



Contents lists available at ScienceDirect

## Vaccine

journal homepage: [www.elsevier.com/locate/vaccine](http://www.elsevier.com/locate/vaccine)

# Assessment of missed opportunities for vaccination (MOV) in Burkina Faso using the World Health Organization's revised MOV strategy: Findings and strategic considerations to improve routine childhood immunization coverage



Lassané Kaboré <sup>a,\*</sup>, Bertrand Meda <sup>a</sup>, Isaïe Médah <sup>b</sup>, Stephanie Shendale <sup>c</sup>, Laura Nic Lochlainn <sup>c</sup>, Colin Sanderson <sup>d</sup>, Mâ Ouattara <sup>e</sup>, William M.F. Kaboré <sup>b</sup>, Edouard Betsem <sup>a,f</sup>, Ikechukwu U. Ogbuanu <sup>c</sup>

<sup>a</sup> Agence de Médecine Préventive (AMP), Ouagadougou, Burkina Faso

<sup>b</sup> Ministry of Health, Direction de la Prévention par les Vaccinations (DPV), Ouagadougou, Burkina Faso

<sup>c</sup> Department of Immunization, Vaccines and Biologicals (IVB), World Health Organization, Geneva, Switzerland

<sup>d</sup> London School of Hygiene and Tropical Medicine, London, United Kingdom

<sup>e</sup> World Health Organization, Country Office, Ouagadougou, Burkina Faso

<sup>f</sup> Laboratoire Mixte International de Vaccinologie (LAMIVAC), Bobo-Dioulasso, Burkina Faso

## ARTICLE INFO

## Article history:

Received 31 July 2020

Received in revised form 4 October 2020

Accepted 7 October 2020

Available online 17 October 2020

## Keywords:

Vaccination  
Missed opportunities  
Routine EPI  
Vaccine  
Burkina Faso  
Reduction strategy

## ABSTRACT

**Background:** Despite the remarkable achievements of the Expanded Programme on Immunization (EPI) in Burkina Faso, numerous challenges remain, including missed opportunities for vaccination (MOV) which occur when people visit a health facility with at least one vaccine due according to the national immunization schedule, are free of contraindications, and leave without receiving all due vaccine doses. In 2016, we used the revised World Health Organization's (WHO) MOV strategy to assess the extent of and reasons for MOV in Burkina Faso.

**Methods:** We purposively selected 27 primary health facilities (PHFs) from the eight health districts with the highest absolute numbers of children who missed the first dose of measles-rubella (MR1) in 2015. We conducted exit interviews with caregivers of children aged 0–23 months, and requested health workers to complete a self-administered knowledge, attitudes and practices (KAP) questionnaire.

**Results:** A total of 489 caregivers were interviewed, of which 411 were eligible for inclusion in our analysis. Medical consultation (35%) and vaccination (24.5%) were the most frequent reasons for visiting PHFs. Among the 73% of children eligible for vaccination, 76% of vaccination opportunities were missed. Among eligible children, the percentage with MOV was significantly higher in those aged  $\geq 12$  months and also in those attending for a reason other than vaccination. A total of 248 health workers completed the KAP questionnaire. Of these, 70% ( $n = 168/239$ ) considered their knowledge on immunization to be insufficient or outdated; 83% failed to correctly identify valid contraindications to vaccination.

**Conclusion:** Addressing MOV offers the potential for substantial increases in vaccine coverage and equity, and ultimately reducing the burden of vaccine-preventable diseases (VPDs). This will require the implementation of a series of interventions aimed at improving community knowledge and practices, raising health workers' awareness, and fostering the integration of immunization with other health services.

© 2020 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

Since the inception of the Expanded Programme on Immunization (EPI) in Burkina Faso in 1980, it has grown from providing mobile immunization, to being fully implemented in all public pri-

mary health facilities (PHFs) [1]. The objective is to lead and manage immunization activities in Burkina Faso, to achieve adequate immunization coverage and ultimately, to protect the population, especially children and pregnant women, against vaccine preventable diseases (VPDs).

In 2016, the national childhood immunization schedule recommended 17 vaccine doses for children up to the age of 18 months [2]. The reported administrative coverages in 2016 for the third

\* Corresponding author.

E-mail address: [lassane.kabore1@yahoo.fr](mailto:lassane.kabore1@yahoo.fr) (L. Kaboré).

dose of pentavalent (diphtheria-tetanus-pertussis (DTP3)), and for the first and second doses of measles-rubella (MR1 and MR2) were 103%, 99.9% and, 74% , respectively [3]. Although administrative coverage was high for most antigens, these estimates are sourced from unstable population denominators. Subsequent coverage surveys reported lower coverage for the period 2016–17, with 86% and 62% for MR1 and MR2, respectively [4], and 69% for fully immunized children [5].

With DTP3 coverage as low as 70% in the African Region, additional efforts are needed to reach and maintain global immunization objectives [6,7]. The Global Vaccine Action Plan (GVAP), which guided global immunization from 2011 to 2020, is currently making way for a new global vision and strategy, the Immunization Agenda 2030 (IA2030) [8].

To attain and maintain high immunization coverage in the next decade, the World Health Organization (WHO) strongly encourages member states to implement the Missed Opportunities for Vaccination (MOV) Strategy. A MOV can be defined as “any contact with health services by a child (or adult) who is eligible for vaccination (unvaccinated or not fully vaccinated/not up-to-date, and free of contraindications), but which does not result in the individual receiving all the vaccine doses for which he or she is eligible” [9]. Reducing MOV requires contextual evidence regarding the prevalence of MOV and its contributing factors. Several studies have investigated MOV elsewhere [10–16], but to our knowledge there have been none to date in Burkina Faso.

