

Mass Distribution Campaign of Long-Lasting Insecticidal Nets in the Democratic Republic of Congo from 2018 to 2021 in the Context of the Emergence of COVID-19: Results and Lessons Learned

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Abstract

Introduction: The DRC had planned 23 mass distribution campaigns distribution of long-lasting insecticidal nets (LLIN) for the years 2018-2020, the implementation of which spanned from 2018 to July 2021. This article reviews the campaign's planning process, the results, challenges, and lessons learned. **Methods:** A descriptive method was used to postpone the planning and implementation process according to the National Malaria Control Program (NMCP) standards adapted to the COVID-19 context. The changes and adaptations implemented as well as the challenges encountered are described. **Results:** Between January 2018 to June 2021, 23 LLIN mass distribution campaigns were organized in the DRC with the financial support of The Global Fund to Fight against Tuberculosis, AIDS and Malaria (GFTAM) and Against

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Malaria Foundation (AMF) allowing the distribution of 55,273,473 LLINs to 19,048,372 households at risk of malaria transmission with an average of 2.9 LLINs per household. The enumerated population (111,081,191) exceeded 7% of the micro plans projected population (102,790,391) while the number of households enumerated (19,311,629) was 3% lower compared to the micro planning projection households (19,862,417). Compared to a reported household coverage of 96% of households achieved over the expected households, the independent monitoring carried out revealed 91% of households served in the intervention areas. The main reasons for not reaching households mentioned by the respondents were absence at the time of distribution (26%) followed by the loss of vouchers (16%). Several communication channels were used among which, community workers were the most frequently mentioned (63.1%), followed by radios (18.5%) and churches (12.4%). **Conclusion:** Good planning, effective coordination of stakeholders, and revision of the implementing campaigns methods following the COVID-19 were factors in the success of this campaign. An effort to respect the schedules for renewing LLINs in households, coupled with good continuous distribution, is necessary to maintain the gains and hope for an impact in terms of morbidity and mortality reduction of malaria.

Keywords

Vector Control, LLIN Campaigns, COVID-19, Lessons,
Democratic Republic of Congo

1. Introduction

During the development of the global technical strategy for malaria 2016-2030 (GTS 2016-2030) and the call for RBM Partnership to end malaria in “Action and Investment to Defeat Malaria 2016-2030” (AIM 2016-2030), the World Health Organization (WHO) estimated a 212 million malaria cases and 429,000 deaths due to malaria worldwide in 2015 [1] [2] [3]. This represented a reduction of 22% of cases and 50% of deaths compared to the situation in 2000 [3]. This impressive progress was due to the development in the 1990s of new disease control tools, including LLINs, rapid diagnostic tests, and more effective drugs combinations. The 2000s marked the increasing of investments in the fight against malaria, the creation of new funding mechanisms, notably the Global Fund to Fight Tuberculosis, AIDS, and Malaria (GFTAM), and the United States President’s Malaria Initiative (PMI), which allowed a large-scale deployment of these new tools [4].

Between 2015 and 2019, malaria incidence globally decreased by only 2%, reflecting a sharp slowdown since 2015 [4]. To revive the momentum for progress, the WHO and the Roll Back Malaria (RBM) partnership, initiated in 2018, the “from a high burden to a strong impact” approach (HBHI) for 11 countries which account for nearly 70% of malaria cases and deaths in the world, with 10 in

sub-Saharan Africa, including the Democratic Republic of Congo (DRC) [4] [5]. Since the DRC NMCP targeted ten provinces which concentrated 64% of malaria cases in 2019 to intensify malaria fighting [6].

GTS 2016-2030, AIM 2016-2030, and HBHI converge on the need for universal coverage of at-risk populations of malaria through key interventions, including the use of LLINs, requiring an investment to achieve the malaria morbidity and mortality reduction targets set at 90% in 2030 compared to the situation in 2015 [1] [2] [5].

The use of LLINs has increased in sub-Saharan Africa (SSA) in the past decade leading to a significant drop in malaria morbidity and mortality in Africa despite the emergence of vector resistance to insecticides [7] [8] [9] [10]. The dysfunctions of health systems due to COVID-19 have led to cancellations and postponements of LLIN distribution campaigns, threatening to reverse the progress made [11] [12] [13].

The promotion of LLINs use is the primary vector control strategy promoted by the DRC NMCP [6]. Between 2007 and 2014, DRC experienced a drastic increase in the possession and use of LLINs following significant investments, mainly from GFTAM and PMI, supporting the DRC NMCP [14] [15]. Secondary analyzes of data from the Demographic and Health Survey (DHS) 2013-2014 showed that the use of LLINs was significantly associated with a reduction of malaria prevalence by up to 44% and in malaria mortality by 41% in children under 5 in the DRC [16] [17] [18].

Mass distribution campaigns are the best way to rapidly increase LLIN coverage of at-risk populations to achieve impact [19]. In the DRC during 2017, out of the eight provinces planned for LLIN mass distribution campaigns, only one had been fully distributed mosquito nets and another partially [20]. At the same time, the NMCP reported an increase in malaria cases from 12,186,639 cases in 2016 to 15,272,767 cases in 2017 and 18,208,440 in 2018 [20] [21] [22]. Therefore, it was important for the NMCP to speed up the organization of campaigns in the next years to catch up and align with the WHO's call for the intensification of the fight and its focus on HBHI countries, including the DRC.

The objective of this study was to review the planning process of LLIN mass distribution campaigns for the years 2018-2020, the implementation of which spanned from 2018 to 2021, and to report obtained results, challenges faced, and lessons learned to guide future distribution campaigns in DRC and other African countries.

2. Methods

2.1. Description of the LLIN Mass Campaign Organization Cycle in the DRC

The DRC had started the mass distribution of LLINs with campaigns associated with vaccination against Measles, polio, vitamin A supplementation as well as deworming with Mebendazole targeting children under 6 to 36 months in the

province of Bas-Congo in 2006, then children aged 0 to 5 in the provinces of South Kivu in 2007 and Equateur in 2008.

The first LLIN distribution campaigns started in 2009 in the Orientale and Maniema provinces. The gradual mobilization of resources made it possible to complete the 1st distribution cycle throughout the country only in 2012. With the 1st round of the GFTAM New Funding Model (NFM1) from 2014-2017 followed by the NFM2 from 2018-2020 coupled with the financing of PMI that the DRC has managed to stabilize a distribution cycle covering the whole country in 3 years and renewing with an interval of 3 years for each province. The Against Malaria Foundation (AMF) contribution in purchasing LLINs from 2019, continuing to cover 9 of the 26 provinces, was decisive in setting these targets within a constraint of limited resources.

From 2018 to 2020, all 26 provinces were planned for mass LLINs distribution campaigns with financial support from the GFTAM (21 provinces) or PMI (5 Provinces) (**Figure 1**) [6].

