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Mobile outreach clinics for improving health care services accessibility in vulnerable populations of the Diffa Region in Niger: a descriptive study

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Abstract

Background Niger is a large country with many distant locations that can be difficult to access because the Sahara Desert covers 80% of the country's land. In Niger, just 49% of residents have access to a health centre within 5 km of their house. Health care may be difficult to access in the Diffa region of Niger, as non-state armed groups strike on a regular basis and floods cause a high rate of vulnerability. This study looked at how mobile clinics can improve healthcare accessibility for vulnerable populations in the Diffa region.

Methods This was a descriptive-comparative study conducted over the period from 15 August 2022 to 15 October 2022, using three months' mobile outreach clinic to improve health outcomes in five districts of the Diffa region, including Bosso, Diffa, Goudoumaria, Mainé Soroa, and N'guigmi.

Results During the three months of mobile outreach clinic, 42,251 people were sensitized about mobile outreaches and 12,004 were treated. A total of 18,708 vaccine doses were delivered to children aged 0–11 months, with Maine Soroa, Goudoumaria, Bosso, Diffa, and N'guigmi districts accounting for 29.24%, 24.62%, 18.54%, 18.05%, and 9.5%, respectively. In the same line, Goudoumaria, Bosso, and Maine Soroa districts recorded relatively high antenatal clinic (ANC) attendance percentages of 27.85%, 25.62%, and 21.89%, respectively. Furthermore, mobile clinic outreach provided a variety of healthcare treatments, both curative and preventative. Mobile Clinic 2 increased vaccine dose received among children aged 0–11 months by 1.11% (95%CI: 0.15%-2.06%, $P=0.023$) when compared to Mobile Clinic 1. In the same line, mobile clinic showed a statistically significant increase of ANC between the three clinical rotations ($P=0001$), showing an increased ANC update over time.

Conclusion This study found that mobile outreach clinic can play an important role in improving healthcare access for vulnerable populations in the Diffa region. However, well-designed, and frequent mobile clinic outreach should be planned and included in the country's public health policy.

Keywords Mobile clinic, Outreaches, Healthcare, Accessibility, Vulnerable populations, Diffa region, Niger

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Background

The health systems in sub-Saharan Africa have been under enormous pressure that coexists with and is aggravated by public health emergencies and other disasters and challenges in Africa, such as natural disasters, socio-economic, political, and conflict situations [1]. In regions where more than two pressures coexist, this may constitute a humanitarian emergency for delivering health services. Humanitarian emergencies present unique challenges for health service delivery including, but not limited to, sudden changes in the nature and extent of the health burden, restricted access to services, and a heightened need to implement safeguarding measures [2]. Humanitarian emergencies frequently result in disrupted and overstretched public health care services and often overwhelm pre-existing fragility of health systems [3]. Among African countries facing humanitarian emergencies for delivering health services, Niger is listed among them, according to the facts mentioned below in this section.

According to the World Bank, Niger has a poorly diversified economy, dependent on agriculture for 40% of its gross domestic product (GDP) [4]. The level of extreme poverty is expected to reach 44.1% in 2023 due to negative per capita growth and rising inflation, which will increase the extremely poor population by 700,000, bringing the total to 12 million in 2023 [4]. Niger was hosting more than 700,000 displaced people, including refugees, asylum seekers, and internally displaced persons. Between August and early September 2023, the United Nations Refugee Agency (UNHCR) recorded the arrival of over 6,900 asylum seekers in Niger, mainly from Chad, Nigeria, and Burkina Faso [4].

In addition, in Niger, several regions are increasingly exposed to flooding linked to climate change, aggravating the vulnerabilities of populations. In most cases, these situations favoured by internal displacement of populations as well as refugees from Nigeria and Mali towards more secure areas of the country, resulting in disruptions to the system of social organization, the economy, education, and health [5]. Most of the affected regions in Niger have experienced attacks on health care: closure of certain health facilities, relocation and mobility of other health facilities, disruption of the continuum of care, and a reduction in the presence of health personnel at health facilities. The people of Niger are exposed to a wide variety of diseases that occur both during the wet and dry seasons. For example, measles, meningitis, polio, and pneumonia are prevalent during the dry season (generally between October and March), while cholera (June to September) and malaria (August to September) are highest during the wet season [6]. Malaria, alongside pneumonia, meningitis, and measles, can cause high mortality in children under-five [7]. Under-five mortality is estimated at 115.2 deaths per 1,000 live births in Niger in 2024 [8]. In the same line, acute malnutrition rate is estimated at 12.2%, of which 2.4% suffer from severe acute malnutrition and 9.8% from moderate acute malnutrition in Niger [9]. Nomadic populations and those living in rural areas are the most affected by food insecurity, which impacts the nutritional state of the elderly, pregnant and breastfeeding women, and especially children. In any case, the health system was able to ensure the delivery of routine care and services, including services belonging to the field of public health (mass campaigns for curative, preventive, and promotional care) in the most affected regions, particularly in the Diffa region. The World Health Organization WHO/Niger reported that 34,475 people in hard-to-reach areas were made aware of the use of health services and 409,356 people in hard-to-reach areas benefited from health services in 2021 [9]. Most of people live in rural areas (84%) in Niger [10]. Presently, 83% of sexually active women in Niger live in rural regions, posing logistical difficulties for obtaining facility-based healthcare [11]. A study on the multidimensional deprivation of children in Niger conducted in 2016 indicates that deprivation in health affects 68% of children under 2 years, of which 76% live in rural areas [10]. The prevalence of multidimensional deprivations is 2.74 times higher in rural areas compared to urban areas among individuals aged 2 to 4 years. An analysis indicated that during the dry season, fewer than 40% of Niger's population resided within an hour's walk of a health center [6]. Diffa's rural characteristics, vulnerability to climatic disturbances, war scenarios, elevated malnutrition rates, and significant incidence and prevalence of infectious and communicable diseases render it an ideal location for a mobile clinic initiative.

Based on these facts, the use of mobile clinics to ensure the continuum of essential services in conflict settings became even more useful [12]. Understanding the different modalities of primary healthcare delivery in conflict-affected settings is important to identify existing practices and gaps in service delivery. Service delivery using community health workers in conflict-affected settings is a low-cost primary care delivery strategy that may help optimize contributions of existing personnel through task shifting [13]. As part of the strategy: support for nutrition; systematic vaccination; maternal, neonatal, and child health; prevention and treatment of malaria in difficult-to-access areas, the WHO/Niger Office proposes to support the Diffa region through funding to support accessibility to health care and services. Thus, a strategy that makes it possible to increase access to health care and services beyond 5 km from the integrated health centre consists

of the implementation of mobile clinics [10]. They aim to facilitate access to health care and services for the poorest and most vulnerable communities living in the most remote areas, and thus increase accessibility and use of care and services by these populations. Establishing mobile clinics, temporary health posts, or transitional health facilities as interim solutions to meet urgent health care needs of crisis affected people are necessary until pre-existing health structures and staffing can be re-established, displaced communities are able to return to their original or more permanent locations while supporting efforts towards early recovery of the national health care system [3].

A review of the literature reveals that no study has been conducted to evaluate the effects of mobile outreach clinics in providing a minimum package of services, including child vaccination, antenatal consultations (ANC), and family planning, for vulnerable populations in Niger. This study mainly looked at mobile outreach clinics in the Diffa region ensure a minimum package of activities including child vaccination, antenatal consultations (ANC) and family planning in vulnerable population of five districts of the Diffa region, including Bosso, Diffa Health District, and Goudoumaria, Mainé Soroa, and N'guigmi. This study defines a vulnerable population as those displaced by armed conflict or natural disasters, who have heightened risks for health issues and inequities.

