

Strengthening National Immunization Coverage Capacity and Effectiveness Strategies in Vaccine Preventable Diseases in Rural and Urban Settings in Sub-Saharan Africa

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Summary

There is an urgent need on the importance of scaling up and sustaining national and regional immunization programs and activities in the prevention and elimination of vaccine preventable infectious and non-infectious diseases in sub-Sahara Africa and worldwide. Optimizing the national immunization coverage capacity and effectiveness is a prerequisite to achieving community and population health, safety and satisfaction, but also return of gains and benefits. The paper provides innovative participatory approaches and strategies in understanding contextual cultural, societal and ecological promoters and barriers towards scaling up and improving immunization coverage, quality services delivery and outcomes. Substantial funding allocation and innovative strategic approaches is required in enhancing local or national transition from Global Immunization Vision and Strategy to the Global Action Plan. Vaccines needs to immunization ownership initiatives integration into national health system priorities and programs. Noteworthy, boosting community trust, confidence and acceptability in a safe and effective participatory immunization increase coverage impacts. Promoting sharing of experiences and best practices, enforcement of mechanisms and policies or in case of only medical and religious exemptions, awareness outreach and public education at all levels. Improving the quality and diligence of participatory immunization service and coverage that extends beyond maternal child health to poverty reduction and in building a sustainable and equitable universal immunization coverage capacity and global health security is imperative.

Contemporary Trends in Immunization Coverage in Africa

Immunization coverage is a key measure of immunization system performance. The transition from the Global Immunization Vision and Strategy to the Global Action Plan including the new Polio Eradication and Endgame Strategic Plan, 2013-2018 and new Global Measles and Rubella Strategic Plan, 2012-2020 requires innovative strategic approaches in enhancing local and national vaccines needs to immunization ownership initiatives and integration into national health system priorities and programs [1]. The period of 2011-2015 has also proved to be a period of remarkable and unprecedented progress and success in reaching more children than ever before, with on

average more than 65 million children in Gavi countries receiving three doses of a DTP-containing vaccine every year since 2010 to record high of 81% in 2014 and estimated timing to immunize a further 300 million children by 2020, preventing another 5-6 million deaths in the process [1].

At least 90% of children received 3 doses, with 91% of infants receiving at least 1 dose of diphtheria-tetanus-pertussis containing vaccines (DTP3) in 129 countries from immunization worldwide in 2014. Compared to 21 million children did not receive even a first dose of DTP, a figure that has now dropped to 12 million in 2000 [2]. Compared to 2012, all 194 WHO Member States endorsed the Global Vaccine Action Plan (GVAP), and committed to ensuring no one misses out on vital immunizations by 2015 and beyond. Of which 65 countries will require innovative strategies in order to meet the GVAP goal. Among them, 6 countries with less than 50% coverage with DTP3: Central African Republic, Chad, Equatorial Guinea, Somalia, South Sudan, DR Congo and Nigeria [2].

Intensified immunization campaigns and improvements in routine coverage MMR since 2001 have showed significant success in most the WHO African member countries by 2010. However weak immunization commitment and financial sustainability is leading to residual and sporadic measles cases resurgence [3] that required urgent actions compared to achievements and equity in the use of routine immunization services of diphtheria and tetanus and acellular pertussis (DTaP) vaccine across these countries (Table 1).

Yet, most WHO-AFRO countries continue to benefit to access to Gavi-negotiated prices, while simultaneously improving immunization coverage and equity in the remaining Gavi-supported countries [2]. The historic transformation of immunization approach towards national demand and ownership in saving millions of the most vulnerable lives in Africa and protecting the world's future requires more operational and evidence-based knowledge and information of the contextual burden and needs impact [3]. Local and national immunization challenges and issues can be majorly linked to political landscape, management issues, insufficient use of information for decision-making and impact monitoring, weaknesses in human resources, bottlenecks in procurement and cold supply chain management, communication logistics, and financial management [4]. The paper aims at exploring innovative solutions in strengthening national immunization coverage capacity and effectiveness in vaccine preventable diseases in rural and urban settings in sub-Saharan Africa.