For the 21 provinces benefiting from GFTAM funding, funds for 15 provinces went through two principal recipients, namely Primary Health Care in Rural Areas/Non-profit organization (SANRU Asbl) for logistics, communication, and

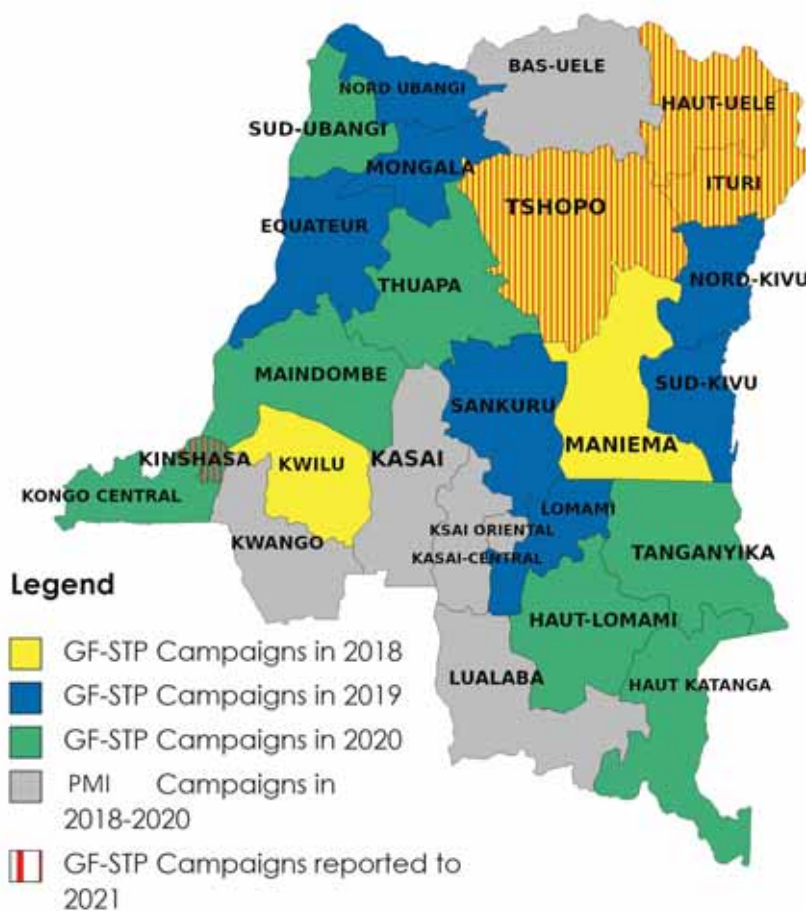


Figure 1. LLIN distribution campaigns planned for the 26 provinces of the DRC between 2018 and 2020.

monitoring aspects and the Ministry of Health Financial Management Support Unit (FMSU) for planning activities, training, LLINs transport from the central offices of the Health Zone (HZ) to the health area (HA) and from there to villages, household count, distribution of LLINs to households and independent monitoring. For the other six provinces, SANRU was the principal recipient but relied on Interchurch Medical Assistance world health (IMA world health) as a sub-recipient which relayed the support to the HZ for all the activities supported by GFTAM in the other provinces.

It should be noted that, among the 5 LLINs mass distribution campaigns with GFTAM funding planned in 2017, four were carried out in 2018, in the provinces of Ituri, Haut Uélé, Maniema, and Tshopo.

This study focuses on the campaign's funding the GFTAM, including the four campaigns postponed from 2017 to 2018 and the 21 campaigns planned for 2018-2021 with co-financing from AMF to purchase the LLINs from 2019 for 9 out of 21 provinces.

2.2. DRC Epidemiological Profile

The entire population is at risk of malaria infection, which is the leading cause of morbidity and mortality. In 2019, the reported incidence of the disease was 327 cases per 100,000 inhabitants, with in-hospital mortality attributed to malaria of 40 deaths per 100,000 inhabitants [22]. Almost the entire population (97%) lives in areas with stable transmission, while a small part of the population (3%) living in the eastern highland area faces seasonal malaria transmission with a risk of malaria outbreaks [23].

Available data show several vectors existing in the country, being mainly *Anopheles gambiae* (92%). *Plasmodium falciparum* is the predominant parasitic species (95%), with *Plasmodium ovale* and *Plasmodium malariae* more rarely encountered [23]. Although *Plasmodium vivax* has been assumed to be absent from sub-Saharan Africa because of the protective mutation conferring the Duffy-negative phenotype, recent evidence has suggested that *P. vivax* infections have been identified in DRC [24] [25].

Anopheles gambiae, the main malaria vector encountered in the country, is resistant to permethrin and a lesser extent, to deltamethrin. Entomological survey data show that, although the presence of the kdr-1014F mutation was very common, the increased mortality of *Anopheles gambiae* after exposure to piperothrin butoxide (PBO) indicates that this resistance is partly due to metabolic mechanisms [26].

2.3. Campaign Planning and Implementation Process

Prior to the COVID-19 pandemic, the planning process of LLIN distribution campaigns in the DRC consisted of 4 key steps: macroplanning, household enumeration, microplanning, and then the distribution of LLINs to households (Figure 2) [27]. Following the occurrence of the COVID-19 pandemic, to reduce the transmission risk, the NMCP decided to link the household enumeration to

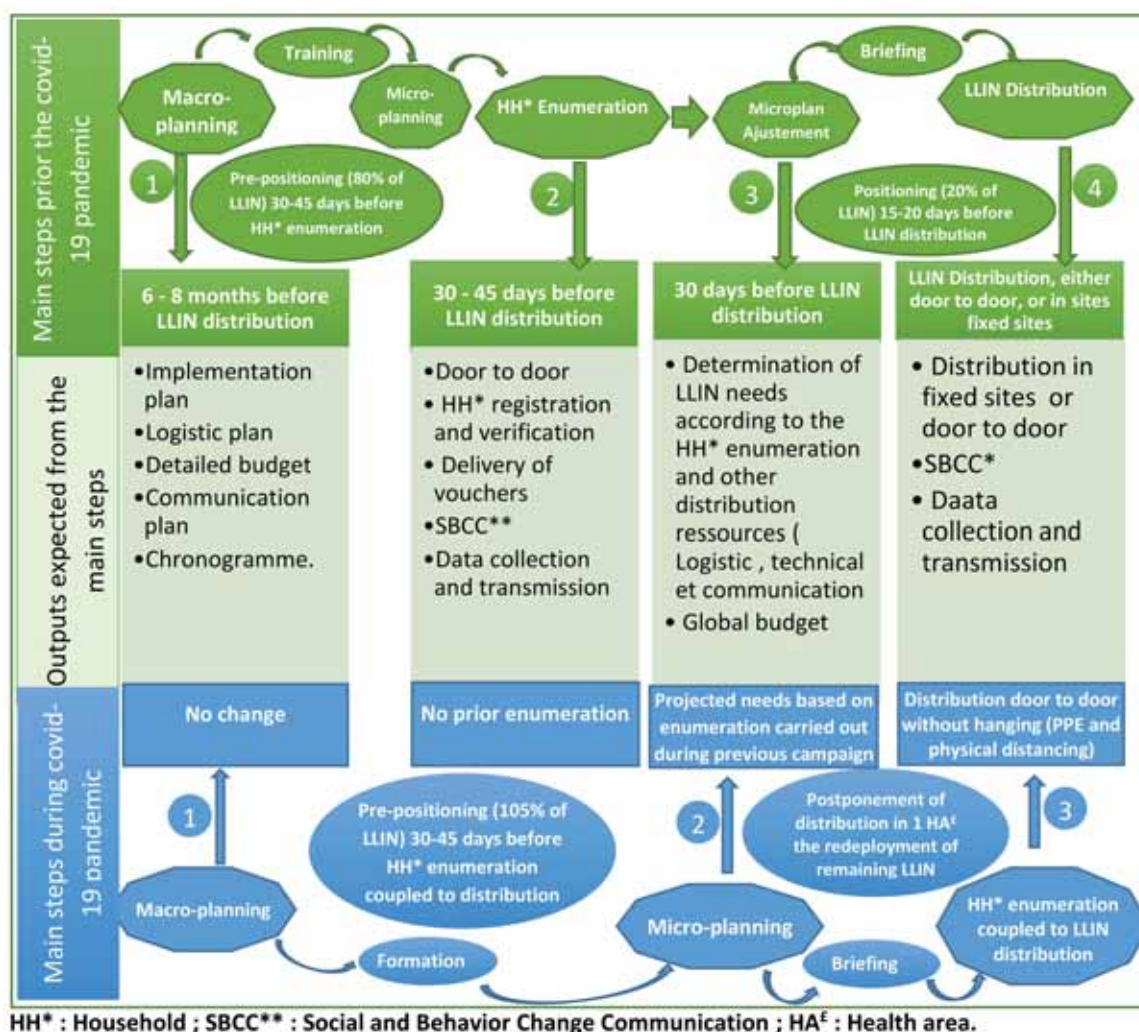


Figure 2. Key stages in the planning and implementation process of mass LLIN campaigns in the DRC and the changes induced by COVID-19.