Methods

Study design and settings

This was a descriptive-comparative study conducted over the period from 15 August 2022 to 15 October 2022, using three months' mobile clinical rotations to improve health outcomes in five districts of Diffa region, including Bosso, Diffa Health District, Goudoumaria, Mainé Soroa, and N'guigmi.

Diffa Health District (18 IHC), Bosso (5 IHC), Mainé Soroa (13 IHC), Goudoumaria (13 IHC), and N'guigmi (5 IHC) provide coverage for all Integrated Health Centres (IHC) in these districts. All districts are in Diffa, a southeast region that borders Agadez Region to the north, Chad to the east, Nigeria to the south, and Zinder Region to the west (Fig. 1). In Niger, the health coverage rate represents the population (0–5 km) served by IHC over the general population [10]. For the Diffa region, the health coverage rate is 49.42% for a population of 815,324 inhabitants [14]. With a mean increase of 3.80% every year, the Diffa population is expected to face more challenges in health accessibility [4]. This assumes that, even in a normalized context, the population of areas larger than 5 km and the residents of this region present unique challenges to accessing care nowadays. The health information in the Diffa region does not gather data to compute the population rate covered by a strategy that serves the population beyond 5 km of health coverage. [15]. However, just 49% can access a health centre within 5 km of their house in Niger. [16] and this is an indicator

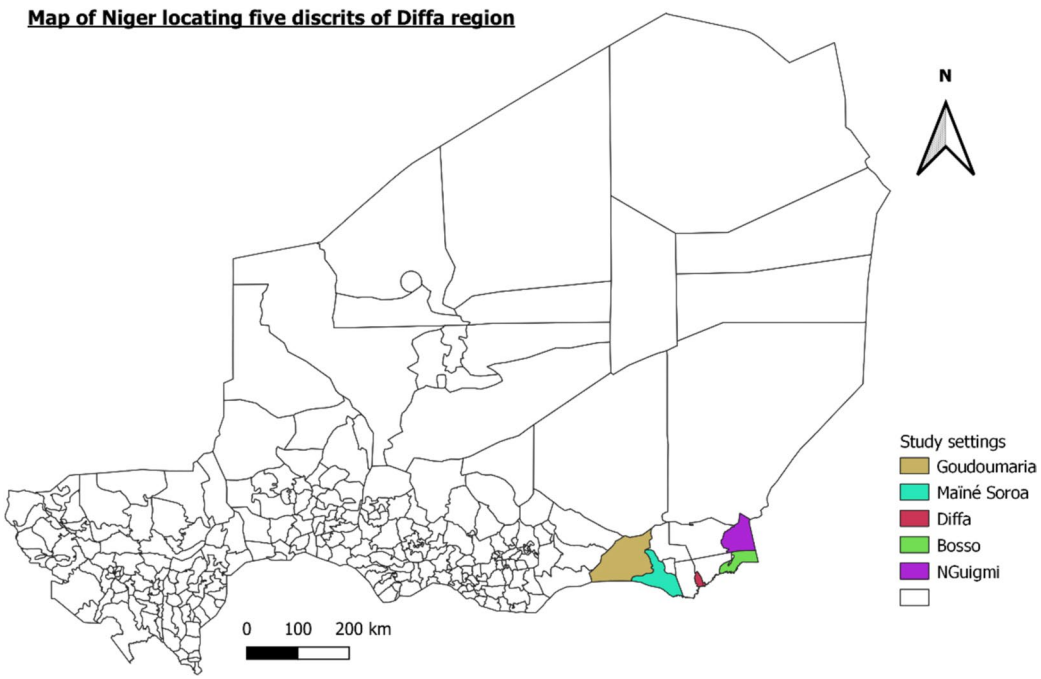

Fig. 1 Study settings: Bosso, Diffa, Goudoumaria, Mainé Soroa, and Nguigmi health districts in Niger

of choice that demonstrates to a certain extent, a certain level of performance of the system has been achieved.

The Diffa region has stood out since 2015 for recurrent attacks by non-state armed groups [17] and the occurrence of floods linked to the Koumadougou, over 32,000 people have been affected by flooding in the Diffa region of Niger, and more than 13,000 have been displaced in 2022 [18]. Furthermore, the population of the Diffa region is in perpetual movement in search of a normalized security situation and non-flooding spaces. In addition, unmet health needs in the Diffa region are increasing more and more due to the combined effects of insecurity, poverty, and other natural disasters such as floods. The health consequences specific to this Diffa region include the disruption of the health system with closure of certain health facilities in three (3) of the six (6) districts in the region, insufficient use of health services linked not only to the movement of populations but also to the non-permanence of available health care and services due to threats to health workers, difficulties in accessing health care and services by populations in perpetual movement, increasing vulnerability of women and children due to this exposure and risk of epidemics occurring for the population. In Diffa region, the districts most affected by insecurity and their consequences are the health districts of Bosso, Diffa, Mainé Soroa, Goudoumaria, and N'guigmi (Fig. 1). The health system in Niger is operationally based on the development of health districts and the latter constitutes the functional unit of the health system. According to the WHO, a health district is a relatively autonomous, economically viable decentralized area covering most of the health needs of the populations residing within its geographical limits, with other related services and health development partners maintaining intersectoral collaboration [19]. In Niger, the health district corresponds to the operational level which is managed by district management teams and is made up of District Hospitals (DH) and their networks of IHC and health cases (HC). In terms of overall accessibility, the following numbers of inhabitants characterize the ICH:—In rural areas, there is one IHC per 10,000 inhabitants with one ICH per 5,000 inhabitants in areas with low population density (IHC Type 1). In urban areas and in areas of high population density, it is established that one IHC per 15,000 inhabitants (IHC Type 2) [20]. The IHC's function is to ensure: (i) the provision of the Minimum Activity Package (MAP). The IHC will be responsible for carrying out curative activities as well as managing specific chronic diseases through treatment strategies, preventative activities, simple laboratory activities, promotional efforts, fairground strategies, and health-care management. health. This MAP is deemed to be full if it is made available at any time and according to the demands of service users; (ii) community management; and (iii) health centre supervision [20]. Mobile clinics provide a variety of services, including ante- and post-natal consultations, childhood immunization, and outpatient consultations for displaced populations living more than 5 km from a health care facility.

Study population

Niger is a vast country facing galloping demographic growth and low population density in the north and centre of the country. Most of this population lives in rural areas, often in isolated villages. The share of the nomadic population is estimated at 20%. This demographic challenge does not facilitate access to basic social services, coupled with the degraded security situation in cross-border areas, which compromises national development efforts. In this study, we considered sick population beyond 5 km of health coverage located in Bosso, Diffa, Goudoumaria, Mainé Soroa, and Nguigmi health districts.