In 2015, WHO launched a revised MOV strategy, which consists of a 10-step process that provides guidance to countries on how to reduce MOV through planning and conducting a MOV assessment, including field work, brainstorming, action planning, and debriefing with the Ministry of Health (MoH). The process culminates in the implementation and monitoring of interventions to reduce MOV [17,18]. The revised strategy was first piloted in Chad and Malawi in 2015 [9].

In June 2016, the MoH in Burkina Faso, in collaboration with the Agence de Médecine Préventive (AMP) and with support from WHO, conducted a MOV assessment using the revised WHO MOV Strategy. The assessment was carried out in selected low per-

forming health districts to evaluate the prevalence and identify possible causes of MOV among health facility attendees. Here, we report the findings of the assessment of MOV among children 0–23 months and discuss possible interventions for their reduction in Burkina Faso.

## 2. Methods

### 2.1. Study design and settings

A cross-sectional assessment was conducted in eight health districts (Fig. 1). Although these districts reported good administrative coverage, they were selected by the MoH on the basis of having the highest absolute numbers of unvaccinated children for MR1 in 2015 (Koupela n = 722; Gaoua n = 973; Kaya n = 1000; Garango n = 1178; Gourcy n = 1224; Ziniare n = 1393; Boulmiougou n = 1930, Koudougou n = 1985). Within each district, at least three PHFs were selected to participate in the assessment after consultation with district health management teams. The selection criteria for PHFs included the size of the population in the catchment area (large PHFs favoured), inclusion of both rural and urban PHFs, and geographical proximity to the district headquarters.

### 2.2. Selection of study participants

We included caregivers of children aged 0 to 23 months who were present in any of the selected PHFs on the day of the assessment. In each PHF, 20 caregiver exit interviews were conducted, aiming to include approximately 10 with caregivers of children aged 0 to 11 months and 10 with caregivers of children aged 12 to 23 months.

Knowledge, attitudes and practices (KAP) questionnaires were provided, for self-administration, to a pre-defined target of 10 health workers in each PHF. When a PHF had a headcount of <10 health workers, field teams visited neighbouring similar PHFs to interview additional health workers.



Fig. 1. Districts included in the assessment of missed opportunities for vaccination (MOV), Burkina Faso, 2016.

### 2.3. Data collection tools

Generic questionnaires developed by WHO [17] were adapted to the country context. For caregivers, the exit interviews were used to collect information related to 1) socio-demographics; 2) vaccination history, availability and use of home-based records; 3) knowledge and information about vaccines and the importance of vaccination opportunities; 4) reasons for non-vaccination; and 5) quality of the immunization services received.

Only documented vaccination dates (from home-based records or health facility registries) were used to complete the caregiver questionnaires. For children with incomplete or unclear recording in home-based records, vaccination history data were extracted from health facility registers, where possible. When documented vaccination dates were available from neither the home-based record (lost or forgotten) nor the facility registry, recall provided by caregivers was not accepted as proof of receipt of vaccine doses. All children with no available documented vaccination records were excluded from further analysis.

Health worker KAP surveys included questions related to socio-demographics, knowledge about immunization and practical decision-making approaches during daily vaccination processes.

### 2.4. Data management and analysis

The data were collected on paper-based questionnaires and then entered into an online platform (Zegeba©). These were subsequently exported into Excel spreadsheets for analysis with the Stata statistical programme (StataCorp. 2013. Stata Statistical Software: Release 13. College Station, TX: StataCorp LP.). Only children with a valid recorded date of birth or age and documented vaccination dates were included in the analysis.

We generated descriptive statistics and estimated the proportion of MOV and timeliness of vaccination among children 0–23 months. All EPI vaccines in the national immunization schedule at the time of the assessment were considered in the determination of MOV (STable 1) [19]. Children were counted as having a MOV if they fulfilled all of the following four criteria: i) they had documented vaccination dates, ii) they were not up-to-date with the recommended national immunization schedule at the beginning of the visit, iii) they reported they were free of contraindication to vaccination on the assessment day, and iv) they exited the PHF without receiving all due vaccine doses. The dose-based MOV rate was defined as the number of all missed doses as a proportion of the total number of eligible doses that would have been given if there had been no MOV.

To identify possible causes of MOV, we used logistic regression to explore the relationships between the occurrence of a MOV (outcome variable) and a series of factors related to children and their caregivers (independent variables).

The timeliness of doses administered was assessed against the national immunization schedule [19]. We classified timeliness of vaccination as “Too early”, “Timely”, or “Delayed” based on the child’s date of birth, the age and interval for each vaccine dose as per the national immunization schedule, and the date the vaccine was given (STable 1).

### 2.5. Ethical considerations

This assessment was approved by the MoH of Burkina Faso and led by its Division of Prevention through Vaccinations. Ethical approval was not required, as this was judged to be a programmatic assessment rather than a research activity. Nonetheless, interviewers requested all participants to provide verbal consent prior to participating in the interviews.

## 3. Results

A total of 27 PHFs from the eight health districts participated in this assessment. Due to the limited number of health workers encountered in the initial 24 health facilities, the field teams visited three more PHFs than originally planned.

### 3.1. Caregivers exit interviews

#### 3.1.1. Socio-demographic characteristics of caregivers and their children

A total of 489 caregivers were interviewed over five days. Of those, age and vaccination data for their children were validated for 85% ( $n = 411$ ) and were included in the final analyses (Fig. 2). The number of caregiver participants per district ranged between 37 (Boulmiougou district) and 59 (Gourcy district). The sample of children was evenly distributed by sex (52% male vs 48% female), and by age group (52% aged 0–11 months vs 48% aged 12–23 months) (STable 2).

The main reasons for caregivers visiting the PHF on the day of the assessment were for medical consultation (35%;  $n = 139/400$ ), vaccination (25.5%;  $n = 102/400$ ) and growth monitoring (23%;  $n = 93/400$ ). Nearly all children (99%,  $n = 403/407$ ) were brought to PHFs by their mother. Three in five ( $n = 244/409$ ) caregivers had no formal education. No participants reported valid contraindications to vaccination (STable 2).

