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**FRAMEWORK FOR IMPLEMENTING THE GLOBAL STRATEGY TO ELIMINATE
YELLOW FEVER EPIDEMICS (EYE), 2017–2026 IN THE AFRICAN REGION**

Report of the Secretariat

EXECUTIVE SUMMARY

1. Despite the availability of a vaccine with life-long immunity, the majority of countries in the World Health Organization African Region are at risk of yellow fever (YF). This is because the national immunization coverage for YF is not yet optimal.
2. To respond to frequent YF outbreaks in West Africa, the YF Initiative (YFI) has, since 2005, supported efforts to reduce the burden of this disease. Although surveillance and response capacities have been progressively improved, over 440 million people remain at risk of YF in the African Region. The recent yellow fever outbreak in Angola and DRC clearly demonstrated that this disease is still a serious health risk within and outside the Region.
3. Currently, the Region is challenged by suboptimal routine YF vaccination, frequent vaccine stock-outs and inadequate implementation of the International Health Regulations (IHR 2005). Further, other risk factors such as climate change and rapid urbanization lead to frequent YF outbreaks.
4. In view of the foregoing, a global strategy to eliminate yellow fever epidemics (EYE) for the period 2017–2026 was developed in 2016. This regional implementation framework has been developed to support the rollout of the global strategy. The three strategic objectives are: (i) to protect populations in all 35 countries at risk through preventive and routine vaccination; (ii) to prevent the international spread of YF through vaccination of travellers and robust screening at major points of entry; and (iii) to detect, confirm and rapidly contain YF outbreaks.
5. The framework also clearly stipulates the targets and milestones. With a single dose of YF vaccine per person, elimination of YF epidemics is indeed a quick public health gain. The Regional Committee is invited to examine and adopt the actions proposed in this framework.

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ABBREVIATIONS

AEFI	Adverse Events Following Immunization
CDC	United States Centers for Disease Control and Prevention
EPI	Expanded Programme on Immunization
EQA	External Quality Assessment
FNV	French Neurotropic Vaccine
ICG	International Coordinating Group on Vaccine Provision
IHR	International Health Regulations
IPD	Institut Pasteur, Dakar
MCV1	Measles Containing Vaccine (first dose)
PMVC	Preventive Mass Vaccination Campaign
QC	Quality Control
UNICEF	United Nations Children's Fund
WHO	World Health Organization
WUENIC	WHO UNICEF Estimates of National Immunization Coverage
YF	Yellow Fever
YFI	YF Initiative

INTRODUCTION

1. Yellow fever (YF) remains a challenge for public health in Africa, despite the availability of a vaccine with life-long immunity.¹ Although mass immunization campaigns have greatly reduced its incidence, outbreaks continue to occur through a sylvatic cycle involving monkeys as a natural reservoir. More countries are at risk of the resurgence of the *Aedes aegypti* mosquito, the primary vector responsible for YF.
2. In 2005, frequent outbreaks in West Africa led to the launch of the YF Initiative (YFI), with support from Gavi, the Vaccine Alliance, resulting in the protection of most people in this subregion.² The YFI enabled vaccination of 114 million people and has, since 2010, eliminated YF epidemics in urban areas in West Africa.³
3. The 2016 unprecedented YF outbreak in Angola that spread to the Democratic Republic of the Congo prompted WHO to develop a global strategy to “eliminate YF epidemics” (EYE) by 2026.⁴ The EYE strategy promotes vaccination and calls for building resilient urban centres and strengthening the application of the International Health Regulations (IHR 2005).⁵
4. This implementation framework has been formulated to guide Member States to roll out the EYE strategy in the African Region. It describes priority interventions and actions for WHO and partners, and Member States that are at risk of YF epidemics (see Annex 1).