Description of mobile clinics

The mobile clinics were coordinated at the district level by the district management team with the full technical participation of the partner involved. Further, district management team also provided local supervision. As the activity was carried out with critical consideration by the national level and the regional level, joint supervision of the WHO consultants, the regional quality assurance focal point, and the regional monitoring and evaluation focal point were carried out for each session. The implementation of mobile clinic activities required broadcasting on community radio and regional radio to not only announce the passage of teams but also ensure the dissemination of essential messages on the different themes developed and implemented by the mobile clinics. In addition to medical input from the mobile clinics, and visibility support was provided by the WHO. A mobile clinic team was made up of two (2) nurses to provide curative healthcare and referrals, one (1) midwife for the reproductive health package, and two (2) vaccinators. A full day of intensive learning for mobile healthcare workers to expand their understanding of how to launch or run a mobile health clinic in Diffa region. The vehicles allocated by district depend on the population of the district, the number of IHCs, and the area of the health district. Thus, the distribution of vehicles allocated was as follows: District of Diffa (5 vehicles), Mainé Soroa health district (3 vehicles), Goudoumaria health district (4 vehicles), N'guigmi health district (2 vehicles), and Bosso health district (2 vehicles). One mobile clinic outreach per month accounted for 5 days. At the level of each meeting village or village where the outreach

site was established, two (2) mobilizers/public criers are recruited. An outreach of 4 days of supervision by the district management teams per month at the level of each district was planned. Mobile clinics were installed in areas where vulnerable populations were more than 5 km from the IHC. A joint outreach of the WHO consultant, the quality assurance focal point of the region, and the monitoring and evaluation focal point of the region to cover the supervision of these 5 districts was assigned ten days per month.

Data collection

Data on the outpatient consultations were extracted for statistical analysis using an Excel spreadsheet. Data collection tools are routine tools used by the Ministry of Public Health as part of the implementation of service provision by Integrated Health Centers. The data clerk and data coordinator received training on the importance of data quality, the use of data collecting instruments (case record form), and the preservation of participant privacy and confidentiality. Data were validated at facility, district, and provincial levels. We obtained the patients' information on mobile clinical outreach, which was recorded in an Excel spreadsheet. Data were obtained about the knowledge of preventive medicine, mainly people who have epidemic potential, systematic vaccination, malnutrition, hygiene, and sanitation, fight against COVID-19, assisted childbirth, and family planning. Furthermore, data were also collected on curative treatment and major and common conditions such as pneumonia, acute diarrhoea, dehydration, conjunctivitis, uncomplicated malaria and complicated malaria, urinary tract infection (UTI), sexually transmitted infections (STIs), dermatosis, gastric ulcer, hypertension, oral candidiasis, malnutrition, wounds, and trauma. For each rotation, data collection was extracted for vaccination campaign data from the field reports and the Ministry of Health´s daily tally sheet and summary sheet filled out by the vaccinators and team supervisors during the vaccination exercise. Detail data was also obtained for women in the first, second, third, and fourth ANC follow-ups. Lastly, we also recorded data on type of contraception administered during mobile clinics.

Statistical analysis

Data analysis was done with Stata version 18. Descriptive and comparative analysis of variables was done using frequency and percentage, as only categorical data were reported. Our analysis described the population sensitized and treated by mobile clinic outreaches. Among those who were treated, immunization service providers were reported in terms of the rate of vaccine dose administration for Bacille Calmette-Guerin (BCG), Penta-1 vaccine (diphtheria, pertussis, tetanus, hepatitis B, and Hemophilus influenza type B (Hib)), penta-3, vaccine antimalarial or yellow fever (VAA), measles, mumps and rubella vaccine (MMR 1 and 2), rotavirus 1 and 2 vaccine, tetanus vaccine or tetanus toxoid (TT), pneumococcal vaccines (pneumo 1 and 2), serogroup A meningococcal vaccine (Men A), and inactivated polio vaccine (IPV 1 and 2). Results were reported by each mobile clinic outreach by district and vaccine. In the same line, ANC and contraception were reported as ANC and contraception rates by each mobile clinic outreach by district, respectively. Other major conditions were reported in the total number of patients treated during mobile clinic outreach. The test of two proportions was used to assess the difference between mobile clinic outreach 1, 2, and 3. *P*-values below 0.05 were considered statistically significant. Bar graphs were used to illustrate different sets of data among population sensitized and treated, including the total number of children aged 0–11 months vaccinated during the 3 mobile clinic visits, ANC, and contraception.

Results

Population sensitized and treated by mobile clinics

A total of 42,251 individuals were sensitized throughout five districts, with 12,004 receiving treatments over the three months of mobile clinic outreach, resulting in a treatment rate of 28.41%. Among the five districts where the population was sensitized for preventive and curative treatment, referred to as the sensitized population, Bosso district had the highest rates of treated population 11.06% (4673/42,251). Diffa Health District reported 7.37% (3116/ 42,251), N'guigmi 3.00% (1270/42,251), 3.04% (1285/ 42,251) in Goudoumaria and 3.93% (1661/ 42,251) in Maine Soroa districts were treated. Figure 2 depicted the variation between sensitized and treated people in each district.

During the first mobile clinic outreach, Maine Soroa and N'guigmi districts had the highest rates of treated patients with 33.77% (561/1661) and 32.68% (415/1270), respectively (Fig. 3). The lowest treatment rate was reported in Diffa district with 16.30% (508/3116) (Fig. 3). In the same line, the treatment rate was quite similar in the second mobile clinic outreach in all the districts, except N'guigmi, where 24.80% (315/1270) was reported (Fig. 3). Besides, the third mobile clinic outreach recorded high treatment rates in all districts, with 44.92% (1400/3116) for Diffa, 42.52% (540/1270) for N'guigmi, 38.24% (1787/4673) for Bosso, 35.02% (450/1285) for Goudoumaria, and 31.31% (520/1661) for Maine Soroa (Fig. 3).

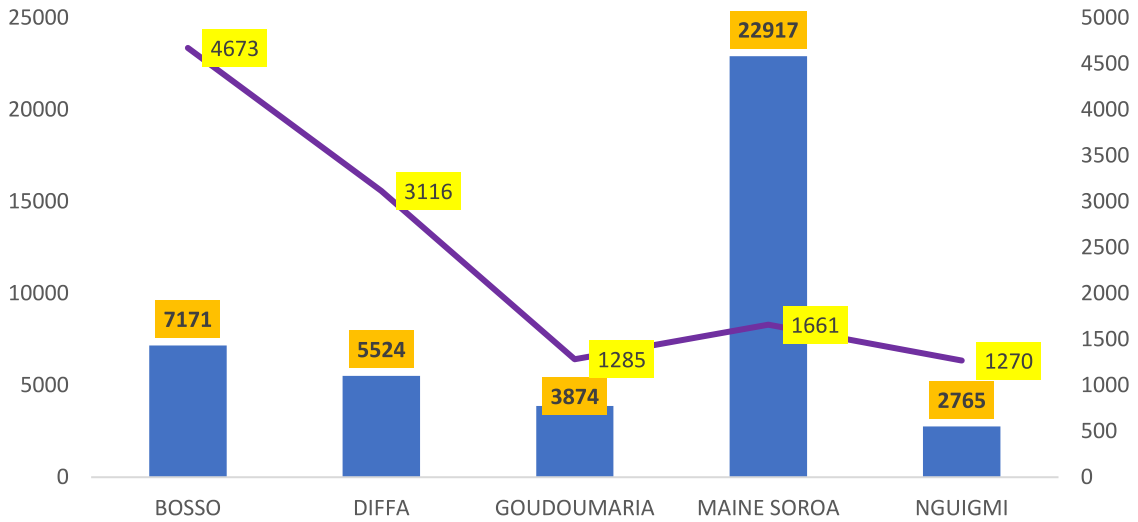

Fig. 2 Number of people sensitized and treated by health district during visits from mobile clinics, Diffa region, Niger, 2022. Blue bars representing the number of sensitized people. Purple line representing the variation of treated people

