Not the Last Pandemic

$, Millions

Initiative	Methodology	Source(s)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total 10 year
Prevention Agenda			**8,831**	**8,831**	**8,831**	**8,831**	**8,831**	**8,831**	**8,831**	**8,831**	**8,831**	**8,831**	**88,307**
Discover unknown zoonotic viral threats (map global virome)	Estimates based on **The Global Virome Project's** calculations: 1. $1.2B over 10 years would allow mapping of 71% of Zoonotic viral threats to humans 2. $3.7B over 10 years would allow mapping of nearly all zoonotic viral threats to humans Average comes down to $2.4B over 10 years, or $245M per year.	Global Virome Project The Lancet	245	245	245	245	245	245	245	245	245	245	2,450
Achieve global immunization	Estimate based on **GAVI's 2021 - 2025 budget**, which would allow to reach over 300M more children with vaccines, saving 7 to 8M lives. This includes a comprehensive package of vaccination to GAVI-supported countries to protect against 18 diseases. This would also help accelerate roll-out of HPV vaccine to girls protecting them against up to 70-90% of cervical cancer cases. The budget broken down on a per year basis accounts for: $5.3B towards vaccine programmes, $281M towards institutionalising post-transition support & exploring MICs, $3.3B towards immunisation systems and enabling infrastructure, and $500M towards Board strategic investments. Does not include COVID-19 vaccines or boosters.	GAVI - page 14 contains mission, page 41 contains budget breakdown	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470	1,470	14,702
Limit human / wildlife interactions	Estimates include reducing spillover from livestock, reducing wild meat trade in China, and regulating wildlife trade. These estimates are based on analysis by Andrew Dobson, Stuart L Pimm and team - published on Sciencemag. 1. **Spillover from Livestock:** Methodology calculates the annual cost of implementing enhanced biosecurity for zoonoses around farming systems for 139 low and middle income countries to be $1.9B for low disease prevalence and $3.4B for high disease prevalence (based on World Bank One World One Health). 31 out of these 139 countries have high risk of wildlife viral spillover, therefore, taking into account 31/139 countries the range becomes $424M to $758M in 2012 dollars, which equates to $476M to $842M 2020 dollars. 2. **Reducing wild meat trade** – China estimate based on a study by the Chinese Academy of Engineering, which concluded that wildlife consumed as food has annual value of $19.4B 2020 dollars, or $14 / capita. Extrapolated to all LIC/MICs by population, the global wild meat market is $89B. Reducing the market by 25% over 10 years equates to $2.2B per year. Wildlife farming for food employs 6.3 Million people, whole wildlife farming sector employs 14 million people in China. 3. **Regulating wildlife trade** - OIE has $34M/yr annual operating budget to assess disease risk in livestock trade without conducting testing. Method then assumes similar budget to assess disease risk in wildlife trade ($30M/year). From there it adds cost of disease surveillance (USAID PREDICT budgets for disease monitoring in 20 countries = $20M/yr) and scale 10-fold (USAID PREDICT built capacity for 100k wildlife specimens in 20 countries. 10-fold increase to account for high volume of shipments that would need to be tested). $30M + $20M = $50M x 10-fold scale = $500M	Science Mag - pages 3-6 World Bank One Health	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	3,415	34,155
Contain antimicrobial resistance	Best available estimates from **U.K. Review on AMR** (Review on Antimicrobial Resistance 2016) and **World Bank** (2012). Estimates includes: 1. **$1.3B** towards Infection prevention and control (IPC), improved waste disposal, and awareness 2. **$2.0B** Extend antimicrobials effectiveness - strengthen quality, trade, distribution, and sales 3. **$300M** towards active management of "antimicrobial commons" for effective, efficient, and equitable access 4. **$100M** towards Global public awareness campaigns	World Bank March 2017 Page 58	3,700	3,700	3,700	3,700	3,700	3,700	3,700	3,700	3,700	3,700	37,000
Detection			**15,563**	**15,563**	**8,142**	**8,142**	**8,142**	**8,142**	**8,142**	**8,142**	**8,142**	**8,142**	**96,267**
