

Impact of COVID-19 Pandemic on the Utilization of Routine Childhood Immunization Services in Aden-Yemen

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DOI: [https://doi.org/10.47372/yjmhr.2025\(14\).1.6](https://doi.org/10.47372/yjmhr.2025(14).1.6)

Abstract

Introduction: COVID-19 pandemic has caused disruption to healthcare services in almost all the world, impacting national and international public health. Routine childhood immunization may be adversely affected by COVID-19 mitigation measures. This study aimed to assess the changes in the utilization of routine childhood immunization services in Aden by comparing the vaccination coverage between year 2019 and during COVID 19 pandemic in 2020 as well as 2021.

Methods: An observational descriptive cross-sectional study was conducted at Aden city. Data of children vaccinated by the Bacillus Calmette–Guérin (BCG), Penta1, Penta3 and Measles-Containing Vaccine (MCV1) as per the National Immunization Schedule for the period April - December during 2019, 2020 and 2021 were retrieved from the immunization records. Doses of these antigens administered were assessed as a proxy measure of vaccine coverage. The vaccination trends of 2019, 2020 and 2021 were compared assuming base year 2019.

Results: A significant drop in the total vaccines' doses after emergence of COVID-19 pandemic was reported in 2020 and 2021 compared to 2019. The maximum drop was seen in July, May, June and April while the minimum drop was found in September, October and August of 2020 and 2021. The mean vaccination coverage showed a decline from 86.80% in 2019 to 72.60% and 65.60% in 2020 and 2021 respectively. A drop-out rate between BCG and Penta3 during the pre-pandemic period was 30.9% and during the post-pandemic period was 33.3% in 2020 and 39.1% in 2021 while the drop-out rate between the BCG and MCV1 during the pre-pandemic period was 24.5% compared to 32.1% in 2020 and 33.3% in 2021.

Conclusion: The impact of COVID-19 pandemic on the childhood utilization of routine immunization services was clear and tangible with the reported decrease in the utilization. This is a concerning issue that increases the risk of vaccine-preventable diseases which necessitates planning and management of routine immunization services in-case of future pandemics to avoid resurgence of vaccine-preventable diseases.

Keywords: COVID-19, Immunization Services, Dropout Rate, Aden.

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تأثير جائحة كوفيد-19 على استخدام خدمات التحصين الروتيني للأطفال في عدن-اليمن

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ملخص الدراسة

المقدمة: تسببت جائحة كوفيد-19 في تعطيل خدمات الرعاية الصحية في جميع أنحاء العالم تقريبًا، كما أثرت على الصحة العامة على المستويين الوطني والدولي. وقد تتأثر التطعيمات الروتينية للأطفال سلبًا بإجراءات التخفيف من آثار كوفيد-19. تهدف هذه الدراسة إلى تقييم التغييرات في استخدام خدمات التطعيم الروتيني للأطفال في عدن من خلال مقارنة تغطية التطعيم بين عام 2019 وأثناء جائحة كوفيد-19 في عامي 2020 و2021.

المنهجية: أجريت دراسة مقطوع عرضي وصفية ومبنية على الملاحظة في مدينة عدن. تم استرجاع بيانات الأطفال الذين تم تطعيمهم بلقاحات BCG و Penta 1 و Penta 3 و MCV1 وفقًا لجدول التحصين الوطني للفترة من أبريل إلى ديسمبر للأعوام 2019 و2020 و2021 من سجلات التحصين. تم تقييم جرعات هذه المستضدات المعطاة كمقياس بديل لتغطية اللقاح. تمت مقارنة اتجاهات التطعيم للأعوام 2019 و2020 و2021 على افتراض أن عام الأساس هو 2019.