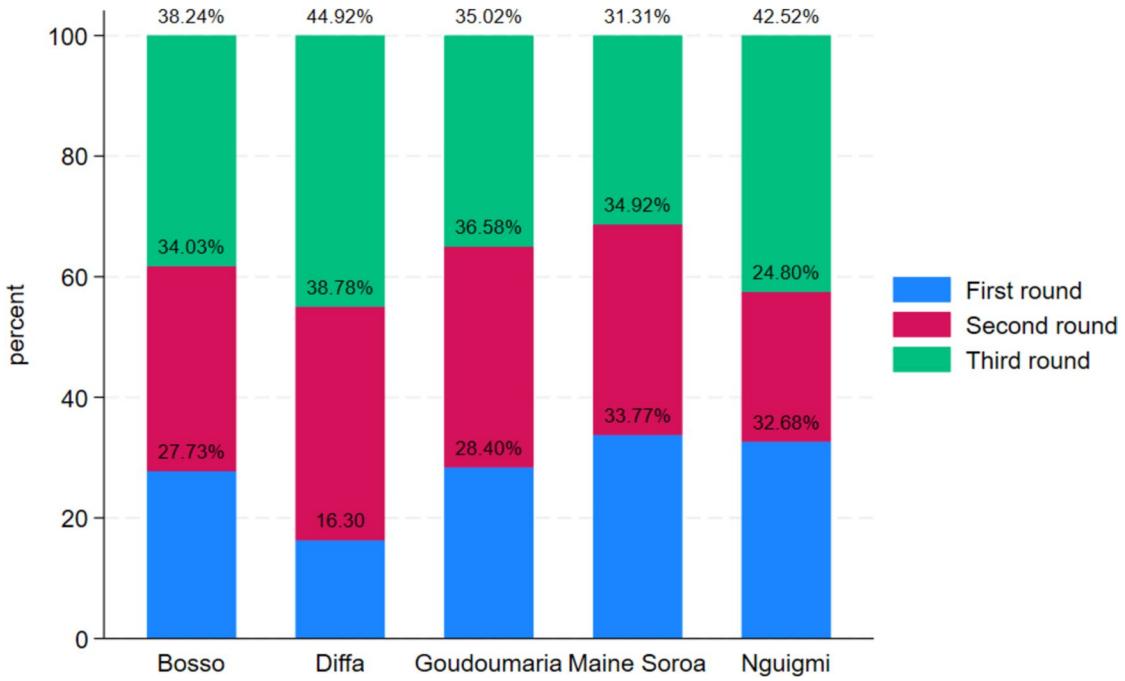

Fig. 3 Number of people treated through mobile clinics by district, Diffa region, Niger 2022

Immunization service providers in the five districts for three months' mobile clinics

A total of 18,708 vaccine doses of Bacille Calmette-Guerin (BCG), Penta-1 vaccine (diphtheria, pertussis, tetanus, hepatitis B and Hemophilus influenza type B (Hib)), penta-3, vaccine antimalarial (yellow fever) (VAA), varicella vaccine (VAR-1 and 2), rotavirus 1 and 2 vaccine, tetanus vaccine or tetanus toxoid (TT), pneumococcal vaccines (pneumo 1 and 2), serogroup A meningococcal vaccine (Men A), and inactivated polio vaccine (IPV 1 and 2) were administered among children aged 0–11 months during the three months' mobile clinics. The results showed that the first, second, and third mobile clinic outreaches administered 32.89% (6153/18708), 34.00% (6361/18708) and 33.11% (6294/18708), respectively. During the three months'

mobile clinic, Mainesoroa district administered the highest vaccine dose among children aged 0–11 months 29.24% (5470/18708), followed by Goudoumaria 24.62% (4607/18708), Bosso 18.54% (3468/18708), Diffa 18.05% (3377/18708), and N'guigmi 9.55% (1786/18708) (Table 1). BCG, Penta-1, VAA, MMR, Pneumo1, and Men A vaccine dose were more commonly administered in children aged 0–11 months with 9.46% (1770/18708), 8.57% (1604/18708), 8.51% (1593/18708), 9.09% (1701/18708), 8.75% (1638/18708), and 8.47% (1587/18708), respectively (Table 1 and Fig. 4). In contrast, IPV-1, IPV-2, TT-1, and TT-2 + reported low-rate dose administration with 2.15% (404/18708), 2.65% (495/18708), 4.31% (807/18708) and 3.13% (588/18708), respectively (Table 1 and Fig. 4).

Table 1 Immunization services in the five districts during the three mobile outreach clinics

Vaccine	Bosso (n/%)	Diffa (n/%)	Goudoumaria (n/%)	Mainesoroa (n/%)	Nguigmi (n/%)	Total (n/%)
BCG	294 (1.57%)	48 (0.26%)	858 (4.59%)	480 (2.56%)	90 (0.48%)	1770 (9.46%)
Penta-1	253 (1.35%)	294 (1.57%)	322 (1.72%)	485 (2.59%)	250 (1.34%)	1604 (8.57%)
Penta-3	255 (1.36%)	265 (1.52%)	330 (1.79%)	457 (2.35%)	163 (0.87%)	1470 (7.89)
VAA	201 (1.07%)	354 (1.89%)	399 (2.15%)	513 (2.77%)	126 (0.67%)	1593 (8.55%)
MMR-1	243 (1.30%)	354 (1.89%)	447 (2.39%)	540 (2.89%)	121 (0.65%)	1701 (9.09%)
MMR-2	216 (1.15%)	361 (1.93%)	447 (2.39%)	343 (1.83%)	111 (0.59%)	1478 (7.89%)
Rota-1	255 (1.36%)	291 (1.55%)	243 (1.30%)	486 (2.60%)	147 (0.78%)	1422 (7.59%)
Rota-2	234 (1.25%)	177 (0.95%)	90 (0.48%)	381 (2.04%)	24 (0.13%)	906 (4.85%)
TT-1	267 (1.43%)	0 (0.00%)	210 (1.12%)	183 (0.98%)	147 (0.78%)	807 (4.31%)
TT-2 +	219 (1.17%)	0 (0.00%)	141 (0.75%)	186 (0.99%)	42 (0.22%)	588 (3.13%)
Pneumo1	255 (1.36%)	309 (1.65%)	333 (1.78%)	492 (2.63%)	249 (1.33%)	1638 (8.75%)
Pneumo3	258 (1.38%)	132 (0.70%)	300 (1.60%)	441 (2.36%)	114 (0.61%)	1245 (6.65%)
Men A	231 (1.23%)	354 (1.89%)	399 (2.13%)	483 (2.58%)	120 (0.64%)	1587 (8.47%)
IPV-1	152 (0.81%)	102 (0.54%)	88 (0.47%)	0 (0.00%)	62 (0.33%)	404 (2.15%)
IPV-2	139 (0.74%)	336 (1.80%)	0 (0.00%)	0 (0.00%)	20 (0.11%)	495 (2.65%)
Total	3468 (18.54%)	3377 (18.05%)	4607 (24.62%)	5470 (29.24%)	1786 (9.55%)	18,708 (100%)

