Health Security at Risk: Assessing Infrastructure and Operational Gaps in Refugee Immunizations Services in Dadaab

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Abstract

Vaccination is vital to public health security, especially in refugee settings where health systems are often weak. This study examined health system barriers influencing vaccination uptake among caregivers of children aged 0–14 years in the Dadaab refugee complex, Kenya. A mixed-methods design was used, combining data from 380 survey respondents and qualitative inputs from key informant interviews and a focus group discussion. Findings revealed wide disparities in vaccine coverage across camps, Dagahaley (99.1%), Hagadera (65.0%), and Ifo (22.0%), attributed to inconsistent healthcare delivery, workforce shortages, and access barriers. Multivariate analysis showed that camp location and incomplete immunization histories significantly predicted low uptake. Qualitative data highlighted additional barriers, including language gaps, poor coordination, and mistrust. Despite vaccine availability, systemic inequities persist. Strengthening routine services, improving access, and fostering community engagement are essential for improving vaccine uptake and enhancing health security in refugee settings.

Introduction

Immunization is a critical public health intervention that is estimated to prevent four million deaths globally each year(WHO, n.d.). It serves as a vital aspect of primary healthcare, facilitating other essential health services and linking families and children with healthcare systems(Behera et al., 2022). Beyond the immediate health benefits, vaccination offers substantial economic and social returns, with an estimated $44 gained for every dollar spent, contributing to lower medical costs, increased productivity, and improvements in education(Ozawa, 2016). Despite extensive progress in preventing vaccine-preventable diseases (VPDs) worldwide, significant obstacles remain, particularly in sub-Saharan Africa, where overall vaccination rates often fall below ideal targets. Communities affected by migration and displacement, such as refugees and migrants, are exceptionally vulnerable, typically exhibiting lower immunization rates and higher susceptibility to VPDs compared to host populations. The World Health Organization (WHO) defines health security as the necessary actions to address and mitigate both reactive and proactive threats posed by serious public health events that could impact health across different regions and borders (WHO, n.d.). In humanitarian settings like refugee camps, managing vaccination programmes is paramount to achieving robust health security.

Kenya has historically been a significant recipient of forcibly displaced people from neighboring countries, including Somalia and South Sudan(UNHCR, 2019). As of January 2024, the country registered 714,137 refugees, with over 84% residing in camps. These refugee-hosting counties, including Garissa where Dadaab is located, are often underdeveloped, grappling with high levels of food insecurity, chronic malnutrition, poverty, limited livelihood opportunities, and inadequate access to basic services and infrastructure (UNHCR, 2019; World Bank, 2016).

The Dadaab refugee complex in Kenya, home to over 320,000 Somali refugees, is a critical and enduring health security flashpoint (KNBS, 2024). The complex comprises three main camps: Dagahaley, Ifo (specifically Ifo 2), and Hagadera. For nearly three decades, its care and maintenance strategy has relied heavily on UNHCR and partners, with sub-optimal County Government support (UNHCR, 2019). This protracted, underdeveloped setting, compounded by continuous refugee influx from low-vaccination Somalia and sub-optimal new arrival screening, significantly elevates the risk of rapid disease epidemics within overcrowded camps and the wider Garissa County (MSF, 2022; WHO, 2023). This context has already led to outbreaks of polio, cholera,

The expansive and ever-growing Dadaab Refugee Camps in Garissa County-Kenya (Photo Credit: Abiri Kenya)

and measles, posing a tangible threat of disease spillover and underscoring the urgent need for a shift towards sustainable, development-oriented programming (MSF, 2022; UN-Habitat, 2022; UNHCR, 2019).

Despite Kenya's constitutional mandate for universal health access and the goals of its Universal Health Coverage (UHC) programme, the reality in Dadaab falls significantly short (HERAF, 2025; WHO, 2025). Although Kenya's national immunization programme (KEPI) is integrated, vaccination efforts face severe systemic challenges, including the absence of a dedicated government system for refugee healthcare, critical resource limitations, persistent logistical barriers, and the transient nature of the refugee population (Jemutai et al., 2021; MSF, 2022; NTLD, 2022; UNHCR, 2019; WHO, 2022). The lingering impact of the COVID-19 pandemic has further exacerbated these issues pandemic (Lupieri, 2021; McAteer et al., 2023).

