Detailed Methods Documentation
IHR Costing Tool Design, Development, and Validation

This document reflects, in detail, the underlying assumptions and methods used to develop and validate the IHR costing datasets. It is a living document and intended to be updated if and as the tool itself is updated. This document was last updated on 5 May, 2023.

General assumptions

As a general rule, the JEE aligns to a regular structure across capacity scores, described below. Where ambiguity exists (e.g., in mapping technical questions to specific capacity levels of the JEE) and where specifics are not otherwise noted, we assume this general structure as a rule:

- **JEE score 2:** National-level plans, trainings, and capacity building without robust, full-scale roll out (starting to develop)
- **JEE score 3:** Initial, robust national-level implementation (starting to implement)
- **JEE score 4**: Sustainable national and subnational-level implementation (finalized)

Unless otherwise specified, activities specified as occurring “periodically” or “systematically” were assumed to occur annually. Similarly, activities specified as occurring “regularly” were assumed to occur quarterly[1]. Where activities were specified as having “some” level of completion, we assumed approximately 10% implementation[2]; where activities were specified as being complete in “selected” areas, we assumed approximately 20% implementation; where activities were specified as being complete in “most” areas, we assumed approximately 60% implementation; and where activities were specified as being complete in “all” areas, we assumed 100% implementation.

In cases where experiences or prior outbreak response efforts were assumed[3] the cost of actual, prior outbreak responses were not costed. Instead, after action reports and/or simulation exercises were costed to allow for reflection and evaluation of how response efforts unfolded.

[1] While specific frequency of regular/recurring meetings vary from country to country, review of publicly available costed NAPHS countries from a number of countries including Liberia, Sierra Leone, and Myanmar all highlighted the occurrence of regular/recurring meetings, reviews, and assessments that occurred quarterly.
[2] This percentage based assumption was determined based on review of actual costed national action plans. For example, several AMR-related indicators of the JEE note participation of “some” health facilities, without defining a specific percentage. For these indicators, Afghanistan considered participation of approximately 9-15% or provinces/sites, Liberia considered participation of 25% of facilities, and Indonesia considered setting up surveillance systems for HCAI in approximately 2.5% of facilities. These ranges are broad and have a substantial impact on overall costs, however, they generally track to a single order of magnitude. For the purpose of simplicity, we assume that "some" (intermediate areas/facilities) maps to a share of about 10% participation, unless otherwise specified. This generally falls in the middle of the range of participation reported by countries completing costed NAPHS.
[3] For example, in P.5.2: “Several experiences of response to zoonotic events confirm timeliness and efficiency of the multisectoral operational mechanism”), or, in R.2.1 “At least one public health emergency response or exercise in the previous year…”

Sectors involved in IHR capacity-building activities

IHR implementation requires robust multisectoral collaboration, though the specific ministries and agencies involved in IHR-related activities will vary from country to country depending on relevant authorities, roles, and responsibilities. Where the JEE notes requirements across "relevant ministries and sectors" (e.g., for planning or budgeting activities), we assume engagement across 20[4] sectors.

Workforce

Prior work has highlighted that workforce costs substantially contribute to the overall cost of IHR implementation. Overall workforce targets (e.g., those costed in D.3 Human Resources) are costed incrementally/additively, in that we assume additional healthcare and public health workers are hired to progress from one score to another. Unless otherwise specified, all overall workforce targets are assumed to be recurring costs. PPE for these healthcare personnel are also costed incrementally as part of requirements related to ensuring 'Safe environment[s] in health facilities' (R.4.3).

Given that, at the time of costing, countries rely on their existing workforce, the tool relies on user-generated inputs to define the the total number of healthcare workers to be costed. Users may choose to cost the *entire* workforce (e.g., 4.45 doctors, nurses, and midwives per 1000 population) or only consider the additional, incremental costs of adding additional workforce until that target is reached.

Specific workforce targets (e.g., per capacity)

Core capacity	**JEE language**	**Score and JEE requirement**	**Assumed workforce requirement**
D.3 Human Resources	"The recommended density of doctors, nurses and midwives per 1000 population for operational routine services is	**Limited capacity (2)** "appropriate human resources are available in some sectors at the national level"	Assume 25% of final target (e.g., 0.25 * 4.45/1000)
		Developed capacity (3) "appropriate human resources are available in all relevant sectors at national and intermediate levels"	Assume 50% of final target (e.g., 0.5 * 4.45/1000)[5]

[4] Within the JEE when discussing sectors related to budgeting considerations (footnote 13, page 12 JEE 3.0), 18 sectors plus "others" are explicitly identified: "Relevant sectors include human health, animal health, agriculture, disaster management, food safety, livestock, fisheries, trade, international transport/points of entry (PoEs), emergency services, environment, finance, chemical safety, radiation safety, labour, education, foreign affairs, civil society, other sectors."