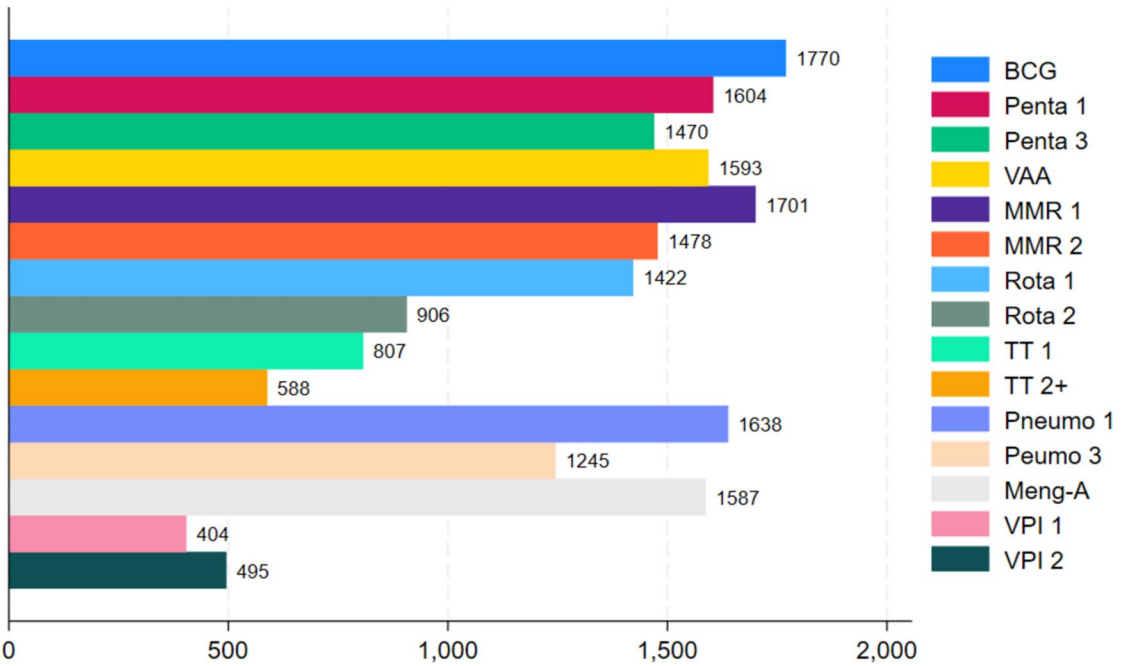

Fig. 4 Number of target children aged 0–11 months vaccinated during the 3 mobile clinic visits by district, Diffa region, Niger 2022

The comparisons of vaccine dose received among children aged 0–11 months conducted during the three mobile clinic outreaches only showed an increased vaccine dose received in mobile clinic 2 with 1.11% (95%CI: 0.15% to 2.06%, *P*-value = 0.023) compared to mobile clinic 1 (Table 2). In contrast, mobile clinic 1 vs. mobile clinic 3 and mobile clinic 2 vs. 3 were not statistically significant with *P*-values of 0.651 and 0.068, respectively (Table 2).

ANC and contraception service providers in the five districts for three months' mobile clinic

Mobile clinics were conducted in 2923 ANC in Bosso, Diffa, Goudoumaria, Maine soroa, and N'guigmi districts. Goudoumaria, Bosso, and MaineSoroa districts reported high ANC attendance rates with 27.85% (814/2923), 25.62% (749/2923), and 21.89% (640/2923), respectively (Table 3). N'guigmi and Diffa districts reported lower ANC attendance rates with 13.00% (380/2923) and 11.63% (340/2923) (Table 3). Furthermore, 488 pregnant women benefited from ANC 4. The Bosso health district caught up in ANC 4 was estimated at 37.29 (182/488), followed by Goudoumaria 29.10% (142/488) and 22.95% (112/488) for Mainé Soroa (Fig. 5). In contrast, Diffa and N'guigmi districts reported the lowest ANC4 rates (Table 2). The comparison of ANC between the three mobile clinics revealed statistically significant differences between mobile clinic 2 vs. 1 with increased ANC of 4.79% (95%CI 2.43% to 7.15%, *P*-value = 0.0001) for mobile clinic 2 (Table 4). In the same line, mobile clinic 3 vs. 1 showed an increased rate of 12.30% (95%CI: 7.62% to 12.43%, *P*-value = 0.0001) for mobile clinic 3 (Table 4). An increased ANC rate was also observed between mobile clinic 3 vs.1 with 5.24% (95%CI: 2.78% to 7.69%, *P*-value = 0.0001) for mobile clinic 3 (Table 4). Overall, ANC uptake significantly increased over the three months' mobile clinics (*P*-value = 0.0001).

Besides, 199 women of childbearing age benefited from contraceptive methods. Diffa and Maine Soroa both reported high use of contraception, with 39.19% (78/199) and 38.19% (76/199), respectively (Table 5 and Fig. 6). In total, during the first visit, 199 women were enrolled in the family planning program for all methods, with a higher number in the Diffa health district, followed by Mainé Soroa.

Other service providers

Other services provided during the 3 mobile clinics in Bosso, Diffa, Goudoumaria, Maine soroa, and N'guigmi districts included the following:

- 42,251 people were informed about diseases with epidemic potential, systematic vaccination, malnutrition, hygiene and sanitation, the fight against COVID-19, assisted birth, and family planning. In addition, patients received treatment for cough/cold, pneumonia, acute diarrhoea, dehydration, conjunctivitis, simple and severe malaria, UTI, STIs, dermatosis, gastric ulcer, hypertension, oral candidiasis, malnutrition, common wounds, and trauma.
- 12,005 patients received curative therapy for diseases with epidemic potential, systematic vaccination, malnutrition, hygiene and sanitation, the fight against COVID-19, assisted birth, and family planning. In addition, patients received treatment for cough/cold, pneumonia, acute diarrhoea, dehydration, conjunctivitis, simple and severe malaria, UTI,

Table 2 Comparisons of vaccination among children aged 0–11 months between the three mobile outreach clinics

Mobile clinic outreaches	P1	P2	P1-P2	Z-test	*P*-value	95%CI
Mobile clinic 1 vs. Mobile clinic 2	6153/18708 (32.89%)	6361/18708 (34.00%)	-0.0111	-2.28	0.023	-0.0206 to -0.00154
Mobile clinic 1 vs. Mobile clinic 3	6153/18708 (32.89%)	6194/18708 (33.11%)	-0.0022	-0.45	0.651	-0.01173 to 0.0073
Mobile clinic 2 vs. Mobile 3	6361/18708 (34.00%)	6194/18708 (33.11%)	0.0089	1.82	0.068	-0.0007 to 0.0185

Table 3 ANC service providers in the five districts for three months' mobile clinic outreach

ANC	Bosso (n/%)	Diffa n/%)	Goudoumaria (n/%)	MaineSoroa (n/%)	Nguigmi (n/%)	Total (n/%)
First ANC	180 (6.16%)	166 (5.68%)	234 (8.00%)	190 (6.50%)	148 (5.06%)	918 (31.41%)
Second ANC	195 (6.67%)	106 (3.63%)	233 (7.97%)	181 (6.19%)	112 (3.83%)	827 (28.29%)
Third ANC	192 (6.57%)	56 (1.91%)	205 (7.01%)	157 (5.37%)	80 (2.74%)	690 (23.60%)
Fourth ANC	182 (6.23%)	12 (0.41%)	142 (4.86%)	112 (3.83%)	40 (1.37%)	488 (16.69%)
Total	749 (25.62%)	340 (11.63%)	814 (27.85%)	640 (21.89%)	380 (13.00%)	2923 (100%)