LLIN distribution to avoid double exposure of household's distribution teams, particularly in the context of fixed-site distributions, which caused population surge that was difficult to control [28].

Macroplanning had to be done early, 6 to 12 months before the distribution, depending on whether the provincial campaigns were scheduled for the year's 2nd, 3rd, or 4th quarter. Thus, this process was planned for the fourth quarter preceding the year of implementation. Its objective was to define the implementation strategy, determine the needs in terms of LLIN quantity, human and material resources required and estimate the estimated overall cost of the campaign, based on the population of the most recent population count.

The macro-planning development workshop was firstly held at the provincial level for five days with the core team of the provincial health divisions (CT-PHD) and the NMCP Provincial Coordination. Then, the delegates from all targeted provinces were invited to a national workshop for annual macro-planning consolidation. The deliverables expected were: an implementation plan with a

provisional budget highlighting a rigorous quantification of the needs to achieve universal coverage of households with LLINs, a detailed timetable, a logistic plan with a deployment plan taking into account the provinces realities, and a communication plan anticipating the bottlenecks encountered during the previous campaigns.

During the years 2018 and 2019, about two months before the households' enumeration (3 to 4 and a half month before LLIN distribution), successive training workshops in the management of LLIN mass distribution campaign were organized for five days to strengthen the capacity of the CT-PHD and core teams of the HZ (CT-HZ) followed by those of the titular nurses (TN) of the health areas (HA) and the chairpersons of the development committees of the HA (CDC-HA) (3 days). The TN and CDC-HA training workshop ended with the development of the first format of HA microplans that will be consolidated into HZ microplans. At the end of the chain, the TNs briefed the community health workers (CHW) on household enumeration procedures (1 day). In 2020, following the occurrence of the COVID-19 pandemic, physical distancing led to the limitation of the number of participants per room (with a consequent increase in the number of rooms, the number of facilitators, and support staff), the provision of masks and bottles of hydro-alcoholic gels had been put in place to reduce the risk of transmission of this disease.

Based on the microplans, Provinces organized the enumeration of households at the HZ level. In the provinces where the "fixed-site" or "door-to-door" distribution methods were selected, each CHW recorded 25 households per day in rural areas or 30 households per day in urban areas. In those where distribution was to be carried out by community participation mechanisms, each CHW had to record 50 households per day, regardless of the environment. After the households were registered, a voucher was given to the heads of household to serve 30 to 45 days later, as an access ticket to the LLINs required according to their household size. In 2020, CHW and their supervisors were also equipped with masks and bottles of hydro-alcoholic to reduce COVID-19 risk of transmission.

After workshops to validate the enumeration data, the CT-HZ adjusted the microplan to obtain the final data to quantify the needs and determine the resources required for the LLINs distribution to households. As for training, in 2020, during data validation workshops, physical distancing measures restricting the number of participants per room (with as a consequence increased number of rooms, facilitators, and staff), the endowment of masks and bottles of hydro-alcoholic gels had been put in place to reduce the risk of transmission of COVID-19.

To be reassured of the quality of the service provided at the time of LLIN distribution, a series of one-day briefings were organized to refresh the actors on the modalities of LLIN distribution. The NMCP team led the CT-PHD briefing. The CT-PHD, in turn, briefed the HZ team, and the latter briefed the TN and CDC-HA. At the end of the chain, the TN briefs the CHW who subsequently

become the distribution teams for LLINs to households. These briefings were given, in 2020, in compliance with the measures above to prevent the transmission of COVID-19.

About two months after the enumeration, the LLIN distribution to households was organized according to one of the three methods below:

- Either a “fixed-site” distribution: the heads of households with a voucher received during the enumeration went to a site planned to distribute LLINs to households in 4 days. Each site maintained by 4 CHW (1 law enforcement officer, one distributor, one pointer, and one mobilizer) had to distribute LLINs every day to 200 households in rural areas or 300 households in urban areas.
- Either a “door-to-door” distribution: teams of 2 CHW (1 LLIN hanger and one recorder) had to serve 20 households per day in rural areas or 30 households per day in urban areas for five days.
- Either a “community” distribution: the distribution was organized by the community animation units (CAU) by unique village/single avenue or villages/avenues grouped according to the size of the villages. This distribution was done in 3 days in rural areas or four days in urban areas.

After the occurrence of COVID-19 outbreak in the 1st quarter of 2020, the NMCP decided, with the support of donors and PTFs, in addition to coupling the household enumeration to the distribution, to switch all distributions to the “door to door” method to avoid groupings of the population that could increase the risk of disease transmission.

2.4. Supply and Inventory Management

The criteria retained by the NMCP to choose the types of LLINs to be distributed in the country were: 1) the manufacturer, the manufacturing site, and the LLIN must be prequalified by the WHO; 2) the manufacturer had to present a certificate from the International Organization for Standardization (ISO); 3) in case of supplier was other than the manufacturer, he had to present a letter of commitment; 4) the product must have obtained a Marketing Authorization (AMM) granted by the MOH Pharmacy and Medicines Department (PMD).

The forecasted quantification was based on the population estimated based on data from the previous enumeration to which the natural increase rate of 2.9% provided by the National Statistical Institute (INS) was applied [29]. Based on the WHO recommendation, the number of LLINs to ensure universal coverage was then obtained by using the formula [30]:

$$\text{Quantity of LLINs required} = (\text{Estimated population})/1.8$$

About 9 to 12 months before the planned distribution date, the lessors placed the orders and signed a contract with a procurement and transit agency. MOH/NMCP support agencies for implementing campaigns (SANRU for GFTAM, UNICEF, or CHEMONICS for PMI) were responsible for monitoring orders and receiving LLINs at the entry points of the country at least 3 - 4 months before distribution.

These agencies then ensured the deployment of the LLINs to the HZs in the beneficiary provinces at the rate of 80%, 30 to 45 days before the distribution, then the 20% temporarily kept in a provincial warehouse were completed according to the readjusted data of the microplans after household enumeration. The CT-HZ organized the deployment of LLINs from the HZ warehouses to the HA and distribution sites, respectively, “in fixed sites” or villages for “door-to-door” or “community” distributions at least seven days before the launch of the distribution.

With the occurrence of the COVID-19 outbreak, to the initial quantification, 5% of contingency stock was added to anticipate any possible stock-out following the uncertainty about populations that may result from their movements since the last enumeration. The risk involved was to see a slightly larger remainder after the distribution. A second adjustment lever was to launch the distribution in all HA of an HZ except the one that hosts the Central Office of the HZ (COHZ), which had to be shifted and whose LLINs could serve as additional stock to be used in the event of stock out. At the end of the distribution, a stock reconciliation should allow redeployments between HA or between HZ to finalize the distribution in the “shifted” HA.