CURRENT SITUATION

5. In the African Region, 23⁶ of the 33⁷ countries at risk have introduced the YF vaccine in their routine immunization programmes. However, only Gambia, Guinea-Bissau and Sao Tome and Principe attained 90% population coverage in 2015.³ The YF national immunization coverage varies from 20% to 97% with a median coverage of 80%, following preventive mass vaccination campaigns (PMVC). Between 2007 and 2015, combined PMVCs and routine immunization reduced the burden of YF by more than half, averted more than half a million cases and protected more than 150 million people.³ The population immunity calculated from PMVCs, routine immunization, outbreak response and catch-up campaigns varies from 0% to 90% (median value of 50%).
6. Through the YFI, Member States’ capacities for early detection and prompt response to outbreaks have been strengthened.² Case-based YF surveillance has been established in 16 countries,⁸ and the capacity of national laboratories for serological screening and laboratory confirmation has been strengthened through training by the WHO regional reference laboratory at

¹ WHO, Meeting of the Strategic Advisory Group of Experts on Immunization, April 2013 – conclusions and recommendations, *World Health Organization Weekly Epidemiological Record*, 88(20): 201-2016, 2013.

² Yactayo S et al. Yellow fever in Africa and the Americas, 2014, *World Health Organization Weekly Epidemiological Record*, 90 (26): 323-332, 2015.

³ WHO, The Yellow Fever Initiative: Towards the elimination of yellow fever outbreaks, World Health Organization, 2015.

⁴ WHO, Global Strategy to eliminate Yellow Fever Epidemics, 2017-2026, Geneva, World Health Organization, December 2016.

⁵ World Health Organization (2015). The International Health Regulations (2005). Second Edition, accessed on 17 April 2016 at: <http://www.who.int/ihr/publications/9789241596664/en/>.

⁶ Angola, Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Côte d’Ivoire, Democratic Republic of the Congo, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Mali, Niger, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone and Togo.

⁷ All except Algeria, Botswana, Cabo Verde, Comoros, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland and Zimbabwe.

⁸ Angola, Benin, Burkina Faso, Cameroon, Central African Republic, Côte d’Ivoire, Democratic Republic of the Congo, Gabon, Ghana, Guinea, Liberia, Mali, Nigeria, Senegal, Sierra Leone and Togo.

Institut Pasteur, Dakar (IPD). In addition, technical support for laboratory networks continues to be provided by WHO and the United States Centers for Disease Control and Prevention (CDC), thanks to financial support from Gavi, the Vaccine Alliance.

7. Following early success of the YF investment case, Gavi endorsed additional support for African countries at medium risk of YF outbreaks in December 2013 to complement PMVCs and routine immunization. Nevertheless, over 440 million people remain at risk of YF in the African Region.

8. To achieve effective YF control, vaccine demand must match supply. In this regard, the emergency stockpile of YF vaccines has increased from 2 million to 6 million doses annually and vaccine production has increased from 30 million doses in 2000 to over 83 million doses in 2012.⁹ Importantly, over 63 million people have been protected using the global YF emergency vaccine stockpile, as emergency reactive vaccination campaigns for over 65 YF outbreaks that occurred between 2001 and 2016.

9. In 2016, Angola experienced the largest YF outbreak in recent history. This outbreak was protracted, with wide geographic spread from the initial epicentre in Luanda. The outbreak spread to 123 districts in 16 out of 18 provinces with 884 laboratory confirmed cases, including 121 deaths (13.7% case fatality ratio).¹⁰ The Angola outbreak further spread to DRC with additional cases imported to Kenya and China, demonstrating that YF is a serious health security risk that requires new strategic actions.

ISSUES AND CHALLENGES

10. **Inadequate and overly rigid vaccination strategies.** The limitation of routine vaccination to children under 11 months old and the unwillingness of health providers to open a 10 or 20 dose vial for one child remain major challenges. In addition, priority for vaccines supply is always given to outbreak response rather than outbreak prevention. As a result, childhood immunization coverage is too low to maintain sufficient herd immunity. Due to competing vaccine introduction priorities and limited political will, no new country has introduced the YF vaccine into national routine immunization programmes since 2008. Nine countries¹¹ in East and Central Africa do not have YF vaccination in routine immunization programmes. Moreover, no PMVCs have been conducted, resulting in YF outbreaks.