#### 3.1.2. Caregiver knowledge about vaccination

Most caregivers (72%;  $n = 293/407$ ) had not heard or seen any vaccination-related messages during the month preceding the assessment. PHFs and community health workers were the most important sources of information about vaccination. Nearly two thirds (68%;  $n = 276/409$ ) indicated that the purpose of the home-based record was “to know what vaccines are due for my child”, but 5% ( $n = 20/409$ ) thought that the card was for birth registration or a form of birth certificate.

The majority of caregivers (87%;  $n = 340/393$ ) responded that vaccination is for the “prevention of diseases”, but 10% ( $n = 40/401$ ) did not know that their children could acquire a disease if they were not vaccinated (Table 1).

#### 3.1.3. Prevalence and reasons for MOV

Among the 411 children, 73% ( $n = 302$ ) were due for at least one vaccine dose, and of these, 76% ( $n = 230$ ) had at least one MOV (Fig. 2, Table 2). Among the 102 children who were brought to the PHFs specifically for vaccination, 95% ( $n = 97$ ) were eligible for at least one vaccine dose, of whom 33% ( $n = 32$ ) had at least one MOV. For 205 children visiting a PHF for a non-vaccination visit and due for some vaccine(s), 97% ( $n = 198$ ) had a MOV (Table 2).

Out of 670 eligible doses that ought to have been administered to the 302 eligible children, 64% ( $n = 427$ ) were missed. This proportion was 22% and 93% for vaccination and non-vaccination visits, respectively (Table 2).

No statistical association was found between the occurrence of MOV and the child’s sex or caregivers’ educational level. However, children older than 12 months (OR = 2.57, 95% CI: 1.72–3.84), and visiting PHFs for a reason unrelated to vaccination (OR for medical consultation = 4.02, 95% CI: 2.33–6.92) were significantly associated with increased MOV (Table 3).

#### 3.1.4. Timeliness of vaccination

The proportion of vaccines given in a timely manner, as per the national immunization schedule, was greater than 80% for Bacillus Calmette–Guérin (BCG), birth dose of oral poliovirus (OPV0), MR1,

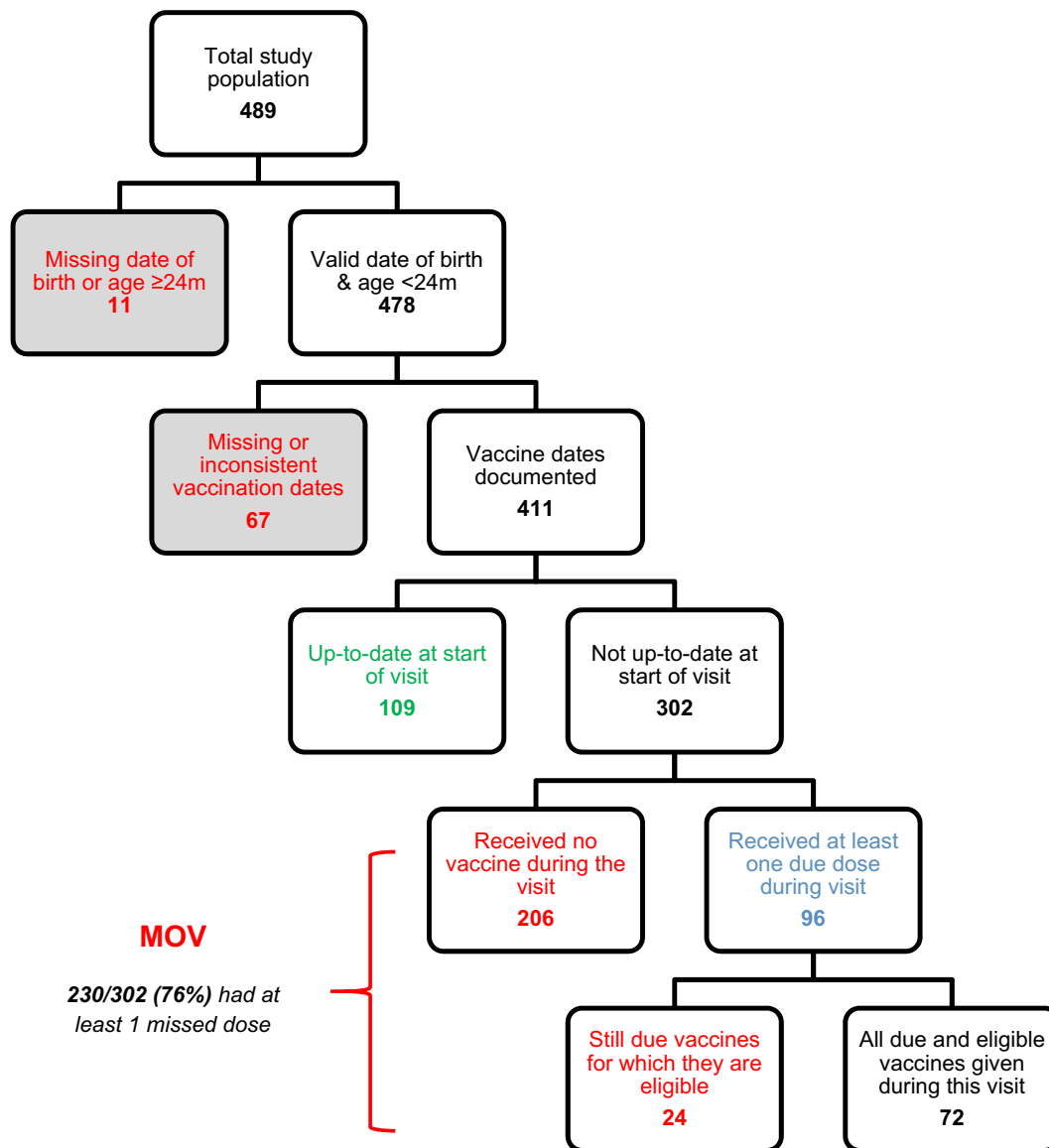


Fig. 2. Flow-chart for determining missed opportunities for vaccination (MOV), Burkina Faso, 2016.

and yellow fever (YF). For the pentavalent vaccine series, as well as the OPV, rotavirus and pneumococcal vaccine series, the percentage of timely doses was found to decrease on average from 72% to 52% between the first and third doses. More than 10% of yellow fever, MR1, and MR2 vaccines were given too early (Fig. 3).