2.5. Campaign Coordination

Campaign coordination was organized at all levels of the health pyramid:

- At the national level: a National Technical Committee (NTC) met weekly to monitor activities implementation, provide feedback to the provinces level, and prepare key elements decision-making during the meetings of NTC.
- At the provincial level: a Provincial Coordination Committee (PCC) ensured the follow-up of the smooth running of the campaign in the HZ. A total of 10 meetings were to be held at the rate of two during the preparatory phase, one daily during the distribution and two after the distribution for a rapid evaluation of the campaign results before the final validation workshop, which should be held two weeks after the end of the campaign.

At the HZ level: the Local Coordination Committees (LCC) ensured the close monitoring of the smooth running of the campaign in the HA through meetings held at the same frequency as that of the PCC with an additional session on the day of the catch-up of unreached households.

2.6. Communication to Support LLIN Distribution Campaign

Communication was considered to be a significant lever for the success of campaigns. The planning of the related activities went through a community diagnosis organized around 4 to 6 months before the distribution of the LLIN, followed by a workshop to readjust the communication plan developed during the macro-planning phase.

The strategies used to support the LLIN distribution campaigns were: 1) advocacy targeting community and political leaders to obtain their ownership of

the activities and their commitment to mobilize the populations and help remove any bottlenecks; 2) lobbying using civil society organizations (CSO) and community-based organizations (CBOs) to ensure “citizen” control contributing to good governance in the management of resources allocated to the campaign and to community mobilization; 3) social mobilization aimed at putting into action all the societal forces and operational networks in the communities, in particular schools and universities, the national police, the armed forces of the DRC, non-governmental organizations (NGOs), associative movements, community based organization (CBO) with particular emphasis on partnership with religious denominations, women’s associations and youth movements as well as the media in raising public awareness; 4) mass communication using channels with a large audience such as: radios and televisions; 5) non-media communication such as billboards, posters, banners, leaflets...; 6) proximity communication using CHW either to animate educational talks, to make home visits or with voice throwers passing village by village and avenue by avenue to announce the key dates of the campaign (enumeration, distribution), communicate on the importance of the LLIN and its good use...; 7) solemn launching ceremonies constituting an opportunity to ensure the visibility of the launch of the distribution translated through distinctive signs (T-shirts, posters, leaflets during the LLIN presentation) and cultural productions attracting the population and allowing to mark it by messages conveyed by artists locally very appreciated and by the politico-administrative authorities.

2.7. Monitoring and Evaluation of the Campaign

In 2018, the enumeration and distribution data began at the community level by filling out vouchers and registers. From 2019, in the provinces supported by SANRU Asbl with IMA World Health as sub-recipient, campaign data started to be collected using tools based on Open Data Kit (ODK) developed by IMA world health using smartphones. Then, with the contribution of the AMF in the purchase of LLINs, there was a scaling up of the digitization of data collection for all campaigns through the development of digitization tools by SANRU Asbl, also based on ODK.

In any case, two days after the end of the distribution, all HA had to complete collection and be validated for transmission to the CT-HZ. One week after the distribution, the CT-HZ was to centralize and validate data before the provincial data validation workshop.

In addition to the data thus collected under the coordination of the CT-HZ with the support of the CT-PHD, independent surveys were carried out either by the national coordination of networks of civil society organizations (NCNCSO) working in the field of health, by the provincial offices of WHO or by a research institution.

WHO Provincial Offices or research institutions used the “lot quality assessment sampling” (LQAS) method for sampling households to be surveyed: 1)

random selection of 2/3 of HZ using the random number table; 2) for each HZ retained, a random selection of 6 localities/villages/street by the same method; 3) in the selected locality/village/street, the total number of households was divided by 10 (10 being the number of households to be surveyed) to obtain the sampling interval k ; 4) the 1st household to be surveyed was selected randomly between 1 and k using a random number table after a plot survey assigning numbers to all the plots of the locality/villages/street; 5) the following households were chosen after a step of k households starting to the right of the 1st household until a total of 10 households per locality/village/street for 5 to 6 days. Data collection was carried out using a structured questionnaire with closed and open-ended questions, administered through a personal interview by investigators trained and supervised daily.

In provinces where neither the WHO nor a research institution was involved, the data from monitoring carried out by NCNCSO were used. In these cases, multi-stage sampling was applied: 1) selection of up to 15 HZs using urn method without replacement (for provinces with ≤ 15 HZ, all HZs were included); 2) in each selected HZ, 2 HA or 4 HA were randomly selected by the same method depending on whether the province had ≤ 15 ZS or > 15 ZS; 3) in each HA, the village hosting the Health Center was selected for logistical reasons; 4) the starting point was randomly determined between 1 and 3 by considering the household of the head of the locality as household N°1 and then following the direction determined by the pen thrown in the air; 5) the following households were identified by adding a sampling step of 3 households until the required number was reached. The sample size was set at 1.5% of households in the province distributed evenly across the selected HZs and HA. In the provinces where WHO and research institutions had worked, data collection was carried out using a structured questionnaire with closed and open questions, administered through a personal interview by investigators trained and supervised daily.

Among the indicators used for campaign evaluation, the following are presented in this article:

- The gap between enumerated population and projected population = $(\text{Enumerated population} - \text{projected population}) / (\text{Projected population}) \times 100$;
- The gap between enumerated households and projected households = $(\text{Enumerated households} - \text{projected households}) / (\text{Projected households}) \times 100$;
- The gap between households served and enumerated households = $(\text{Households served} - \text{enumerated households}) / (\text{Enumerated households}) \times 100$;
- The proportion of households served = $(\Sigma \text{households served}) / (\Sigma \text{projected households}) \times 100$ (This is the proportion of households served as reported by the HZ team, local distribution coordination structures);
- Household coverage = $(\Sigma \text{households served}) / (\Sigma \text{households surveyed}) \times 100$ (This is the proportion of households served as collected by independent monitoring carried out either by the provincial office of the WHO, by a research institution, or by the CNRSC);
- The Proportion of LLIN distributed = $(\Sigma \text{LLIN distributed}) / (\Sigma \text{MILD required})$

- × 100;
- The gap between the quantity of LLIN planned and the amount of LLIN received at the country's entry doors = Quantity of LLIN received at the entry door – Quantity of LLIN required;
 - The LLIN balance at the entry point = Quantity of LLIN shipped to HZ – Quantity of LLIN received at the entry point;
 - The gap between the quantity of LLIN received in the HZs, and the amount of LLIN shipped to the HZs = Quantity of LLIN received in the HZs – Quantity of LLIN sent to the HZs;
 - The Theoretical balance of LLINs in HZs = Quantity received in HZs – Quantity of LLINs distributed to households;
 - The Certified LLIN balance in HZs = Physical balance after contradictory inventory between HZ team and a SANRU Sub-Recipient agent;
 - The Loss of LLINs in HZs = Theoretical balance of LLINs in HZs—certified balance of LLINs in HZs.
 - The Loss rate = (Number of LLINs lost in HZs)/(Quantity received in HZs) × 100;
 - The Proportion of different sources of information on LLINs cited by respondents = (Σrespondents who cited the source)/(ΣPeople surveyed) × 100;
 - The Proportion of unserved households = (Σunserved households)/(ΣHouseholds surveyed) × 100;
 - The Proportion of different causes of non-reaching households during LLIN distributions = (Σnumber of respondents who cited a cause)/(ΣNumber of people surveyed) × 100.

3. Results

During the 23 LLIN distribution campaigns organized in 20 provinces, a total of 111,081,191 people were enumerated in 19,311,629 households (**Table 1**).

There was an average increase of 7% in the enumerated population compared to the projected population in microplans and a 3% reduction in enumerated households compared to the projected microplanning number of households (**Table 1**). Before COVID-19, distribution was preceded by enumeration, and the proportion of unserved households compared to enumerated households was –1%. The average number of people living in households was 5.8 people, ranging from 4.4 in Haut Uélé in 2018 to 6.8 in Kinshasa in 2021.