Population-representative surveillance foundation	**CRVS:** Top down estimates for software, systems costs and cost per registration event from the World Bank CRVS report and CRVS Gateway. Expert interviews used to narrow in on wide range provided to $100M for HICs. Cost per registration used to derive per capita cost based on countries annual birth/death rate from the World Bank. Given other non-surveillance uses of a CRVS system, only 2/3 assumed to be for CRVS. HICs assumed to have 90% of target state CRVS systems. For CRVS, HIC assumes best-in-class CRVS for incremental funding needed **SRS:** Used total costs for the COMSA program in Mozambique to estimate a per capita spend for a SRS for L/MICs – L/MICs assumed to have 20% of target state SRS systems. **L/MICs assume target state SRS** **Mortality:** Cost per activity (cause of death verification, verbal autopsy, autopsy) from CRVS Gateway, Sierra Leone MITS program, benchmark of published data, and expert interviews. • % undergoing autopsy/equivalent: 1% (target based on ideal MITS program) and 2% for best in class (based on WHO data for European countries of 10% current autopsy rate, of which 20% cost attributed to surveillance) •% cause of death attributed target: 80-99%; 50% of verification cost attributed to surveillance L/MICs assumed to have 10% of target state mortaility surveillance systems, HICs assumed to have 90% For incremental spending for mortality assumes average of target and best-in-class	World Bank & WHC World Bank CRVS Gate Journal of COMSA M CHAMPS c AHA Journ WHO UK Gov BBC Expert interviews	2,493	2,493	1,696	1,696	1,696	1,696	1,696	1,696	1,696	1,696	18,557
Notifiable disease and IDSR-like surveillance	**Community based surveillance:** L/MIC: using network of CHW receiving modest incentive and salaried supervisors. No. of volunteer CHW estimated from study showing 33% sensitivity with 1000 pop per CHW. Number of volunteers increased linearly for higher sensitivity (50% for target, 80% for best-in-class). No. of surveillance managers per volunteers assumed to be 1:25, and data managers assumed to be 1:75 HIC: assumed cost of an ongoing health awareness campaign to direct population towards health system or national phone hotline L/MICs assumed to have 30% of target state indicator based surveillance systems, HICs assumed to have 60% **Indicator based surveillance:** Main cost (~80% of total) comes from FTEs related to data collection and data entry of data from health facilities and labs. Assuming ~2 FTEs per 500k population from expert interviews L/MICs assumed to have 20% of target state mortality surveillance systems, HICs assumed to have 90% **Response:** estimated rapid response team FTEs needed (a team of 5 per 200k of population for target and 100k for best-in-class) per expert interview and IHR's Joint External Evaluation L/MICs assumed to have 30% of target response teams, HICs assumed to have 60% Incremental spending estimate assumes mid-point average between target and best-in-class spending for all components	PLOS J Interval Epiden World Ban JHU (Ahm Springer CDC FCBO Emerging / PR Resolu Expert inte Expert interviews	1,940	1,940	1,914	1,914	1,914	1,914	1,914	1,914	1,914	1,914	19,195
Pathogen surveillance including sequencing	**Lab costs:** Set up cost of up to $40M per lab from APHL estimate for HIC, $20M for L/MIC, with 1 lab per 6M population in target and per 3M in best-in-class. Ongoing labor costs of 40 people per lab. 15% of total public health lab cost assumed to be for surveillance per ECDC analysis L/MICs assumed to have 30% of target lab systems, HICs assumed to have 80% Incremental spending estimate assumes mid-point average between target and best-in-class spending **Pathogen Genomic Sequencing:** assuming sequencing platforms to be added to existing public health labs • Capacity: Weekly sequencing capacity needed is most uncertain input given recency of PGS technology. Yearly capacity (as % of total population) 0.5% for target and 2.5% for best-in-class That roughly translates to ~2% of weekly COVID-19 peak number of positive cases for target and ~10% for best-in-class, or (though COVID-19 cases and peak varies significantly by country) • Fixed costs: For a capacity of ~500k sequenced samples per year, labor and platform capital costs estimated as a blended average of different high throughput lab network set-ups – totaling ~$2.5M in HIC and ~$5M in L/MICs, with an ongoing labor cost of ~$600k/year and $200k/year respectively • Variable costs: Sample prep, logistics and sequencing cost of reagents and consumables calculated to be ~$60/sample. Total variable cost calculated based on capacity multiplied expected utilization of 50% L/MICs assumed to have 20% of target PGS systems, HICs assumed to have 50% For PGS, given recency of technology use, with lower existing baseline, therefore