These factors collectively result in significant gaps in immunization coverage, leading to recurrent outbreaks of vaccine-preventable diseases like measles, cholera, and polio, directly threatening both refugee and host communities (WHO, n.d.). This high disease burden within the camps carries severe repercussions: diverting crucial resources from Kenya's general population, posing a direct risk of disease spillover, and potentially fostering social tensions and diplomatic strains (Larson et al., 2015; MOH Kenya, 2022; Tankwanchi et al., 2020; WHO, n.d.). Exacerbated by a heavy reliance on unpredictable donor funding and insufficient domestic health budget allocation, the situation leaves health security critically exposed and impedes broader national and global vaccination goals (Dzaba et al., 2024).

The theoretical optics for the study are primarily derived from the Global Health Justice Theory. This framework provides a critical lens by directly addressing ethical, social, and political global health inequalities. It fundamentally emphasizes the importance of equal access to healthcare resources and the minimization of health disparity differences, asserting the universal right to optimal health regardless of socio-economic or geographic determinants (Ruger, 2010).

Through these theoretical optics, the study frames the complex issues of vaccine delivery and health security in Dadaab not merely as operational or logistical challenges, but as profound matters of justice and human rights. Equity in Access is a key dimension of the theory since it underscores the principle of ensuring equity in the distribution of health resources. This directly informs the study's investigation into the poorly defined extent of under-vaccination among refugees and the significant disparities observed in vaccination coverage across

different Dadaab camps. It compels an examination of these structural inequities (Farmer et al., 2013; Gostin et al., 2018).

Human Rights and Universal Health Coverage (UHC) is another key dimension for the Global Health Justice positions the right to health as a fundamental human right, aligning with Article 43(1)(a) of the 2010 Kenyan Constitution, which mandates guaranteeing the highest attainable standard of health for all individuals, including refugees (Kickbusch & Holly, 2023). The theory advocates for the inclusion of refugees in national health goals, such as the UHC Program under the Bottom-Up Economic Transformation Agenda (BETA).

The framework seeks to hold governments, international organizations, and private enterprises accountable for their roles in perpetuating or reducing health inequities. It calls for "global solidarity" to address transnational health concerns like pandemics, (United Nations, 1948, United Nations, 1966). This optic is crucial for understanding the risk of disease spillover from camps into host communities and broader health security threats, framing them as shared responsibilities.

Global Health Justice specifically also focuses on eliminating barriers such as cost, distance, and inadequate infrastructure that hinder equitable healthcare provision(Crenshaw, 1991; GAVI, 2020; Marmot, 2005; Watts et al., 2018). This theoretical lens directs the study to investigate "health system barriers," including frequent vaccine stock-outs, logistical challenges, understaffing, and inadequate cold chain storage, interpreting these as systemic failures against the principle of equity and justice.

Materials and Methods

This study was conducted within the Dadaab refugee complex, focusing specifically on the Hagadera, Dagahaley, and Ifo camps, examining vaccination services and their impact on regional and national health security. The target population included refugee caregivers of children aged 014 years, healthcare providers, and policymakers. The research employed a mixed-methods approach specifically explanatory sequential research design. Quantitative data were collected through structured questionnaires from a sample of 380 caregivers, supplemented by qualitative data obtained through four key informant interviews (KIIs) and one focus group discussion (FGD). The timeframe for the study was 2020-2024 in order to gain insights into the impact of the COVID19 pandemic on healthcare services and vaccination programmes. While the study provides an indepth exploration of Dadaab, its findings might not be generalizable to other refugee settings due to demographic, location, and infrastructure differences. Efforts were made to overcome limitations such as incomplete record-keeping and language barriers through trained research assistants and consistent methodologies. Data analysis combined descriptive and inferential statistics using SPSS v20 for quantitative data, and thematic analysis using NVivo v15 for qualitative data, allowing for triangulation of findings. Ethical considerations were paramount, ensuring informed consent, confidentiality, and cultural sensitivity to protect the vulnerable refugees.