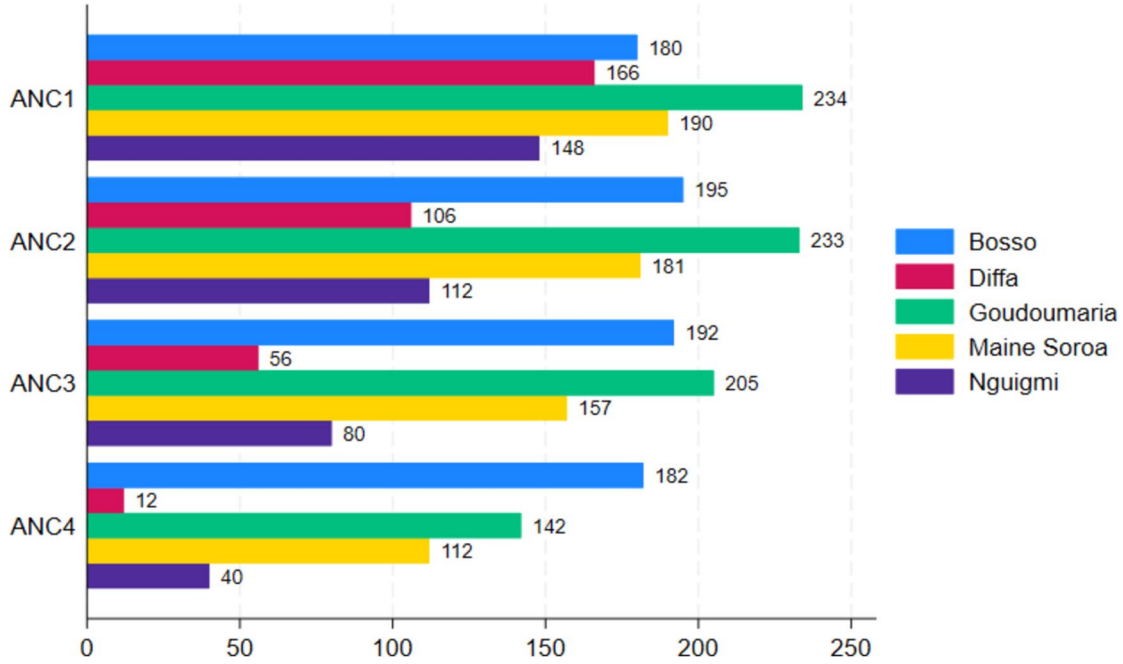

Fig. 5 Number of pregnant women seen at the ANC through mobile clinics by district, Diffa region, Niger 2022

Table 4 Comparison of ANC between the three mobile clinics

Mobile clinic outreaches	P1	P2	P1-P2	Z-test	*P*-value	95%CI
Mobile clinic 1 vs. Mobile clinic 2	830/2923 (28.39%)	970/2923 (33.18%)	-0.0479	-3.97	0.0001	-0.0715 to -0.0243
Mobile clinic 1 vs. Mobile clinic 3	830/2923 (28.39%)	1123/2923 (38.42%)	0.123	-8.13	0.0001	-0.1243 to -0.0762
Mobile clinic 2 vs. Mobile clinic 3	970/2923 (33.18%)	1123/2923 (38.42%)	-.0524	-4.18	0.0001	-0.0769 to -0.0278

Table 5 Contraception service providers in the five districts for first months' mobile clinic

Districts	Bosso	Diffa	Goudoumaria	Maine soroa	N'guigmi	Total
Combined pill	12 (3.81%)	44 (13.97%)	0 (0.00%)	20 (6.35%)	0 (0.00%)	76 (24.13%)
Progestin pill	17 (5.40%)	16 (5.08%)	24 (7.62%)	14 (4.44%)	0 (0.00%)	71 (22.54%)
Depo-Provera	0 (0.00%)	16 (5.08%)	38 (12.06%)	35 (11.11%)	5 (1.59%)	94 (29.84%)
Implanon	18 (5.71%)	2 (0.63%)	7 (2.22%)	7 (2.22%)	0 (0.00%)	34 (10.79%)
Subcutaneous injection	0 (0.00%)	30 (9.52%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	30 (9.52%)
Injectable intra-musculaire	0 (0.00%)	2 (0.63%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	2 (0.63%)
Sayana	8 (2.54%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	8 (2.54%)
Total	55 (17.46%)	110 (34.92%)	69 (21.90%)	76 (24.13%)	5 (1.59%)	315 (100%)

STIs, dermatosis, gastric ulcer, hypertension, oral candidiasis, malnutrition, common wounds, and trauma.

- 376 patients with critical conditions such as severe malnutrition, severe malaria, pregnancies associated with complications and chronic diseases in the latest stage were referred to DH.
- During the implementation of mobile clinics at the team level, there is no stock out of necessary drugs. This shows how frequently the activity was considered at the district level. The drugs used were primarily donations made accessible to the region by the WHO as part of its efforts to boost the care of vulnerable individuals during health and humanitarian

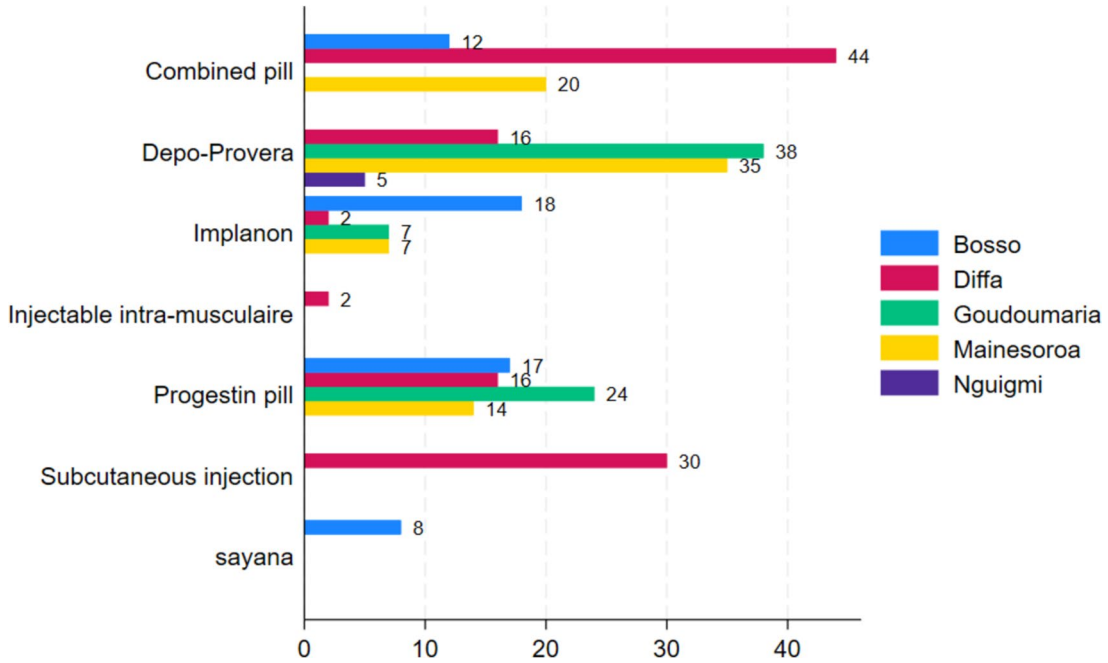

Fig. 6 Number of types of contraception given through mobile clinic by district, Diffa region, Niger 2022

emergencies. Districts also used partial cost recovery funds to assure free care for categories exempt from recovery, such as children under five and pregnant women.