11. **Limited vaccine supply and emergency stockpile.** Between 2013 and 2015, fifteen countries among the 23 that introduced the YF vaccine into their routine immunization programmes reported YF vaccine stock-outs at national level. Consequently, vaccine coverage has stagnated. Prior to the epidemic in Angola and the Democratic Republic of the Congo, only 6 million doses were reserved annually as emergency stockpile to respond to any YF outbreaks. In 2016, the YF emergency stockpile was replenished twice and exceeded 18 million doses to enable the control of the YF outbreaks in Angola, DRC and Uganda.

12. **Weak coordination and surveillance.** Yellow fever vaccination requirements are clearly stated in the International Health Regulations (IHR 2005), but are not being fully implemented.¹² Past efforts to control YF have not been sufficiently aligned and have failed to bring partners

⁹ WHO, The Yellow Fever Initiative: Towards the elimination of yellow fever outbreaks, World Health Organization, 2015.

¹⁰ WHO, Yellow Fever Outbreak Situation Report, Angola, World Health Organization, December 2016.

¹¹ Burundi, Equatorial Guinea, Eritrea, Ethiopia, Rwanda, South Sudan, United Republic of Tanzania, Uganda and Zambia.

¹² WHO, Implementation of International Health Regulations (2005) in the WHO African Region, Luanda, World Health Organization, 2012 (AFR/RC62/12).

together under a common vision and a single coordinated and effective mechanism. Crucial functions such as surveillance, laboratory capacity and case management have often lacked an integrated approach. Despite the existence of national laboratory networks using standardized methods and tools for early detection and confirmation of YF, inadequate laboratory capacity continues to be a challenge.

13. **Environmental risk.** Deforestation, climate change, incursions into forests and jungles for mining, construction and agriculture continue to maintain a high volume of contacts between humans, the animal reservoir and the vectors. All these factors contribute to the proliferation of and exposure of humans to infected mosquitoes, maintaining transmission and driving the change in YF epidemiology. Although YF outbreaks have been well documented in many countries in the past decade, the exact extent of the risk of re-emergence is uncertain due to inadequate risk assessments, hence the need for the EYE implementation framework.

14. **Risk specific to urban outbreaks.** Rapid and unplanned urbanization, high population growth, low population herd immunity, coupled with frequent population movements to and from affected areas, create conditions which increase transmissibility. Responding to outbreaks in large urban settings is challenging and costly due to their rapid amplification and risk of international spread, resulting in high negative public health, economic, social and political impact.

THE REGIONAL IMPLEMENTATION FRAMEWORK

Vision, goal, objectives, targets and milestones

Vision

15. A Region free of YF epidemics.

Goal

16. To eliminate YF epidemics in the African Region by 2026.

Objectives

17. The objectives are:

- (a) To protect populations in all 35 countries at risk through preventive and routine vaccination.
- (b) To prevent international spread of YF through vaccination of travellers and robust screening and onsite vaccination for people not vaccinated at major points of entry.
- (c) To rapidly detect, confirm and contain outbreaks.

Targets

18. By the end of 2026:

- (a) All high-risk countries will have completed national preventive mass vaccination campaigns.
- (b) At least 440 million people will have been vaccinated in the African Region.

Milestones

19. The key milestones are:

By the end of 2019:

- (a) All at-risk countries will have initiated the implementation of this framework.
- (b) Three regional reference laboratories will have fully functional confirmation capacity.
- (c) All high-risk countries will have introduced YF vaccination into routine immunization (see Annexes 1 and 2 for risk categorization and indicators, respectively).
- (d) Preventive mass campaigns will have been completed in Angola, Congo (Republic) and Ghana and will have been initiated in DRC, Nigeria and Uganda.

