

The Contribution of Periodic Intensification of Routine Immunization to Vaccination Coverage and Disease Surveillance in the South West Region of Cameroon amid Sociopolitical Crisis and Covid-19 Outbreak in 2020

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Abstract

Introduction: The Southwest Region of Cameroon has been hit by an armed conflict for over half a decade now, which has negatively affected routine immunization and disease surveillance activities in the region. This negative effect was further exacerbated by the Covid-19 pandemic, which alongside the conflict caused thousands of children to miss out on life saving vaccinations. Herein, we present the contribution of periodic intensification of routine immunization, in improving immunization and surveillance activities amid crises.

Method

Periodic intensification of routine immunization (PIRI) and surveillance was carried out in three rounds per health district. Prior to the intervention, the security profile of each district involved was reviewed. Data for this study was extracted on vaccination and surveillance activities from the District Health Information Software and from monthly regional reports for 2019 and 2020.

Results

In total 54,242 persons were vaccinated in the SW region following these interventions. An increase in performance was observed in all 18 health districts of the region in 2020, with both DPT-3 and OPV-3 coverage rising by 28% points. Similarly, the proportion of health districts that investigated at least a case of acute flaccid paralysis increased by 83%, rising from just 3 districts in 2019 to 18 in 2020.

Conclusion

PIRI was a very useful approach to improve both vaccination coverage and surveillance indicators in this region amidst the ongoing conflict and Covid-19 pandemic.

Introduction

Immunization is a global health and development success story that has made an enormous contribution to human health and wellbeing worldwide [1–3]. The discipline saves millions of lives each year, helping populations across the globe to live longer and enjoy healthier lives [3]. In Africa, there is no better depiction of the immunization success story than global efforts which resulted in the African Region being declared free of the wild polio virus in August of 2020 [4]. Indeed, this African Region has registered remarkable progress in disease control ever since the Expanded Program of Immunization (EPI) was set up in the mid 1970's. EPIs in this region have successfully raised vaccine coverage for many pediatric vaccines from below 3% in the mid-70s to nearly 80% in 2019 [5,6].

Despite this progress, coverage for many of these antigens have plateaued-and slipping back- in many countries in the region. This stagnation/regression in coverage leaves almost 10 million children in the region vulnerable to vaccine preventable diseases (VPDS) [6]. This vulnerability is further heightened by factors such as armed conflicts and the Covid-19 pandemic. The pandemic has caused unparallel

disruptions in health systems across several countries, impacting both the demand and supply sides of immunizations[6,7]. In fact, in 2020 Covid-19 led to the cancellation of over a dozen vaccination campaigns in the region [6]. The result was a whopping 8 million African children missing out on the DTP-1 in 2020 – almost twice the figure recorded in 2019, and a further 2 million children missing out on the DTP-3.

Cameroon recorded its first case of Covid-19 in March, 2020, in the capital city, Yaoundé [9] and its rapid spread to other regions led to the institution of major travel restrictions in the same month to limit its spread within the country [10]. These restrictions limited gatherings, including major health interventions like mass vaccination activities, which indeed led to suspension of the March 2020 national immunization days against poliomyelitis. The Covid-19 outbreak caused a dramatic decline in the utilization of health services, including routine vaccination services in many regions of the country [11–13]. In one region- The South West Region- Covid-19 helped to further worsened a prevailing situation: an armed conflict which the region has been witnessing for over half a decade now. This crisis is associated with looting and destruction of health facilities, as well as the kidnap and killing of healthcare workers [14]. These have had a negative effect on health service delivery in the region, with immunization services being particularly affected. In fact, a recently published paper, we reported that the region has experienced a 42% drop in DPT-3 coverage by between 2016 and 2019 [14].

With the worsening trend in vaccination coverage and other indicators of the EPI in this region, the ministry of health and its partners decided to implement a periodic intensification of routine immunization (PIRI) so as to limit outbreaks of VPDs in the region [14]. However, an assessment of the contribution of this intervention to overall vaccination coverage in the region has not been reported. As such, we set out to assess the contribution of the PIRI to vaccination coverage and disease surveillance in the SW region.

Materials And Method

Study design

This was a cross-sectional study carried out from March through August 2021, using data on vaccination and surveillance activities from all 18 health districts of the SW. This study design enabled the researchers to explore the impact of PIRI on immunization coverage and surveillance activities in the SW Region amidst the ongoing sociopolitical crisis and the Covid-19 pandemic.

Study Area

This study was conducted in the SW Region of Cameroon. The SW Region is a home to over two million persons, with diverse cultural and traditional backgrounds. Over 44% percent of its inhabitants reside in rural areas and are mainly involved in activities like farming and fishing. The region has been hit by insecurity since late 2016, resulting into mass displacement of a considerable proportion of its population. The conflict has also resulted into destruction and looting of health facilities, abduction and

killing of health workers and distortion of the health system in the region [8,15]. Furthermore, on 2nd April 2020, the region recorded its first case of Covid-19 and has since experienced a rise in the number of cases, and this peaked between epidemiologic week 20 and 25 of 2020 [17].

