

Yellow fever

Vaccine investment strategy

Background document #5

November 2013



Executive summary

Since 2001, GAVI has spent ~\$250M on yellow fever control

- \$102M on routine vaccination in 17 countries
- ~\$160M on campaigns in "A" risk countries¹ and epidemic response (through the stockpile)

Additional GAVI support for yellow fever campaigns could help prevent future epidemics at a relatively low cost compared to other vaccine investments

- Investment scenario: contingent on completion of risk assessments, one-time campaigns in unvaccinated populations in countries previously targeted with mass campaigns as well as GAVI eligible "B" risk countries¹
- High value for money, with a cost of ~\$1600 per death averted
- Promotes supply stability and could potentially lower price
- Low risk of operational challenges given existing experience supporting yellow fever mass campaigns; possible challenges in planning and execution of risk assessments

Potential downsides of the investment

- Low overall direct health impact relative to most current GAVI vaccines, explained by small country scope (~10 out of 56 GAVI-eligible countries based on current risk assessment) and epidemic nature of disease
- Uncertainty of exact campaign need and cost implications linked to dynamic nature of YF epidemiology

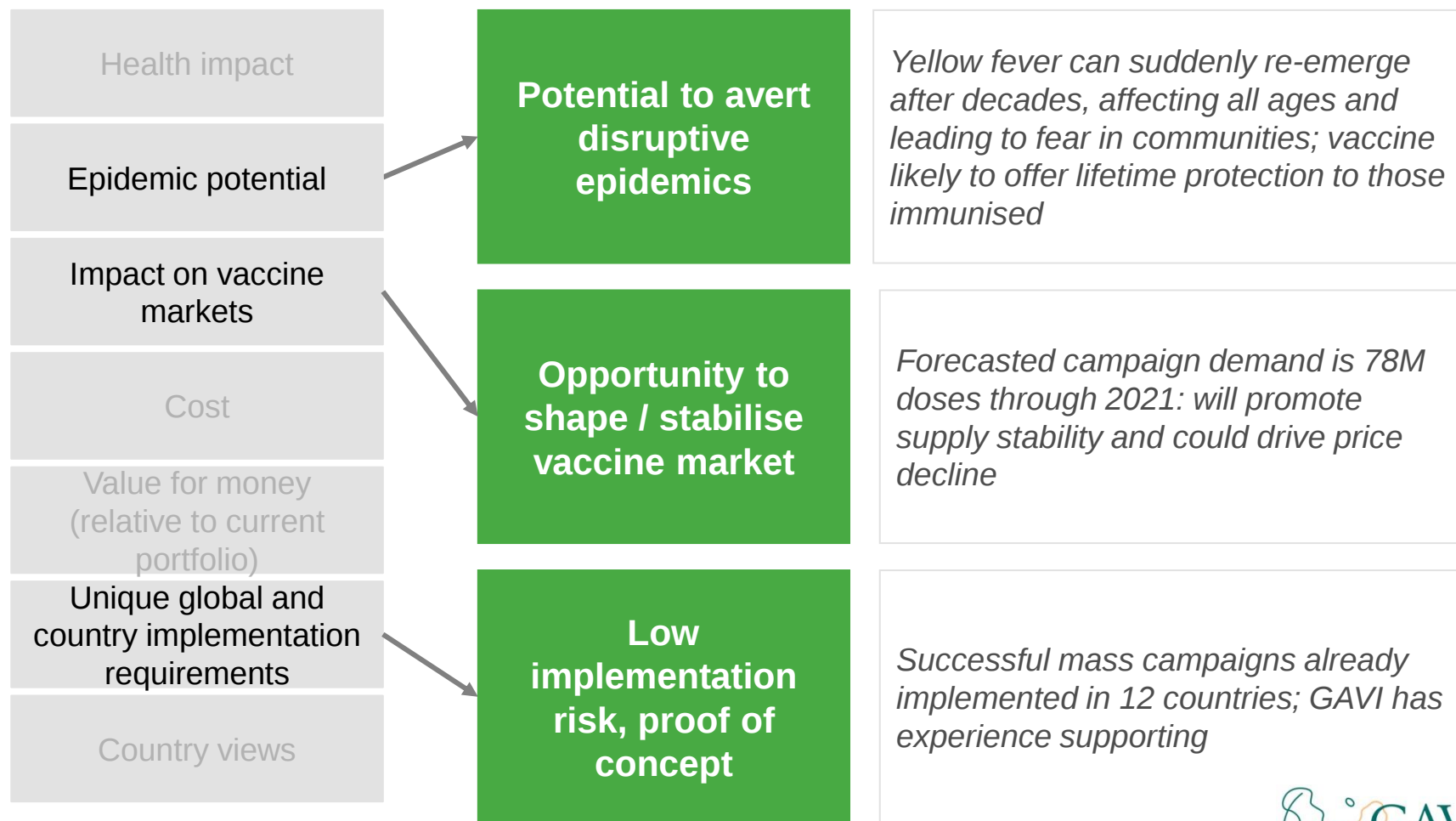
Recommendation: support new yellow fever vaccine campaigns and develop a process for the funding of individual campaigns on the basis of robust risk assessments.

- Projected costs: ~\$140 over 2015-2030

1. WHO defines "A" risk countries as countries reporting multiple YF outbreaks (≥ 2) in the previous 30 years; "B" risk countries are countries reporting at least one YF event in the previous 50 years and with evidence of YF circulation