النتائج: تم تسجيل انخفاض ملموس في إجمالي جرعات اللقاحات بعد ظهور جائحة كوفيد-19 في عامي 2020 و2021 مقارنة بعام 2019. وقد لوحظ أقصى انخفاض في يوليو ومايو ويونيو وأبريل بينما وجد أدنى انخفاض في سبتمبر وأكتوبر وأغسطس عامي 2020 و2021. وأظهر متوسط التغطية للتطعيم انخفاضًا من 86.80% في عام 2019 إلى 72.60% و 65.60% في عامي 2020 و2021 على التوالي. وبلغ معدل التسرب بين BCG و Penta3 خلال فترة ما قبل الجائحة 30.9% وخلال فترة ما بعد الجائحة 33.3% في عام 2020 و 39.1% في عام 2021. بينما بلغ معدل التسرب بين BCG و MCV1 خلال فترة ما قبل الجائحة 24.5% مقارنة بـ 32.1% في عام 2020 و 33.3% في عام 2021.

الخلاصة: كان تأثير جائحة كوفيد-19 على استخدام الأطفال لخدمات التحصين الروتيني واضحًا وملموًا مع تسجيل انخفاض في الاستخدام، وهي قضية مثيرة للقلق تزيد من خطر الإصابة بالأمراض التي يمكن الوقاية منها باللقاحات، مما يستلزم التخطيط والإدارة لخدمات التحصين الروتيني في حالة حدوث أوبئة مستقبلية لتجنب عودة ظهور الأمراض التي يمكن الوقاية منها باللقاحات.

كلمات مفتاحية: كوفيد-19، خدمات التحصين، معدل التسرب، عدن.

قسم الصيدلة، جامعة صنعاء، اليمن.

Introduction

Immunization is a life-saving and cost-effective public health intervention [1]. Routine childhood immunization is an essential component of child healthcare globally [2]. The Expanded Program on Immunization (EPI) was established in 1974 to strengthen routine immunization programs across all World Health Organization (WHO) regions [3].

WHO declared COVID-19 as a global pandemic on 11 March 2020 [4]. Since then, the COVID-19 pandemic is a threat to public health and healthcare systems worldwide [5]; prompting governments to implement numerous interventions such as curfews, extensive screening measures and travel bans to prevent the further spread of COVID-19 [6]. School closure has been a vital intervention strategy to curb community transmission during the pandemic [7,8].

Disruptions of critical life-saving services such as routine immunization during the COVID-19 pandemic due to the diversion of the resources and efforts of healthcare systems towards supporting the response to the pandemic, in addition to the alterations in health-seeking behaviors as a result of social distancing requirements and public hesitancy increase the susceptibility of countries to outbreaks of vaccine-preventable diseases (VPDs) [9].

The occurrence of such outbreaks jeopardized the health status of the most vulnerable countries and imposed an additional burden on health systems already drained by the

COVID-19 pandemic [10]. According to a pulse survey conducted in 105 countries by WHO, 90% countries reported disruptions to essential health services amongst which routine immunization services were most frequently disrupted [11]. Another survey done in 19 countries reported 95% (18/19 countries) vaccine delivery disruption experienced by both private and public sectors [12]. Globally, 25 million children were either unvaccinated or under-vaccinated by year 2020, which marks the largest sustained decline in childhood vaccinations in last 30 years [13]. The United Nations Children's Fund (UNICEF) estimates that there were 67 million children who missed out on all or some routine vaccines between 2019 and 2021. Of them, UNICEF estimates that 48 million received no routine vaccines during this period. This has set back routine immunized coverage to levels prior to 2008 [14]. Recognizing the disastrous consequences of the decline in immunization rates, the WHO has issued, on March 26th, 2020, interim guidance for immunization services during the COVID-19 pandemic.

Since 1979, the EPI was established in Yemen, the community has free access to vaccines for the main VPDs. EPI is coordinated at national level under the Primary Health Care sector in the Ministry of Public Health and Population and the vaccination services are provided to the beneficiaries through fixed centers and outreach activities. Although the national EPI strategy 2016-2020 aimed to reach 95% coverage at the national level, and not less than 80% at the district level [15], WHO and UNICEF in 2023 estimate shows a lower coverage rate than the national target with only 73%, 67% and 46%

of the targeted children received Pentavalent (Penta) 3, three doses of injectable poliovirus (IPV) or oral polio virus (OPV) and Measles-Containing Vaccine 2 (MCV) respectively [16]. Further decline in childhood vaccinations in Yemen was also expected during 2020 and 2021 due to COVID-19 pandemic waves. Therefore, this study aimed to assess the changes in the utilization of routine childhood immunization services in Aden by comparing the vaccination coverage between year 2019 and during COVID 19 pandemic in 2020 and 2021.