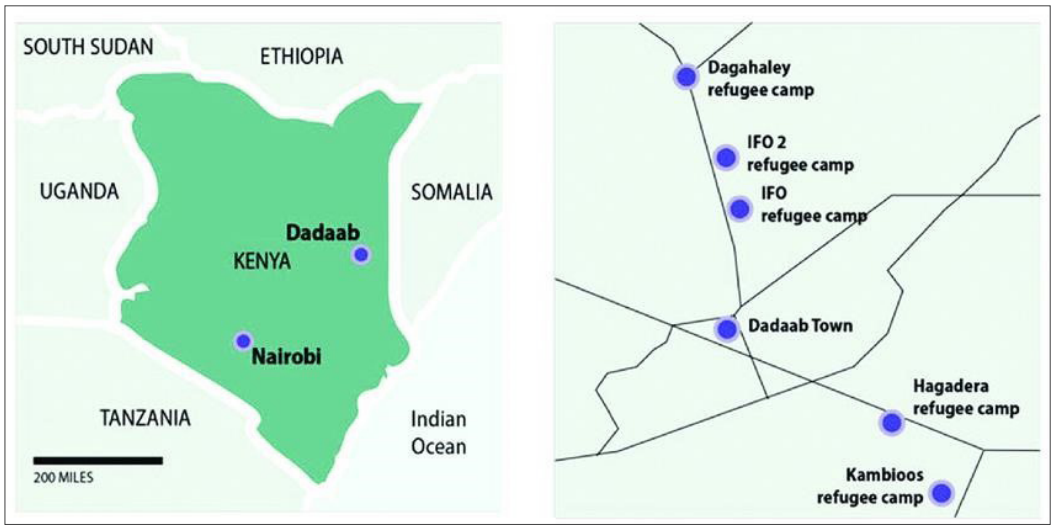

Figure 1: Study Setting

Source: *(Research challenges in evaluating gender-based violence response services in a refugee camp," by (McAlpine et al., 2020))*

Results

The study engaged a total of 380 participants through surveys, achieving a high response rate of 98.7%. The majority of respondents were female (87%) and aged between 30-49 years (47.1%) or 18-29 years (44.7%), with a significant proportion having no formal education (68.9%). Family size also varied considerably among respondents. On average, each participant reported having five children (SD = 2.83), with the number of children ranging from one to fifteen. The sample was distributed across the three Dadaab camps: Hagadera (41.3%), Dagahaley (29.5%), and Ifo (29.2%). Qualitative data were gathered through four KIIs and one FGD.

Table 1 presents the sociodemographic characteristics of the participants interviewed in the survey.

Table 1: A summary of socio demographics characteristics of participants, (n=380)

	Respondent	Frequency	Percentage
Gender	Male	49	12.89
	Female	331	87.11
Age bracket	18-29 years	170	44.74
	30-49 years	179	47.11
	50-64 years	25	6.58
	65 years and above	6	1.58
Education Level	Primary	101	26.58
	Secondary	16	4.12
	College	1	0.26
	No Education	262	68.95
Marital Status	Divorced	54	13.68
	Married	307	79.21
	Single	3	0.53
	Widowed/Widowered	25	6.58
Occupation	Jobless / No Occupation	150	38.68
	Housewife / Stay-at-home	104	26.32
	Casual Laborers	67	17.11
	Community Role	30	7.89
	Business / Self-Employment	24	6.32
	Skilled/Specific Jobs	9	2.37
Camp	Dagahaley Camp	112	29.47
	Hagdera Camp	157	41.32
	Ifo camp	111	29.21
Household Number of Children	1-3	128	33.68
	4-6	142	37.37
	7+	110	28.95

Source: Field data (2025)

Secondly, the study revealed that funding gaps significantly undermine health security in the Dadaab Refugee Complex by directly impacting vaccine availability, straining healthcare systems, and increasing the risk of disease outbreaks. The reliance on unpredictable external aid, particularly from donors like USAID, creates considerable uncertainty for sustained health service provision. The survey results show that vaccine unavailability was the primary reason for nonvaccination, reported by 45.5% (n=65) of unvaccinated respondents. This was particularly seen in Hagadera (61.82%) and Ifo (35.63%) camps. This quantitative finding directly reflects the supply chain issues and stock-outs highlighted qualitatively, which are linked to funding instability. The KII participants also confirmed that frequent stock outs affected their indicators, indicating a direct impact on measured vaccination coverage.