From a health map perspective, the region consists of 18 health districts, each of which is led by a district medical officer (DMO). Each health district is further sub-divided into health areas (116 health areas in total for the region), which are led by a chief of health area. The chief of the health area is by default the chief of the leading health facility within the health area. Each of these health areas has at least one health facility which could be public or private [14].

Organization of immunization services

In each health area, the leading health facility stores vaccines, coordinates vaccination and other EPI activities for all facilities within the health area and ensures reporting using the District Health Information Software (DHIS2) and other paper based weekly and monthly tools. Vaccines are administered through the EPI in Cameroon as initially described [14]. In addition to these vaccines described, from March, 2020, the second dose of the Measles Rubella (MR2) vaccine was introduced to be administered at 15 months. Also, from October, 2020, the vaccine against the Human Papilloma Virus (HPV) was introduced to be administered to adolescent girls 9 years old [16] and the second dose administered 6 months after the first (Fig 1). From April, 2021, to curb the spread of Covid-19, the vaccine against severe acute respiratory syndrome coronavirus 2 (SARS COV2) was introduced for persons aged 18 years and above [17] (Fig. 1). According to national guidelines, these vaccines are administered to all eligible persons at the vaccinating health facility on daily basis and in outreach sites, where feasible, at no cost.

Mindful of the negative effects of the Covid-19 outbreak and the insecurity on immunization service delivery, the EPI manager of the SW region (under the supervision of the EPI Central Technical Group) engaged in intensification of immunization and surveillance activities in the health districts of the SW region under the sponsorship of the United Nations Children Funds (UNICEF). In each health district, PIRI was carried out in three rounds and each round was separated from the next by 28 to 30 days. The interventions took place in the months of March, May, June, November and December, 2020 and the last phase in January, 2021. The month of April, 2020 was skipped following the measures put in place by the government to control the spread of the Covid-19 outbreak in the country. This period also was used to elaborate guidelines to ensure continuity of vaccination services amid Covid-19. The onset of PIRI involved 03 days of sensitization followed immediately by 03 more days of vaccination and active case search in the community for VPDs (poliomyelitis, measles, yellow fever and neonatal tetanus). However, the team paid more attention to poliomyelitis surveillance through AFP case search as the country strived to be certified free of wild poliovirus in 2020.

Interventions before the PIRI

Prior to the onset of PIRI the regional EPI programmer manager and the DMOs did an assessment and set up strategies to permit them carryout a successful PIRI amid insecurity and Covid-19. Firstly, each health district came up with a micro plan within which they estimated the amount of vaccines and consumables needed; mapped sites where internally displaced persons (IDP) could be readily found; estimated the amount of human resource needed and the cost of intervention. Then, the district and regional teams assessed the level of insecurity within each health area of the respective health districts and equally anticipated the most probable days when violence could erupt or when curfews could be announced either by the government or the non-state armed groups. Periods considered included national public holidays, major state events like elections and trial days for arrested leaders of the non-state arm groups. These guided the planning of the most likely time to organize a given round of PIRI per district or health area. Once the period for intervention was identified, commodities as needed were pushed from the region to the districts and from the district to the health facilities during a safe period and using the safest means of transport for the concerned area. In addition, all health workers (community health workers and health facility staff) used to carryout PIRI in a given community were those that were physically healthy and permanently residing in those communities. These health workers were briefed on their respective task and were deployed to work within the communities. Before the day of onset of the activity, community actors were used to advocate with local opinion leaders. Secondly, announcements on the period of PIRI and the commodities to be administered were made in gatherings like churches, Mosque and markets. Town criers also made announcements especially in the rural communities, and the radio was equally used where available. Three days to the start of PIRI, communication activities were intensified in every community on daily basis.

Interventions during PIRI

Following the national guideline on continuity of immunization in the context of Covid-19, each health workers used a face mask and had a hand disinfecting solution. The major strategy used was outreach in communities and in sites where IDP were identified to be based. Vaccination activities equally continued in health facilities. Each vaccination team was made up of a vaccinator, a recorder and a mobiliser. Within the community, door to door was the major strategy used and the vaccination team that transported vaccine through a vaccine carrier ensured that all vaccinations activities were carried out in a shade out of the homes visited. Commodities administered included vaccines, vitamin A and Mebendazole to infants, adolescent girls and pregnant women. Before administration of any commodity, the individuals age, vaccine receipt and pregnancy status were verified to identify the missed vaccine and catchup doses were administered. Vitamin A and Mebendazole were systematically administered to every child under 5 years. After administration of the commodities, the recorder tallied the information on a sheet. During the PIRI, the vaccination teams actively searched for missed cases of acute flaccid paralysis (AFP), measles, yellow fever and neonatal tetanus. If any missed case was identified, the investigation form was filled and the infant was guided to the health facility where specimen was collected as indicated and forwarded to Yaounde for analysis at Centre Pasteur.

After PIRI

At the end of each day, an evaluation was done at the respective health areas, with a synthesis of number of persons who benefitted from the respective interventions made and sent to the district health service. During this health area evaluation, corrective measures were made to improve performance and ensure the safety of the workers for the subsequent days. At the end of each round of PIRI, the respective health districts had an evaluation meeting with the health area leads (chief of health areas and communication focal persons). At the end of the district evaluation, a synthesis of the results obtained per health area was made and shared with the regional EPI team. Each health facility in the health area then entered the data alongside data of other health interventions at the end of the month into the Dhis2.