Methods

Study design and setting

This was an observational descriptive cross-sectional study based on secondary analysis of monthly immunization data available for children aged ≤ 12 months from the EPI Department, Public Health Directorate in all eight districts of the city. Aden city is the recent capital of the liberated areas in the country. Routine immunization services are provided by the government free of charge to all citizens and to internally displaced peoples as well as to refugees.

Sampling

A universal sampling that intended to include the records of all vaccinated children as per the national EPI between 0 and 12 months of age during the pre-pandemic period from April to December 2019 and in the same period at 2020 and 2021 after the beginning of the pandemic were used.

Sampling technique

At the health facility level, routine immunization data of vaccine doses administered to children under the age of one are captured individually and recorded in the registers of a total 43 health facilities providing routine immunization services in Aden. Monthly, the immunization data of each facility are aggregated and entered into EPI district health information system version 2 (DHIS2) by a responsible officer. From each of the eight districts immunization data, data aggregated monthly at the governorate level.

Data collection

Data from DHIS2 were used to retrieve vaccination data at Aden city level in Yemen. Data of Bacillus Calmette–Guérin (BCG), Measles–Rubella (MR) 1 and Penta antigens only were extracted because they are used as indicators to determine whether children have acquired full immunity. Moreover, these antigens serve as a proxy for the other antigens that are simultaneously administered to the same target population. Total number of doses administered for BCG, MR1, and Penta 1 and 3 for the period from April to December in 2019, 2020 and 2021 were the main data collected.

Statistical analysis

Data were extracted from the EPI health information system included the number of vaccinated children under the age of one and the type and dose of vaccine administered. Data sorting and cleaning were carried out, and entered into the Statistical Package for Social Sciences (SPSS), version 23.0 for analysis. Appropriate descriptive statistics and suitable tables and charts were used.

Ethical consideration

Permission was given from the Ministry of Public Health and Population, Primary Health Care Sector and EPI based on an official letter from the Yemeni Council of Medical Specialization-Aden. There were no other ethical issues needed in the conduct of this study. Informed consent was not necessary because only anonymized routine record-based data were analyzed retrospectively.

Results

The analysis of vaccine data across various vaccine types for the period April to December in 2019, 2020 and 2021 years reveals some noteworthy trends (Table 1). A significant drop in the total vaccines' doses after emergence of COVID-19 pandemic and formally announced in the country at the 10th of April 2020 was reported in April up to October 2020 compared to same months in 2019. The maximum drop in vaccines doses received for the year 2020, was seen in July, May, June and April with a

missed of 2777, 2363, 1849 and 1405 doses respectively, while the minimum drop was found in September (116), October (410) and August (515). In contrast to the reported decline during April up to October, November and December 2020 showed modest increase in the total vaccines' doses (9301) and (10976) respectively compared to November (9032) and December (9863) in 2019.

The analysis of vaccine data across various vaccine types for the year 2021 reveals a similar trend of decline in all months with the maximum missed doses was seen also in July (4370 doses) and May (1199 doses) compared to 2019 (Table 2).