[5] Tool calculates this as the cost to hire an additional 25% of the target workforce, beyond 25% previously costed at a score of Limited capacity (2)

	4.45 plus 30% surge capacity."	**Demonstrated capacity (4)** "human resources are available as required in all relevant sectors at the national, intermediate and primary public health levels"	Assume 100% of final target (e.g., 1 * 4.45/1000)[6]
	"The optimal target for surveillance is one trained (field) epidemiologist (or equivalent) per 200 000 population who can systematically cooperate to meet relevant core competencies for IHR and OIE PVS."[7]	**Limited capacity (2)** "appropriate human resources are available in some sectors at the national level"	Assume 1 trained (field) epidemiologist or equivalent per 500,000 population
		Developed capacity (3) "appropriate human resources are available in all relevant sectors at national and intermediate levels"	Assume 1 trained (field) epidemiologist or equivalent per 200,000 population
		Demonstrated capacity (4) "human resources are available as required in all relevant sectors at the national, intermediate and primary public health levels"	Assume 1 trained (field) epidemiologist or equivalent per 150,000 population
	"One trained epidemiologist is needed per rapid response team."	Incorporated into rapid response team estimates based on CDC guidance (see "rapid response teams" section below"	Incorporated into rapid response team estimates based on CDC guidance (see "rapid response teams" section below"
P.5 Zoonotic Disease	"...satisfactory level of preparedness, detection, assessment and response capacities for zoonotic diseases." (P.5) "Existence of a corresponding workforce in the animal sector of	**Limited capacity (2)** N/A – no specific language/target in JEE cost indicated as "optional" in tool	Assume 1 trained (field) epidemiologist or equivalent per 500,000 population
		Developed capacity (3) N/A – no specific language/target in JEE cost indicated as "optional" in tool	Assume 1 trained (field) epidemiologist or equivalent per 200,000 population
		Demonstrated capacity (4) N/A – no specific language/target in JEE cost indicated as "optional" in tool	Assume 1 trained (field) epidemiologist or equivalent per 150,000 population

[6] Tool calculates this as the cost to hire an additional 50% of the target workforce, beyond 50% previously costed at a score of Limited capacity (2) and Developed capacity (3)

[7] From D.3.2 Technical question: Is there a simple measure of the numbers of epidemiologists per unit of total population that may help differentiate quality levels – for example: less than 1 per 500,000 in capacity levels 1 or 2; 1 per 200,000 to 500,000 in capacity level 3; or more than 1 per 200,000 in capacity levels 4 or 5.

	veterinarians, para-veterinarians, animal health professionals..." (D.3)"		

Surge capacity is not explicitly costed, rather, the tool takes into account the costs of salaried trainers, HR specialists, and training events to ensure availability to “hire and train personnel to serve as surge capacity for public health emergencies”. While the core capacity for health services provision (R.3) takes into account utilization of health services (R.3.2), healthcare worker salaries related to the time spent providing care is already considered costed within the human resource core capacity (D.3) and thus not re-costed on indicators related to utilization.

For centers requiring 24/7 coverage (e.g., national IHR focal points) we include costs of 5 full-time employees, one director-level manager, two support staff members (e.g., janitor, administrative assistant), and part-time effort (25%) from a human resources professional to help with hiring and other HR-related activities. Assuming 40 work hours/week/person, with 168 hours in a week, 5 full-time employees covers this time plus allows for provision of PTO and sick time.

Where activities could be completed either by a salaried staff member or by a consultant, we erred on the side of assuming activities would be completed by a salaried staff member working full or part-time. We assume that the vast majority of meetings will not require travel and/or per diems, unless otherwise specified, and that they will be held in personnel’s existing workspaces and/or virtually.[8]

Where consultants were costed, it was typically for start-up activities (e.g., leading initial training or developing initial SOPs) that would benefit from shared expertise that may not yet be available at the national or subnational levels. As countries progressed to higher capacity scores, we assumed hiring and relevant training of salaried staff members (e.g., training events and/or conference attendance) to eventually establish responsibility for those tasks and expertise.

The tables below highlight general guidelines and assumptions used by the research team for estimating the duration of a specific type of task.

[8] This reflects the real-world shifts that occurred during COVID-19. For instance, Sane et al note that "...due to travel restrictions and other challenge, this work [related to IHR implementation] was performed through teleconferences." Sane J, Ruutu P, Soleman S, Elmi M. Implementation of the International Health Regulations in Somaliland supports multisectoral response to COVID-19. J Glob Health. 10(2):020364.

Salaried personnel effort assumptions

Category of task	Type of task	Personnel effort	Reference
Legislation, action plans, SOPs, and documentation	Draft or review of documents, legislation, or plans in a narrowly defined specific context (e.g., review of legislation related to AMR)	0.25 years (3 months), one time	Prior GHSS work; CDC workshop planning guidance for priority zoonotic diseases[9]
	Draft or review of documents, legislation, or plans that span a range of use cases or IHR contexts	0.5 years (6 months), one time	Prior GHSS work
	Draft or review particularly high complexity action plans or SOP (e.g., national surveillance plan)	1 year	Tool assumption
	Annual updates or review of documents, legislation, or plans at either the national or the subnational levels	0.083 years (1 month), recurring	Prior GHSS work
Monitoring, evaluation, and reporting	Ongoing support for monitoring, evaluation, and reporting, including necessary data collection	1 year, recurring	Tool assumption