A total of 19,048,372 households were served during the 23 campaigns organized. The proportion of households served was 96% compared to projections made at microplanning, with variations ranging from 59% in MONGALA province in 2019 to 118% in Haut Uélé province in 2018 (**Figure 3**). Independent monitoring carried out 2 to 7 days after distribution showed that 91.3% of the households surveyed had been served with LLINs with variations ranging from 75% in the province of Haut-Uélé in 2021 to 100% in the province North Ubangi and Lomami in 2019 (**Figure 3**).

Table 1. Population and households enumerated compared to projections from microplans.

Year	Province	Number of HZ	Population enumeration			Household enumeration			The average number of people per household		
			Projected population	Enumerated population	Deviations	Projected households	Enumerated households	Deviations		Served household	
2018	Haut Uele	13	1,854,701	2,179,666	15%	411,994	495,116	17%	485,864	-2%	4.4
2018	Tshopo	23	3,469,788	3,785,300	8%	751,998	732,524	-3%	725,539	-1%	5.2
2018	Ituri	36	5,813,479	6,453,110	10%	1,221,063	1,267,667	4%	1,246,987	-2%	5.1
2018	Maniema	18	2,682,414	3,188,887	16%	555,068	575,133	3%	568,038	-1%	5.5
2018	Kwilu	24	5,359,688	5,826,393	8%	1,061,353	1,063,964	0%	1,049,539	-1%	5.5
2019	Sankuru	16	2,231,605	2,404,655	7%	458,445	460,657	0%	458,593	0%	5.2
2019	Lomami	16	4,287,681	4,502,055	5%	830,821	832,306	0%	824,830	-1%	5.4
2019	Equateur	18	2,729,691	2,747,362	1%	466,480	524,395	11%	516,107	-2%	5.2
2019	Nord Kivu	32	9,223,200	10,158,199	9%	1,623,299	1,678,654	3%	1,634,720	-3%	6.1
2019	Sud Kivu	34	7,582,219	8,818,157	14%	1,432,868	1,436,662	0%	1,390,363	-3%	6.1
2019	Mongala	12	2,796,468	2,883,734	3%	505,004	259,519	-95%	296,726	13%	11.1
2019	Nord Ubangi	11	1,406,173	1,707,606	18%	252,305	263,233	4%	204,953	-28%	6.5
2020	Sud Ubangi	16	3,297,166	3,002,789	-10%	589,577	545,370	-8%	535,282	-2%	5.5
2020	Haut Katanga	27	7,302,348	8,537,857	14%	1,415,999	1,419,613	0%	1,369,168	-4%	6.0
2020	Tshuapa	12	2,194,212	2,311,184	5%	412,822	413,357	0%	402,745	-3%	5.6
2020	Maindombe	14	2,253,634	2,567,383	12%	505,383	507,404	0%	502,863	-1%	5.1
2020	Haut Lomami	16	4,197,702	4,711,289	11%	875,044	791,021	-11%	791,021	0%	6.0
2020	Tanganyika	11	3,615,169	3,896,017	7%	742,208	714,233	-4%	714,233	0%	5.5
2020	Kongo Central	31	5,206,632	5,629,211	8%	1,136,027	1,065,537	-7%	1,065,537	0%	5.3
2021	Kinshasa	35	12,063,643	12,921,953	7%	2,036,755	1,921,054	-6%	1,921,054	0%	6.7
2021	Haut Uélé	13	2,305,110	2,031,476	-13%	452,577	418,716	-8%	418,716	0%	4.9
2021	Ituri	36	6,909,212	6,449,701	-7%	1,339,354	1,172,055	-14%	1,172,055	0%	5.5
2021	Tshopo	23	4,008,456	4,367,207	8%	785,973	753,439	-4%	753,439	0%	5.8
	Total	487	102,790,391	111,081,191	7%	19,862,417	19,311,629	-3%	19,048,372	-1%	5.8

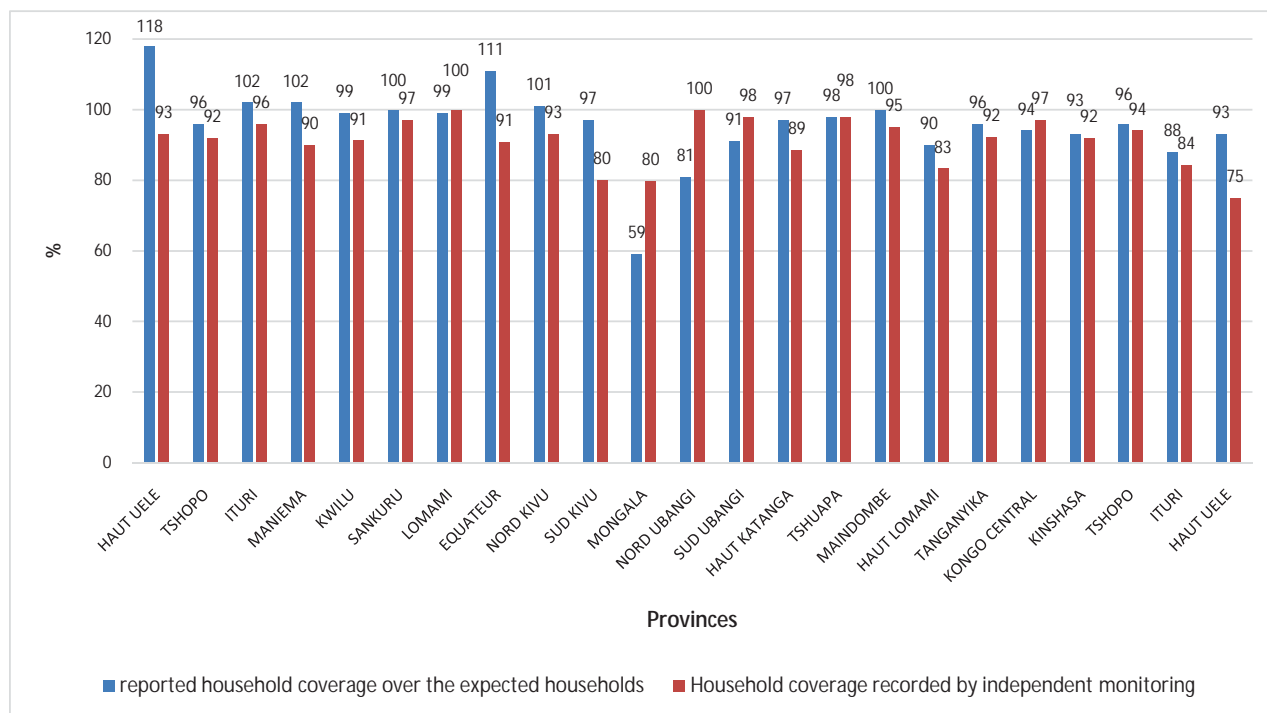


Figure 3. The proportion of households served compared to projected households vs. coverage of surveyed households.

Table 2 shows the results of various monitoring surveys, which revealed an average of 8.7% of households not served with LLINs. The main reasons mentioned by respondents were absence at the time of distribution (26%), loss of vouchers (16%). However, considering each province individually, certain reasons had a significant role among the reasons that did not allow households to access LLINs, such as stockouts in the Tshopo (34%) in 2018, households not visited in the door-to-door distribution in the province of Tshuapa (21%) in 2020 and Kinshasa (21%) in 2021.

Overall, the proportion of LLINs distributed to households compared to the planned quantities was 98%, with a variation from 90% in Nord Kivu to 110% in Kongo Central (**Figure 4**).