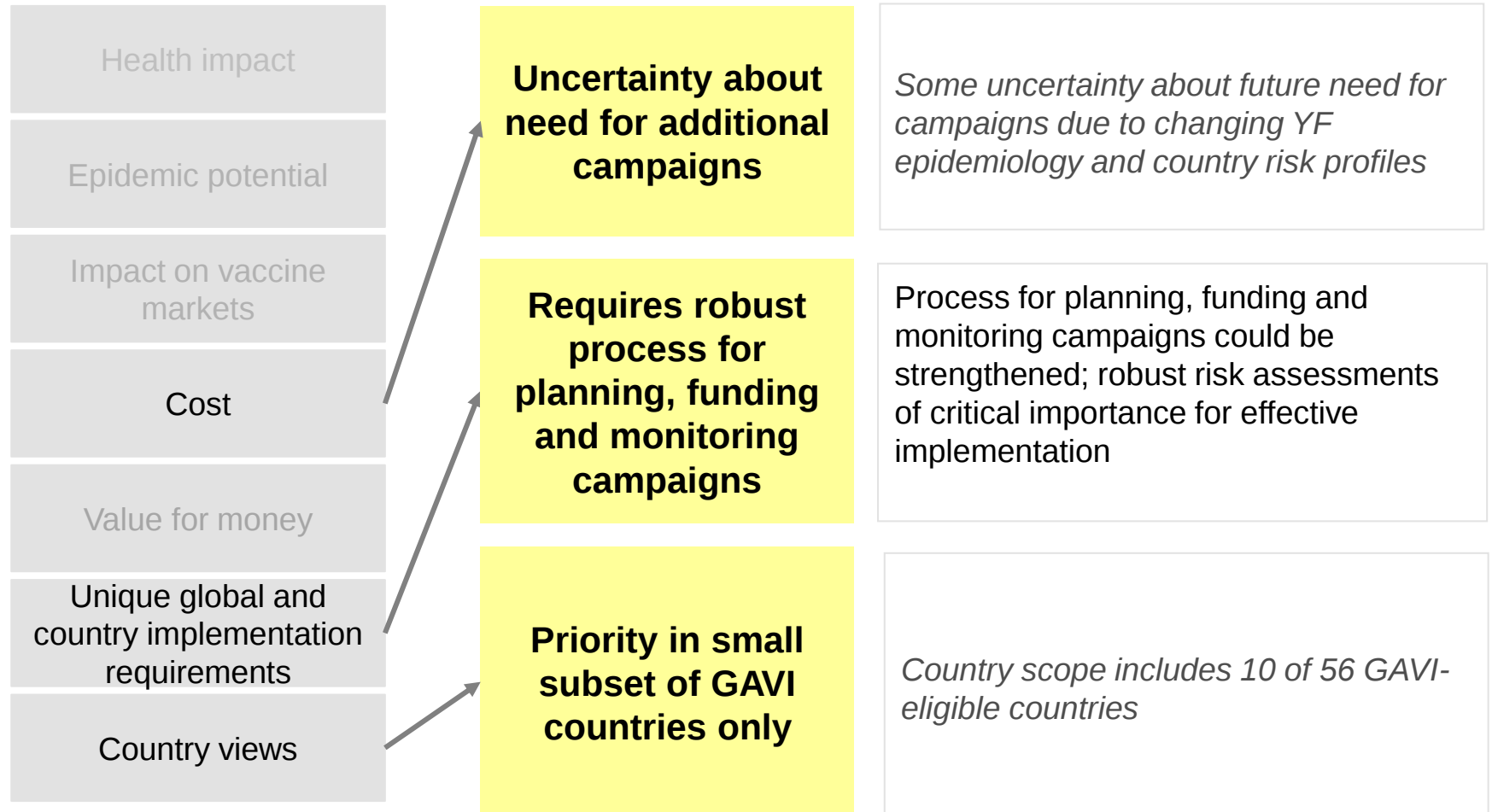
Key yellow fever vaccine benefits

Key benefits



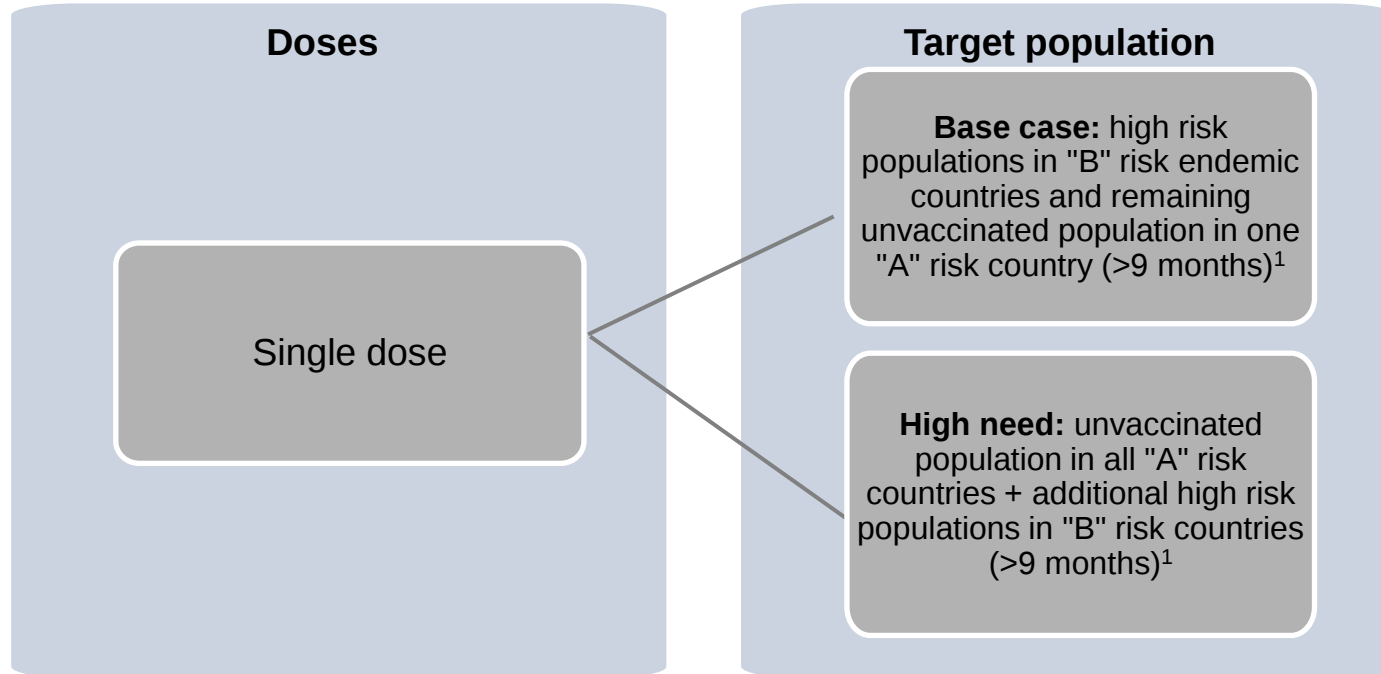
No major challenges foreseen with YF campaigns