### 3.1.5. Availability and quality of vaccination services

Among the 205 children who were eligible for vaccination but did not receive any due vaccine(s), 69% (n = 142) of caregivers said that the reason for non-vaccination was related to health workers. In 53% (n = 76) they said that the health workers considered the child “up-to-date with the schedule” and in 44% (n = 62) they said that the health workers did not check whether the child was due vaccines. Other reasons for not receiving vaccine(s) were related to logistics, such as a lack of vaccines or vaccination not being offered on the day of the visit.

Of the 97 caregivers whose child was vaccinated (fully or partially) on the day of the assessment, two thirds (n = 63) did not receive information on possible adverse events following immunization (AEFI) or how to manage an AEFI (n = 63). Nonetheless,

80% of caregivers (n = 78) reported being satisfied with the immunization services provided (Table 4).

## 3.2. Health worker KAP survey

### 3.2.1. Sociodemographic characteristics of surveyed health workers

The 248 health workers who completed the KAP self-assessment were aged between 23 and 57 years, with a median age of 36 years; and 63% were females. The most frequent profession among surveyed health workers was mobile health workers (nurse assistants) (52%, n = 129/247), followed by nurses/midwives (44%, n = 109/247). The extent of work experience ranged from one month to 35 years, but most had five or more years of experience (72%, n = 164/229).

Nearly one third of health workers (n = 74/210) were employed in preventive care services, which includes vaccination. However, 36% of health workers (n = 90/247) said they had never received training about vaccines and VPDs. Among those who had received training (n = 153), in most cases this occurred more than a year prior to the survey date (90%, n = 137) (STable 3).

**Table 1**  
Caregiver vaccination knowledge and attitudes, Burkina Faso, 2016.

Questions assessed	N	%
<b>Did you see/hear a message about immunization in the past month?</b>	<b>407</b>	
Yes	114	28
No	293	72
<b>If yes, what were the sources of the messages received about immunization?</b>	<b>99</b>	
Health center	44	45
Community health worker	25	25
Radio	10	10
TV	3	3
Church	2	2
Other	15	15
<b>What is the purpose of a home-based record?</b>	<b>409</b>	
To know what vaccines are due for my child	276	68
Child's health monitoring/medical consultation	91	22
To establish birth certificate	20	5
Others	12	3
I don't know	10	2
<b>What is the purpose of vaccinations?</b>	<b>393</b>	
To prevent diseases	267	67
To cure diseases	11	3
To prevent and cure diseases	18	5
To have children grow up in good health	36	9
To prevent diseases and have children grow up in good health	52	13
To prevent diseases, cure diseases and have children grow up in good health	3	1
I don't know	6	2
<b>Do you think your child can have a disease if s/he is not vaccinated?</b>	<b>401</b>	
Yes	355	89
No	40	10
I don't know	6	1

3.2.2. Health workers knowledge, attitudes and practices

The majority of health workers (70%; n = 168/239) reported having insufficient or outdated knowledge about vaccination, and 40% (n = 103/246) considered their knowledge about vaccination to be insufficient for their health facility needs. A similar proportion (38%; n = 92/241) mentioned that they feared AEFI. Regarding awareness of valid contraindications to vaccination, only 17% (n = 38/221) selected “pneumonia and other serious diseases” as the correct response.

When issuing a new home-based record, most health workers (93%; n = 226/244) would advise caregivers to bring the home-based record to all health facility visits. However, only 50% (n = 116/233) of health workers considered that a child's vaccination status should be systematically assessed at every health visit.

**Table 2**  
Proportion of missed opportunities for vaccination by reason for health facility visit, Burkina Faso, 2016.

Reason for visit	Total children with documented vaccination dates	Child-based MOV		Dose-based MOV			
		No. of children with 1 + eligible doses due	Frequency of children with 1 + MOV	No. of eligible doses among children with 1 + eligible doses due	Frequency of total eligible doses that were missed		
						n	%
Vaccination visit	<b>102</b>	<b>97</b>	<b>32</b>	<b>33.0</b>	<b>274</b>	<b>60</b>	<b>22.0</b>
Non-vaccination visit							
Medical consultation	139	91	90	99.0	183	182	99
Healthy child visit or check-up	93	59	57	97.0	111	99	89.0
Child is accompanying adult	38	29	28	97.0	56	53	95.0
Hospitalization	7	7	7	100.0	11	11	100.0
Other	21	8	7	88.0	12	10	83.0
No reason reported	11	11	9	82.0	23	12	52.0
Total non-vaccination visit	<b>309</b>	<b>205</b>	<b>198</b>	<b>97.0</b>	<b>396</b>	<b>367</b>	<b>93.0</b>
Total	<b>411</b>	<b>302</b>	<b>230</b>	<b>76.0</b>	<b>670</b>	<b>427</b>	<b>64.0</b>

More than half of the staff (53%; n = 128/243) reported that completing vaccination documents was a cause of delay during routine immunization service delivery.

One third (n = 73/220) of health workers reported that the main reason for incomplete vaccination among children was due to the caregivers' negative opinion about vaccination (Table 5).

4. Discussion

Burkina Faso was the first country to independently and successfully conduct a MOV assessment using the revised MOV strategy, following the pilot assessments conducted by the WHO in Chad and Malawi [9]. We were able to estimate the magnitude of MOV and obtain context-specific insights into their causes in eight poor-performing health districts.