Discussion

We conducted a descriptive study to investigate the impact of mobile clinics on the provision of health care and services to internally displaced people and refugees in five districts of the Diffa region/Niger, including Bosso, Diffa Health, Goudoumaria, Mainé Soroa, and N'guigmi. Even though this study included all therapeutic and preventive measures in these five districts, it focused on child immunization, ANC, and family planning. Our findings revealed that 42,251 people were sensitized throughout the three-month mobile clinic. 18,708 vaccine doses were delivered to children aged 0 to 11 months during the three-month mobile clinic. BCG, Penta-1, VAA, MMR-1, Pneumo1, and Men A vaccine dose were more commonly administered in children aged 0–11 months with 9.46%, 8.57%, 8.51%, 9.09%, 8.75%, and 8.47% of total doses, respectively. In the same line, mobile clinic outreaches were conducted for 2923 ANC in Goudoumaria, Bosso, and Maine Soroa districts which reported high ANC attendance rates of 27.85%, 25.62%, and 21.89%, respectively. Lastly, 199 women of reproductive age received contraceptive services during the initial mobile clinic. Diffa and Maine Soroa districts reported high contraceptive use at 39.19% and 38.19%, respectively. According to the WHO and the United Nations International Children's Emergency Fund (UNICEF), nearly 70,000 children aged 1–23 months do not have access to vaccines in Niger, and the percentage of children who have received three doses of diphtheria, tetanus, and pertussis (DTP-3) vaccines, known as basic marker of vaccination coverage, has remained stable at around 80% (82% in 2021). This basic biomarker is satisfactory by the expected standards of 90% vaccination coverage [21]. A meticulous analysis made it possible to target the health areas with the highest number of unvaccinated or undervaccinated children. Since its launch in October 2022, more than 17,000 zero-dose children have been identified in 15 districts across Niger, of which 14,000 have received their first vaccination [21]. This study played an important role in vaccination catch up in Bosso, Diffa, Goudoumaria, Mainé Soroa, and Nguigmi health districts as children miss out on vaccines in many remote areas of Niger [21]. Healthcare facilities and vaccination centres are often far away from rural populations, making it challenging for parents to bring their children for vaccinations. In addition, long distances and lack of financial means are among the main obstacles to the ANC in Niger [16]. Besides, only 49% can access a health facility within 5 km of their home in Niger [16] and the Diffa region is subject to recurrent attacks by non-state armed groups, poverty, the occurrence of natural disasters such as floods linked to the Koumadougou and perpetual movement in search of a normalized security situation

and non-flooding spaces. Based on all these facts, health care and services can be made accessible by mobile clinics in the Diffa region. Mobile clinics bring reliable access to primary care to people living in some of the smallest, underserved communities [22]. A study conducted by Ouedraogo et al. reported that the evaluation of the strategy of mobile clinics in emergency situations in the Sahel and north-central regions of Burkina Faso has the advantage of ensuring access to care for certain populations excluded from the health system due to insecurity, distance, and even the cost of care [16]. Comparatively to our results, Ouedraogo et al. also reported that several care and health services were provided during mobile clinics, and the minimum package of activities included curative services, preventive, educational, and promotional [23]. In Bangladesh, immunization programme is a remarkable achievement, with less than one per cent of children aged under one year are zero-dose children [24]. This is due to going mobile to reach Bangladesh's zero-dose children has played an important role in this achievement [24]. A recent review suggested that contraceptive distribution through mobile or community-based services was an effective and acceptable way to increase access to contraceptives, particularly injectable contraceptives and long-acting or permanent methods [25]. In the same line, just as women of childbearing age who are around health facilities benefit from family planning services, women far from health centres can benefit from them thanks to mobile clinics. Mobile local services help correct disparities in access to family planning services and products in order to help women and men meet their reproductive health needs [26].

Our findings also revealed that 42,251 people were sensitized about diseases with epidemic potential, systematic vaccination, malnutrition, hygiene and sanitation, the fight against COVID-19, assisted birth, and family planning. In addition, patients received treatment for cough/cold, pneumonia, acute diarrhoea, dehydration, conjunctivitis, simple and severe malaria, UTI, STIs, dermatosis, gastric ulcer, hypertension, oral candidiasis, malnutrition, common wounds, and trauma. Among those who were educated, only 28.41% were treated. This low treatment rate could be explained by limited resources allocated in mobile health outreach, strong social barriers, customs, and beliefs in Niger. However, our findings were in the line with studies undertaken in other settings. In Chad, a study focused primarily on villages beyond 5 km from a health centre that are difficult to access due to limited resources or terrain and are considered mobile clinic strategies to combat malnutrition [27]. Another study conducted in a conflict affected area of Afghanistan revealed that sustained, scheduled mobile clinic services to conflict-affected and remote regions were associated with improved coverage of important maternal and child health interventions. In the Republic of Haiti, clinics were tested in schools and contributed to providing a timely response to the problem of accessibility and availability of health care to children from marginalized areas of the population [28]. Mobile clinic is an essential service and not just an 'optional extra' for the most deprived mothers and children [29]. Mobile clinic is used in many countries to provide health services to women and children, such as prenatal care, childhood immunizations, family planning services, and breast cancer screening [30]. In certain contexts, mobile clinics are much more used to improve reproductive health services, mainly family planning. In addition, mobile clinic enables strategic and flexible deployment of resources, including health care providers, family planning commodities, supplies, equipment, vehicles, and infrastructure to areas of high need and at intervals that respond most effectively on the demand of remote populations [26]. Another study revealed that mobile clinics investigated disease outbreaks including cholera, measles, Rift Valley fever, and COVID-19 [31].

Besides, our results revealed a low-rate dose vaccine administration of IPV-1, IPV-2, TT-1, and TT-2 + reported low-rate dose administration with 2.15%, 2.65%, 4.31%, and 3.13%, respectively. This could be explained by dispelling myths and misinformation in the Diffa region. This could be further explained by lack of a significant increase number of vaccinated children during the three mobile clinics, which only showed an increased dose rate of vaccination in Mobile Clinic 2 with 1.11% (95%CI: 0.15% to 2.06%). Mobile Clinics 1 and 3 did not show a statistically significant number of vaccinated children. Comparatively, ANC between the three mobile clinics revealed a statistically significant increase in ANC between Mobile Clinics 1, 2 and 3 over time. This shows that mobile clinic can significantly improve maternal health if the intervention is prolonged for vulnerable population of the Diffa region. This illustrated that the Diffa region faces significant challenges to improving vaccination coverage among children. By the way, community health workers may play an important role in ensuring rural populations get the appropriate information about child vaccinations before mobile clinic in the Diffa region [21]. Furthermore, it will be vital to collaborate with Diffa region leaders to identify corridors of transit and weekly marketplaces where they obtain supplies, as well as to station immunization teams in these various districts. Mobile clinics must first innovate and collaborate with their leaders to obtain information and assistance in the Diffa region [21].

Based on the above discussion, the use of mobile clinic has shown multiple advantages in underserved and conflicted districts in the Diffa region. In fact, the use of

mobile medical teams, usually self-sufficient, multidisciplinary medical teams with sufficient flexibility to deploy rapidly, is a common modality in humanitarian emergencies. Mobile clinics deliver preventive (i.e. immunization, screening, and health education) and curative (i.e. treatment of common morbidities and minor surgeries) services to communities that are unable to access health facilities [2, 31]. The mobile health services are operated with clear referral pathways for services that cannot be rendered by the mobile clinic [12]. Mobile clinics are common and preferred in humanitarian crises, although they are limited in coverage, expensive and logistically burdensome, and lack sustainability and continuity for chronic illnesses [2, 31, 32]. This study highlights critical areas, such as Diffa region in Niger, where health services/facilities may need to be improved using realistic travel time estimates to represent access times during the dry and wet seasons [6]. If we compare our findings using this criterion, then we can clearly see that in Niger, access to health facilities is highly inadequate, with greater than 75% of the population having to travel more than an hour by foot to the nearest health facility during the wet season and greater than 60% of the population during the dry season. Based on this, A cost–benefit analysis of mobile clinics is essential due to their limited coverage, high costs, logistical challenges, and lack of sustainability and continuity. Access can be improved using vehicular travel [6], as efforts increase to reduce childhood mortality in the Diffa region. It is clear that improving access and delivery of health care to reduce hospitalization and mortality is greatly needed in the Diffa region [6]. In fact, it is recommended that mobile clinics be used as a "last resort" to reach populations who are cut off from health services in the Diffa region [2, 12, 33]. The Diffa region with a fragile health system and limited access to health care, mobile clinic outreaches may be effective to address this gap. Further, mobile clinics reduced the cost of transportation and increased linkage to healthcare [12]. In rural areas, the quality and conditions of roads and lack of proper transportation necessitates the presence of mobile clinics especially for elderly patients, pregnant women, and children that are in need of constant medical attention [34]. Following the general strategy of improved health care, these mobile clinics make it possible to access basic and specialized health care services regardless of location, local medical equipment, the financial situation of patients, type of health care, and structural barriers such as problems in transferring patients from remote locations in the Diffa region [35, 36].