By the end of 2022:

- (a) Six subregional reference laboratories will be fully functional for both serology and molecular diagnosis of YF.
- (b) Six of the 13 high-risk countries will have completed preventive mass vaccination campaigns and three new ones (Guinea-Bissau, Ethiopia and South Sudan) will have initiated mass preventive campaigns (see Annex 2 for sequencing).
- (c) All high-risk countries will have established diagnostic capacity to confirm YF.

Guiding principles

20. The guiding principles that underpin the framework are:

- (a) **Country ownership and leadership:** Governments will own, coordinate and ensure that all interventions by partners are in line with relevant national guidelines.
- (b) **Community participation:** The engagement of communities, civil society and the private sector is critical for the success of this framework.
- (c) **Gender and human rights:** The implementation of this framework will ensure incorporation of gender equity and human rights perspectives.
- (d) **Equity:** All actions should ensure access for all to services, including vulnerable populations, migrant populations, under-served areas and states emerging from civil strife.
- (e) **Partnerships:** A broad range of stakeholders within and outside the health sector, with research and academic institutions, will be involved in all actions.
- (f) **Intersectoral collaboration:** It is critical to ensure intersectoral collaboration at local and regional levels between human health, animal health, the environment and wildlife sectors using the “One Health approach”.
- (g) **Evidence-led and forward looking:** All actions should take into account emerging trends, risks and health innovations.
- (h) **Intercountry, regional, subregional and cross-border cooperation:** This will ensure coordinated interventions within and among Member States.
- (i) **Rapid information sharing:** In line with IHR (2005), Member States, WHO and partners will ensure that there is transparency and rapid information sharing about YF risk assessments and timely notification of YF outbreaks.

PRIORITY INTERVENTIONS AND ACTIONS

21. **Undertaking risk assessment and catch-up campaigns.** Member States should regularly undertake risk assessments, using WHO recommended methodology,¹³ and should revise the YF classification, in line with the IHR (2005) requirements. Where many people are susceptible due to low routine vaccination coverage, targeted ‘catch-up campaigns’ are recommended to reach under-vaccinated cohorts. These could, for example, target age-specific vaccination gaps or geographic areas where population immunity is low.

22. **Applying the IHR (2005).** The strict implementation of IHR (2005) for travellers to and from countries at risk of YF is paramount to prevent, detect and respond to potential epidemic threats. Port and border control authorities need to be actively engaged to identify gaps and ensure that the vaccination status of all travellers entering and leaving endemic areas is known and appropriate action immediately taken. All countries need to engage transportation agencies and border control authorities to strengthen screening for YF immunization status, with capacity for onsite vaccination of defaulters.

23. **Vaccinating everyone in areas or countries at high risk of YF.** In 13 Member States identified as at very high risk, no PMVCs have been conducted since the YF Initiative commenced. PMVCs targeting all age groups should be conducted in these Member States to rapidly raise population herd immunity. Member States that are yet to complete national PMVCs such as Ghana and Nigeria are also included in this category.

24. **Improving routine immunization and vaccinating every child.** The best way to maintain high herd immunity in high-risk countries is to ensure that all new cohorts are immunized in infancy. High coverage in successive cohorts will gradually ensure that the population immunity does not decrease after mass vaccination campaigns. All 13 Member States at high risk should introduce YF vaccination into the national routine vaccination schedule so as to achieve and sustain population coverage of over 80%. To achieve this target, YF vaccine stocks (see Annex 3) and ancillary supplies should be reliable, and political and financial commitment should be increased to ensure that children, displaced populations and refugees are vaccinated. Further, community engagement should be conducted at all levels. Importantly, synergies should be maximized with other programmes such as the prevention of measles. Finally, the knowledge and awareness of health-care workers about the importance of childhood YF vaccination should be heightened. Close monitoring of interventions is required to ensure good coverage (see Annex 4).