Disease	Global estimated prevalence	Global estimated deaths, 2014	Vaccine type	Dose up to 35 months of age	Averted deaths from immunization up to 2014	Major challenges and issues in immunization	References
Poliomyelitis	359 reported cases except endemicity in Pakistan and Afghanistan with estimate 200 000 new cases every year	NA	Inactivated poliovirus (IPV)	3	More than 13 million people	Political instability, insecurity and other anecdotes -Weak country leadership commitment, local accountability and stewardship -Weak capacity of health workers at all levels	[2]
Measles, Mumps and Rubella	18.7 million infants worldwide	114 900 measles deaths globally	measles-mumps-rubella (MMR),	1	2 to 3 million deaths per year	Weak logistics and fragmentation of planning -Unproductive immunization data management and use to inform programme innovations	[1,29]
Varicella	4.2 million	4200 deaths	varicella-zoster virus (VZB),	1	2.5 million child deaths per year	Shortages cold supply chain management and logistics systems of vaccines including other essential commodities	[2,4]
Hepatitis B	240 million people	780 000- 1 million deaths/year	hepatitis B virus (HBV),	3	3.7 million future deaths per year	-Limited healthcare service delivery	[2,4]
Influenza b	3 to 5 million cases	250 000 to 500 000 deaths	Haemophilus influenza type b (Hib)	3	NA	Limited immunization spots and outreach sites -Fragile communication strategies at all levels	[1,4]
Diphtheria, Tetanus and Pertussis	18.7 million infants	2 to 3 million deaths every year	Diphtheria, Tetanus and acellular Tertussis (DTaP) vaccine	4 and at 13-15 years old)	2.5 million child deaths every year	Scarce availability of vaccines storage capacity at all levels in most countries, -Lack of funding for vaccine distribution in most remotes rural settings -Health system dysfunctionment	[1,4]

Table1: Major challenges in attaining national immunization coverage targets in WHO-AFRO countries.

Practical Spectrum of National Vaccines Immunization Opportunities in Africa Settings

Promoting effective mass population vaccines immunization advocacy and mitigation in resilience against vaccines preventable diseases requires local and national leadership decision-making policy and stewardship to support regulation processes [5]. Participatory and supportive partnership and collaborative communication and initiatives among policy makers and community implementers, public-private partnerships and public are very important in immunization program ownership in these endemic diseases elimination [5]. Similarly, galvanizing sustained direction momentum and significant resources mobilization and investments through cooperative participation and coordination mechanisms is needed in crystalizing concerted local and national immunization laws implementation, immunization services distribution at all levels and mainly at the most remotes settings is needed to fight against vaccines-preventable diseases.

Improving and sustaining high levels of participatory immunization program coverage and effectiveness require increasing accessibility and cost-effectiveness and reducing proven barriers for vaccines for the hard-to-reach and most vulnerable groups (e.g., under five years) in Africa [3,5]. Communitywide expansion of access services in public and private healthcare settings can increase immunization rates and support positive behavior change provider -vulnerable offering and seeking practices respectively [6]. Also expansion of provider-based

interventions in schools and faith based organizations in increasing community demand and needs for immunizations. These complementary strategies are to boost vaccine supply and service delivery efforts intended to increase coverage levels within populations that require additional assistance in achieving up-to-date immunizations and best practice in different types of interventions in militating against inequality and vulnerability in attaining universal health coverage and SDGs in Africa [7].

Participatory Community Engagement in Immunization Campaigns and Service Delivery

Building trust, confidence acceptance and other uptake enhancers are paramount to the success of any program, intervention coupled with strategic mobilization campaigns together with the government, non-governmental organizations (NGO), private institutions, third-party payers; the media and community mobilizers or volunteers in increasing immunization coverage in SSA [8]. Aligning immunization needs to local community health needs and demand in increasing community participation and engaged behavior is needed to reduce absentee/ refusal and minimizing the risk of vaccine preventable diseases transmission [9]. Developing an acceptable and enhancement accessible in boosting mass immunization campaigns outreach, tracing and tracking services of high-risk populations in remote and hard to reach rural settings in as much as regular supervision visitations is vital. Establishment of population-based early warning, surveillance

and monitoring immunization that provide coverage patterns and extend coupled with community constant vigilance to emerging threat or outbreak is imperative.

Effective and integrated community programs ownership consensus, participative coordination and management policy, governance and accountability are vital options in increasing awareness and education in optimizing vaccination safety and coverage tenets [10]. Moreover, there is a need to increase development of innovative and sustainable expansion of community immunization coverage strategies such as integrative local private-community financing with effective mechanisms. Likewise, re-enforcing individual to community-based immunization programs are needed in upholding positive attitudes and behavioral health seeking and utilization transformation, liable resilience and culture in maximizing widespread community uptake of existing and future immunization/vaccination packages.