Table 1: Number of Vaccines' Doses among Children under the Age of One During April- December 2019 and 2020, Aden City

Months	2019					2020					
	Number of Vaccines' Doses					BCG	Penta1	Penta3	MR1	Total	Diff
April	1939	1605	2036	1766	7346	1606	1352	1582	1401	5941	-1405
May	1298	1149	1269	1075	4791	711	587	599	531	2428	-2363
June	1938	1587	1314	1782	6621	1420	1124	912	1316	4772	-1849
July	2431	2061	1481	2627	8600	1901	1557	1096	1269	5823	-2777
Aug	1703	1422	1085	1499	5709	1664	1343	1004	1183	5194	-515
Sept	3009	2428	1744	2395	9576	3129	2482	1802	2047	9460	-116
Oct	3225	2730	2044	2178	10177	3152	2579	1891	2145	9767	-410
Nov	2791	2554	1986	1701	9032	2916	2566	1953	1866	9301	+269
Dec	2958	2858	2447	1600	9863	3462	3123	2538	1853	10976	+1113
Total	21292	18394	15406	16623	71715	19961	16713	13377	13611	63662	-8053

Table 2: Number of Vaccines' Doses among Children under the Age of One April-December 2019 and 2021, Aden City

Months	2019					2021					
	Number of Vaccines' Doses										
	BCG	Penta1	Penta3	MR1	Total	BCG	Penta1	Penta3	MR1	Total	Diff
April	1939	1605	2036	1766	7346	1037	883	1356	904	4180	-3166
May	1298	1149	1269	1075	4791	1062	795	794	941	3592	-1199
June	1938	1587	1314	1782	6621	2068	1925	1392	2507	7892	+1271
July	2431	2061	1481	2627	8600	1167	1057	720	1286	4230	-4370
Aug	1703	1422	1085	1499	5709	2684	1752	1247	2049	7732	+2023
Sept	3009	2428	1744	2395	9576	2675	2042	1262	1661	7640	-1936
Oct	3225	2730	2044	2178	10177	3294	2738	1438	1646	9116	-1061
Nov	2791	2554	1986	1701	9032	2972	2609	1826	1369	8776	-256
Dec	2958	2858	2447	1600	9863	3640	3368	2533	1401	10942	+1079
Total	21292	18394	15406	16623	71715	20599	17169	12568	13764	64100	-7615

The overall mean vaccination coverage measured by the percentage of children received Penta 3 during the comparable period at 2019, 2020 and 2021 showed a decline from 80.9% in 2019 to 67.7% in 2020 reflecting a 13.2% decrease in the utilization of routine vaccination services. Unfortunately, a further drop was reported in the overall mean vaccination coverage at same period in 2021 with an average of only 61.3% of targeted children received Penta 3 (Table 3).

It is also clear from Table 3 that each of the other three of four assessed vaccine types experienced similar declining trend in its mean coverage between pre and post pandemic periods.

Table 3: the mean Vaccination Coverage among Children under the Age of One April-December 2019 and 2021, Aden City

Type of Vaccine	Mean Vaccination Coverage		
	2019	2020	2021
BCG	111.8%	101.0%	100.4%
Penta1	103.6%	89.5%	83.7%
Penta3	80.9%	67.7%	61.3%
MR1	87.3%	68.9%	67.1%

Table 4 shows significant drop in the total vaccines' doses received by children under one year of age in 2020 and 2021 compared to 2019. The total missed doses are 8053 in 2020 and 7615 in 2021. Drop-out rates were

derived by comparing the number of infants who began the immunization schedule with those who successfully completed it. Table 4 also reveals a drop-out rate between BCG and Penta3 during the pre-pandemic

period in 2019 of 30.9% and the drop-out rates during the post-pandemic period in 2020 and 2021 of 33.3% and 39.1% respectively while the rate

between BCG and MCV1 during the pre-pandemic period was 24.5% compared to 32.1% in 2020 and 33.3% in 2021.