> *"We rely heavily on donor funding, but post-COVID-19, funding has become more unpredictable, affecting our vaccine stock levels... We get a substantial amount of funding from the US government… so yes, we are affected… we are working on ways of navigating that… but we are bound to make some cost changes to continue services,"* - ***[KII participant 03, 2025]***.

Community members observed that vaccination campaigns are infrequent, often occurring with long intervals, sometimes up to a year, between different initiatives. These campaigns are commonly perceived as reactive measures triggered by disease outbreaks (such as COVID-19, measles, cholera, or chikungunya), rather than part of a proactive and sustained immunization strategy. The persistence of vaccine-preventable diseases like cholera (3,773 cases between 20222023) and a significant measles surge in 2024 (Dagahaley: 791 cases, Ifo: 267 cases) underscore these vulnerabilities despite immunization campaigns. This reactive approach contributes to inconsistent vaccine coverage and hinders the achievement of continuous immunization needed for robust health security.

Thirdly, between 2022 and 2024, overall vaccination rates generally improved, with most vaccines showing a 15%–50% increase in coverage. However, key stakeholders noted fluctuations, with overall coverage dropping from above 92% (2021-2023) to 88% in 2024, primarily attributed to challenges in target population calculations.

Table 2: Percentage Increase in Vaccination Rates between 2022 to 2024

Vaccine	Ifo Ward (%)	Hagadera Ward (%)	Dagahaley Ward (%)	Dadaab Refugee Camp Sub-County (%)
BCG	11.10%	59.70%	2.20%	23.10%
DPT/Hep+HiB1	13.60%	42.10%	-9.60%	20.80%
DPT/Hep+HiB3 Dropout Rate	-13.2% (Improved)	-132.0% (Improved)	-45.7% (Improved)	-49.7% (Improved)
OPV Birth Dose	0.40%	59.50%	2.20%	19.70%
OPV 1	6.40%	37.20%	-9.50%	15.90%
OPV 3	8.60%	54.70%	1.60%	25.50%
Measles & Rubella 1	6.10%	178.40%	13.90%	48.70%
Pneumococcal 1	13.60%	42.60%	-12.30%	18.90%
Pneumococcal 3	14.70%	55.30%	1.60%	29%

Vaccine	Ifo Ward (%)	Hagadera Ward (%)	Dagahaley Ward (%)	Dadaab Refugee Camp Sub-County (%)
Rota 1	1257.20%	139.70%	312.70%	338.70%
Rota 2	1322.50%	148.10%	483.10%	397.50%

Source: Field data (2025)

Although vaccination uptake is generally high, the continuous inflow of refugees from Somalia and population mobility in and out of the camps make it difficult to establish a stable target population for immunization efforts. Health managers struggle to determine accurate vaccination coverage rates, as they must rely on varying population estimates from the county government, UNHCR, and their own internal data sources. One Key Informant highlighted the impact of inconsistent population data:

> *"So we have two different types of population targets given. We have one given by the county and we have one given by UNHCR. … Now we don't know which population to use on calculating denominator… But this year we decided to use the county population now, but we just don't know because in the first month, I think our MR two coverage is at 56% which is extremely low,"*
> ***- [KII participant 01, 2025].***

Moreover, the transient nature of the refugee population presents a significant challenge to maintaining adequate vaccination coverage and achieving herd immunity. Between 2020 and 2024, the population across the three Dadaab camps increased by 18%, from 323,080 to 380,933. with Ifo ward recording the highest growth rate at 31%, indicating a substantial influx of new arrivals. This constant movement, combined with low immunization coverage in countries of origin such as Somalia, elevates the risk of disease outbreaks within the already overcrowded camps. The continued presence of vaccine-preventable diseases—such as cholera (3,773 cases reported between 2022–2023) and a sharp rise in measles cases in 2024 (Dagahaley: 791 cases, Ifo: 267 cases)—highlights these vulnerabilities despite periodic immunization efforts.