assume less progress towards best-in-class (only 25% of best-in-class) **Sewer and septic:** Sample sites assumed to cover population of 50-100k population, with enough sites to cover 50-80% of the population, per expert interviews and ongoing Malawi waste water surveillance effort. Frequency of sample collection per site ranges from twice a month once a week L/MICs assumed to have 15% of target sewer and septic surveillance systems, HICs assumed to have 25% Incremental spending estimate assumes mid-point average between target and best-in-class spending	APHL - Next genera CDC UK.gov World Bar APHL COG Cons Illumino J/A5 Science Di Bourcore Illumina ThermoFis EC Expert inte	9,782	9,782	3,561	3,561	3,561	3,561	3,561	3,561	3,561	3,561	48,050
Specialized surveillance programs	Main costs are program management costs of a couple of FTE per program and sample collection and analysis Costs per sample collected and analyzed multiplied by the number of samples taken as part of study or survey Total cost of ~$0.5M per study in HIC. Assuming 1-8 sero-surveillance studies per year and 1-3 vaccine effectiveness studies per year L/MICs assumed to have 10% of specialized surveillance programs, HICs assumed to have 40% Incremental spending estimate assumes mid-point average between target and best-in-class spending for all components	WHO Medisave Expert interviews	410	410	402	402	402	402	402	402	402	402	4,034
Data integration	For a country of 30M people, necessary cloud infrastructure costing $300k/year, with software licenses costing $100k/year (and an additional $300k in the first year) Team of 5 dedicated FTEs during set-up to lobby and push for health centers and for each surveillance program to share data and to have interoperable data with common meta-data – 2 dedicated FTEs ongoing Build team of nearly 40 FTEs ($1.5M for LIC/MIC and $3M for HIC) to set up system. Ongoing support from 20 data scientists and 10 data and IT support staff ($1.5M for LIC/MIC and $3M for HIC) L/MICs assumed to have 30% of data integration capacity, HICs assumed to have 80% Incremental spending estimate assumes mid-point average between target and best-in-class spending	DHIS Measureevaluat CDC Expert interviews	613	613	319	319	319	319	319	319	319	319	3,779

Item	Description	Sources	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Total
National Public Health Institute	Assuming regional hub teams responsible for local populations of ~3m each, with 1 single centralized national-level set-up per country. Assuming a team of ~15 dedicated FTEs (e.g., data encoders, program officers, managers, epidemiologists) per every 3M population per expert interviews. L/MICs assumed to have 30% of central NPHI capacity, HICs assumed to have 80%. Incremental spending estimate assumes mid-point average between target and best-in-class spending	IANPHI; Expert interviews	325	325	250	250	250	250	250	250	250	250	2,652
Response - Always On			**9,470**	**9,254**	**4,598**	**4,598**	**4,598**	**4,598**	**4,598**	**4,598**	**4,598**	**4,598**	**55,509**
Emergency Operations	Estimates include filling gaps in emergency operations and emergency financial funds. 1. Emergency operations: US spend per capita based on CDC's PHEP program's "State and Local Preparedness and Response capability" budget of $675M for FY 2020 was used as proxy for standard operations. WHO estimates a 37% gap, which was used to calculated weighted average gaps between HIC and LIC/MIC economies to obtain $854M to $1,230M. Estimate also triangulated through IHR estimated gaps in Benin, Thailand, and South Africa, which were used to extrapolate global gap. 2. Emergency Financial Funds: Sums average funding required for Pandemic Emergency Financing Facility, WHO's Contingency Fund for Emergencies, and WHO's CHEPR	CDC HHS Budget FY 2020; WHO e-SPAR; NAM 2016, page 22	1,515	1,515	1,515	1,515	1,515	1,515	1,515	1,515	1,515	1,515	15,154
Supply chain prep (global stockpile)	Baseline stockpile per person calculated through proposed US SNS budget for FY 2022 of $905M divided by US population. Global population then split into HIC and LIC/MIC using World Bank's population estimates and economic classifications. Gap in stockpiling identified in LIC/MIC was triangulated through two sources. PLOS Journal identified PPE deficiencies from SPAs assessments in Nepal, DRC, Haiti, Tanzania, and Afghanistan to be 62%. QuartzAfrica cited South Africa planned to produce an additional 10k ventilators to supplement their 6k on hand in April 2020, implying a gap of 63%. Gap in HIC identified based on US's SNS FY 2022 budget proposal increase to $905M (28% increase). Rationale was cited as "to maintain replenishment of critical medical supplies and restructuring efforts initiated during the COVID-19 pandemic". Maintenance calculated by using US's annual stockpile budget / total value of stockpile as a proxy for share of stockpile gap cost needed for annual maintenance	CDC HHS Budget FY 2020; PLOS Journals July 2020; ACEP April 2021	6,017	6,017	1,361	1,361	1,361	1,361	1,361	1,361	1,361	1,361	22,924
