Bahamas	400 516	13.8	5 527	461
Barbados	288 023	11.6	3 341	278
Belize	412 190	22.9	9 439	787
Bermuda	61 814	8.3	513	43
British Virgin Islands	30 638	10.9	334	28
Cayman Islands	67 282	12.6	848	71
Dominica	72 344	9.6	695	58
Grenada	113 475	15.2	1 725	144
Guyana	794 045	15.4	12 228	1 019
Haiti	11 541 683	23.6	272 384	22 699
Jamaica	2 987 247	15.7	46 900	3 908
Montserrat	4 998	11.7	58	5
Saint Kitts and Nevis	53 959	11.2	604	50
Saint Lucia	185 138	11.7	2 166	181
Saint Vincent and the Grenadines	111 551	13.9	1 551	129
Suriname	596 980	18.1	10 805	900
Trinidad and Tobago	1 406 585	12.2	17 160	1 430
Turks and Caicos Islands	39 775	14.9	593	49
Total	**19 283 026**	**281.1**	**388 608**	**32 384**

CARICOM, Caribbean Community.
Source: Author calculations using data from the World Bank (https://data.worldbank.org/indicator/SP.DYN.CBRT.IN); Knoema (https://knoema.com/data/crude-birth-rate); and Index Mundi (https://www.indexmundi.com/).

with maternal immunization entities could consolidate efforts to develop maternal electronic immunization registries as well.

Technical consultants should also consider the challenges experienced by other low-income countries during implementation of electronic immunization registries (19), such as difficulty in incorporating new electronic immunization registries into existing workflow processes at local health care facilities (19). Incorporating electronic immunization registries in established hospital workflow processes, such as those used to report maternal human immunodeficiency virus (HIV) infections, could remove this barrier. Electronic immunization registries used primarily for childhood vaccination may also have elements that can be easily adapted to maternal vaccination.

Other barriers to generating open data on maternal COVID-19 vaccination in the Caribbean include outdated data-sharing legislation that is not yet aligned with the European Union's General Data Protection Regulation (20), timing of the availability of COVID-19 vaccinations, antivaccination views in the media, and attitudes of health care workers to the COVID-19 vaccination.

COLLABORATION WITH LOCAL PARTNERS SKILLED IN DATA MANAGEMENT AND ANALYTICS TO FACILITATE OPEN DATA

Data on vaccination coverage are generated by several agencies in the Caribbean including ministries of health, CARPHA, the statistics division of the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), and statistical institutes. Statistical institutes and divisions are well equipped with staff experienced in data analytics; therefore, partnerships could facilitate timely analysis and easy interpretability of data generated from proposed maternal electronic immunization registries (13). Collaboration between these agencies could also prevent duplication of efforts and generate new solutions for data management and analysis. Similar data-sharing and collaboration has been proposed between ECLAC and health ministries to address climate change and other environmental challenges in the Caribbean (20). Partnerships between health ministries and local universities have also been shown to maximize the benefits of open data with collaborative efforts often leading to new public health interventions and policies in high-income countries (9).

RECOMMENDATIONS

A multipronged strategy to improve the availability of open data on maternal COVID-19 vaccination in the Caribbean requires the following actions: (i) adapting digital health software tools for maternal electronic immunization registries; (ii) utilizing existing Caribbean maternal immunization data collection and reporting entities; and (iii) expanding country-level partnerships with local partners skilled in data literacy and analytics, including universities and statistical institutes.

Monthly measurable maternal vaccination goals could be devised using PAHO's suggested formula (16), which estimates the number of pregnant people living in a country each month based on the country's annual birth rate (Table 1). To overcome the challenges identified in tracking pregnant people

from national vaccination campaigns, Caribbean countries/ territories could report COVID-19 vaccine uptake for pregnant people giving birth on a monthly basis, similar to in the United Kingdom. As 90% of births in the Caribbean occur in a hospital (16), capturing vaccination data for people giving birth could be easier to achieve. Equipping hospitals that provide delivery services with electronic immunization registries capable of generating open data would assist this effort. To avoid the workflow challenges experienced by Sierra Leone when trying to incorporate new maternal electronic immunization registries into existing hospital workflow processes (19), Caribbean countries/territories could modify the data collection systems created for the elimination of vertical transmission of HIV and syphilis. Merging maternal vaccination data with this preexisting maternal data collection and reporting platform would foster efficiencies.