Data Source and analysis

The data for this study were retrieved from the standard EPI data reporting tool, the DHIS2 for 2019 and 2020. From 2018, the DHIS2 given its benefits [18], was used as the main reporting tool, replacing the DVDMT at all levels of the health pyramid. According to standard practice, this platform is updated on a monthly basis with data from health facilities in each district for the corresponding period.

Also, monthly reports from the region were used to obtain surveillance data while a pretested questionnaire was used to abstract key variables, including the security profile of the health districts, and the approach and time of implementation of PIRI. These data were extracted for 2019 till 2020 during which PIRI was carried out amidst insecurity and Covid-19 breakout in the region. The questionnaires were filled by the EPI lead of the region. The investigation team then resolved any identified data discrepancy by directly calling the regional head or the district medical officers concerned.

Data obtained were analyzed using Microsoft Office Excel 2019. Variables were presented as counts with percentages. Bar charts and line graphs were used to display trends and compare EPI vaccination performance across the years investigated.

Results

At the end of the intensification of routine immunization and surveillance activities in the region, a total of 54,242 persons benefitted from at least one catchup dose of a missed vaccine during the intervention. This activity also gave the opportunity to improve on the number of persons who received vaccines that were newly introduced in the country's EPI in 2020 (MR2 at 15 months and HPV vaccine at 9 years) (Figure 1). The cost per person vaccinated in 2020 during the PIRI was 4.50 USD.

The security situation in the region in 2020 was found to be similar to what was observed in 2019 [14]. It was observed that the number of children vaccinated per month peaked in the months corresponding to the periods when PIRI was carried out (Figure 2). Every health district experienced an improvement in their performance in 2020 compared to the previous year (Figure 3 and Figure 4), with the region experiencing a rise in its DPT 3 coverage by 28% points, going from 43% in 2019 to 71.1% in 2020 (Figure 4). A similar trend was observed for other vaccines given at the same time (OPV-3 and IPV). Also, the vaccination coverage of MR-1 experienced 27% points gain, moving from 43.2% in 2019 to 70.5% in 2020.

Furthermore, the BCG experienced a 25%-point gain with coverage moving from 48.4% in 2019 to 73.2% in 2020. The annual regional coverage for vaccines newly introduced into the EPI in 2020 stood at 48% for MR-2 and 11% for the first dose of the HPV vaccine.

There was equally an improvement in surveillance indicators in 2020 compared to 2019. In total, 72% of health districts investigated a case of yellow fever in 2020 against 56% in 2019 and 66% of these districts investigated a case of measles in 2020 compared to 50% in 2019. It was realized that all 18 health districts investigated at least a case of AFP in 2020 against just 03 in 2019 (Figure 3).

None of the actors who took part in the implementation of PIRI in the region was reported to have been hurt within the context of insecurity during the implementation of the activity. Also, none of these health workers were reported to have presented with symptoms of Covid-19 during and 3 weeks after the implementation of PIRI in their respective communities.

Discussion

The consequences of the ongoing civil strife in the southwest region of Cameroon have been enormous over the previous 03 years with a drop in DPT 3 coverage between 2016 and 2019 by 42 percent points [14]. To this was later added the challenge posed by the Covid-19 outbreak that hit the country from 06 March, 2020 and greatly affecting health service delivery in general and immunization services in particular [11–13,16]. Notwithstanding, knowing the benefits of adapting their strategy to the existing challenges [21], the health actors in this region embarked in the intensification of routine immunization activities in a context of insecurity and Covid-19.

The goal of this study was to assess the impact of the PIRI carried out in the SW Region of Cameroon in 2020 within the context of insecurity and Covid-19, on vaccination service delivery within the SW Region. Particular interest was focused on its effect on the coverage of key antigens and some major VPDs surveillance indicators.

There were 54,242 persons vaccinated in the SW region following PIRI and globally, there was an improvement in the vaccination coverage of all antigens. Also, unlike in 2019 when the region had just 03 districts that investigated a case of acute flaccid paralysis (AFP), in 2020, all 18 health districts investigated at least a case of AFP (Figure 3) with more districts investigating cases of other vaccine preventable disease.

In spite of the great improvement made by the EPI since its creation in improving immunization coverage and limiting outbreaks due to vaccine preventable diseases, it was obvious that innovative interventions were relevant in administering routine EPI interventions in this region of Cameroon that was hit by sociopolitical crisis for over 5-years and also Covid-19 in 2020. With the major challenges posed by insecurity with killing of health workers, destruction and lotting of health infrastructures and population displacement [14], the EPI staff of this region and its 18 health district managers worked closely with the community to identify persons that were physically healthy resident and accepted in their respective