> The frequent movement of families between Somalia and the camps increases the risk of importing vaccinepreventable diseases. Notably, reported polio cases in the camps have been linked to individuals arriving from areas with weak health systems, particularly in Somalia

Unregistered and underserved new arrivals further complicate vaccination efforts, as population estimates remain unreliable. Many individuals enter or leave the camps without being officially recorded, making it difficult to identify and vaccinate unregistered children. The frequent movement of families between Somalia and the camps increases the risk of importing vaccinepreventable diseases. Notably, reported polio cases in the camps have been linked to individuals arriving from areas with weak health systems, particularly in Somalia.

> *"There's a lot of influx from Somalia… a lot of unregistered population… they just come in and leave… it's difficult to get those children and link them to vaccination centers."*
> ***- [KII Participant 01, 2025]***

Moreover, instances of incompleteness in retrospective vaccination data posed limitations in verifying historical coverage trends. This made it challenging to accurately assess past performance in identifying long-term patterns or improvements. Similarly, the study revealed that there were potential gaps in the data entry into systems like the Kenya Health Information System (KHIS), which further limits the ability to get an accurate picture of the vaccination status and can restrict researchers from making necessary adjustments to the data. These therefore causes a significant challenge in linking unregistered populations to services and identifying reliable targets.

In addition, although non-governmental organizations (NGOs) are the primary healthcare providers, nearly 44.21% of respondents reported facing challenges in

accessing vaccination services. The most frequently cited issue by far was long queues (93.45% of those facing challenges). Qualitative data provided deeper insight into the systemic issues contributing to these long wait times. Key informants pointed to understaffing, a lack of fully trained personnel, and inadequate cold chain storage as critical problems.

> One participant stated, *"There are only three health facilities in the entire camp, and they are overwhelmed. The few available staff are not fully trained as nurses, which further slows down service delivery"* - ***[KII participant 01, 2025].***

Logistical challenges, particularly the daily transportation of vaccines to and from health facilities, were reported to compromise the cold chain and affect vaccine integrity, often resulting in stockouts. Health providers noted that vaccines must be delivered each morning and returned in the afternoon, disrupting consistent temperature control and undermining vaccine efficacy. This presents a significant logistical barrier, consistent with existing literature on infrastructure limitations in refugee settings.

> *"We have to ship these vaccines every day to the facilities and back in the afternoon. Yeah. So of course, that compromises our cold chain and the integrity of these vaccines"* - ***[KII participant 01, 2025].***

Multivariate analysis confirmed that geographic location significantly impacted vaccine uptake, with caregivers in Hagadera (AOR= 0.012, P=<0.000) and Ifo (AOR= 0.01, P= <0.000) camps being substantially less likely to be vaccinated compared to those in Dagahaley. This suggests inconsistencies in healthcare delivery across the camp system. Furthermore, caregivers whose children had not received all KEPI vaccines were significantly less likely to be vaccinated themselves (AOR = 0.046, p = 0.009), highlighting critical gaps in family-level immunization.

Finally, refugees in Dadaab consistently report high levels of trust in vaccines as a tool for disease prevention. Ifo Camp recorded a perfect mean trust score of 1.000, while Hagadera Camp had the lowest at 0.975. Despite this strong confidence, vaccination uptake remains suboptimal due to persistent systemic and operational weaknesses within the health system. Our statistical analysis revealed no significant association between vaccine trust and actual uptake (AOR = 0.06; 95% CI: 0.00–3820.28; p = 0.62), indicating that structural barriers undermine the influence of trust on vaccination behaviour. Furthermore, the observed variation in trust levels across the three camps was not statistically significant (F(2,377) = 1.74, p = 0.1775), suggesting the differences could be due to random variation rather than meaningful disparities, as shown in Table 3.