Out of a total of 56,267,554 planned LLINs, overall, we had received 1,844,163 additional LLINs (*i.e.* 3.3%), particularly for some of the provinces that distributed in 2020 and those of 2021. Of the 58,111,717 LLINs received at the country entry point, 57,056,293 were sent to the HZ, and a difference of 1,055,424 LLINs was kept at the entry point. 55,581,961 LLINs were distributed to households during the 23 campaigns organized (**Table 3**). The proportion of LLINs distributed compared to planned targets was 98.8%. The reception rate at the HZ level was 99.9%. Finally, after the distribution of LLINs to households, the overall loss rate was 0.31%, with a variation ranging from 0.00% in Katanga to 2.78% in Mongala province.

Table 4 shows that, overall, the most common source of information cited by respondents was RECOs/mobilizers/town criers (63.1%), followed by radios (18.5%) and then churches (12.4%).

Table 2. Reasons for not reaching households.

Total households surveyed	Proportion of households not served	Reasons for not reaching households												Information source	
		Refusal to receive LLINs	Absence/travel during delivery	Loss of vouchers	Plan to go later to the distribution site	Stockout	Distribution site too far away	Not informed of the campaign	Not knowing the location of the distribution site	Too many people	Houses not visited during distribution	Not recorded during enumeration	Other		
n	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
Campaigns organized in 2021															
Haut-Uélé	1186	25.1	-	-	-	-	-	-	-	-	-	-	-	-	PADEMA
Ituri	2925	15.7	-	-	-	-	-	-	-	-	-	-	-	-	CEREM
Tshopo	4020	6	0	39.4	NA ^a	51	NA ^a	0.4	NA ^a	NA ^a	8.7	NA ^a	0	0	OMS
Kinshasa	12,015	8	2	62	NA ^a	9	NA ^a	4	NA ^a	NA ^a	21	NA ^a	1	1	OMS
Campaigns organized in 2020															
Sud Ubangi	680	2.2	0	6.7	20	0	0	0	0	0	0	0	40%	0	ESP/KIN
Tanganyika	1174	7.7	0	6.3	0	0	0	0	0	0	0	0	NA ^a	0	CEREM
Haut Lomami	95	16.7	-	-	-	-	-	-	-	-	-	-	-	ND ^a	ESP/LSHI
Haut-Katanga	480	11.5	-	-	FG ^b	-	FG ^b	-	-	-	-	-	-	-	OMS
Mai Ndombe	5380	5	7	45	37	NA ^a	1.7	NA ^a	0	NA ^a	8.7	0	0	1.4	OMS
Tshuapa	5820	2	4	28	38	NA ^a	0	NA ^a	0	NA ^a	21	0	0	4	OMS
Kongo Central	9086	3	1	81	NA ^a	8	NA ^a	0	NA ^a	NA ^a	5	NA ^a	5	5	OMS
Campaigns organized in 2019															
Mongala	760	20.1	-	FG ^b	-	-	FG ^b	-	-	-	FG ^b	-	-	-	FMP/UNIKIS
Nord Ubangi	338	0	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	ESP/KIN
Equateur	10,117	9.3	4	40	26	5	12	5	1	3	4	NA ^a	NA ^a	0	OMS
Nord-Kivu	8280	7	15	41	46	12	0	0	0	0	3	NA ^a	NA ^a	0	OMS
Sud-Kivu	8267	12	6	28	34	9	8	2	0	5	4	NA ^a	NA ^a	3	OMS
Sankuru	3960	3	0	20	71	3	2	0	2	0	1	NA ^a	NA ^a	1	OMS
Lomami	5782	0	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	NA ^a	CNRSC
Campaigns organized in 2018															
Ituri	13,439	4	4	41	22	3	12	8	1	4	4	NA ^a	NA ^a	1	OMS
Tshopo	9603	8	3	12	16	1	34	2	0	0	1	NA ^a	NA ^a	3	OMS
Haut-Uélé	3600	7	3	58	19	10	3	2	1	0	3	NA ^a	NA ^a	1	OMS
Maniema	4308	10	2	43	27	2	13	1	0	0	2	NA ^a	NA ^a	10	OMS
Kwana	1785	8.8	0	0	0	100	0	0	0	0	0	0	0	0	OMS
Medium	112,420	8.7	2	26	16	2	12	1	0	1	1	3	0	1	OMS

^a NA = Not applicable, ^bFG = Collected during Focus groups.

Table 3. The flow of LLINs from forecast to household distribution.

Years	Provinces	Required quantities of LLINs	Quantity of LLINs received at the entry point	Difference in quantities required Vs received	Quantity of LLINs shipped to HZs	Balance of LLINs at the entry point	Quantity of LLINs received in HZs	Difference Quantity shipped Vs Received in HZs	Quantity of LLINs distributed to households	Theoretical balance of LLINs in HZs	Certified balance of LLINs in HZs	Loss of LLINs in HZs	Loss rate of LLINs in HZs(%)
2018	ITURI	3,089,662	3,089,650	-12	3,074,252	15,398	3,074,252	0	3,026,713	47,539	45,527	2012	0.07
2018	HAUT UELE	1,004,086	1,004,069	-17	1,004,069	0	1,004,069	0	991,669	12,400	9802	2598	0.26
2018	KWILU	2,947,808	2,947,808	-	2,944,827	2981	2,944,827	0	2,905,893	38,934	26,215	12,719	0.43
2018	MANIEMA	1,405,661	1,405,647	-14	1,405,647	0	1,405,647	0	1,388,168	17,479	15,578	1901	0.14
2018	TSHOPO	1,742,616	1,742,533	-83	1,712,080	30,453	1,712,080	0	1,694,079	18,001	15,140	2861	0.17
2019	EQUATEUR	1,476,852	1,476,911	59	1,474,187	2724	1,473,435	752	1,451,745	21,690	19,310	2380	0.16
2019	LOMAMI	2,382,186	2,381,988	-198	2,378,028	3960	2,378,028	0	2,366,894	11,134	10,707	427	0.02
2019	MONGALA	1,598,862	1,598,800	-62	1,598,800	0	1,586,688	12,272	1,529,500	57,188	13,055	44,133	2.78
2019	NORD KIVU	5,230,047	5,073,433	-156,614	4,809,026	264,407	4,809,026	0	4,687,807	121,219	117,941	3278	0.07
2019	NORD UBANGI	798,768	905,204	106,436	829,720	75,484	829,720	0	787,290	42,430	42,272	158	0.02
2019	SANKURU	1,242,604	1,242,690	86	1,239,897	2793	1,239,897	0	1,234,418	5479	5124	355	0.03
2019	SUD KIVU	4,428,907	4,428,853	-54	4,349,124	79,729	4,349,124	0	4,229,632	119,492	114,484	5008	0.12
2020	SUD UBANGI	1,866,978	1,866,100	-878	1,832,550	33,550	1,832,550	0	1,772,503	60,047	59,029	1018	0.06
2020	TSHUAPA	1,230,628	1,233,081	2453	1,226,731	6350	1,226,731	0	1,194,653	32,078	30,039	2039	0.17
2020	MAINDOMBE	1,237,174	1,237,163	-11	1,237,163	0	1,237,117	46	1,226,609	10,508	8979	1529	0.12
2020	HAUT KATANGA	4,050,151	4,047,900	-2251	4,024,471	23,429	4,023,921	550	3,888,575	135,346	135,346	0	0.00
2020	HAUT LOMAMI	2,376,707	3,041,150	664,443	2,693,319	347,831	2,651,329	41,990	2,540,342	110,987	110,447	540	0.02
2020	KONGO CENTRAL	2,633,960	3,062,563	428,603	3,055,157	7406	3,055,014	143	2,886,096	168,918	160,171	2832	0.29
2020	TANGANYIKA	2,010,764	2,311,789	301,025	2,226,160	85,629	2,226,160	0	2,034,309	191,851	187,806	4045	0.18
2021	HAUT UELE	1,181,010	1,131,805	-49,205	1,131,665	140	1,131,665	0	1,127,792	3873	3604	269	0.02
2021	KINSHASA	6,676,211	6,934,600	258,389	6,863,360	71,240	6,861,760	1500	6,813,354	48,406	0	48,406	0.71
2021	TSHOPO	2,155,654	2,315,680	160,026	2,313,180	2500	2,313,180	0	2,245,687	67,493	41,504	25,989	1.12
2021	ITURI	3,500,258	3,632,300	132,042	3,632,980	-680	3,632,980	0	3,558,233	74,747	70,802	3945	0.11
Total de la période		56,267,554	58,111,717	1,844,163	57,056,293	1,055,424	56,999,200	57,093	55,581,961	1,417,239	1,242,882	174,357	0.31