communities to help ensure the continuity of health services like vaccination and disease surveillance. This community led approach helped to adopt an intervention that helped downplay the impact of the local challenges[21] and improved vaccine uptake and disease surveillance performances. PIRI in this case helped the health workers to reach a population that had been partially served for more than 4 years following insecurity. The major intervention was through mobile teams reaching the population in their homes and internally displaced sites rendering healthcare services at the site and time of convenience; this improved vaccine uptake[22]. Though with the outbreak of Covid-19 that favored the suspension of mass immunization activities in Cameroon and in the WHO African Region at large in 2020 [23], PIRI and other routine immunization activities enabled the southwest region of Cameroon to vaccinate 37,673 infants with the third dose of Oral Polio Vaccine (OPV-3). This enabled the southwest region OPV-3 coverage to improve from 43.1% in 2019 to 71.1% (28 percent points gained) in 2020. So, bringing the community to action helped the region to attain its objective in the fight against poliomyelitis amid crisis [24]. Also, newly introduced vaccines like MR-2 and HPV experienced a rapid uptake. For instance, MR-2 vaccine rollout coverage reached 48% in just 9 months following its introduction in March, 2020. This MR-2 performance was closed to the target set by the World Health Organization (WHO) for the end of 2020 in spite of the crisis in this region [25]. Also, HPV annual coverage reached 11% after just two months following its introduction in October, 2020. This was equally a major mile stone in the introduction of the HPV vaccine [25], protecting several adolescent girls from human papilloma viruses in the region. The health workers used to implement PIRI in the communities were locally recruited and were persons residing in the respective communities within the context of insecurity. This likely helped improve access and penetration into the community to ensure the effective delivery of this life saving healthcare services. Also, respecting the guideline set to ensure continuity of immunization and other healthcare services helped the actors to effectively carryout vaccination and active disease surveillance amid Covid-19 pandemic. However, though none of the health workers involved in the implementation of the activity were reported to have presented with Covid-19 related symptoms during and even up to 3 weeks following PIRI in the communities, the risk of Covid-19 spread still remained. Moreover, in early 2020, screening of Covid-19 was not common especially in the rural communities of Cameroon. Also, at the onset, polymerized chain reaction (PCR) was the main test done in three diagnostic sites located in the center and littoral regions of the country [26].

The community workers used to administer the package of PIRI were also trained on disease surveillance. This gave the opportunity for active case search of the major vaccine preventable diseases to be carried out in every community with an improvement in disease surveillance indicators in 2020. This synergy between immunization and surveillance activities helped to favor the investigation of at least a case of AFP (poliomyelitis search) in all 18 health districts of the region in 2020 compared to 2019 when just 03 health districts investigated at least a case of AFP. This AFP surveillance improvement partly contributed in attaining the goals of the Global Polio Eradication Initiative, even in this area in insecurity in 2020 [25]. Notwithstanding, though an improvement was also observed in the proportion of health districts that investigated at least a case of the other vaccine preventable diseases, this improvement was more remarkable with AFP surveillance. This may prompt one to think that more attention was laid on

poliomyelitis surveillance in this war-torn region than to the surveillance of the other vaccine preventable diseases as the country and Africa continent was aiming towards being certified free of wild polio virus in 2020 [23].

To the best of our knowledge, this is the first systematic report on the impact of PIRI on immunization and surveillance performances in the context of insecurity and Covid-19 outbreak in the SW region of Cameroon. In spite of this merit, this piece of work had some limitations. Firstly, the primary data was collected in a context of insecurity and this could have introduced some bias into the data. Also, the denominator used to calculate coverages was based on estimates from the central level which may not necessarily have reflected the real situation on the ground given the population movement reported in this area since the onset of the crisis [26]. Finally, due to the subjective reported Covid-19 status based on the Covid-19 related signs and symptoms reported by the actors involved in the activity, some cases of Covid-19 may have occurred within the communities linked to PIRI, but this could have been missed by this research design. In spite of these limitations, we strongly believe that this study sets the scene for a preliminary understanding of the impact of PIRI in this setting in improving vaccination and surveillance performances in the context of insecurity and Covid-19 pandemic. We remain hopeful that this study will stimulate more research to clearly elucidate the benefit of PIRI in the context of Covid-19 pandemic and to clearly state the risk that may be associated with carrying out PIRI in the current Covid-19 era and proposed adequate mitigating strategies.

Conclusion

The findings of this study suggest that PIRI improved the performance of routine vaccination coverage and disease surveillance of VPDs in the SW Region of Cameroon in the context of insecurity and Covid-19. PIRI also helped to rapidly stimulate the uptake of newly introduced vaccines like the MR-2 and HPV vaccines. These findings suggest that PIRI could be a useful strategy to rapidly improve vaccine uptake and surveillance performances. It equally suggests that if health actors respect the recommended policies, PIRI could be used as a roll out strategy for new vaccines, particularly in emergency context such as those posed by the Covid-19 pandemic and the armed crisis in the SW Region of Cameroon.

Abbreviations

BCG: Bacilli, Calmette Guerin, **Covid:** Corona Virus Diseases, **DVDMT:** District Vaccine and Data Management Tool, **DPT:** Diphtheria, Pertussis and Tetanus, **HPV:** Human Papilloma Virus, **IPV:** Inactivated Polio Vaccine, **MR:** Measles and Rubella, **OPV:** Oral Polio Vaccine, **PCV:** Pneumococcal Conjugate Vaccine, **PCR:** polymerized chain reaction, **PIRI:** Periodic Intensification of Routine Immunization, **SW:** South West, **UNICEF:** United Nations Children Fund, **WHO:** World Health Organization, **VPD:** Vaccine Preventable Diseases

Declarations

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No funding was available for this work. The cost for data collection was borne by NAA

Availability of data and Materials

The datasets used during this study are available from the corresponding author on reasonable request. Part of this data can also be directly obtained from the Dhis 2 data base of this region.