Table 3: Difference between camps based on trust in vaccines availability and cultural influences on vaccination

Determinant		Sum of Squares	Df	Mean Square	F	Sig
	Between Groups	**0450**	**2**	**.0225**	**1.74**	**0.1775**
Trust in Vaccine	Within Groups Total	4.889 4.934	377 379	.0130 .0130		
Vaccine Readily available	Between Groups Within Groups	0 0	2 377	0 0		
	Total	**0**	**379**			
Cultural influence on vaccination	Between Groups Within Groups	108.33 538.71	2 377	54.16 1.429	37.90	0.0000
	Total	**647.04**	**379**	**1.707**		

Source: Field data (2025)

Qualitative insights show while refugees in Dadaab demonstrate high intrinsic trust in vaccines, qualitative insights reveal that this trust is gradually undermined by persistent operational and infrastructural deficiencies that compromise health security

Similarly, only 8.35% of vaccinated respondents cited trust in the health care system as their primary motivation factor, highlighting a crucial disconnect between general vaccine confidence and institutional trust. Instead, interpersonal trust in healthcare workers (57.33% of caregivers sought their advice) and community health promoters is key to fostering vaccine uptake and countering misinformation.

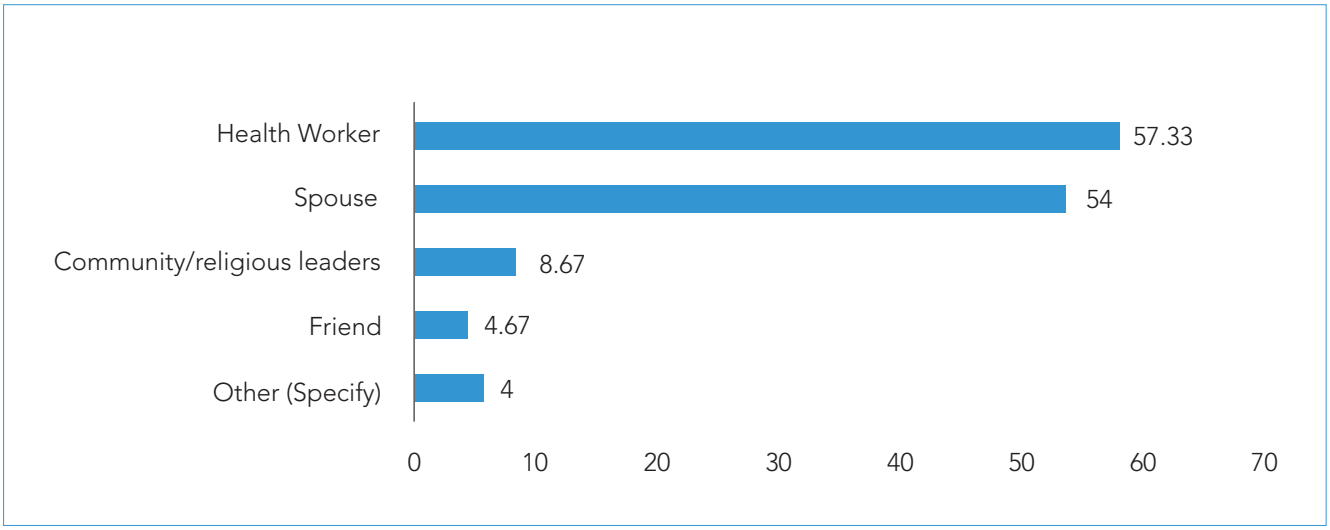

Figure 2: Sources of Consultation Before Vaccination Decisions in percentages (n=148)

Qualitative insights show while refugees in Dadaab demonstrate high intrinsic trust in vaccines, qualitative insights reveal that this trust is gradually undermined by persistent operational and infrastructural deficiencies that compromise health security. Caregivers noted that vaccination campaigns are irregular and largely reactive, typically launched in response to outbreaks like measles, cholera, or COVID-19, rather than being part of a proactive, continuous immunization strategy. This reactive model leads to inconsistent vaccine coverage and hampers the development of sustained immunity in the population.