In the surveyed PHFs, nearly three in four children were eligible for at least one vaccine dose on the day of the assessment. Yet, these opportunities to improve vaccine coverage were mostly missed, as 76% of these children had a MOV. Strikingly, 97% of children had a MOV whose reason for visiting the PHF was a non-vaccination visit. This would suggest poor organization and system inefficiencies within the PHF structure, due to a lack of integration between immunization and other preventive or curative services. This is supported by our finding that 44% of unvaccinated children were not asked by a health worker for their home-based record during the PHF visit, and that only 50% of health workers considered that a child's vaccination status should be systematically assessed at every health visit. Since 2016, health services in Burkina Faso are supported by the free care policy [20]. There is therefore great potential for improved system efficiency through integration of preventative and curative services between EPI and other health programmes.

The findings from the health workers KAP surveys provide further insights into the possible causes of MOV. Health workers reported that their knowledge about vaccination was inadequate in the context of an evolving immunization system. Furthermore, vaccination opportunities may also be missed because their daily attitudes are not conducive to the detection and reduction of MOV, as one third of health workers consider that a child's vaccination status should only be assessed by health workers responsible for EPI.

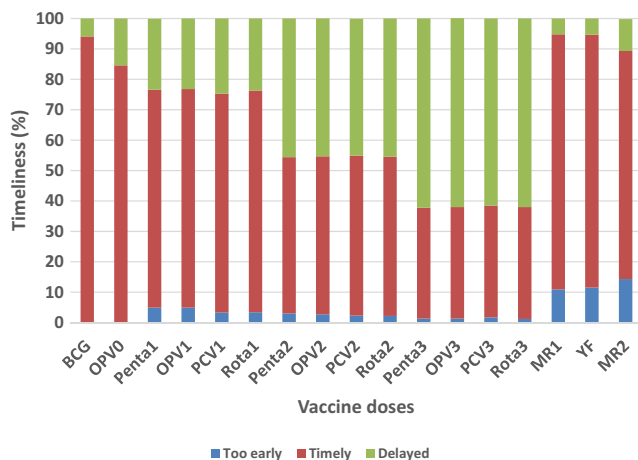
Updated national policies, refresher training, job aids and supportive supervision are needed to change these attitudes and practices, which will have a significant positive impact on vaccination coverage in Burkina Faso.



**Table 3**  
Proportion of missed opportunities for vaccination (MOV) stratified by child and caregiver factors: Burkina Faso, 2016.

Factor	Total children with documented vaccination dates* (N = 411)	MOV		Odds ratio	95% CI		p-value
		n	%		Lower bound	Upper bound	
<b>Reason for visit</b>							
Vaccination	102	32	31	1.00	–	–	–
Medical consultation	139	90	65	4.02	2.33	6.92	<0.01
Healthy child visit or check-up	93	57	61	3.46	1.92	6.25	<0.01
Other	97	51	66	4.29	2.28	8.06	<0.01
<b>Child's age</b>							
< 12 m	215	97	45	1.00	–	–	–
12 m+	196	133	68	2.57	1.72	3.84	<0.01
<b>Child's sex</b>							
Male	211	115	55	1.00	–	–	–
Female	197	114	58	1.15	0.78	1.70	0.49
<b>Caregiver's educational level</b>							
At least some secondary	96	51	53	1.00	–	–	–
At least some primary	69	32	46	0.76	0.41	1.42	0.39
None	244	145	59	1.29	0.80	2.08	0.29
<b>Health center in home town/village?</b>							
Yes	289	164	57	1.00	–	–	–
No	117	63	54	0.89	0.58	1.37	0.59
<b>Child has a home-based record?</b>							
Yes, and I have it with me	371	200	54	1.00	–	–	–
Yes, but I do not have it with me	33	25	76	2.67	1.17	6.08	0.02
No	3	2	67	1.71	0.15	19.02	0.66
No response	4	3	75	2.56	0.26	24.89	0.42

\* Due to missing information, numbers do not always add up to 411.



**Fig. 3.** Timeliness of vaccination by antigen, assessment of missed opportunities for vaccination (MOV), Burkina Faso, 2016. Abbreviations: BCG: Bacillus Calmette-Guérin; OPV: oral polio vaccine; Pentax: Diphtheria-tetanus-pertussis-hepatitis B-Haemophilus influenzae type b; PCV: pneumococcal conjugated vaccine; Rota: rotavirus; MR: measles-rubella, YF: yellow fever. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

In addition to poor integration of services and low awareness among health workers, logistics, especially vaccine shortage, and not providing vaccination services on a daily basis were also found to contribute to MOV. Unfortunately, current deep-rooted practices in many PHFs are aimed at minimizing vaccine wastage, and health workers may be reluctant to vaccinate any child visiting health facilities, especially those who are overdue for vaccines [1,19]. This relates to health workers' reluctance or refusal to open a multi-dose vial unless a critical mass of children are gathered, which is especially true for lyophilized vaccines such as BCG, MR and YF [21]. Packaging small, single-dose vials or prefilled syringes are a possible approach to address this issue, although overall pro-

**Table 4**

Availability and quality of vaccination services among children eligible for vaccination, Burkina Faso, 2016.