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References

- [1] Greenwood B. The contribution of vaccination to global health: past, present and future. *Philosophical Transactions of the Royal Society of London Series B, Biological Sciences* 2014;369:20130433. <https://doi.org/10.1098/rstb.2013.0433>.
- [2] Lynch HJ, Marcuse EK. Vaccines and immunization. *The Social Ecology of Infectious Diseases* 2008:275–99. <https://doi.org/10.1016/B978-012370466-5.50015-7>.
- [3] Sidhu S, Abad-Vergara D. WHO and UNICEF warn of a decline in vaccinations during COVID-19. *WHO* 2020;41.

[4] CDC. World Polio Day 2020 n.d. <https://www.cdc.gov/globalhealth/immunization/wpd/index.html> (accessed September 22, 2021).

[5] Vanderende K, Gacic-Dobo M, Diallo MS, Conklin LM, Wallace AS. Morbidity and Mortality Weekly Report Global Routine Vaccination Coverage-2017. 2010.

[6] UNICEF. Immunization coverage_ Are we losing ground_ - UNICEF DATA n.d. <https://data.unicef.org/resources/immunization-coverage-are-we-losing-ground/> (accessed September 23, 2021).

[7] Abad-Vergara D. Maintaining vaccination during the Covid-19 Pan-demic 4-7 World Immunization Week. n.d.

[8] Harris RC, Chen Y, Côte P, Ardillon A, Nievera MC, Ong-Lim A, et al. Impact of COVID-19 on routine immunisation in South-East Asia and Western Pacific: Disruptions and solutions. *The Lancet Regional Health – Western Pacific* 2021;10. <https://doi.org/10.1016/j.lanwpc.2021.100140>.

[9] Tih F. Cameroon confirms first coronavirus case n.d. <https://www.aa.com.tr/en/africa/cameroon-confirms-first-coronavirus-case/1756866> (accessed August 20, 2021).

[10] GOVERNMENT RESPONSE STRATEGY TO THE CORONAVIRUS PANDEMIC (COVID-19) _ Prime Minister's Office n.d. <https://www.spm.gov.cm/site/?q=en/content/government-response-strategy-coronavirus-pandemic-covid-19> (accessed August 20, 2021).

[11] Fouogue JT, Noubom M, Kenfack B, Dongmo NT, Tabeu M, Megozeu L, et al. Poor knowledge of COVID-19 and unfavourable perception of the response to the pandemic by healthcare workers at the Bafoussam Regional Hospital (West Region-Cameroon). *Pan African Medical Journal* 2020;37. <https://doi.org/10.11604/pamj.supp.2020.37.1.25688>.

[12] Ngeh EN, Kuaban C. COVID-19: challenges and the impact on care in clinical settings in Cameroon. *The Pan African Medical Journal* 2020;35:122. <https://doi.org/10.11604/pamj.supp.2020.35.24929>.

[13] Chelo D, Nguéfack F, Enyama D, Nansseu R, Feudjo Tefoueyet G, Mbassi Awa HD, et al. Impact and projections of the COVID-19 epidemic on attendance and routine vaccinations at a pediatric referral hospital in Cameroon. *Archives de Pédiatrie* 2021;28:441–50. <https://doi.org/https://doi.org/10.1016/j.arcped.2021.05.006>.

[14] Saidu Y, Vouking M, Njoh AA, Bachire H ben, Tonga C, Mofor R, et al. The effect of the ongoing civil strife on key immunisation outcomes in the North West and South West regions of Cameroon. *Conflict and Health* 2021;15:8. <https://doi.org/10.1186/s13031-021-00341-0>.

[15] Patel Murthy B, Zell E, Kirtland K, Jones-Jack N, Harris L, Sprague C, et al. MMWR, Impact of the COVID-19 Pandemic on Administration of Selected Routine Childhood and Adolescent Vaccinations – 10 U.S. Jurisdictions, March–September 2020. n.d.