As one participant explained:

> *"…there were a lot of sensitizations… health talks when they come for medications… using public address systems. Like during COVID-19, people were saying if you take the vaccine, you will not be able to produce."*
> ***- KII participant 04 (January 2025)***

Additional concerns around service delivery, such as frequent vaccine stockouts, unreliable cold chain systems, and the use of undertrained, incentive-based staff, further weaken confidence in the system. Despite overall trust in vaccines, misinformation about specific vaccines like HPV and COVID-19 remains widespread. Caregivers also reported inadequate communication about potential side effects, leading to hesitancy or outright refusal of doses.

Discussion

The research uncovered significant disparities in vaccination uptake across the Dadaab camps, with Dagahaley demonstrating near-universal caregiver coverage (99.1%) and child vaccination (100%), while Ifo had the lowest rates (22.0% for caregivers, 80% for children) and Hagadera showed moderate uptake (65.0%). Multivariate analysis confirmed that individuals in Ifo (AOR = 0.01, $p < 0.000$) and Hagadera (AOR = 0.012, $p < 0.000$) were substantially less likely to be vaccinated

compared to those in Dagahaley. According to Ruger (2010), These disparities reflect profound structural inequities, directly violating the Global Health Justice Theory's call for equitable distribution of health resources and the removal of systemic barriers.

Farmer et al. (2013) argue that structural violence manifests when health systems are constrained by economic and geopolitical forces beyond the control of those most affected. A primary driver of these inequities is vaccine unavailability, reported by 45.5% of unvaccinated respondents, peaking at 61.82% in Hagadera. This is directly linked to donor-dependent supply chains vulnerable to post-COVID-19 fiscal contractions as also shown in literature discussed by Dzaba et al., (2024). Concerns raised by Health Rights Advocacy Forum (HERAF) highlighting overdependency on unpredictable donor funding was noted by key informants who raise concern that these dependence on external aid, particularly from major donors like USAID, creates immense uncertainty for sustained health service provision, often forcing "cost changes to continue services". This aligns with the concept of structural violence, where health systems are constrained by economic and geopolitical forces beyond the control of those most affected as Gavi (2021) outlines.

Global Health Justice framework demands anticipatory and inclusive health strategies that prioritize structurally disadvantaged populations. However, contrary to this, the observation that vaccination campaigns are infrequent and often reactive, triggered only by outbreaks (e.g., COVID-19, measles, cholera, chikungunya), rather than proactive, sustained immunization strategies, exacerbates the population's vulnerability. The persistence of vaccine-preventable diseases like cholera (3,773 cases between 2022-2023) and a significant measles surge in 2024 (Dagahaley: 791 cases, Ifo: 267 cases). As Kickbusch et al. (2021) noted, to realize Global Health Justice, there is need for political will, adequate resources and a balanced geographical influence which Dadaab shows a failure in and national interest overshadow global solidarity.

The reliance on external funding also violates the principle of equal moral worth, where refugee populations should not receive second-tier health services due to their

Parents in Dadaab Refugee Camp take their child for measles and cholera vaccinations to prevent an outbreak within the camp (Photo Credit: Médecins Sans Frontières)

geopolitical status. This directly contradicts Kenya's Shirika Plan(Ministry of Interior and National administration, 2025), which aims to transition humanitarian assistance into government-led, development-oriented responses by integrating refugees into national systems, including health. While Kenya's UHC under Vision 2030 prioritizes equity and access, the structural dependence on external funding for essential services like vaccination creates an automatic two-tiered system, leaving refugees outside the full benefits of UHC and compromising national health security goals. Gostin et al. (2020) further stresses that sustainable financing mechanisms are essential to safeguard global health equity and uphold the rights of vulnerable populations.

Despite an overall improvement in vaccination rates between 2022 and 2024, with most vaccines showing a 15%–50% increase in coverage, operational and structural challenges persist in achieving and sustaining high coverage. The decline in overall coverage from 92% (2021-2023) to 88% in 2024 is primarily attributed to inconsistencies in target population calculations contrary to the principle of proportionality central to global health justice (Ruger, 2010). Which is more of a systemic inefficiency. Literature affirms that in mobile, high-density refugee contexts, accurate population tracking is foundational to effective health programming (WHO, 2018; Gostin et al., 2020), In this case, UNHCR, and their own internal records, reflecting a lack of standardized, integrated data systems.