25. **Protecting high-risk workers.** People working in a wide range of extractive industries such as oil, mining, construction and forestry are at high risk of developing and spreading YF locally and internationally. These workers are particularly exposed to sylvatic transmission when they work or reside in forest or recently deforested areas. Member States are urged to establish political and technical steering committees consisting of relevant companies, industries and stakeholders from relevant sectors to develop strategies to protect local and international workers who are at risk. The private sector should be actively engaged to ensure that their staff and families are protected.

26. **Building resilient urban centres and establishing readiness plans.** Reducing the risk of epidemics in urban centres requires increased readiness. Member States are urged to formulate plans for timely and rapid vaccination during urban outbreaks as part of the overall urban readiness plans, conduct continuous risk assessment and formulate plans for transportation hubs.

¹³ WHO, Risk assessment on yellow fever virus circulation in endemic countries: Working document from an informal consultation of experts, A Protocol for risk assessment at the field level, Geneva, World Health Organization, 2014.

27. **Sustaining vector surveillance and control programmes in cities.** *Aedes aegypti* indices should be measured regularly in cities at risk or with potential for YF. Such monitoring should be integrated into urban emergency planning and should trigger activities based on the estimated level of risk. These measures should be part of a broader arbovirus surveillance and readiness plan in countries at risk of Dengue, Zika and Chikungunya viruses. Integrated vector management requires sustained efforts to maintain low mosquito density, particularly for the *Aedes* vectors which are well adapted to humans. Communities should be engaged in the management of the environment to reduce breeding sites.

28. **Strengthening surveillance and diagnosis for early detection.** In all Member States, the Integrated Disease Surveillance and Response strategy will be the foundation for YF surveillance. Community-based surveillance should be promoted for early warning. The adaptation and strengthening of case-based surveillance should focus on: (i) revision of national surveillance guidelines, based on WHO and partners' guidance; (ii) training of health workers to improve diagnosis and collection of YF vaccination information; and (iii) establishment of a national database of YF epidemiological and laboratory confirmed cases. All Member States should enhance their national laboratory capacity with the availability of reagents in adequate quantities and should establish a specimen referral network. It will be essential to establish agreements with transportation companies and to have protocols of cooperation between Member States for the safe transportation and shipment of specimens. Strengthening external quality assurance and quality control (EQA/QC) for laboratories should be fully functional and monitored for molecular and serological diagnosis. Member States should work with WHO and partners to develop, test and validate new methods for diagnostic confirmation.

29. **Regional and subregional networks.** At the regional level, WHO and partners should establish a regional surveillance network bringing together all high-risk countries to facilitate standardization of case definitions and diagnostic procedures. Furthermore, the number of regional and subregional reference laboratories should, as a matter of urgency, be increased. WHO and partners should support these regional laboratories to ensure that they have molecular and serological capacity complying with international standards.

30. **Ensuring emergency stockpile of YF vaccines.** Emergency stockpiles ensure timely and equitable access to vaccines during emergencies. WHO and partners should work with the International Coordinating Group (ICG) on Vaccine Provision for YF to implement a new stockpile model to maintain a revolving emergency stock of 6 million doses at any time over a given year. The stockpile should be replenished after its use to respond to an outbreak as soon as released vaccines become available.

31. **Fostering rapid outbreak response.** An effective YF outbreak response requires rapid detection of cases, reactive vaccination, good case management and vector control, and community mobilization. Rapid investigation with emphasis on assessing the risk of spread (transportation hubs, population movements, points of entry and vector density) should be streamlined. Efforts should be made to provide essential information and mobilize communities through social mobilization and risk communication. Member States are urged to conduct pre-emptive vaccination campaigns during any ongoing YF outbreak in areas that are not affected but face heightened risk and vulnerability due to weak surveillance or where population immunity is low.

Actions proposed

32. The Regional Committee is invited to examine and adopt the priority interventions and actions proposed in this Framework.