Questions assessed (among children with at least one dose due at start of visit)	n	%
<b>Was your child vaccinated today (N = 302)?</b>		
Yes*	97	32
No	205	68
<b>Reasons why your child was not vaccinated today</b>		
<b>Related to health workers (N = 142)</b>		
They said the child was up-to-date with the schedule	76	53
They didn't ask me about it	62	44
The child was sick	4	3
<b>Related to caregiver (N = 61)</b>		
The child is completely vaccinated	12	20
We didn't come for vaccination	38	62
I forgot	2	3
Other	9	15
<b>Related to the logistics (N = 21)</b>		
There was no vaccine	3	14
Today was not a vaccination day	6	29
Other	12	57
<b>For children vaccinated today, did you receive information on possible adverse reactions (N = 97)?</b>		
Yes	34	35
No	63	65
<b>For children vaccinated today, did you receive information on how to manage possible adverse reactions (N = 95)?</b>		
Yes	32	34
No	63	66
<b>Are you satisfied with the vaccination services provided today (N = 97)?</b>		
Yes	78	80
No	19	20

\* One child was misclassified by the caregiver. Fig. 2 (based on home-based record) indicates 96 children vaccinated.

gramme costs are likely to increase [22–24], in addition to increased burdens on cold chain capacity, waste management and the environment. Moreover, a paradigm shift from overemphasis on “wastage rates” to the acknowledgement of “utilization

**Table 5**  
Knowledge of health workers during the assessment of missed opportunities for vaccination in 8 health districts of Burkina Faso, 2016.

Health workers knowledge, attitudes, practices	n	%
	248	
<b>I feel my knowledge on vaccination is insufficient or out of date</b>	<b>239</b>	
Agree	168	70.0
Disagree	71	30.0
<b>My knowledge on vaccination and EPI is sufficient to meet the needs the health facility I work for</b>	<b>246</b>	
Yes	143	60.0
No	103	40.0
<b>What are the contraindications for any vaccine?</b>	<b>221</b>	
Local reaction to previous dose	40	18
Low grade fever	32	15
Seizures under medical treatment	15	7
Pneumonia and other serious disease	38	17
None of the above	96	43
<b>Is there a difference between the quality of vaccines delivered by public or private health centers?</b>	<b>246</b>	
Yes	20	8
No	184	75
Don't know	42	17
<b>I fear adverse reactions to vaccines?</b>	<b>241</b>	
Agree	92	38
Disagree	149	62
<b>When should vaccination status be assessed?</b>	<b>233</b>	
Child's wellness/routine visit	51	22
Consultation for any illness	65	28
When a child is accompanying an adult for any reason	1	0
All of above	116	50
From day to day, who should evaluate the vaccination status of children?	<b>239</b>	
Child's caregivers or parents	11	5
Health worker responsible for EPI	79	33
Medical staff	12	5
All of above	89	37
Only child's caregivers or parents and the health worker responsible for EPI	48	20
<b>What instructions do you give to caregivers when you give them a new home-based record?</b>	<b>244</b>	
Keep this home-based record safe	152	62
Bring this home-based record to all visits to the health facility	226	93
Bring this home-based record only when you come for vaccinations	44	18
Other	10	4
No instructions given	5	2
<b>Completing vaccination registers delays vaccination?</b>	<b>243</b>	
Agree	128	53
Disagree	115	47
<b>Why is vaccination status incomplete for some children?</b>	<b>220</b>	
Parents' negative beliefs related to vaccination	73	33
Hours of vaccination are incompatible with parents' schedule	15	7
Health workers do not complete children's home-based records or vaccination status	9	4
Health workers do not review children's home-based records or vaccination status	10	5
False contraindications for vaccination by health workers	3	1
Distance to the vaccination site	14	6
All of the above	96	44
<b>There is sufficient staff offering immunization services at this facility</b>	<b>246</b>	
Agree	150	61
Disagree	96	39
<b>There is enough vaccine supply (vials) for all patients in need</b>	<b>240</b>	
Agree	194	81
Disagree	46	19

rates" is needed within the global immunization community. Similarly, promoting the reporting of vaccine- and district/facility-specific rates should be supported, as this will show how utilization rates differ across facilities and target population sizes [25]. This would encourage local immunization managers to implement opportunistic vaccinations, at least in poor-performing health districts or PHFs, even at the expense of losing some vaccine doses.

Community-related factors also contribute to MOV. Less than a third of caregivers had heard or seen any vaccination-related messages in the month leading up to the MOV assessment. In addition, up to 8% of caregivers failed to bring their home-based records to PHFs, and some were unaware of the benefit of vaccines. The poor caregiver knowledge and attitudes on the value of vaccination will prevent them from being proactive in requesting vaccination services. This was corroborated by the fact that some caregivers justified the non-vaccination of their child during the assessment by saying "we didn't come for vaccination". These findings warrant a tailored communication strategy towards community members, using appropriate channels, such as community health workers, to increase knowledge and demand for vaccination [26–29]. The contribution of civil society organizations could be significant in the implementation of such activities. Every health service encounter should be promoted as an opportunity to vaccinate every child.

We found that the proportion of MOV was not evenly distributed across age groups, with higher proportions among children aged 12–23 months. The proportion of MOV also varied between health districts (results not shown). These findings suggest immunization inequities in Burkina Faso and call for targeted actions to increase access to immunization services within all social and geographical groups. They also highlight the need for strengthening the platform for administering vaccines in the second year of life (2YL), including identification and mitigation of barriers that may prevent older children from receiving the vaccines they are due [30].

Our findings share certain similarities with recent MOV assessments in other countries [9–11,13], indicating their potential relevance for countries with no formal MOV assessment. In such settings, immunization managers could consider skipping the assessment step and summarizing evidence from published studies and proceed to brainstorming, action-planning, and implementation of MOV-reduction activities, as recently proposed by WHO [31].

#### 4.1. Burkina Faso's plan to mitigate MOV

As recommended in the revised MOV strategy [17,18], a brainstorming session was held with immunization stakeholders from all levels of the MoH. Based on the preliminary results of the assessment, actions to reduce MOV were planned for implementation (Personal communication, the African Region West EPI Managers Meeting held in Ghana in September 2017). The MOV-reduction work-plan is currently being rolled out, thanks to financial (catalytic funds) and technical support provided to the MoH by WHO, the United States Centers for Disease Control and Prevention and AMP.