Fulfilling Participatory Expanded Program on Immunization (PEPI) requires understanding of local context cultural, societal and ecological tactics/strategies at schools and faith-based organizations (FBO) is important in maximizing on the national immunization programs capacity [6,10]. Enhancing expanded accessibility to vaccines delivery services and community demand for immunization, and related interventions should be improved in national immunization resilience and coverage [10]. In addition, there is a need for adequate capacity development, training and motivation of field supply chain management of primary and secondary health workers and laboratory staff on immunization services and practices standards. Continuous and proper medical supervision and follow up post immunization activities is vital by qualified health professional or trained teachers based on establish mechanisms for enforcement of formal and informal private and public schools or faith based organizations immunization approach. The use of participatory and complementary actions such as monitoring in investigations of disease reports should require community and independent laboratory confirmation to meet clinical case definitions, as well as epidemiological analysis to identify, map and track disease origins, transmission dynamics and high-risk settings [11]. Such investigations commonly involve close and swift data collection and exchange among local, provincial or state and national/federal employees collaboration in educating and alerting health professionals, related science disciplines and communities about important disease patterns and viable information on immunization needs and demand [12].

However, culturally, the diverse of traditional beliefs, faith-based culture and practices, religious convictions and use of traditional medicines are common practices in most African communities [13]. As well growing frequency of drugs and insecticides resistance continues to erode the confidence that communities on modern healthcare. Hence, existing immunization challenges and issues from beliefs, customs and traditional medicine and other man-made bottlenecks have increased the search for more effective, safe and suitable alternatives in optimizing uptake and coverage rate in most resources limited settings in Africa and elsewhere.

Optimizing On Contextual Anthropological, Cultural, Societal and Ecological Immunization Promoters

In sub Saharan Africa, it is local common beliefs, customs and perceptions that the health of a community depends on people's ideas about illness and treatment, thus anthropological beliefs shape care

seeking attitudes and practices. It should be understood that any health intervention such as vaccines immunization or mass drug administration needs must be sensible contextual diversity in beliefs and practices across SSA [2]. Combined and appropriate societal, linguistic and cultural tailored-approaches are powerful tools in maximizing and maintaining effective immunization uptake and coverage by populations, health professionals and policy-makers [3,7,12]. Nevertheless, the ignorance of social inequity, poverty and illiteracy levels of vulnerable populations and health workers motivations as well as political and economic factors might limit health access and effectiveness, coupled with any opinions, suspicions and controversies, divergences or traditional religious objectives over the efficacy, safety and morality of such immunization program(s) in public health and wellbeing [2,17].

Improving active and coherent participatory community information communication and cooperation on continuous implementation of immunization policies and programs uptake is critical on psychosocial and behavioural patterns to services delivery, welfare and impact on health outcomes. Reducing the immunization disparities amongst unprivileged in remotes rural communities to uptake immunization programs as a need and demand against knowledge limitations and not as "a government or political party pay back/compensation post-election into power or political agenda" is the ultimate responsibility of health professionals and stakeholders to distance from such illed-practices and politics misconception or reality [18].

Establishing sustainable immunization community-based care programs can provide added more familiar advantage information with a given population's culture and values of effective strategies for maximizing immunization coverage promotion (e.g.: Organized media or social media) in diverse populations against provider-related ethnic and racial inequalities [3,29]. Hence, boosting optimal immunization universal healthcare coverage and equity requires addressing timely other barriers and challenges such as age-based, risk group-based comprehensive schools immunization curriculum and medical education, lack of funding, lack of public health infrastructure such as old chain in remote communities in improving delivery to the most vulnerable maternal-child and elderly groups [17,19,29].

Further research in emerging infectious diseases burden (Ebola, Zika, dengue, influenza and pneumococcal, etc...), immunization gaps and integrated consensus response strategies are needed, in addition to increasing resources allocation commitment and lessons learnt in national polio, meningitis and hepatitis immunization effective uptake and coverage rate in sustained control and elimination.

Strengthening National Participatory Immunization Programs Capacity

Building, monitoring, and sustaining participatory immunization capacity in striving balanced responsibilities between the great concerns between government roles in public health provide the necessary context for private-sector activity reliable and equitable action in the fulfillment of society's rights, interest and for the community public health good [1,13]. Quality assurance, policy development is needed in community partnership and ownership of programs/projects in infectious disease prevention and control service delivery interventions and sustainable education outreach towards nationalization of immunization and medical insurance schemes and services.