ANNEX 1: Priority interventions to eliminate YF epidemics in the African Region

Country	Yellow Fever Vaccination		Improve surveillance, lab & response capacity	Strengthen screening & vaccination at points of entry
	Routine	Mass campaign		
Algeria	N	N	Y	Y
Angola	Y	Y	Y	Y
Benin	Y	N	Y	Y
Botswana	N	N	Y	Y
Burkina Faso	Y	N	Y	Y
Burundi	N	N	Y	Y
Cameroon	Y	N	Y	Y
Cabo Verde	N	N	Y	Y
CAR	Y	N	Y	Y
Chad	Y	Y	Y	Y
Comoros	N	N	Y	Y
Congo	Y	Y	Y	Y
Côte d'Ivoire	Y	N	Y	Y
D R Congo	Y	Y	Y	Y
Equatorial Guinea	Y	Y	Y	Y
Eritrea	Y	N	Y	Y
Ethiopia	Y	Y	Y	Y
Gabon	Y	Y	Y	Y
Gambia	Y	N	Y	Y
Ghana	Y	Y	Y	Y
Guinea	Y	N	Y	Y
Guinea-Bissau	Y	Y	Y	Y
Kenya	Y	N	Y	Y
Lesotho	N	N	Y	Y
Liberia	Y	N	Y	Y
Madagascar	N	N	Y	Y
Malawi	N	N	Y	Y
Mali	Y	N	Y	Y
Mauritania	N	N	Y	Y
Mauritius	N	N	Y	Y
Mozambique	N	N	Y	Y
Namibia	N	N	Y	Y
Niger	Y	Y	Y	Y
Nigeria	Y	Y	Y	Y
Rwanda	N	N	Y	Y
Sao Tome and Principe	N	N	Y	Y
Senegal	Y	N	Y	Y
Seychelles	N	N	Y	Y
Sierra Leone	Y	N	Y	Y
South Africa	N	N	Y	Y
South Sudan	Y	Y	Y	Y
Swaziland	N	N	Y	Y
Tanzania	N	N	Y	Y
Togo	Y	N	Y	Y
Uganda	Y	Y	Y	Y
Zambia	N	N	Y	Y
Zimbabwe	N	N	Y	Y
	Yes = 27	Yes = 13	All the 47 countries	All the 47 countries

Y = yes; N = no.

All countries will need to continue to carry out regular risk assessments and conduct catch-up campaigns when required.