- [16] OCHA. Cameroon_ Humanitarian Dashboard - Response Monitoring (January - December 2020) _ HumanitarianResponse n.d. <https://www.humanitarianresponse.info/en/operations/cameroon/infographic/cameroon-humanitarian-dashboard-response-monitoring-january-december> (accessed August 21, 2021).
- [17] MINSANTE. covid19.minsante.cm n.d. <https://covid19.minsante.cm/> (accessed September 23, 2021).
- [18] Fabiola Kemegni. Cameroon _ Controversy Sparks over Gardasil Vaccines Launched on Young Girls n.d. <https://www.afriqconnect.com/index.php/en/categories/actualite-2/sante-environnement/cameroon-controversy-sparks-over-gardasil-vaccines-launched-on-young-girls> (accessed August 21, 2021).
- [19] Rédaction Africanews. Cameroon starts Covid vaccination using jabs given by China _ Africanews n.d. <https://www.africanews.com/2021/04/13/cameroon-starts-covid-vaccination-using-jabs-given-by-china/> (accessed August 22, 2021).
- [20] MEASURE Evaluation. Using DHIS 2 to Strengthen Health Systems MEASURE Evaluation 2017. <https://www.measureevaluation.org/his-strengthening-resource->.
- [21] Mantel C, Cherian T. New immunization strategies: adapting to global challenges. *Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz* 2020;63:25–31. <https://doi.org/10.1007/s00103-019-03066-x>.
- [22] Eggers R. Global Routine Immunization Strategies and Practices (GRISP). World Health Organization 2015.
- [23] World Health Organization. Africa's wild polio-free status to be determined in August _ WHO _ Regional Office for Africa 2020. <https://www.afro.who.int/news/africas-wild-polio-free-status-be-determined-august>.
- [24] Alonge O, Neel AH, Kalbarczyk A, Peters MA, Mahendradhata Y, Sarker M, et al. Synthesis and translation of research and innovations from polio eradication (STRIPE): Initial findings from a global mixed methods study. *BMC Public Health* 2020;20. <https://doi.org/10.1186/s12889-020-09156-9>.
- [25] WHO. Immunization coverage n.d. <https://www.who.int/news-room/fact-sheets/detail/immunization-coverage> (accessed September 3, 2021).
- [26] CDC. COVID-19 Information for Cameroon _ U.S. Embassy in Cameroon n.d. <https://cm.usembassy.gov/covid-19-information/> (accessed September 3, 2021).
- [27] Tangermann RH, Lamoureux C, Tallis G, Goel A. The critical role of acute flaccid paralysis surveillance in the Global Polio Eradication Initiative. *International Health* 2017;9:156–63. <https://doi.org/10.1093/inthealth/ihx016>.

Figures

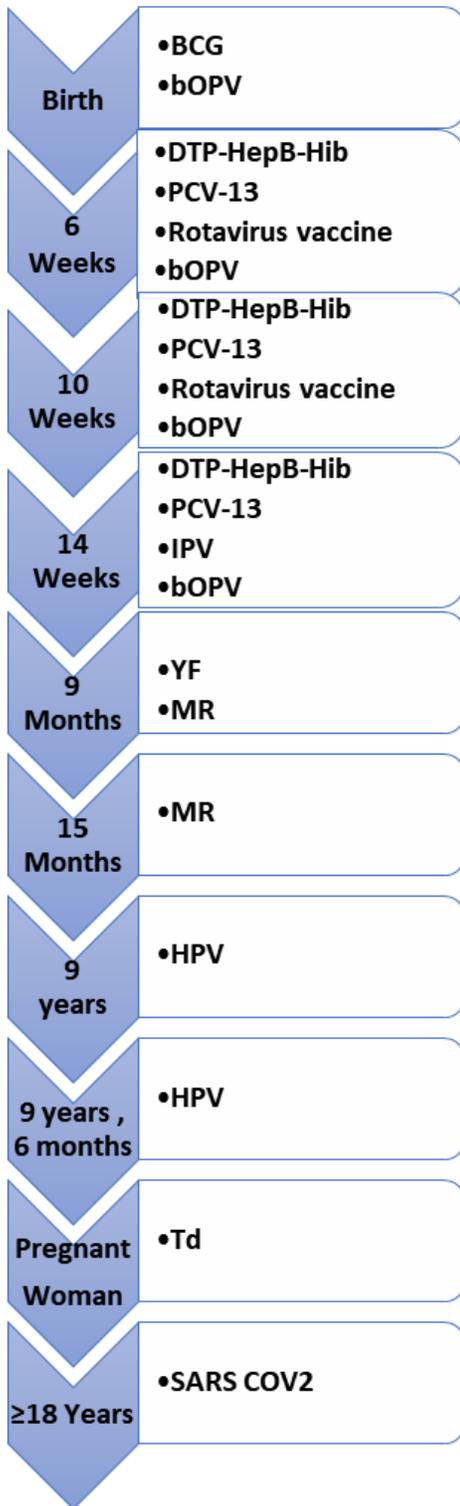


Figure 1

EPI Immunization schedule in Cameroon. Illustrates the vaccination calendar of Cameroon. The timeframe by each vaccine indicates the age from birth at which the vaccine is authorized to be administered to the target. For pregnant women who received the tetanus vaccine in childhood, three doses of Td are administered. The first dose at contact and the next is given one month after, the third dose is then given 6 months after the third dose. For women who did not receive a tetanus vaccine in childhood, a total of five doses are administered. After the first three doses above a fourth dose is given one year later and the fifth dose one year after the fourth.