Conduct regular simulations and other cross-sectoral exercises	Estimate uses FEMA's Category 3 hurricane simulation as a proxy to calculate spend per capita. This is then applied to global population to yield global spending needed of $12M/year	Brookings 2021; WHO 2018	12	12	12	12	12	12	12	12	12	12	117
Communication and messaging	Estimates calculated using South Africa, Thailand, and Benin IHR costing results. Total annual and startup costs from each country were divided by their respective GDP. Average cost/GDP ratios were then multiplied by total Global GDP for LIC and MIC to extrapolate total start-up and annual costs required. Each cost was further extrapolated for each line-item in IHR costing tool. Baseline HIC estimates extrapolated from LIC/MIC using population ratios. Gap for LICs uses eSPAR assessment for African continent. Gap for HICs calculated using WHO eSPAR assessment for Italy and South Korea as proxies. Each cost was further extrapolated for each line-item in IHR costing tool. Communication initiative includes: 1. "risk communication systems" 2. "internal and partner communication and coordination" 3. "public coordination" 4. "communication engagement with affected communities" 5. "dynamic listening and rumor management". Gaps identified based on WHO e-SPAR results.	IHR Costing; WHO e-SPAR	391	351	351	351	351	351	351	351	351	351	3,547
Border Health	Estimates calculated using South Africa, Thailand, and Benin IHR costing results. Total annual and startup costs from each country were divided by their respective GDP. Average cost/GDP ratios were then multiplied by total Global GDP for LIC and MIC to extrapolate total start-up and annual costs required. Each cost was further extrapolated for each line-item in IHR costing tool. Baseline HIC estimates extrapolated from LIC/MIC using population ratios. Gap for LICs uses eSPAR assessment for African continent. Gap for HICs calculated using WHO eSPAR assessment for Italy and South Korea as proxies. Each cost was further extrapolated for each line-item in IHR costing tool. Border Health initiative includes: 1. "Routine capacities are established at POE", and 2. "effective public health response at POE". Gaps identified based on WHO e-SPAR results	IHR Costing; WHO e-SPAR	1,535	1,359	1,359	1,359	1,359	1,359	1,359	1,359	1,359	1,359	13,768
Response - Healthcare capacity			**10,620**	**10,620**	**10,620**	**3,227**	**3,227**	**3,227**	**3,227**	**3,227**	**3,227**	**3,227**	**54,447**
Pandemic specific health system strengthening	Extrapolated gap in strengthening health systems based on Kenya's HHFA results (one of pilot countries for HHFA in 2018/2019). Codified 500+ line items of services and equipment in HHFA results as either related to pandemic preparedness or general. From there, calculated deficiency (difference between Kenya result vs. target) for each line item, then took the average (assumes that each line item holds same weight) which yielded an average total deficiency of 53%. Calculated percentage of deficiencies related to pandemic preparedness to be 18% by taking the sum of deficiencies related to pandemic preparedness divided by sum of total deficiencies. Took Kenya's annual spend on Healthcare per capita ($88) and increased it by 53% to reflect the total annual spend needed in Kenya per capita ($134). Took the difference to find the gap of $46 per person (which is close to the LIC/LMIC global gap identified by Moses et. al in an article published on The Lancet in December 2018). Multiplied the gap of $46 per person by the percentage of deficiencies related to pandemic preparedness to get $9 per capita. Multiplied the $9 by total LMIC / LIC population to get to $30.2B. Assumed ramp up would take two years to address that gap ($15B per year) and that maintenance cost would be 10% per year ($3.0B)	Kenya Harmonized Health Facility Assessment (2018/2019); Open AFRICA	10,562	10,562	10,562	3,169	3,169	3,169	3,169	3,169	3,169	3,169	53,866