The study's strength is that it demonstrated various lessons to be learned from the planning of mobile clinic interventions. Our research found that mobile clinics can provide access to health care for Diffa populations who live more than 5 km away from a health centre. The study also showed that well designed mobile clinic activities were on the schedule day in all areas, but only if cars and inputs were available. The district management team's availability at each district level, and its dedication to supervising the teams characterized the good performance of the teams each time they were supervised. This implied a high sensitized population around the mobile clinic site if the whole package of scheduled activities was available with patient registration and acceptance of the activity at the community level during in-process monitoring carried out by the supervisors with a rate of 100% at the site level. Mobile clinics also played an important role in referring cases of severe acute malnutrition to appropriate health centre management, improvement of vaccination coverage with catch-up of several zero-dose children and under vaccinated children, improved ANC and family planning coverage, use of curative treatment by all health districts, including an increased number of people treated for malaria, respiratory infections, trauma and common injuries, the involvement of administrative and customary authorities in the implementation of activities. Furthermore, three mobile outreaches were performed, comparable indicators have been used to ensure to assess health services. This mobile clinic model is similar to that used in Operation Koutouho in Niger, which includes the use of mobile clinic services, a high-impact practice proven to increase access to vaccination in geographically remote settings [16, 33]. Depending on the geographic specificities and lifestyles of the populations in the Diffa region, the provision of care and services should be ensured through appropriate strategies, fixed strategies, advanced strategies implemented by the IHCs, and decentralized mobile strategies implemented by the district management teams.Recommendations for the evaluation and monitoring of mobile clinics involve conducting comparative studies of various modalities to discern the effects of mobile clinics, which are essential in Niger, especially in the Diffa region. It may be necessary to implement measures to guarantee the accurate collection and reporting of service delivery indicators. Monitoring and evaluation must be enhanced through the implementation of more precise indicators that track the health professionals providing each service, the availability of health workers for these services, and the capacity of mobile clinic services to deliver a comprehensive, evidence-based package of high-impact preventive, promotional, and curative interventions for maternal, child, and adolescent health, thereby supporting the health system in Niger [37]. The study's limitations include an insufficient supply of supplies for treating malaria cases in the N'guigmi health district; the rupture of several antigens, including VAA, Men-A, and BCG in the N'guigmi

health district. There was insufficient information about the schedule of mobile clinics at the population level in all districts due to the lack of radio broadcasts announcing these activities. The population, teams, and district management teams do not know when their next trips will be. To attain quantifiable enhancements in accessibility and utilization, mobile clinics must be integrated with efficient outreach programs that can identify target the need of vulnerable population. This necessitates denominator-focused design, oversight, and evaluation of mobile clinic services. Detailed data collection plays a crucial role in ensuring that mobile clinic efforts are effective, well-coordinated, and reach the intended populations. Lack of detailed data in this study impacted poor reports of conditions such as malnutrition, immunization, acute diarrhoea, dehydration, hypertension, diabetes mellitus, and COVID-19 in Diffa district. Furthermore, the study could not say if mobile clinic could improve vaccination coverage. Finally, while this is a short-term study, more research into the long-term impact of mobile clinics on healthcare in Niger's vulnerable population is required.

Conclusion

Mobile outreach clinic has demonstrated a double advantage, namely improved the health of difficult-to-access populations, and improved the primary health care indicators in Bosso, Diffa, Goudoumaria, Maine Soroa, and N'guigmi districts/Niger. Given that only 49% can access a health facility within 5 km of their home in Niger, recurrent insecurity, and natural disasters in the Diffa region may worsen healthcare accessibility. Continued and regular mobile clinics over a long period, as shown in the results of this study, are needed in the Diffa region. The deployment of mobile medical clinics in underserved populations in the Diffa region is a step toward enhancing healthcare access, including providing high-quality to patients. This will help to continue supporting health districts within the framework of mobile clinics and updating data centralization, and ensuring availability of all inputs, including Expanded Programme on Immunization (EPI) antigens to districts as part of mobile clinics. Furthermore, adapted population sensitization, including radio broadcast (involvement of community radio stations), community members, and leaders are substantial in improving vaccination coverage during mobile clinics, where the study found there was no palpable increase in vaccine dose administration during the three mobile clinic outreaches. Given the challenges encountered during mobile outreach clinic, a well-defined national strategy using mobile clinic to improve access to health care and services for vulnerable populations is required, as is the sustainability of the implementation of mobile clinic in the Diffa region, and in Niger in general.

Abbreviations

ANC	Antenatal consultations
BCG	Bacille Calmette-Guerin
COVID-19	Coronavirus disease 2019
DH	District Hospitals
DTP	Vaccines against diphtheria, tetanus, and pertussis
GDP	Gross domestic product
EPI	Expanded Programme on Immunization
IHC	Integrated Health Centres
IPV	Inactivated polio vaccine
HC	Health Cases
MAP	Minimum Activity Package
Penta-1 vaccine	Diphtheria, pertussis, tetanus, hepatitis B and Hemophilus influenza type B
Men A	Serogroup A meningococcal vaccine
MMR	Measles, mumps and rubella vaccine
STIs	Sexually transmitted infections
TT	Tetanus toxoid
UNICEF	United Nations International Children's Emergency Fund
UNHCR	United Nations Refugee Agency
UTI	Urinary tract infection
VAA	Vaccine antimalarial
WHO	World Health Organization

Authors' contributions

Conceptualization: L.M.R. Data curation: L.M.R. and J.L.T. Investigation: L.M.R., B.O., D.M., J.L.T., and P.D.M.C.K. Methodology: L.M.R., B.O., D.M., J.L.T., and P.D.M.C.K. Formal analysis: L.M.R. and J.L.T. Writing and drafting: L.M.R., B.O., D.M., M.A., C.I., J.L.T., P.D.M.C.K., C.S.W., and B.P.M.A. Reviewing, & editing: L.M.R., B.O., D.M., M.A., C.I., J.L.T., P.D.M.C.K., C.S.W., B.P.M.A., and M.C.T.

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Data availability

The datasets collected and/or analyzed during this work are by WHO-NIger, and are thus not publicly available. The data, however, can be obtained by the relevant author with permission from the WHO-Niger (Dr. Lawali Mahaman Rabiou, lawalim@who.int).

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from Institutional Review Board of the Niger Ministry of Public Health. Written informed consent was obtained from all subjects. After explaining the purpose of the study. The confidentiality of the participants' information was preserved by assigning a code number to each participant and locking the data in the closet and computer with a password.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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