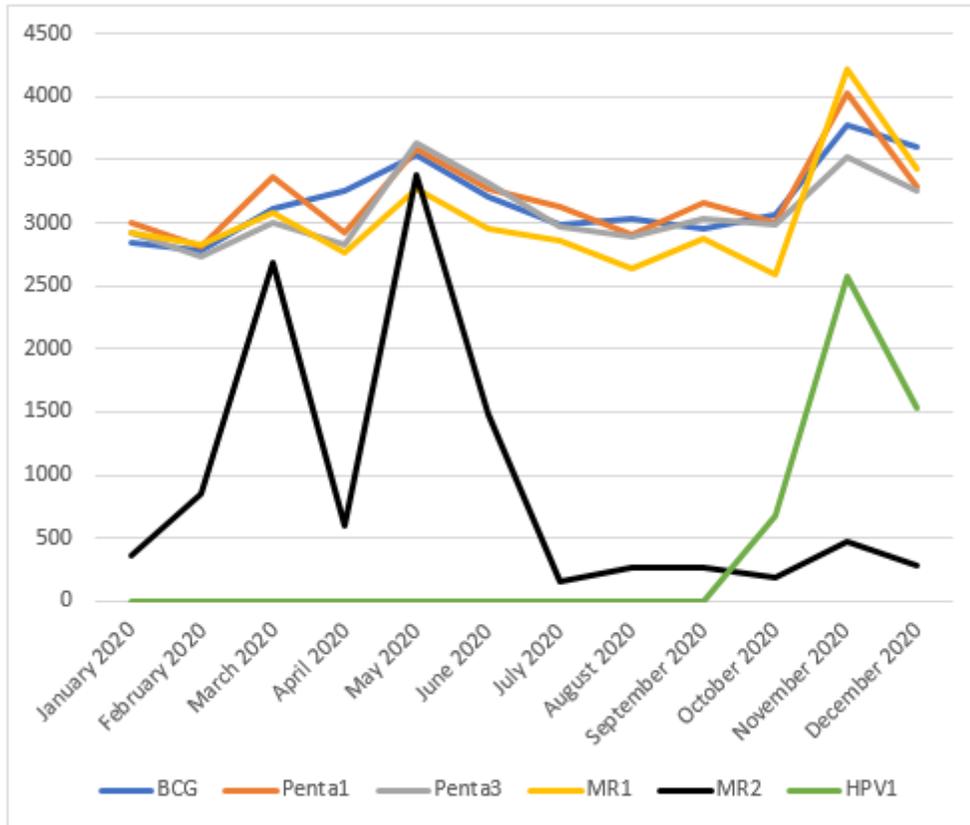


Figure 2

Trends in the number of infants vaccinated and reported in Dhis 2 in 2020 The line graph presents the trend in the total number of infants or adolescent vaccinated with the third dose of DPT (Penta), first and second dose of Measles Rubella vaccine and first dose of Human Papilloma Virus Vaccine (for adolescent girls). The blue line represents the infants vaccinate with DPT-3 (Penta 3), brown those vaccinated with the first dose of Measles Rubella vaccine, black line represents the infants vaccinate with the second dose of measles Rubella vaccine and yellow line represents the infants vaccinated with the first dose of Human Papilloma Virus vaccine (introduced 12 October, 2020). The spikes represent the periods of PIRI while the lull represents the period of routine immunization.

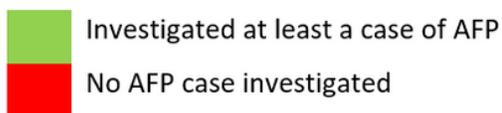
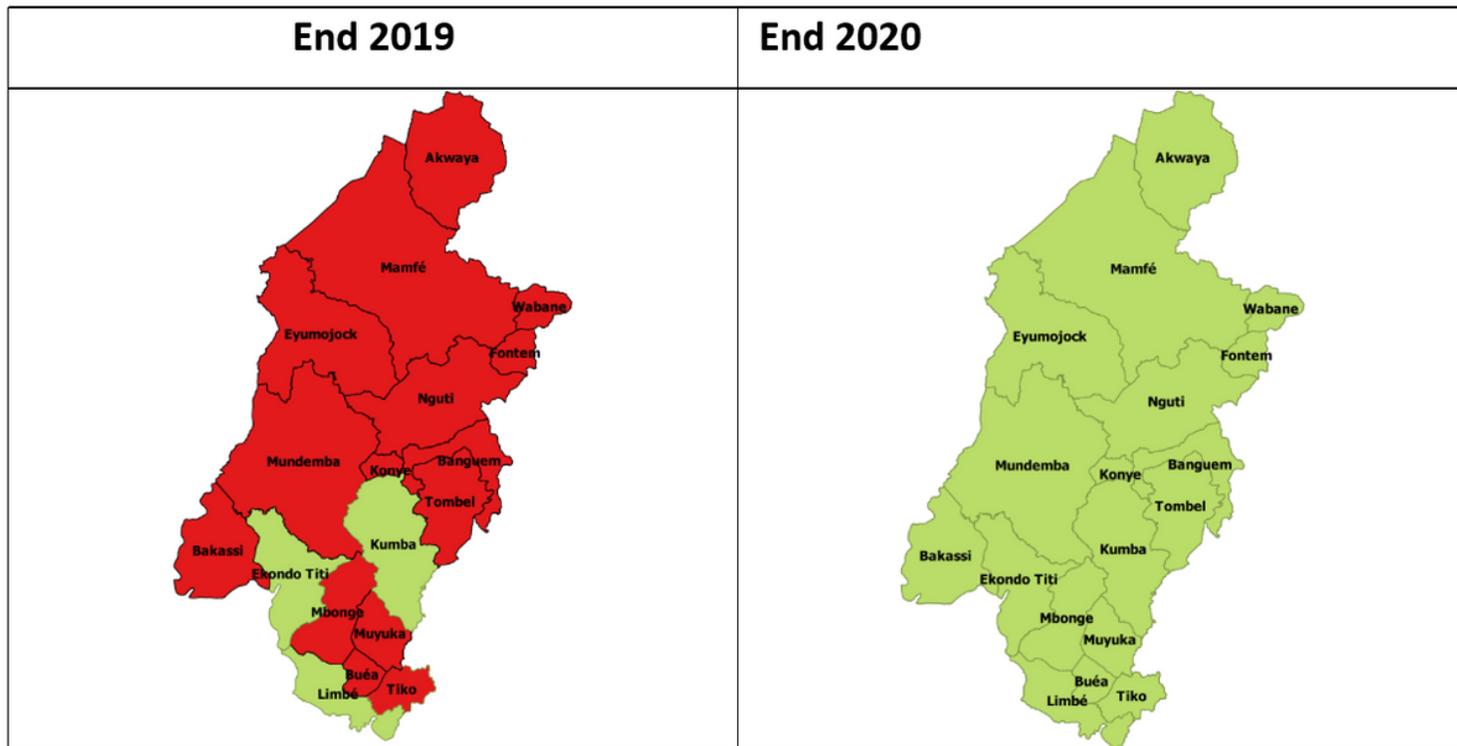