Table 4. Frequency of information sources on LLINs cited by respondents during monitoring.

	Radios		Televisions		Leaflets		Posters		Advertising panels		Churches/Mosques		RECO/Mobilizers/town criers		Musical groups		Educational talks at the health facility		Political and administrative authorities		Others		Source of information					
	n	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%			
Campaigns organized in 2021																												
Haut-Uélé	1186	52.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	PADEMA		
Ituri	2925	16.8	1.2	0.0	0.0	0.0	5.7	12.8	43.2	0.0	0.0	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.9	CEREM	
Tshopo	4020	12.0	0.0	0.0	1.0	0.0	0.0	5.0	78.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	OMS	
Kinshasa	12015	9.0	15.0	0.0	0.0	4.0	0.0	0.0	3.0	62.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	OMS	
Campaigns organized in 2020																												
Sud Ubangi	680	52.6	0.0	0.0	0.0	2.8	0.0	9.8	68.7	0.0	0.0	0.0	68.7	0.0	0.0	0.0	0.0	15.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.1	ESP/KIN	
Tanganyika	1174	21.2	2.1	0.0	0.0	0.0	1.9	3.5	53.4	0.0	0.0	0.0	53.4	0.0	0.0	0.0	0.0	13.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	CEREM	
Haut Lomami	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	NC*	ESP/L'SHI
Haut-Katanga	13 538	16.0	25.0	4.0	4.0	4.0	3.0	3.0	41.0	0.0	0.0	0.0	41.0	0.0	0.0	0.0	0.0	3.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	CNRSC	
Mai Ndombe	5 380	16.0	0.2	0.0	0.0	7.4	0.0	17.5	58.0	0.0	0.6	0.0	58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	OMS	
Tshuapa	5 820	0.9	1.0	0.0	1.2	0.0	0.0	17.1	79.3	0.0	0.0	0.0	79.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	CNRSC	
Kongo Central	9 086	15.0	9.0	0.0	0.0	4.0	0.0	6.0	62.0	0.0	1.0	0.0	62.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	OMS	
Campaigns organized in 2019																												
Mongala	760	36.0	1.0	0.0	0.0	0.0	0.0	12.0	59.0	0.0	0.0	0.0	59.0	0.0	0.0	0.0	0.0	22.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	FMP/UNIKI	
Nord Ubangi	338	19.9	0.0	0.0	0.0	2.2	0.0	34.5	95.3	0.0	0.0	0.0	95.3	0.0	0.0	0.0	0.0	20.6	0.0	0.0	0.0	0.0	0.0	0.0	21.7	0.0	ESP/KIN	
Equateur	10,117	6.0	1.0	0.0	0.0	12.0	0.0	20.0	44.0	0.0	2.0	0.0	44.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	OMS	
Nord-Kivu	8280	26.0	3.0	0.0	0.0	9.5	0.0	23.0	64.0	0.0	74.5	0.0	64.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	OMS	
Sud-Kivu	8267	14.0	7.0	0.0	0.0	11.0	0.0	15.0	51.0	0.0	0.0	0.0	51.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	OMS	
Sankuru	3960	20.0	2.0	0.0	0.0	10.0	0.0	7.0	60.0	0.0	0.0	0.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	OMS	
Lomami	5782	24.0	1.0	5.0	6.0	2.0	10.0	43.0	63.1	0.0	0.0	0.0	43.0	0.0	0.0	0.0	0.0	4.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	CNRSC	
Campaigns organized in 2018																												
Ituri	13,439	34.0	1.0	0.0	0.0	10.0	0.0	33.0	88.0	0.0	2.0	0.0	88.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	OMS	
Tshopo	9603	10.0	3.0	0.0	3.0	0.0	0.0	14.0	93.0	0.0	1.0	0.0	93.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	OMS	
Haut-Uélé	1100	16.0	0.0	4.0	4.0	3.0	0.0	3.0	41.0	0.0	0.0	0.0	41.0	0.0	0.0	0.0	0.0	3.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	CNRSC	
Maniema	4308	17.0	1.0	0.0	6.0	0.0	0.0	13.0	59.0	0.0	0.0	0.0	59.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	OMS	
Kwilu	8481	6.0	2.0	0.0	0.0	0.0	0.0	9.0	82.0	0.0	0.0	0.0	82.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	OMS	
Moyennes	129,579	18.5	3.6	0.6	4.5	0.7	12.4	63.1	63.1	0.1	3.9	3.5	63.1	3.9	0.1	3.1	3.1	3.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	3.1	3.1	

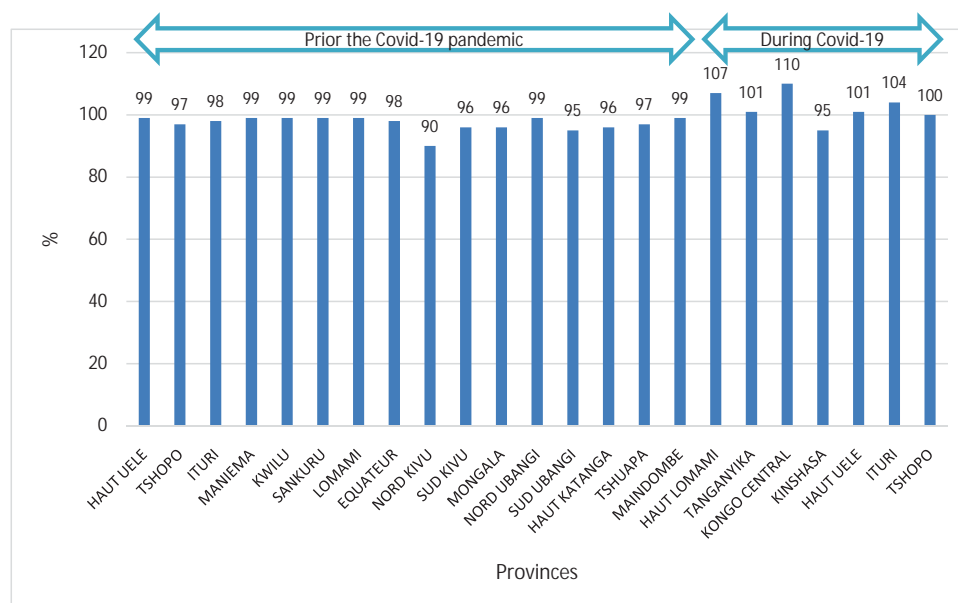


Figure 4. Proportions of LLINs distributed compared to the contractual target.