Ongoing activities include a national workshop with key immunization stakeholders, the design and distribution of national MOV-reduction guidelines and job-aids, the training of 30 regional and national immunization officers on MOV and related topics, and logistical and technical support to these officers to conduct supportive supervision at the lower levels. A follow-up assessment is planned in 2020 to assess the impact of these interventions on the prevalence of MOV.

#### 4.2. Limitations

The eight health districts and the health facilities within these districts were selected through convenience sampling based on absolute numbers of children unvaccinated with MR1 in 2015. In line with the WHO recommendations, this study design is not intended to provide a nationally representative estimate of MOV. Since the eight districts were selected as they were lower performing, our results are likely to overestimate the true magnitude of

MOV in the country. Secondly, in the estimation of MOV, we excluded children without documented vaccination history (either from a home-based record or health facility register). Children with no vaccination records may be more likely to have a MOV. Therefore, this approach may have resulted in an underestimation of MOV in the sample population. Also, for some of our comparisons and estimates, the numbers were small and should be interpreted with caution. Finally, the exit interviews with caregivers were conducted in the vicinity of the health facilities. Although efforts were made to ensure health workers were not listening to the interviews, caregivers may have felt inhibited from speaking freely about the services they had just received.

## 5. Conclusion

In this assessment, the magnitude of MOV was substantial, with nearly eight in 10 children experiencing a MOV during a health facility visit. Despite the steps taken by Burkina Faso in recent years to improve immunization services, there are various coexisting explanatory factors and causes that are contributing towards this high prevalence of MOV, including inappropriate health service delivery, lack of integration, insufficient communication and logistical issues. These factors are being addressed through a variety of interventions, the impact of which will be evaluated at a later date.

Given the many factors observed in children aged 0–23 months in the current assessment, and potential for these factors to affect other groups already included or planned for inclusion in vaccination programmes (older children, adolescents, pregnant women and older adults), further studies are needed to assess the progress of the interventions, as well as to address all aspects of this multifaceted problem.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgements

The authors wish to thank Anyie J. Li (US Centers for Disease Control and Prevention (CDC)), Alima Essoh, Haoua Tall, Dramane Palenfo, Mamadou Bountogo, and Armel Bambara (Agence de Médecine Préventive (AMP)) for their great support to this work. The authors wish to also thank all Regional, District and health facility medical staff and caregivers for their participation in this assessment. Finally, our appreciation goes to the many caregivers and health workers who participated in the interviews and freely provided us with their valuable time and their opinions.

## Authors Contributions

Conceived and designed the study: IM, SS, MO, WMFK, EB, IUO.  
 Performed data collection: LK, BM, IM, WMFK, EB.  
 Analysed the data: LK, BM, CS, EB.  
 Drafted the manuscript: LK, BM, LNL.  
 Reviewed the final draft manuscript: LK, IM, SS, MO, WMFK, EB, IUO, BM, CS, LNL.

## Funding source

World Health Organization.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2020.10.021>.