Conduct relevant assessments to highlight gaps in healthcare systems	Estimates assuming HHFA (Harmonized Health Facility Assessment is the assessment conducted). HHFA does not have specific details in costing, but builds off of SARA, SDI, and SPA. Therefore, given that it is lengthier and more comprehensive that previous assessments, assumed a 30% cost increase to SARA. SARA cost was estimated using the SARA reference manual, which provides estimates for conducting assessment in small, medium, large countries for different options of the assessment. Size of country is defined by number of hospitals in SARA, therefore used OECD data on number of hospitals by coutry to identify the number of countries in each category determined by SARA's cutoffs. There are five options on how to conduct SARA assessment. Option 1: "National Estimates" is the most common form of assessment (based on reference manual), so model assumes 80% of assessments follow that cost guideline. Remaining 20% assumed to follow "District sample" option. All large countries follow District sample since "National Estimates" option does not provide cost estimates for large countries. The proportion of assessments that are National vs. District are used to estimate the total cost of SARA for small, medium, and large countries ($44.66M). The assumed 30% higher cost is then applied to yield $58M for HHFA.	WHO - SARA Reference Manual; WHO HHFA	58	58	58	58	58	58	58	58	58	58	581
R&D			**9,971**	**9,971**	**7,877**	**5,197**	**4,832**	**4,832**	**4,832**	**4,832**	**4,832**	**4,832**	**62,006**
Close known existing vaccine and therapeutic gaps	Estimate includes the cost of closing the existing vaccine gap and closing the therapeutics gap. 1. Closing the existing vaccine gap uses Gouglas et al.'s estimates that the cost of progressing at least 1 Vx through end of phase 2a for each disease in portfolio of 11 priority epidemic infectious diseases (Chikungunya, Zika, Rift Valley Fever, MERS, Marbug, Lassa, CCHF, Nipah, SARS, SFTs, Ebola) is ~$3.25B. This is then multiplied by 2 to take into account that at least 2 vaccines would need to be progressed (one mRNA and one protein sub-unit, which assumes two different players are needed). 2. Closing the existing therapeutics gap assumes 6 virus families will progress 2 therapeutics through phase 3. Six virus families include: Corona, Orthomyxo, Paramyxo, Arena, Flavi, and Filo. 3. Progressing universal influenza vaccine calculated using average cost of bringing two candidates of the 11 priority epidemic infectious diseases through Phase II, and applying a 2.5x multiple to account for complexity.	CEPI, March 2021; Gouglas et al. on The Lancet, October 2018; Paul et al. 2010; TDR	3,279	3,279	1,185	1,185	820	820	820	820	820	820	13,847
Scale vaccine manufacturing capacity	Used current COVID vaccine supply curve to estimate time needed to produce sufficient vaccine for global population at current capacity level. Assumed target months to produce a new vaccine should be half the time of current response, thereby requiring a doubling of manufacturing capabilities. Assuming each facility can produce 400M doses per year, and that the target is for 14.7B doses to be produced, that would require 37 new facilities to be built at a cost of $500M each (based on WHO and NCBI estimates). Ramp up of building these new facilities was spread across 3 years. WHO estimates maintenance of facilities to be 250M each, though costs were reduced for interpandemic years. DP maintenance, assumed to account for 50% of costs, was eliminated. DS maintenance, assumed to account for the other 50% of costs, was discounted by 25%.	WHO - May 2016; NCBI	6,125	6,125	6,125	3,445	3,445	3,445	3,445	3,445	3,445	3,445	42,492
Invest in new antiviral, antibody, and vaccine platforms	Investment in platforms includes the following categories of investments: 1. Investing in development of antiviral platforms, assumption references Gilead's $1B investment in remdesivir (Bloomberg) 2. Investing in development of antibody platforms references mAb investments of $1.2B (NCBI) 3. Investing in development of a vaccine platform references Moderna's $100M annual investment in mRNA platform (Science) 4. Investing in development of a new diagnostic platform is 1/3 of investment in antibody platform (assumption). 5. Number of new antiviral platforms (2), antibody platforms (2), vaccine platforms (1), and diagnostic platform (1) are assumptions.	Bloomberg July 2020; ScienceMag March 2020	567	567	567	567	567	567	567	567	567	567	5,667
TOTAL ESTIMATE COST			**54,455**	**54,239**	**40,068**	**29,995**	**29,630**	**29,630**	**29,630**	**29,630**	**29,630**	**29,630**	**356,535**