Figure 3

Trend in the investigation of Acute Flaccid Paralysis (AFP) per health district of the Southwest Regions from 2019-2020. A schematic representation of the evolution of AFP investigation in the southwest region of Cameroon between 2019 and 2020. For the corresponding periods, the areas in green are health districts that investigated at least a case of AFP during the given year. Meanwhile, the areas in red are health districts that did not investigate even a case of AFP for the corresponding period.

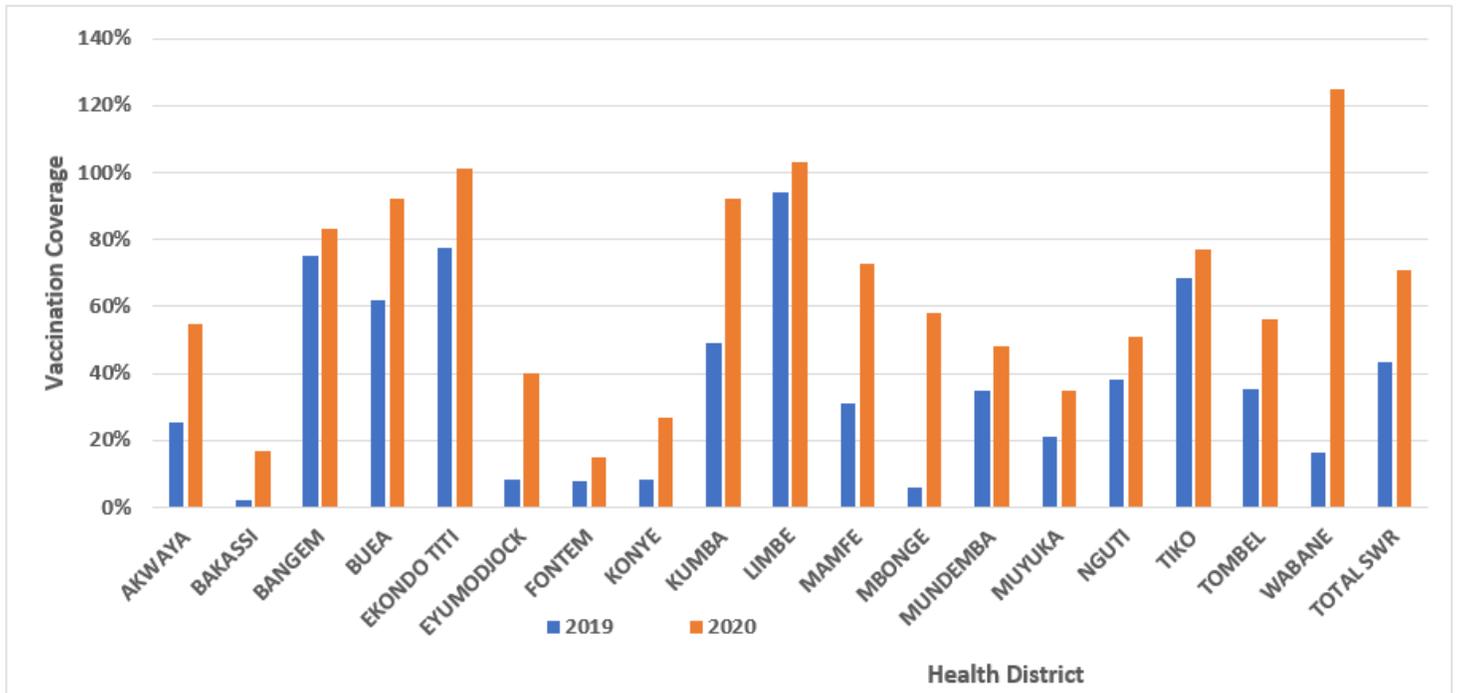


Figure 4

DPT-3 coverage per district 2019 to 2020 The bar chart presents the DPT-3 coverage the respective health districts of the SW. Blue represents the coverage in 2019 while brown presents the coverage in 2020.