CONCLUSION

Maternal morbidity and mortality related to COVID-19 are significantly reduced by COVID-19 vaccination. High-income countries have utilized open data on maternal COVID-19 vaccination to improve vaccination coverage for pregnant people. Despite several barriers, the Caribbean has the potential to generate and use open data on maternal COVID-19 vaccination using a multipronged approach. Ultimately, open data on maternal COVID-19 vaccination in the Caribbean could improve COVID-19 vaccination coverage for pregnant people in the Caribbean and reduce maternal morbidity and mortality related to COVID-19.

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Necesidad de datos abiertos sobre la aceptación de la vacuna contra la COVID-19 entre las mujeres durante el embarazo en el Caribe: un llamado a la acción

RESUMEN
Las embarazadas con la enfermedad por coronavirus del 2019 (COVID-19) tienen un mayor riesgo de resultados maternos y fetales adversos que aquellas libres de la enfermedad. En el 2021, en Jamaica se notificó un gran aumento de la mortalidad materna, del cual casi la mitad fue atribuible a la COVID-19. Se ha demostrado que la vacunación contra la COVID-19 reduce tales riesgos, pero los países de ingresos bajos y medianos carecen de datos gratuitos y de carácter público, conocidos como datos abiertos, sobre la aceptación de la vacuna contra la COVID-19 por parte de las mujeres durante el embarazo. Los objetivos del presente artículo consistieron en examinar cómo los países de ingresos altos utilizan los datos abiertos para detectar las tendencias de aceptación de la vacuna contra la COVID-19 entre las mujeres durante el embarazo y formular estrategias de distribución de las vacunas; señalar los obstáculos que dificultan la disponibilidad de los datos abiertos sobre la vacunación materna contra la COVID-19 en el Caribe; y proponer una estrategia múltiple que permita aumentar la disponibilidad de datos abiertos sobre la vacunación materna contra la COVID-19 en el Caribe. Una estrategia múltiple para llenar este vacío de información implicaría: a) utilizar las entidades de recopilación de datos sobre inmunización materna ya existentes en el Caribe; b) adaptar las herramientas informáticas digitales para crear registros electrónicos de vacunación materna; y c) colaborar con asociados locales especializados en el análisis de datos. Facilitar el acceso a los datos abiertos sobre la aceptación de la vacuna contra la COVID-19 entre las mujeres durante el embarazo en el Caribe podría ofrecer beneficios considerables, tales como el establecimiento de objetivos cuantificables en materia de vacunación materna contra la COVID-19, y propiciar las deliberaciones sobre la toma de decisiones en materia de vacunación entre los prestadores de atención de salud y las embarazadas.

Palabras clave
COVID-19; vacunación; embarazo; Región del Caribe.

Necessidade de dados abertos sobre a adesão de gestantes à vacinação contra a COVID-19 no Caribe: um chamado à ação

RESUMO
Gestantes com a doença pelo coronavírus 2019 (COVID-19) têm maior risco de desfechos maternos e fetais adversos em comparação com gestantes sem COVID-19. Em 2021, foi registrado um aumento acentuado da mortalidade materna na Jamaica, e quase metade era atribuível à COVID-19. Foi demonstrado que a vacinação contra a COVID-19 reduz esses riscos, mas os países de baixa e média renda não dispõem de dados gratuitos e publicamente disponíveis (os chamados dados abertos) sobre a adesão à vacina contra a COVID-19 entre gestantes. Os objetivos deste estudo foram: analisar como os países de alta renda usam dados abertos para detectar tendências na adesão à vacina contra a COVID-19 entre gestantes e desenvolver estratégias de distribuição da vacina; descrever os obstáculos para disponibilizar dados abertos sobre a vacinação materna contra a COVID-19 no Caribe; e propor uma estratégia multifacetada que aumente a disponibilidade de dados abertos sobre a vacinação materna contra a COVID-19 no Caribe. Uma estratégia multifacetada para obter dados a fim de preencher essa lacuna envolveria: (i) utilização das entidades existentes que coletam dados de imunização materna no Caribe; (ii) adaptação de ferramentas de software para estabelecer registros eletrônicos de imunização materna; e (iii) colaboração com parceiros locais especializados em análise de dados. A disponibilização de dados abertos sobre a adesão de gestantes à vacinação contra a COVID-19 no Caribe poderia oferecer benefícios substanciais, incluindo o desenvolvimento de metas mensuráveis de vacinação materna contra a COVID-19, e facilitar discussões entre profissionais de saúde e gestantes para a tomada de decisões sobre vacinas.

Palavras-chave
COVID-19; vacinação; gravidez; Região do Caribe.