## References

- [1] Ministère de la Santé, Burkina Faso. Plan Pluri Annuel Complet 2016–2020. 2015.
- [2] Vaccines for Africa Initiative (University of Cape Town). National Immunization schedule, Burkina Faso [Internet]. Available from: [http://www.vacfa.uct.ac.za/sites/default/files/image\\_tool/images/210/Immunization\\_Schedules/Burkina%20Faso.pdf](http://www.vacfa.uct.ac.za/sites/default/files/image_tool/images/210/Immunization_Schedules/Burkina%20Faso.pdf)
- [3] Ministère de la Santé, Burkina Faso. Annuaire Statistique 2016 [Internet]. 2017. Available from: [http://www.cns.bf/IMG/pdf/annuaire\\_2016\\_ms\\_signe](http://www.cns.bf/IMG/pdf/annuaire_2016_ms_signe)
- [4] Zoma RL, Walldorf JA, Tarbangdo F, Patel JC, Diallo AO, Nkwenkeu SF, et al. Evaluation of the Impact of Meningococcal Serogroup A Conjugate Vaccine Introduction on Second-Year-of-Life Vaccination Coverage in Burkina Faso. *J Infect Dis*. 2019 Oct 31;220(Supplement 4):S233–43.
- [5] Kaboré L, Média CZ, Sawadogo F, Bengue MM, Kaboré WM, Essoh AT, et al. Quality and reliability of vaccination documentation in the routine childhood immunization program in Burkina Faso: Results from a cross-sectional survey. *Vaccine*. 2020 Mar 17;38(13):2808–15.
- [6] World Health Organization, Unicef. Progress and Challenges with Achieving Universal Immunization Coverage: 2015 Estimates of Immunization Coverage [Internet]. [cited 2020 Apr 2]. Available from: [https://www.who.int/immunization/monitoring\\_surveillance/who-immuniz-2015.pdf](https://www.who.int/immunization/monitoring_surveillance/who-immuniz-2015.pdf)
- [7] Strategic Advisory Group of Experts (SAGE). World Health Organization. 2017 assessment of the Global Vaccine Action Plan [Internet]. 2017 [cited 2020 Apr 2]. Available from: [https://www.who.int/immunization/web\\_2017\\_sage\\_gvap\\_assessment\\_report\\_en.pdf?ua=1](https://www.who.int/immunization/web_2017_sage_gvap_assessment_report_en.pdf?ua=1)
- [8] World Health Organization. Immunization Agenda 2030: A global strategy to leave no one behind. Geneva: World Health Organization; 2020. Available from: [https://www.who.int/immunization/IA2030\\_draft\\_4\\_WHA.pdf/](https://www.who.int/immunization/IA2030_draft_4_WHA.pdf/)
- [9] Ogbuanu JU, Li AJ, Anya B-PM, Tamadji M, Chirwa G, Chiwaya KW, et al. Can vaccination coverage be improved by reducing missed opportunities for vaccination? Findings from assessments in Chad and Malawi using the new WHO methodology. *PLoS ONE* 2019;14(1):e0210648.
- [10] Li AJ, Peiris TSR, Sanderson C, Nic Lochlainn L, Mausiry M, Da Silva RBJBM, et al. Opportunities to improve vaccination coverage in a country with a fledgling health system: Findings from an assessment of missed opportunities for vaccination among health center attendees-Timor Leste, 2016. *Vaccine* 2019 18;37(31):4281–90.
- [11] Li AJ, Tabu C, Shendale S, Okoth PO, Serگون K, Maree E, et al. Qualitative insights into reasons for missed opportunities for vaccination in Kenyan health facilities. *PLoS ONE* 2020;15(3).
- [12] Hutchins SS, Jansen HA, Robertson SE, Evans P, Kim-Farley RJ. Studies of missed opportunities for immunization in developing and industrialized countries. *Bull. World Health Organ*. 1993;71(5):549–60.
- [13] Garib Z, Vargas AL, Trumbo SP, Anthony K, Diaz-Ortega JL, Bravo-Alcántara P, et al. Missed Opportunities for Vaccination in the Dominican Republic: Results of an Operational Investigation. *Biomed Res Int* [Internet]. 2016;2016. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC5080475/>.
- [14] Restrepo-Méndez MC, Barros AJD, Wong KLM, Johnson HL, Pariyo G, Wehrmeister FC, et al. Missed opportunities in full immunization coverage: findings from low- and lower-middle-income countries. *Glob Health Action*. 2016;9:30963.
- [15] Zewdie A, Letebo M, Mekonnen T. Reasons for defaulting from childhood immunization program: a qualitative study from Hadiya zone, Southern Ethiopia. *BMC Public Health*. 2016 09;16(1):1240.
- [16] Velandia-González M, Trumbo SP, Díaz-Ortega JL, Bravo-Alcántara P, Danovaro-Holliday MC, Dietz V, et al. Lessons learned from the development of a new methodology to assess missed opportunities for vaccination in Latin America and the Caribbean. *BMC Int Health Hum Rights*. 2015 Feb;21(15):5.
- [17] Pan American Health Organization. Methodology for the Evaluation of Missed Opportunities for Vaccination [Internet]. 2014. Available from: <https://www.paho.org/hq/dmdocuments/2015/MissedOpportunity-Vaccination-Protocol-2014.pdf>
- [18] World Health Organization. Planning guide to reduce missed opportunities for vaccination. Geneva: World Health Organization; 2017. Available from: <https://apps.who.int/iris/bitstream/handle/10665/259202/9789241512947-eng.pdf?sequence=1>
- [19] Ministère de la Santé, Burkina Faso. Guide de vaccination. 2018.
- [20] World Health Organization | Regional Office for Africa. Bilan 2017 de la gratuité des soins au profit de la femme et des enfants de moins de cinq ans au Burkina Faso [Internet]. [cited 2020 Jun 17]. Available from: <https://www.afro.who.int/node/10108>
- [21] World Health Organization. Vaccination pratique: guide à l'usage des personnels de santé, Mise à jour 2015. Module 2: La chaîne du froid vaccinale. Geneva: World Health Organization; 2015. Available from: [https://www.who.int/immunization/documents/IIP\\_Module2\\_fr.pdf](https://www.who.int/immunization/documents/IIP_Module2_fr.pdf)



- [22] Haidari LA, Wahl B, Brown ST, Privor-Dumm L, Wallman-Stokes C, Gorham K, et al. One size does not fit all: The impact of primary vaccine container size on vaccine distribution and delivery. *Vaccine*. 2015 Jun 22;33(28):3242–7.
- [23] Yang W, Parisi M, Lahue BJ, Uddin MJ, Bishai D. The budget impact of controlling wastage with smaller vials: A data driven model of session sizes in Bangladesh, India (Uttar Pradesh), Mozambique, and Uganda. *Vaccine*. 2014 Nov 20;32(49):6643–8.
- [24] Parmar D, Baruwa EM, Zuber P, Kone S. Impact of wastage on single and multi-dose vaccine vials: Implications for introducing pneumococcal vaccines in developing countries. *Hum Vaccin*. 2010 Mar 21;6(3).
- [25] Wallace AS, Krey K, Hustedt J, Burnett E, Choun N, Daniels D, et al. Assessment of vaccine wastage rates, missed opportunities, and related knowledge, attitudes and practices during introduction of a second dose of measles-containing vaccine into Cambodia's national immunization program. *Vaccine*. 2018 Jul 16;36(30):4517–24.
- [26] Nzioki JM, Ouma J, Ombaka JH, Onyango RO. Community health worker interventions are key to optimal infant immunization coverage, evidence from a pretest-posttest experiment in Mwingi. Kenya. *Pan Afr Med J*. 2017;28:21.
- [27] Perez F, Ba H, Dastagire SG, Altmann M. The role of community health workers in improving child health programmes in Mali. *BMC Int Health Hum Rights*. 2009 Nov;10(9):28.
- [28] Jain M, Taneja G, Amin R, Steinglass R, Favon M. Engaging communities with a simple tool to help increase immunization coverage. *Glob Health Sci Pract*. 2015 Mar;3(1):117–25.
- [29] Gilmore B, McAuliffe E. Effectiveness of community health workers delivering preventive interventions for maternal and child health in low- and middle-income countries: a systematic review. *BMC Public Health*. 2013 Sep;13(13):847.
- [30] World Health Organization. Establishing and strengthening immunization in the second year of life. Geneva: World Health Organization; 2018. Available from: <https://apps.who.int/iris/bitstream/handle/10665/260556/9789241513678-eng.pdf>
- [31] World Health Organization. Intervention guidebook for implementing and monitoring activities to reduce Missed Opportunities for Vaccination. Geneva: World Health Organization; 2019. Available from: <https://apps.who.int/iris/bitstream/handle/10665/330101/9789241516310-eng.pdf>