Key challenges



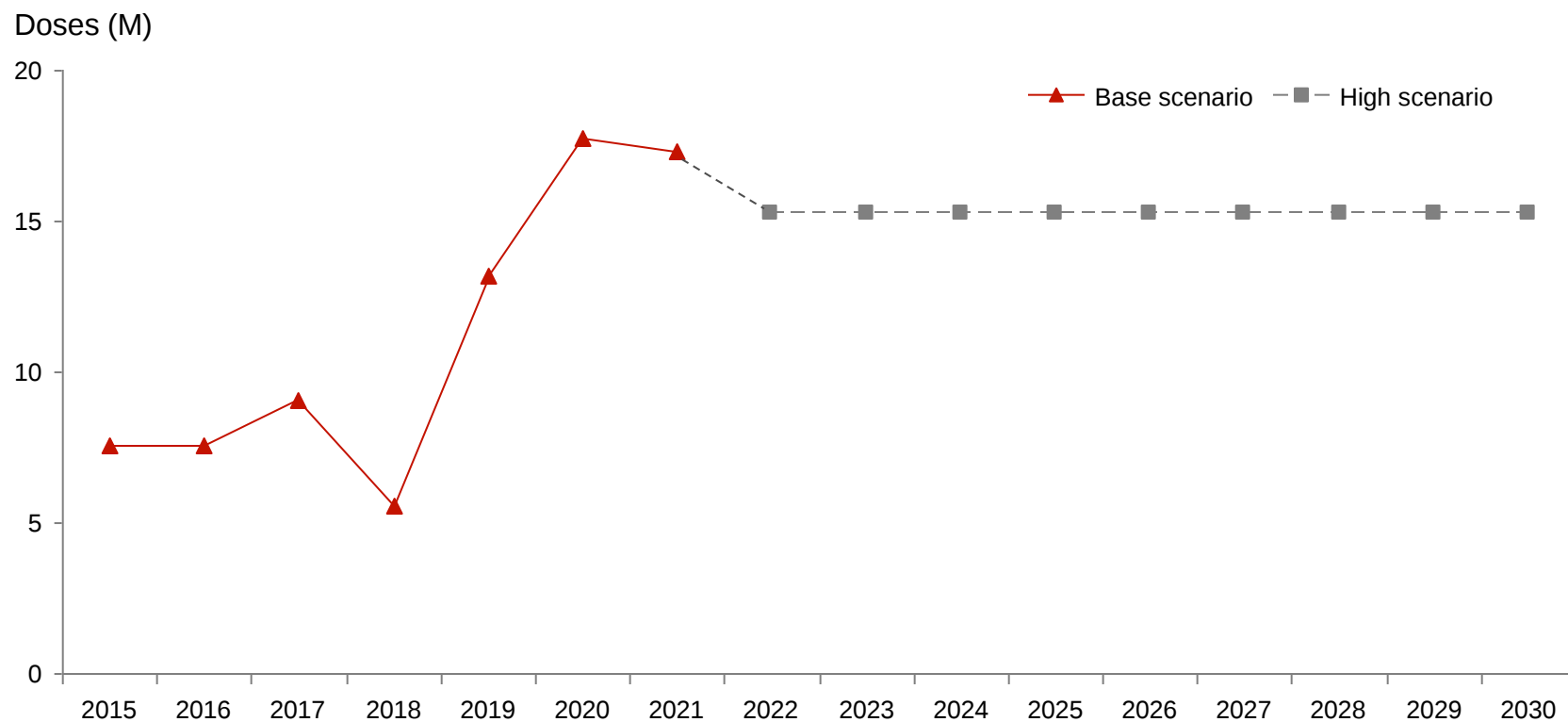
Yellow fever vaccine investment scenario: add mass campaigns in high risk countries

Strategies and assumptions are for modeling purposes. Actual implementation strategies will be based upon latest guidance received from WHO's Strategic Advisory Group of Experts and other WHO expert bodies. All strategies are modelled without financial constraints



1. WHO defines "A" risk countries as countries reporting multiple YF outbreaks (≥ 2) in the previous 50 years; "B" risk countries are countries reporting at least one YF event in the previous 50 years and with evidence of YF circulation

Base case need estimated to be 78M doses;
high need could add ~137M doses (through 2030)



countries
starting
campaigns

2

0

1

0

3

1

3

TBD

TBD

TBD

TBD

TBD

TBD

TBD

TBD

TBD

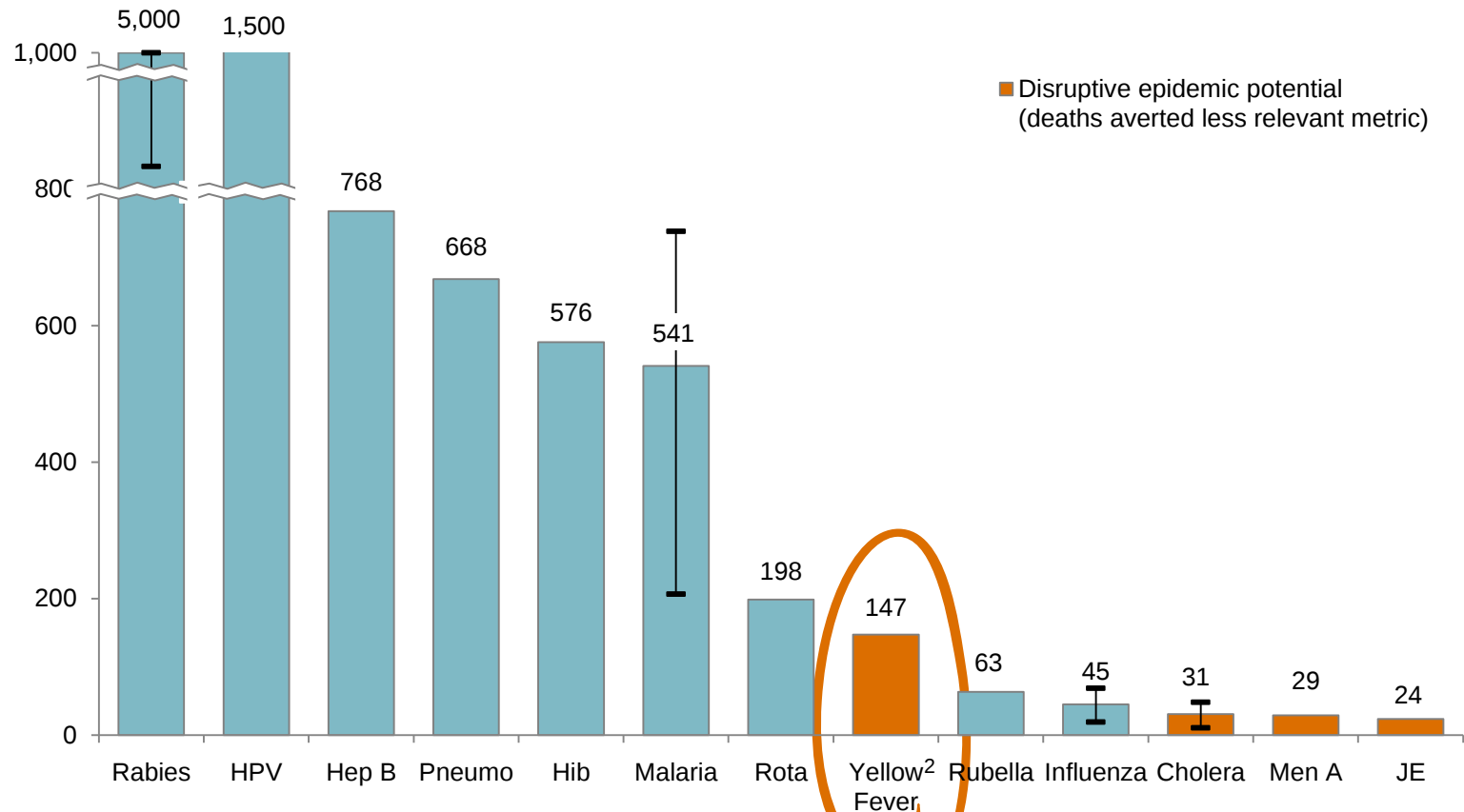
TBD

Base case: potential to avert 104,000 deaths at a total cost of \$163 M over 2015-2021 period