Identifying systemic features that need to be addressed within local and national health systems to promote quality care delivery and improve immunization coverage efficiency against these diseases recurrence or epidemics [14]. Moreover, continuously improvements of practical skill and knowledge in edifying local health workers voices and competence widespread within the local community to national in-service training of health care workers is vital in improving evidence-based practice and interactive dialogue and communication. Simple and reliable information dissemination provide opportunity for sustainable positive attitudes and behavioral changes of local community, and making decision in creating the enabling environment for specific action plans to address challenges also training, including management workshops to introduce new activities [14,15]. These are very importance to ensure the use of information in improving care services delivery, reducing vaccine wastage and guide innovative policies process and activities intended to strengthen cold chain and interactive and participatory communication management processes [4,7,10]. Moreover making immunization effectiveness practical and sustainable by helping health workers and managers to address identified gaps in specific guidelines implementation supervision supporting efforts in strengthening the ability of health system to continually improve the quality of care delivery and sustained success in return of investment and national economic growth [1,2,15].

Contextual community-based strategies as well as interactive and supportive supervision, continuous monitoring and evaluation of immunization program to identify bottlenecks that contribute to poor program implementation or policy translation are helpful in innovative strategies and outcomes [16]. More resilient, practical and sustainable immunization engagement approaches with digitalization technologies can enhance strengthening of routine and expanded immunization program and services delivery and best practices at all levels in Africa [12,14,15].

Setting Participatory Immunization Coverage Surveillance and Monitoring System

Developing and integrating participatory immunization coverage early warning and surveillance programs is vital in enhancing evidence on the immunization effectiveness and quality index, timely exchange of information and sharing lessons learnt [16]. This provides real time and reliable mechanism for generating new evidence knowledge in developing contextual policy and approaches to combat these diseases and / or any issues arising with all stakeholders including support of local population volunteers [14,16]. Moreover, institutionalization of comprehensive digital immunization programs and services capacity in supporting vaccine preventable diseases threat and epidemics surveillance and forecasting , planning, monitoring and evaluation review of delivery progress and performance, building development and training, and empowerment is needed at all levels [17]. To protect vulnerable populations from disease, innovative digital approaches that rely on surveying the populations at greatest risk to determine their immunization coverage level and to identify points of vulnerability can upgrade mitigation strategies from either variety of causes, including shifts in population trends, disruptions in health care services, and/ or new behaviors among providers or community [19]. These efforts can improve and sustain high vaccine coverage level require immunization adequate and continuously surveillance and monitoring of immunization financing-based programs, policies and accountable practices.

Digitalization of public health laboratories have an intrinsic role in supporting surveillance activities, detection and identification of the organisms, conduct threat and outbreak inquiries, timely reporting and dissemination to all stakeholders as well as monitor and participatory response to existing or newly emerging infectious diseases and effective coverage management [20]. However, Africa remains challenged with the increasingly difficult for the public health laboratories to fulfill their missions on vulnerable populations [2, 19,20]. Moreover, increasing private health sector and independent laboratories consolidation, integration of clinical and digital information technologies in health systems delivery transformation is in progress in most African countries as an integral health development priority and economic growth. In the public sector, the public health safety is being redefined with increasing reliance on technical support and technology transfer, international stakeholders and bilateral cooperation in addressing the public health needs, as national budget allocations have become further compelled to respond [21]. The strategies used to achieve the goals of public health laboratories needs to be altered to reflect these contextual changes [2,3]. Presently, there is much variation among the African states in the way the core public health and laboratories are carried out, and require common consensus on standards clinical and laboratory practices strategic plans to emerging infectious diseases [19,21]. Increased national decentralized leadership, technical guidance and assistance support is useful in assessing the local laboratory standard services, in supporting information supply cold chain and health infrastructure development, and in enabling cooperation between public-private concerns, community immunization service uptake and prime coverage.

Hence, digital functioning surveillance system requires installations of basic facilities, equipment and technical know-how set to guide participatory immunization system within the designated immunization infrastructure for services including insurance coverage and standard benefits to vulnerable populations [15,21]. The quality assessment technical assistance efforts is required to monitor and evaluate the immunization performance of health care providers and service coverage which depends on the extent to which the public-private collaboration, communication and dialogue in understanding the needs of vulnerable populations [22]. The need to maximizing on public- private partnership in providing appropriate and safe wearable immunization sensor/device in boosters' doses/regimen service delivery adherence and monitoring of adverse effects to those in most need requires reliable immunization benchmark and engagement measurement metrics.

Measuring of Multiple Universal Immunization Coverage and Safety Impact

Immunization coverage data and information through local and national surveillance and monitoring systems is the most reliable and effective baseline data and information platform, it is poorly established in most African countries [8,14,23]. However, direct information about immunization coverage impacts from school entry surveys/ records, special area and population surveys, National Immunization Data and Reports (NIDR) can be seldom and inaccurate[1,3,23]. NIDR is the primary source of both national and statewide estimates of coverage, including estimates by poverty and ethnic status in most Africa countries. NIDR relies on data to monitor state progress in achieving childhood or adult immunization

objectives, to compare coverage rates across provinces on the basis of percentage of immunization services delivery from registry [23].