**Annex 2: Proposed sequencing of preventive mass vaccination campaigns over time, Africa
(Number of doses (1000s)¹⁴**

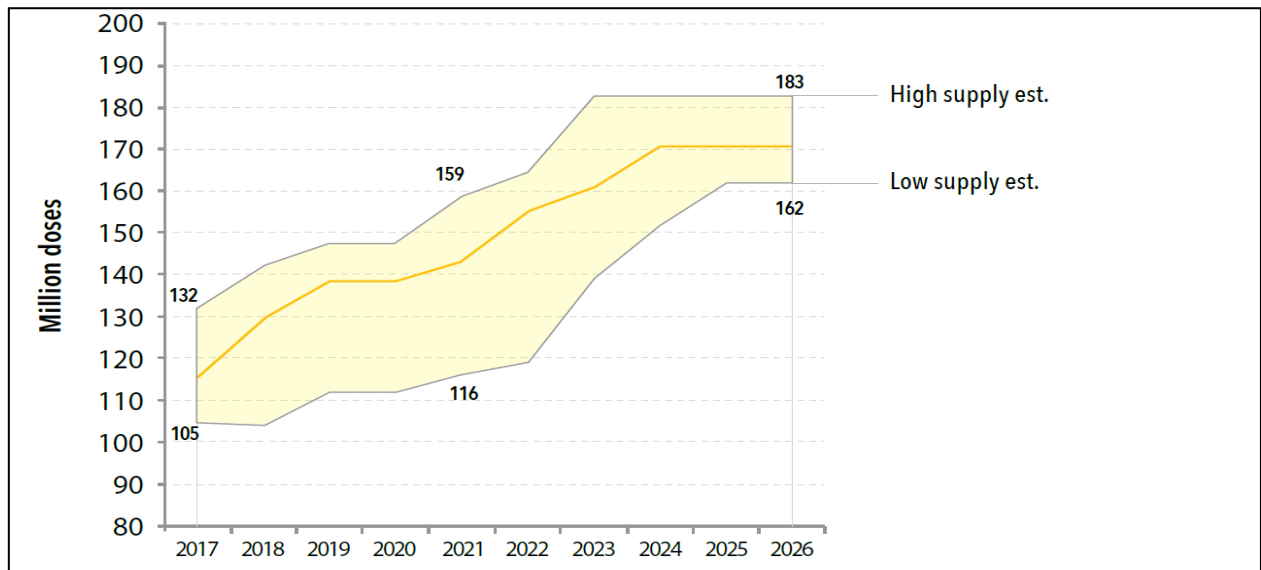
Country	2018	2019	2020	2021	2022	2023	2024	2025	TOTAL
1. Angola	2843	1467	0	0	0	0	0	0	4310
2. Ghana	3057	6246	6380	0	0	0	0	0	15 683
3. Nigeria	14 324	20 987	21 520	22 062	22 613	23 174	23 744	12 162	160 585
4. Democratic Republic of the Congo	0	20 426	21 039	21 664	21 186	0	0	0	84 314
5. Congo	0	2489	0	0	0	0	0	0	2489
6. Uganda	0	4 891	20 190	20 829	0	0	0	0	45 910
7. Guinea-Bissau	0	0	2354	0	0	0	0	0	2354
8. Ethiopia	0	0	0	19 164	19 585	20 007	6810	0	65 566
9. South Sudan	0	0	0	0	8310	8507	0	0	16 817
10. Equatorial	0	0	0	0	0	1147	0	0	1147
11. Chad	0	0	0	0	0	0	9881	10 173	20 054
12. Niger	0	0	0	0	0	0	15 810	16 441	32 252
13. Gabon	0	0	0	0	0	0	0	677	677
TOTAL	20 224	56 506	71 483	83 719	71 724	52 835	56 245	39 453	452 189

¹⁴ WHO, Global Strategy to eliminate Yellow Fever Epidemics, 2017-2026, Geneva, World Health Organization, December 2016.

ANNEX 3: Global YF vaccine supply outlook 2017–2026

The global supply of YF vaccines is expected to increase to between 105 and 132 million doses in 2017, to between 116 and 159 million doses in 2021, and to between 162 and 183 million doses in 2026. The increased capacity expected during 2017–2020 should be achieved by prioritizing and optimizing YF vaccine production and contracting manufacturer operations for filling and freeze-drying. New production capacity is mainly expected after 2021, when new facilities of two manufacturers will start production.

Estimated global YF vaccine supply (high to low risk-adjusted estimates), 2017–2026



ANNEX 4: Key Regional indicators

The following indicators will be measured on a regular basis to reflect implementation and impact of the EYE strategy.

Preventive mass vaccination campaigns

- (a) Number of countries which mounted preventive mass vaccination campaigns.
- (b) Number of persons vaccinated.
- (c) District-level coverage.
- (d) Wastage rate.
- (e) Rate of adverse events following immunization (AEFI) and severe adverse effects.

Routine immunization

- (a) Number of persons vaccinated.
- (b) Proportion of district with coverage level < 80%.
- (c) Difference between YF, DTP3 and measles coverage; (WUENIC).
- (d) Number of vaccine stock-outs.

Laboratory capacity

Number of Regional and national reference laboratories with appropriate diagnostic capacity for YF.

Application of International Health Regulations (2005)

- (a) Immunization status checked upon entry in country.
- (b) Immunization status checked upon departure from country.

Impact

Number of urban outbreaks.