4. Discussion

Between January 2018 and June 2021, 23 free LLIN distribution campaigns were organized in DRC under GFTAM funding with co-financing from AMF resulting in the distribution of 55,581,961 LLINs to 19,048,372 households at risk of malaria transmission. This corresponds to a LLIN mass distribution for 20 of the 26 provinces of the country in 3 years and a 2nd renewal campaign for 3 of them. Of the six provinces funded by PMI during the same period, two (Kasai and Kasai Oriental) benefited from the planned free distribution, while four (Lualaba, Kwango, Kasai Central and Bas Uélé) were being prepared for distribution in 2021, one of which (Bas-Uélé) has been reallocated to fund by the GFTAM. In a literature review of 14 free LLIN distribution campaigns in East Africa, Sexton *et al.* noted that programs that financially depend on single donors greatly hamper any possible sustainability [31]. In the case of the DRC, the participation of the AMF in the co-financing of campaigns supported by the GFTAM has been a remarkable contribution to the sustainability of the intervention.

The particularity of the campaigns in the DRC is that they are spread over about 3 years to cover all the 26 provinces of the country, unlike some African countries which distribute throughout the national territory at the same period [32] [33]. Some other countries with heavy malaria burdens and large populations to cover also use a staggered campaign over more than one year [34] [35]. In most cases, this approach, generally dictated by the constraints of gradual mobilization of resources followed by the need to keep a distribution interval of 3 years, has linked the DRC in a configuration of spreading out in 3 years of distributions to cover the country. Additional constraints such as logistical difficulties related to insufficient road infrastructure, armed conflicts, and the COVID-19

pandemic are added to this, leading to the spread of distributions in some provinces beyond 3 years as is the case for the provinces of Kinshasa, Ituri, Haut-Uélé, and Ituri in the scope of intervention of the GFTAM in the DRC.

On the demographic considerations, DRC LLINs mass distribution campaigns showed discrepancies between the projections made during microplanning and the results (**Table 1**). Compared to projections, the general trend was to have a more enumerated population (+7% on average) while the number of households was lower (−3% on average). A mass distribution campaign organized in Benin in 2020 showed differences that all went in the same direction: +9% of households and +13% of the population [32]. In the case of the DRC, this trend probably indicates a propensity to exaggerate the number of people living in the household to benefit more LLINs. Indeed, the NMCP recommends distribution of LLINs according to the size of households at a rate of 1, 2, 3, 4, and 5 LLINs for households of 1 to 2, 3 to 4, 5 to 6, 7 to 8 people, and ≥9 people respectively. As the DRC is between its 3rd and 4th round of LLIN distribution, the population is already aware of the link between household size and the number of LLINs to be received.

These discrepancies make the quantification of LLINs for the countryside more complex, as it depends on a good definition of targets to ensure universal household coverage [30]. Targets are defined based on projection data. Prior to COVID-19, enumeration preceded distribution, leaving a period of adjustment for redeployment of LLINs to the HZs according to their real needs. After the occurrence of COVID-19, the NMCP and its partners had agreed to couple enumeration with distribution to reduce the necessary contacts between the distribution staff and the beneficiaries as recommended by the Alliance for Malaria Prevention (AMP) [36]. As the adjustment window was thus compromised, the NMCP and the partners considered 2 measures to reduce the risks of stock-outs and minimize their impact: 1) an additional order of 5% of LLINs and 2) the postponement of distribution in at least one HA in each HZ to allow the CT-HZ to deploy its stock to the other HA if necessary and to await the reconciliation of stocks at the end of the distribution in the 1st series of HA and the redeployments between HA and between HZ to finalize the distribution. In the complex emergency context such as in Ituri where to the COVID-19 was added an active armed conflict, the number of HA shifted in the city of Bunia which hosted the majority of the displaced populations of the surrounding HZ, the number of HA staggered went up to 3 HA to minimize the risk of stock out.

These provisions made it possible to achieve good performance in the distribution in the context of COVID-19 (≥95) as before COVID-19 (**Figure 3**). While the administrative data indicated an average coverage of 96% compared to the projections made at the micro plans, the independent monitoring carried out 2 to 7 days after the visit of the distribution agents showed that 91% of the households surveyed had been served in LLINs. The difference of 5% shows the success of the campaigns organized to cover households at malaria risk transmis-

sion in DRC.

The results of the various monitoring (**Table 2**) show that, on average, 8.7% of households surveyed were not served with LLINs, and the reasons for not receiving them were mainly absence from home at the time of distribution and loss of vouchers. Some authors also mentioned travel, household members not being on the enumeration distribution list, stock-outs, the absence or loss of a vouchers, not having an official identity card, and insecurity [35] [37]. After the occurrence of COVID-9, some of the reasons previously mentioned no longer applied in a distribution coupling the enumeration to the distribution, in particular the loss of the voucher. It thus appears that the risk of stock-outs due to an unreliable quantification in the absence of updated enumeration was compensated for by better access to households in a door-to-door approach combining enumeration of household members and immediate delivery of LLINs in the function the number of people living in these households.

Good supply chain management is necessary for the success of campaigns. In the case of the DRC, the supply chain management from orders based on a quantification of needs in accordance with recommendations of the WHO and the AMP, the flexibility of the AMF to add a contingency stock to compensate for possible stock-outs in the context of COVID-19 having made it necessary to skip a preliminary enumeration step before distribution and the logistical follow-up ensuring good traceability of the inputs from the front door to households have made it possible to ensure the distribution of 98% LLINs targeted for distribution with deviations $\leq 2\%$ (LLINs received vs. LLINs shipped to HZs = 1.8%, LLINs shipped to HZs vs. LLINs received at HZs = 0.1%, LLIN loss rate in HZs = 0.31%) (**Table 3**). The various deviations included: 1) quantities of LLINs reallocated (leftovers) to routine distribution with an option to subsequently recover stocks from routine distribution to campaigns in other provinces, 2) quantities of LLINs (balance after taking microplanning into account) reallocated directly to campaigns in other provinces, 3) marginally, there were losses due to shipwrecks or losses at warehouses or during transport. These losses were subject to restitution either by insurers or by deduction from the payments of service providers (transporters or warehouse owners).

Multi-channel behavior change communication campaigns are effective in increasing the culture of net attachment and use, especially among vulnerable groups [38]. As was the case in the DRC (**Table 4**), proximity communication using different communication channels (radio, television, leaflets, CHW, etc.) has been taken up by several authors. CHWs, churches and community leaders have been found to be the main sources of information for households in several studies of mass distribution experiences in Africa [35] [38]. In Tanzania, Reggli *et al.* reported radio as the primary source of information in an approach that used community outreach radio stations more than national radio and television stations [39]. The geographic coverage of radio stations varying from one country to another and within the same country from one province to another could ex-

plain this variability.

One of the limitations of the evaluation of the campaigns in the DRC is the lack of standardization of independent monitoring, which results in some missing data and a variability of methodological approaches that is detrimental to the strict comparison of results. In addition, the digitization of the management of free LLIN distribution campaigns only takes into account enumeration and distribution data. A roadmap was drawn up by the NMCP and its partners to add modules relating to the management of training, supervision, and input tracking.

5. Conclusion

The DRC organized an LLIN replacement cycle in the particular context of the COVID-19 pandemic and armed conflicts in the eastern provinces. Despite the many challenges of its implementation, the LLIN campaigns were successfully implemented and contributed to increasing household coverage and population access to LLINs. Good planning, effective coordination of stakeholders, and the revision of campaign implementation modalities in line with COVID-19 were factors of the success of this campaign. An effort to respect household LLIN renewal schedules, coupled with good routine distribution, is necessary to maintain the gains and hope for an impact in terms of reducing malaria morbidity and mortality.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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