Understanding the nature and origins of the differences and opportunities for greater complementarity or comparability may be achieved through technical assistance and program leadership with significant and sufficient sensitivity to detect signs of change or development disruption, school or work absenteeism and traditional births among vulnerable populations [24]. Local immunization surveillance and monitoring provides intelligence needed to manage the community health system effectively, target needy groups, and ensure accountability within the public and private health care sectors [6,19,24]. However, significant financial barriers and human resources challenges in most rural settings further reduce efforts to engage and track vulnerable groups call for more investment need to maintain constant interactive immunization communication, vaccines safety surveillance and monitoring of adverse events and enhanced follow-up after vaccination [25,26].

Concerns about vaccines quality, safety, and reliability can be expected to grow as use of vaccines expands, particularly as the threat of infectious disease diminishes and long-term commitment public health impacts on national economic and stakeholders are attained. Timely and adequate adverse event reporting and investigation and provision of lifesaving medicines for use in the rare case of adverse events such as body rash, hyperpyrexia or sometimes complications including pneumonia, ear infections, or diarrhea more common in children younger than age 5 and adults [1,2,3,4,26]. The potential for adverse events argues for the need to sustain both reliable monitoring systems and sources of expertise that can investigate anecdotal and clinical evaluations [27]. The ability to distinguish between causal relationships and coincidence should adverse events occur requires an evidentiary base, as well as risk assessment judgments that can guide health care and public policy decisions during periods of uncertainty [14,21,23]. Extensive media coverage of claims about possible adverse events associated with vaccine use before research information is available to guide health professionals, policy makers, and the public prompts skepticism and even alarm that can lead to reduced vaccine use in the absence of scientific consensus [28].

Addressing Immunization Cold Supply Chain Management and Delivery Systems

There has not been significant investment in building appropriate, quality-controlled cold chain systems that improve national sustainable vaccine immunization effectiveness [29]. Vaccine immunization effectiveness in rural and urban settings can be complete and more operative when good cold chain knowledge health systems delivery capacity supported by local government and stakeholders in infrastructures, facilities and local human resources are in place [21,28].

Sustaining high levels of immunization coverage for an increasing requires various forms of data collection, identification and analysis of high-risk and minority populations, and technical assistance to health care providers. But also roles and responsibilities integrated into routine primary care within the public health sector acquire greater or lesser importance as health conditions shift and private providers acquire new responsibilities for immunization services [29]. Proper care of cold chain equipment and power backup, leading to a loss of vaccine potency, storage and distribution practices, recordkeeping, and stock reconciliation [28]. As local or country cost of acquisition,

storage, administration and financial viability complexity in vaccines procurement and delivery, shortages or disruptions of vaccines may lead to parental anxiety and increased demands on the practice setting [1,7,11,28].

Sharing cross-cultural experiences and best practices in immunization programs across countries and stakeholders on vaccine preventable diseases is needed [6,7,13]. Applications of appropriate and standards with regard to quality immunization coverage and service delivery effectiveness and performance are essential towards innovative development of norms similar to Good Storage and Delivery Practices for service providers and Good Manufacturing Practices (GMPs) requirements for manufacturers [29]. Exploring the usefulness of modern technologies and approaches coupled with reliable and trusted communication on vaccine preventable diseases programs and safe vaccine immunization delivery require further research in optimizing immunization programs success in Africa and globally [29]. Digital health and universal immunization records implementation can significantly improving the elimination of these irregularities [29,30]. Ensuring the completeness, timeliness and cost effective of national vaccines immunization, availability accessibility and also maintaining consistent in refusal or delays communication in vaccines supply and participatory immunization services to vulnerable populations, while promoting greater transparency and accountability regarding quick return of benefits.

Conclusion

Evidence, need-based and participatory immunization policy and programs are needed in promoting partnerships in uptake and coverage rate. Wider awareness and access to affordable vaccines, surveillance and monitoring of good practices, safety care and management services enhancers such as wearable immunization sensors/devices package potential opportunities in averting considerable vaccine-preventable diseases burden in our population and significant in revamping healthcare, societal and regional economic benefits.

Competing Interest

Author declares no conflict of interest.

Author's Contribution

ET conceived idea, scrutinized and identified the most appropriate literature. ET analyzed, synthesized and wrote the first draft of the manuscript. ET provided further insights. The author read and approved the final version of the manuscript.

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