		<u>Base case:</u> mass campaigns in A and B risk countries (2015-2021)	<u>Base case + high need:</u> additional campaigns in A and B risk countries (2022-2030)
Impact	Fully vaccinated persons	70 M	194 M
	Total future deaths averted	104,000	Not modeled
	Deaths averted per 100k vaccinated	147	Not modeled
Cost	GAVI procurement cost	\$94 M	\$258 M
	GAVI operational costs	\$46 M	\$128 M
	Total GAVI cost	\$140M	\$386M
	Country operational costs	\$22 M	\$62 M
	Total cost	\$163 M	\$448 M
Value for money	Total cost per death averted	\$1,600	Not modeled

Yellow fever campaigns would have moderate direct impact and reduce risk of epidemics

Future deaths averted per 100k vaccinated¹



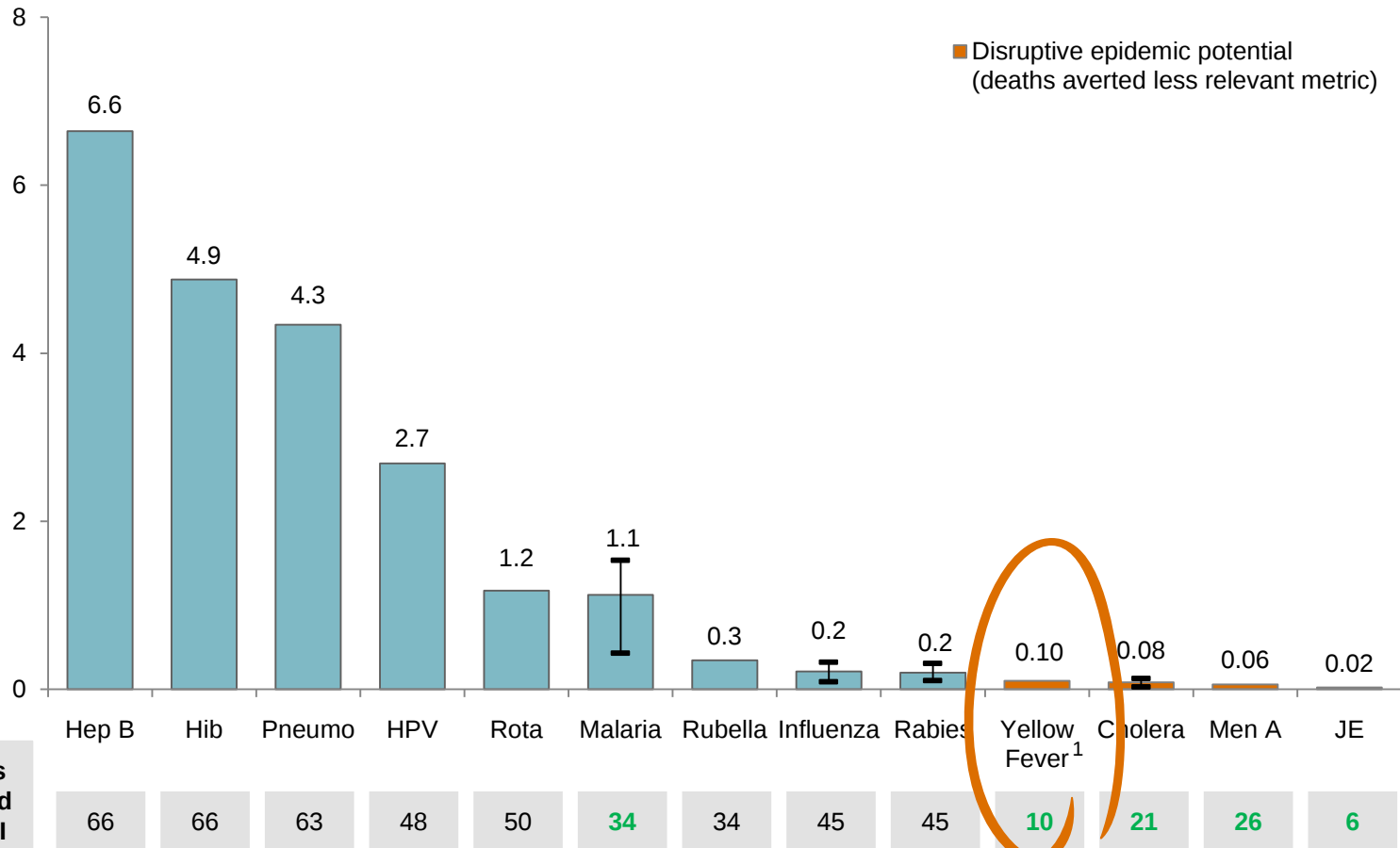
1. Over 2015-2030 2. VIS only

Note: Model outputs shown for base case (10 campaigns)

Source: Imperial College Impact model

Low impact relative to other investments due to small scope (~10 campaigns)

Future deaths averted, 2015–2030 (M)



Countries introduced with GAVI support

Note: **green** indicates vaccine would only be rolled out in a subset of GAVI countries