Table 4: Total Missed Doses and the Drop-out Rates among Children under the Age of One, April-December 2019 and 2021, Aden City

Type of Vaccine	Total Doses			Missed Doses	
	2019	2020	2021	2020	2021
BCG	21292	19961	20599	1331	693
Penta1	18394	16713	17169	1681	1225
Penta3	15406	13377	12568	2029	2838
MR1	16623	13611	13764	3012	2859
Total doses	71715	63662	64100	8053 (- 11.2%)	7615 (- 10.6%)
Drop-Out Rates					
	2019	2020	2021		
BCG -Penta3	30.9%	33.3%	39.1%		
BCG - MR1	24.5%	32.1%	33.3%		

Discussion

The first case of COVID-19 infection in Yemen (Hadramout governorate) was reported officially on 10th April 2020, while the impact of the pandemic on community members and the health system was revealed much earlier in 2020 [17]. This study assessed the changes in the utilization of routine immunization services at Aden city during the period April to December 2019 and the same period of 2020 and 2021.

In July 2020, the WHO and UNICEF draw attention to concerns about the accessibility of routine immunization services and issued a warning of a potential decline in routine immunization rates owing to the COVID-19 pandemic [18].

At least 80 million children under the age of one are at risk of VPDs due to disruptions in routine vaccination caused by COVID-19 [19]. To the best of the researcher knowledge, this

study was the first to assess the impact of the COVID-19 pandemic on the utilization of vaccination services not only in Aden city but in all Yemen. Similar studies were conducted in Saudi Arabia [20], Lebanon [21], Sierra Leone [22] and many other countries [19].

Significant drop in the total vaccines' doses received by children under one year of age in 2020 and 2021 compared to 2019 was reported in this study, with negative differences (missed doses) of 8053 (-11.2%) and 7615 (-10.6%) doses were detected in the number of administered vaccines' doses in 2020 (63662) and 2021 (64100) respectively compared to same period in 2019 (71715). Similarly, the number of vaccine doses administered in the public sector during October 2019 and March 2020 in Lebanon decreased by 20% [21]. Alsuhailani and Alaqeel [20] in their study in Saudi Arabia also reported 24% vaccination delay in children during the first 3 months of the pandemic. At international level, Shet

et al. [19] reported decline in vaccine doses administered in 170 countries in the first half of 2020 with the lowest in April. Likewise, Abid *et al.* [23] in their study in Afghanistan reported 21.4% significant decline in the total immunization coverage during April–July 2020. A sharp fall in the total doses of vaccines administered was further reported in India [24].

Even studies conducted in high-income countries have reported similar findings in disruption in routine vaccination services. Santoli *et al.* [25] in the United States, McDonald *et al.* [26] in England, and Silveira *et al.* [27] in Brazil reported reduction in routine vaccinations in children during 2020.

The assessment of fluctuations in the number of vaccine doses received by our children under one year of age in 2020 and 2021 compared to 2019 yielded a similar pattern, the most prominent reductions in this study were detected for the Penta3 and measles vaccines, and during July and May in both 2020 and 2021 with a better improvement of received doses reported in 2021 except for Penta3. In Lebanon [21], the greater reductions were in OPV and measles vaccines, during October 2019 and March 2020 and in Kuwait [28], vaccinations scheduled for children aged ≤ 24 months showed a reduction in delivered vaccine doses in March 2020–May 2020.

The pandemic and its response measures were projected to cause a decline in vaccination coverage in Yemen as well with a decline in the overall mean vaccination coverage (measured by the percentage of children received Penta 3 from 86.80% in 2019 to 72.60% in 2020

reflecting a 13.2% decrease in the utilization of routine vaccination services. Unfortunately, a further drop was also reported at same period in 2021 with an average of 65.60% only of targeted children received Penta 3. Same trends of decline in immunization coverage measured by the mean Penta 3 coverage during post pandemic compared to corresponding pre pandemic period has been found in countries like Sierra Leone [22] and Kuwait [28].

The present study and Indonesian findings [29] indeed show a decrease in coverage, which is correlated with an increase in drop-out rates in routine immunization, with a significant difference over three consecutive years.

Conclusion

The impact of COVID-19 pandemic on the childhood utilization of routine immunization services was clear and tangible with the reported decrease in the utilization, a concerning issue that increases the risk of vaccine-preventable diseases, that necessitates planning and management of routine immunization services in-case of future pandemics to avoid resurgence of vaccine-preventable diseases.

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