This directly undermines accurate planning and coverage assessments. Routine immunization rounds overlook unregistered and underserved new arrivals, raising the possibility of bringing in vaccine-preventable illnesses like the confirmed polio cases connected to arrivals from regions with weaker health systems bringing forth the need for integrated surveillance systems that are suited to humanitarian situations.

Furthermore, gaps in Kenya Health Information System (KHIS) data entry and retrospective record-keeping reflect systemic weaknesses that hamper long-term program evaluation and weaken real-time outbreak responses. Without resolving the "denominator problem," and formally integrating refugees into national systems, routine immunization programs in humanitarian contexts like Dadaab will remain reactionary rather than preventive, leaving health security critically compromised as Gavi (2021) outlines.

Approximately 44.21% of respondents reported difficulties in accessing vaccination services, with long queues (93.45%) being the predominant challenge. Qualitative data indicates these long wait times are due to deeper systemic issues, including understaffing, insufficiently trained personnel, and overburdened health facilities. A critical infrastructure limitation is the logistical burden of daily vaccine transportation, which often compromises the cold chain and vaccine integrity, leading to stock-outs (Crenshaw, 1991; GAVI, 2020).

Furthermore, geographic disparities in service delivery evident between the camps suggests uneven resource allocation or operational challenges across the camps. The strong association found between child and caregiver vaccination status (caregivers whose children were not fully vaccinated were less likely to be vaccinated themselves) highlights household-level service gaps or knowledge barriers. These issues collectively represent "systemic failures against the principle of equity and justice" (Ruger, 2010).

Refugees in Dadaab consistently express high mean trust in vaccines as a tool for disease prevention, with Ifo Camp reporting a perfect score of 1.000. However, this intrinsic confidence does not consistently translate into optimal vaccination uptake. Though there is still a high level of public trust in vaccines, community members pointed out that systemic problems like irregular, outbreak-driven vaccination campaigns, frequent stock-outs, and undertrained personnel erode that trust. Hesitancy and unequal coverage are exacerbated by these operational flaws, ongoing disinformation, and carers' lack of awareness regarding vaccine side effects. According to Larson et al. (2015), interpersonal relationships, particularly those with frontline healthcare workers, often have a greater influence on vaccine trust than does faith in the larger health system. The fact that 57.33% of respondents consulted medical professionals prior to receiving a vaccination reflects this, highlighting the vital role that community-level involvement plays in maintaining vaccine confidence.

In conclusion, even though the Dadaab refugee camps have seen a general improvement in vaccine uptake, access to vaccine still is unequal because of the structural and systemic issues that are coupled in the camp. Although refugees report a high level of trust in vaccines, which is primarily based on personal relationships with frontline health workers, systemic barriers such as

reactive campaigns, logistical gaps, misinformation, and limited health system reliability undermine this trust, underscoring the need for structural reform and sustained, community-driven engagement.

As the Global Health Justice framework states, refugees have equal rights to quality healthcare, there is need for Kenya to entrench refugees in the UHC agenda through mechanisms such as Shirika plan, since this is not only for equity but also health security. This study therefore recommends that: there is need to integrate refugees into Kenya's UHC and Shirika Plan which will eliminate the two tired healthcare system. In turn this would promote equitable access to routine immunization and align refugee health with Kenya's development agenda.

It is also key to establish a sustainable co financing model for refugees in order to reduce the volatile dependency on donor funding and hence therefore stabilize vaccine supply supporting both governments led health and system for refugees and host populations; Stakeholders need to harmonize population data and strengthen health information Systems such as KHIS, so that an accurate denominator can be used for effective immunization planning, resource allocation, and timely

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response to disease outbreaks; in order to make vaccines readily available and not compromise the integrity of the vaccines, there is a pressing need to improve the way vaccines are stored and transported in the camps. Setting up permanent and solar powered facilities to store vaccines help vaccines remain potent and builds trust in the system therefore reducing missed opportunities and; more qualified health workers need to be recruited to serve in this high demand area, Dadaab, therefore reducing waiting times and also making experiences more respectful efficient and consistent.

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