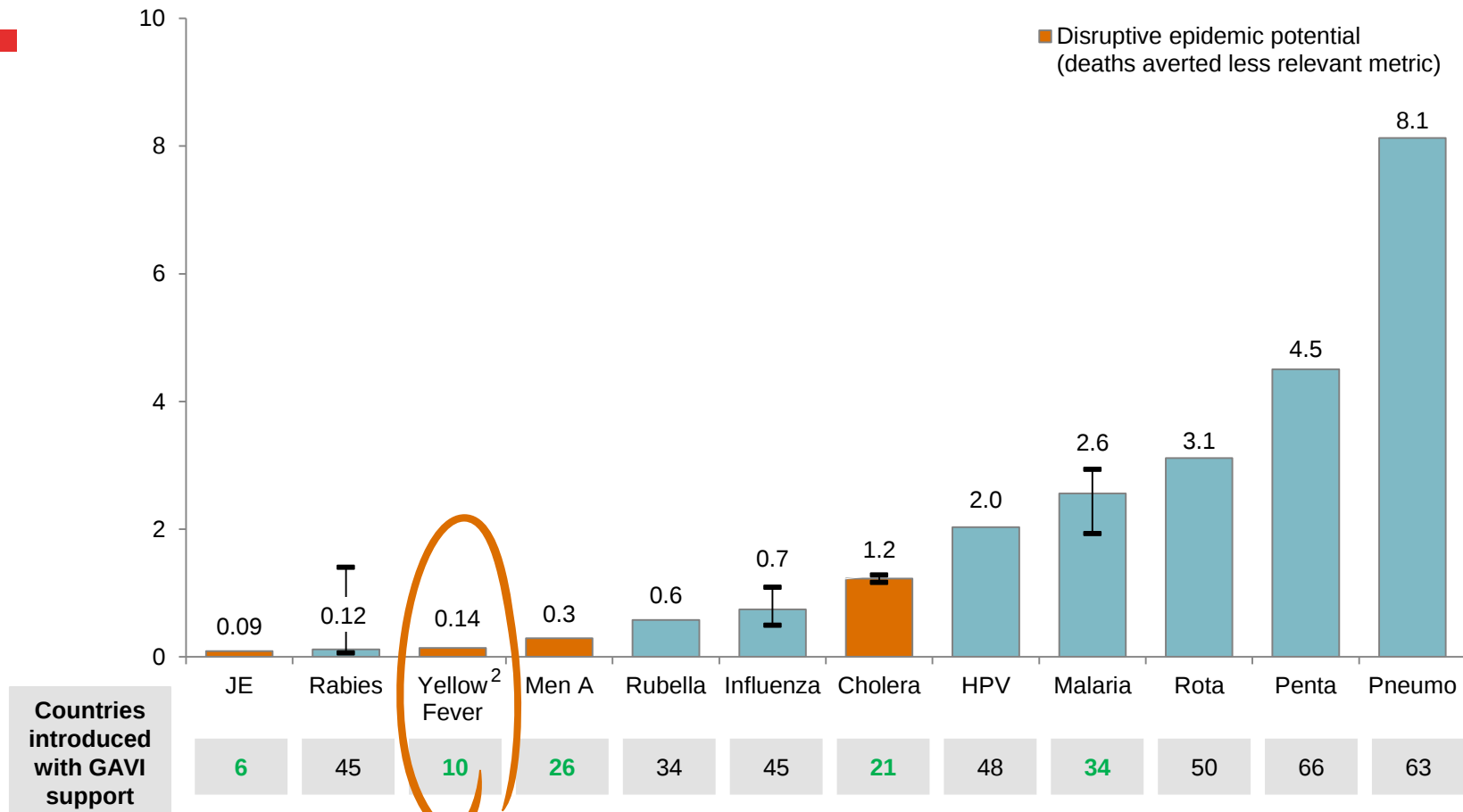
1. VIS only

Note: Model outputs shown for base case (10 campaigns)

Source: Imperial College impact model

Additional yellow fever campaigns constitute a relatively small investment

Total cost to GAVI, 2015–2030 (\$B)¹

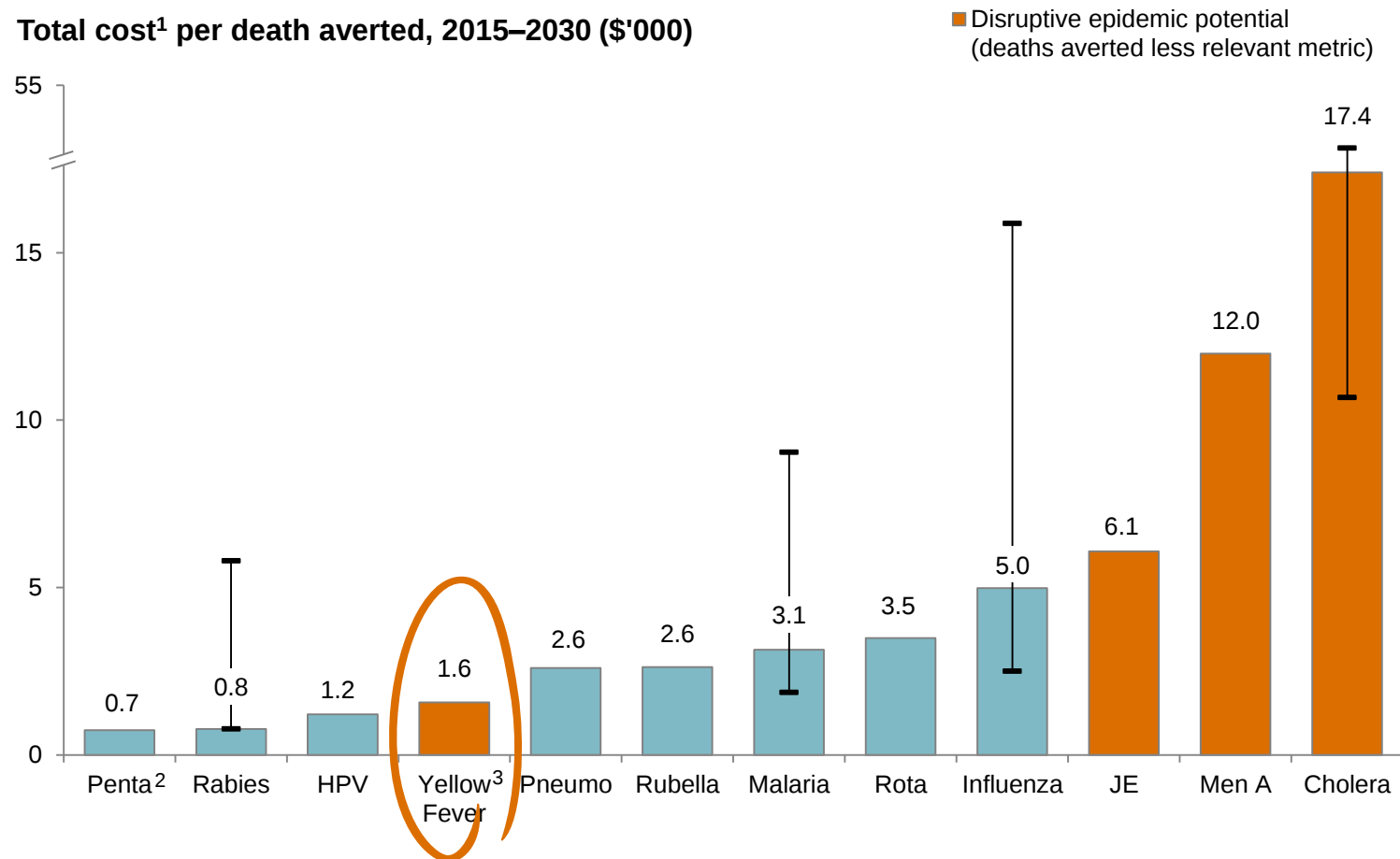


Note: **green** indicates vaccine would only be rolled out in a subset of GAVI countries

1. Includes GAVI procurement cost + vaccine introduction grants + GAVI operational cost grants; 2. VIS only
 Note: model output based on base case (~10 campaigns); Source: GAVI Financial Forecast v7.0Fb as of July 2013, VIS analysis

Yellow fever campaign investment is relatively strong value for money

Total cost¹ per death averted, 2015–2030 (\$'000)



1. Includes operational + procurement cost to GAVI and country

2. Includes deaths averted for Hep B and Hib

3. VIS only

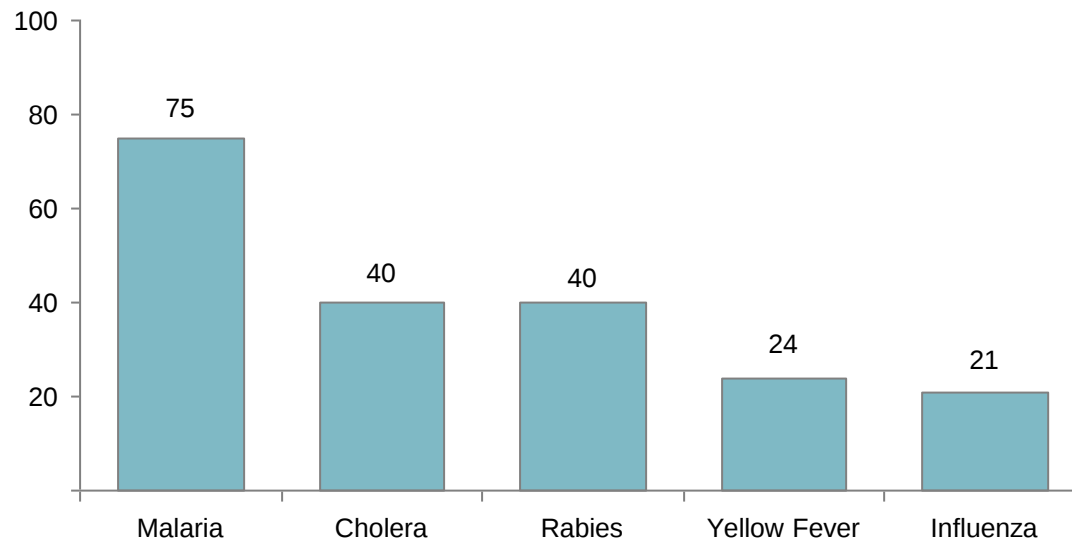
Note: Model outputs base case (~1 campaigns)

Source: GAVI Financial Forecast v7.0Fb as of July 2013, VIS analysis

1/4 of respondents rated yellow fever campaigns as a priority

Survey: yellow fever a lower priority in overall sample of respondents

% of respondents ranking disease as 1 or 2



Average
priority

1.9

2.8

3.1

3.8

3.4

Quotes from in-depth country interviews

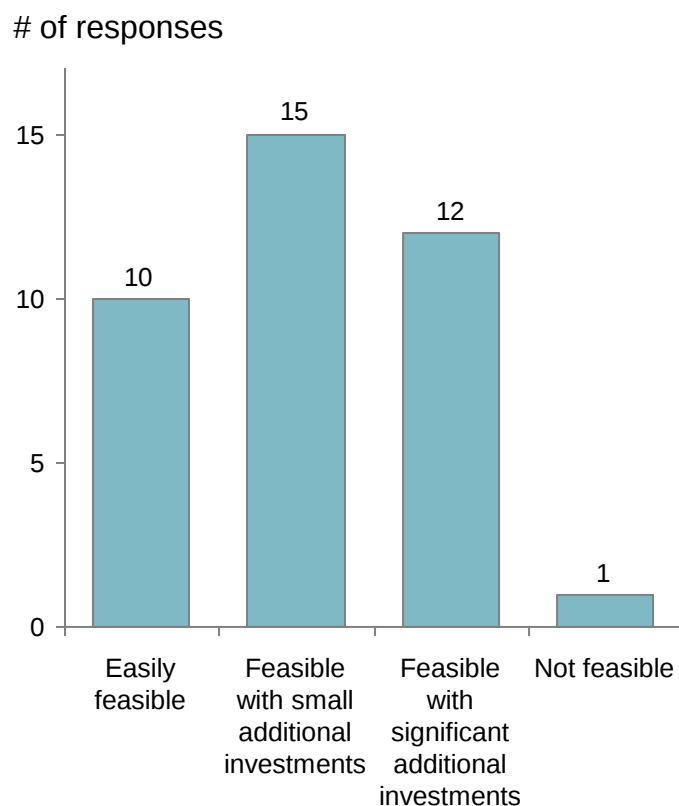
“Yellow fever mass campaigns are game changers.”

“We tend to under estimate the impact of YF. Once you see an epidemic, you pray not to see another one in your life time!”

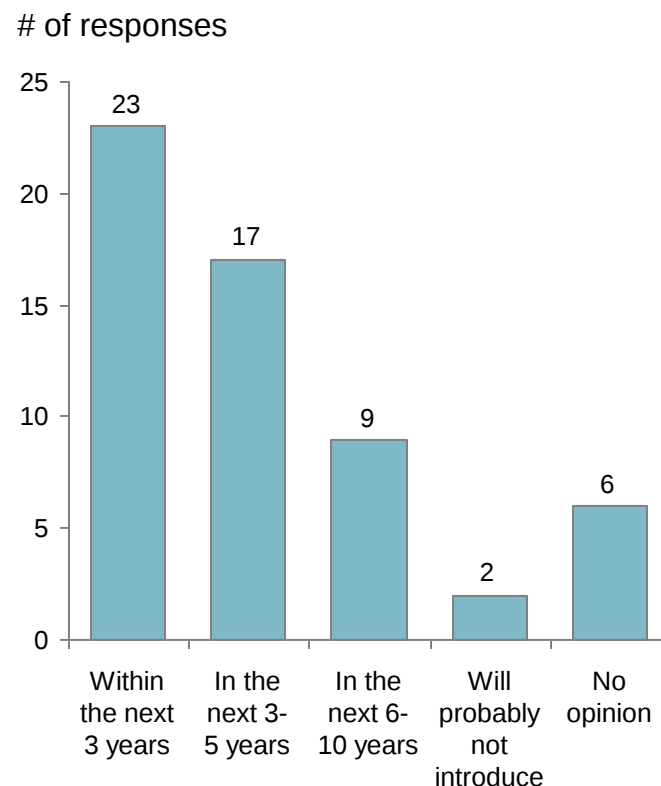
“Campaigns are feasible, but they are challenging”

Majority of respondents see campaigns as feasible and desirable within 3-5 years

How feasible do you think the proposed campaign would be in your country?



When would you want to introduce yellow fever vaccines in your country?



Source: 2013 GAVI Phase II country consultation survey, total n = 182; yellow fever-specific questions asked only to respondents ranking yellow fever as a first or second priority for introduction

No special, challenging implementation requirements foreseen

	Area of focus	Unique implementation requirements	Unique costs
Global level	Policies and processes	Requires robust process for planning, funding and monitoring campaigns; stockpile management requirement	WHO stockpile management costs
	Supply	Limited production capacity, due to be expanded in 2016; need to ensure current efforts to overcome these difficulties are successful	No direct costs
Country level	Health workforce	No unique health workforce requirements for implementing campaigns	N/A
	Social mobilisation, education, communication	Yellow fever is well known in endemic countries so there is no special need for intensified IEC	N/A
	Supply chain infrastructure and logistics	May require significant cold-chain capacity due to large target population	No direct costs
	Surveillance	- Risk assessments must be conducted before mass campaigns - Need to maintain and strengthen surveillance system (integrate remaining at-risk countries, enhance lab capacity and quality, improve sample collection and transportation)	Risk assessments (business plan)
	Planning, coordination, integration	N/A	N/A
		Unique but manageable	May not be manageable in short term / within current GAVI model

Options for a yellow fever investment

Support new yellow fever vaccine campaigns and develop a process for the funding of individual campaigns on the basis of robust risk assessments

Allocate funding (capped) for new campaigns in specific countries / target populations currently identified by WHO at a total cost to GAVI of \$140 M

Allocate funding (capped) for new campaigns in specific countries / target populations, high need scenario (with additional campaigns on top of current WHO request) at a total cost to GAVI of \$386 M

Do not to support new yellow fever campaigns

Recommended option

Implications of no GAVI support

- 1. Risk of YF resurgence and urban outbreaks if preventive campaigns are not conducted in targeted countries, necessitating urgent response**
- 2. Unfunded demand for yellow fever vaccine could lead to higher prices and less reliable supply**

Yellow fever: experts and sources consulted

Sources

- WHO Addendum to Strategic Framework for Yellow Fever Immunization Initiative in Africa 2012-2020 (July 2013)
- WHO Yellow Fever Initiative Joint WHO and UNICEF progress reports, Annexes (2009, 2010, 2011)
- Garske T, Kerkhove M, Yactoyo S, Ronveaux O, Lewis R, Staples J, Perea W, Ferguson N, et al. (2012) Yellow Fever in Africa: burden of disease and impact of mass vaccination.
- Yellow Fever, WHO Position Paper, July 2013

Experts

- Sergio Yactayo, WHO
 - Alejandro Costa, WHO
 - William Perea, WHO
 - Oyewale Tomori, Redeemer's University, Nigeria
 - Rosamund Lewis, Public Health Agency of Canada (former WHO, former GAVI)
 - Erin Staples, CDC
 - Michel Van Herp, MSF
 - Michael Clark, GAVI consultant (MC Consulting)
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Appendix

Demand forecasting assumptions

Base case per WHO recommendation: one "A" risk and nine "B" risk gavi-eligible countries

Element	Assumptions	Rationale / source
Country scope	"A" risk country (1), "B" risk countries (9), per current WHO recommendation	Expansion of current support to "A" and "B" risk countries as defined in WHO YF Strategic Framework
Target population	High risk populations as defined by WHO risk assessment	High risk populations are targeted to decrease potential for epidemic outbreak
Introduction dates	Campaigns span multiple years from 2015-2021	WHO input
Uptake	Instant uptake	Standard GAVI analogue for campaigns
Analogue Coverage	Demand: 100% of high risk target population FVP: MSIA coverage	WHO input and standard SDF assumption
Products	Products from 4 manufacturers (WHO pre-qualified); lyophilised, 5-, 10-, and 20-dose vials	Manufacturer product insert
Logistics	Wastage Factor: 1.11 (10% wastage rate)	WHO recommendation for 10 dose lyo product

High need scenario forecasting assumptions

Additional mass campaigns in "A" and "B" risk countries

Element	Assumptions	Rationale / source	Add. demand	Add. total cost
Country scope and target population	"A" risk countries – all remaining unvaccinated individuals	Potential need to vaccinate all unvaccinated individuals given the high risk of YF in these countries	11 M	\$24M
	"B" risk countries in endemic areas without routine YF coverage + additional countries suggested by experts – 80% of unvaccinated individuals	Countries without YF routine vaccination have a moderate risk of having a outbreak; additional high risk countries suggested by experts	126 M	\$262M
Total			144 M	\$285M

Note: Other assumptions remain the same as in base case: instant uptake, FVP – MSIA coverage, products from 4 manufactures and wastage factor of 1.11

Yellow fever vaccine impact modelling assumptions

Imperial College¹

Model structure

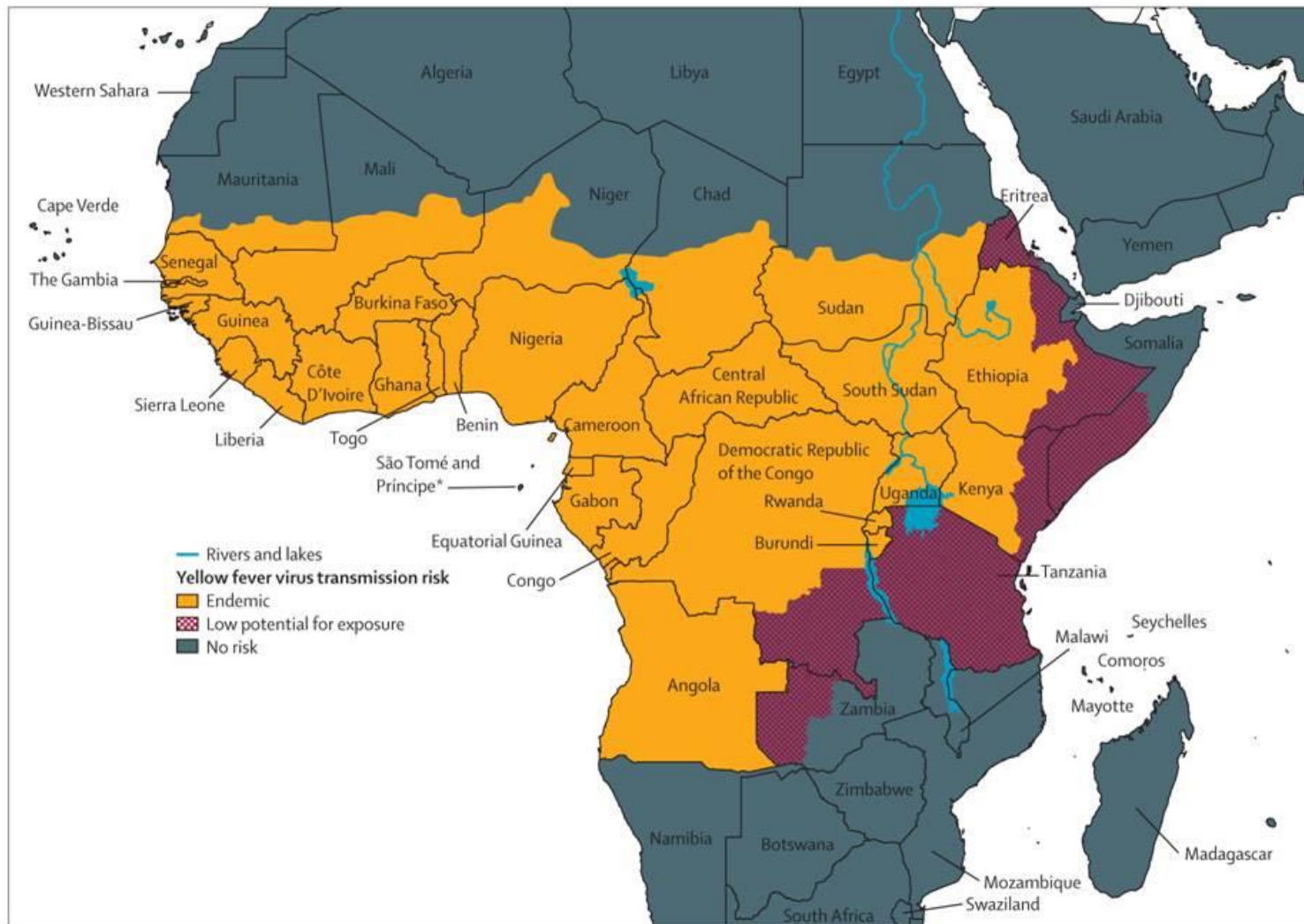
- Generalized linear model
- Markov Chain Monte Carlo techniques used to combine several inputs: Environmental data, serological surveys, disease occurrence, surveillance quality, demographic data, age dependent vaccination coverage, etc.
- Produces estimates of yellow fever deaths and cases averted
- Counterfactual is coverage without additional campaigns

Key assumptions

- **Vaccine efficacy:** 100% (WHO)
- **Disease severity:** 10% of infections presented as severe cases
- **Severity leading to death:** 20% of severe cases of yellow fever eventually lead to death
- **Surveillance quality:** 29,237 records of suspected cases of yellow fever used from 21 countries (YFSD)
- **Disease occurrence:** database of reported outbreaks in the 25 year period between 1987 and 2011 is used
- **Age dependent vaccination coverage:** 2011 EPI coverage rates used

¹ Garske T, Kerkhove M, Yactoyo S, Ronveaux O, Lewis R, Staples J, Perea W, Ferguson N, et al. (2012) Yellow Fever in Africa: burden of disease and impact of mass vaccination.

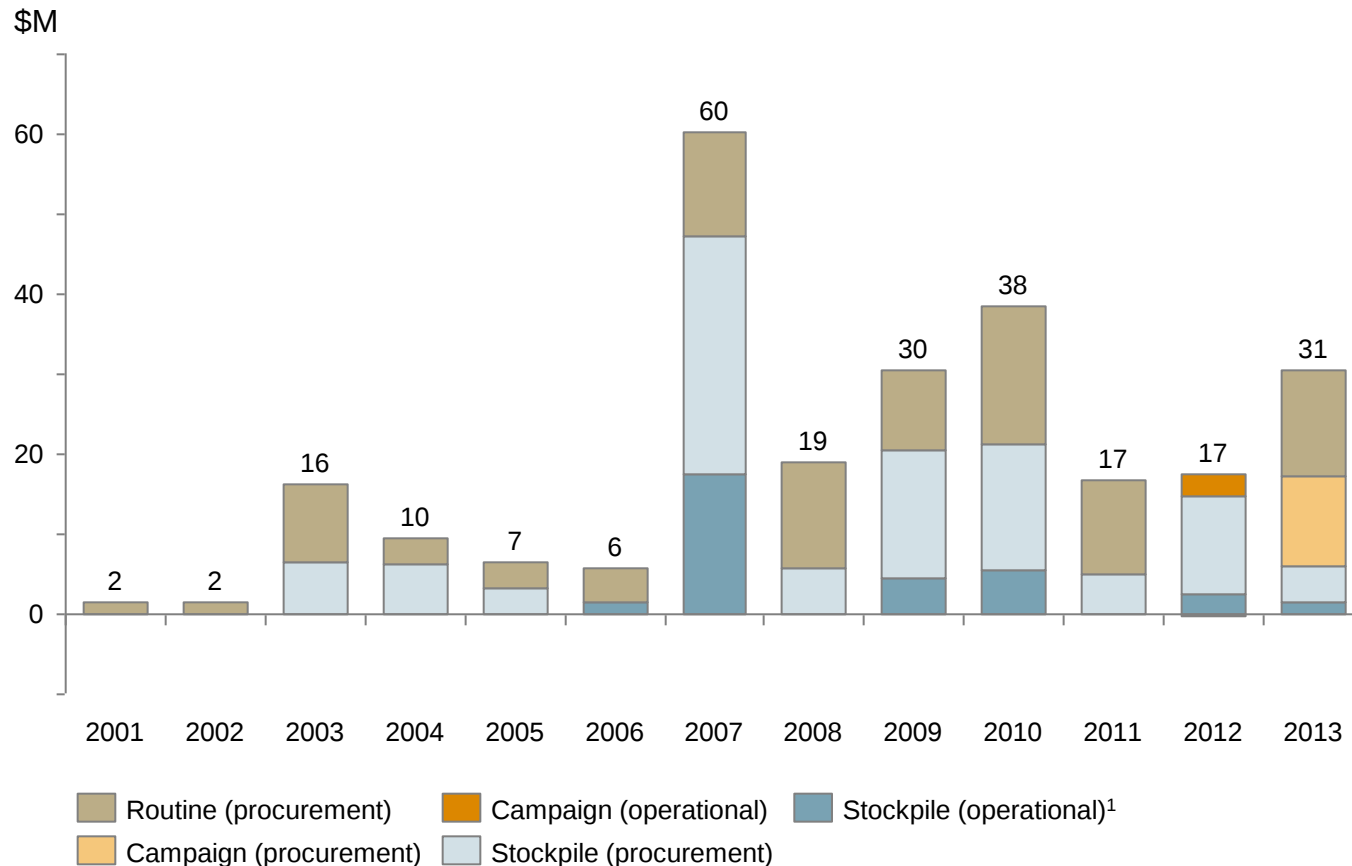
Yellow fever transmission in Africa



GAVI has supported yellow fever efforts in 20 countries to date

Country	Routine intro year	Campaign year
Benin	2002	2009
Burkina Faso	-	2008
Cameroon	2004	2009
CAR	2000	2010
CHAD	1985	-
DRC Congo	2004	-
Congo Republic	2004	-
Cote d'Ivoire	-	2011-2012
Ghana	1992	2011-2012
Guinea	2002	2010
Guinea Bissau	2008?	-
Kenya	1992	-
Liberia	2001	2009
Mali	1992	2008
Niger	2000	-
Nigeria	1992	-
Sao Tome Principe	2003	-
Senegal	-	2007
Sierra Leone	2002	2009
Togo	1992	2007

GAVI has spent \$253M on yellow fever since 2001



1. Operational cost under investment case
UNICEF Source: GAVI YF Investment 2002-2013 overview

WHO designates countries by their risk of having a yellow fever outbreak

"A" Countries

Countries reporting multiple YF outbreaks (≥ 2) in the previous 30 years

- Benin
- Burkina Faso
- Cameroon
- Central African Republic
- Cote d'Ivoire
- **Ghana
- Guinea
- Liberia
- Mali
- Nigeria
- Senegal
- Sierra Leone
- Togo

"B" Countries

Countries reporting at least one YF event in the previous 50 years

- **Angola
- Chad
- **Congo
- DR Congo
- Ethiopia
- Guinea Bissau
- Kenya
- Mauritania
- Niger
- South Sudan
- Sudan
- Uganda

"C" Countries

No reported outbreaks within last 50 years; low current risk

- Burundi
- **Equatorial Guinea
- Eritrea
- **Gabon
- Gambia
- Rwanda
- Sao Tome Principe
- Somalia
- Tanzania

**Countries projected to be non-eligible as of eligibility policy 2013