Consultant effort assumptions

Category of task	Type of task	Personnel effort	Reference
Training and education events	Plan and lead general training events	30 days	Prior GHSS training events
Documents, legislation, budgets, and plans	Review policy documents, SOPs, and plans, and provide expert advice	30 days	General assumption

[9] US CDC. (2022, June 6). One Health Zoonotic Disease Prioritization Process Overview. https://www.cdc.gov/onehealth/what-we-do/zoonotic-disease-prioritization/fact-sheet.html

	Review and provide guidance on detailed national budgets	30 days	General assumption

Meeting duration assumptions

Category of meeting	**Type of meeting**	**Duration**	**Reference**
Training and education events	Attendance of general training seminar (does not include event planning)	2 days	Prior GHSS training events
Review of legislation, action plans, SOPs, and documentation	Review of documents, legislation, or plans in a narrowly defined specific context (e.g., review of legislation related to AMR)	2 days	General assumption
	Review of documents, legislation, or plans that span a range of use cases or IHR contexts, or for more complex planning efforts	4 days	General assumption

Rapid response teams

The US CDC notes that rapid response teams (RRT) may vary in composition depending on the technical roles needed for standard outbreak response, outbreak characteristics, geography, and scale, population characteristics, and occupational risk assessment. Appendix 4 of CDC's Guidance for U.S. Centers for Disease Control and Prevention Staff for the Establishment and Management of Public Health Rapid Response Teams for Disease Outbreaks notes the following roles on an outbreak response team:

- team leader (can be a dual role on a small team)
- epidemiologist/surveillance officer
- case manager/IPC expert
- communications/social mobilization expert
- laboratory expert

Within the tool, where rapid response teams are costed, we assume an average size of 5 RRT team members per RRT team, including a sixth team member (a food safety expert and/or veterinarian) for RRTs specifically focused on food safety or zoonotic outbreaks[10].

Rapid response teams are costed in the following indicators:

- P6.1. Surveillance of foodborne diseases and contamination
- P5.2. Response to zoonotic diseases

Water, sanitation and hygiene (WASH)

Extensive work has been previously completed to estimate the cost of WASH implementation; such analysis is both extremely valuable, and beyond the scope of this tool. Tool users are encouraged to consult detailed WASH costing estimates where possible to inform cost estimation, including work completed by USAID, WASH FIT evaluations, and published elsewhere. Based on the modeled findings articulated by Chaitkin et. al.[11] for lower-middle income countries, we assume WASH investment costs of $0.50 per capita per year ($0.30 capital, $0.20 recurring). Within the tool, this cost is assumed to be incurred 10% for a score of 3 ("some health facilities"), 60% for a score of 4 ("at national and intermediate levels"), and 100% for a score of 5 (which is not costed).

The Chaitkin et. al. estimates largely align with requirements set forth in the WHO global standards[12] and referenced in the JEE. The estimates represent baseline costs of basic WASH and waste services, including capital investments (i.e. improved water sources, toilets) and

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[10] Nwafor CD, Ilori E, Olayinka A, Ochu C, Olorundare R, Edeh E, et al. The One Health approach to incident management of the 2019 Lassa fever outbreak response in Nigeria. One Health. 2021 Dec 1;13:100346. Rapid response teams deployed to respond to Lassa outbreak in Nigeria included epidemiologists, clinicians, data analysts, veterinarians, environmental health officers, risk communication officers, surveillance officers, and laboratorians.

[11] Chaitkin, M., McCormick, S., Torreano, J. A.-S., Amongin, I., Gaya, S., Hanssen, O. N., Johnston, R., Slaymaker, T., Chase, C., Hutton, G., & Montgomery, M. (2022). Estimating the cost of achieving basic water, sanitation, hygiene, and waste management services in public health-care facilities in the 46 UN designated least-developed countries: A modelling study. The Lancet Global Health, 10(6), e840–e849. https://doi.org/10.1016/S2214-109X(22)00099-7

[12] Adams J, Bartram J, Chartier Y. Essential environmental health standards in health care. Geneva: World Health Organization; 2008 (https://apps.who.int/iris/handle/10665/43767)

recurrent costs (i.e. dedicated staff, consumables) for waste management, sanitation, water, and hygiene across hospitals and non-hospitals in rural and urban settings.[13] The Chatikin et al. estimates are based only on existing facilities and do not include capital maintenance, environmental cleaning, and cross-cutting activities such as training, supervision, and monitoring and evaluation which are required for WASH implementation.

Training programs

Field epidemiology training (FETP) progress are assumed to include 10 students per annual cohort, based on guidance from The CDC's Field Epidemiology Training Program Development Handbook. Training costs and consumables are costed for this number of students, but may be adjusted from within the tool by updated multiplier values.[14]

Of note, a number of costs related to FETP programs are indicated as optional in the tool, given that JEE 3.0 notes that trainees may also attend a “comparable applied epidemiology training programme is in place in the country or in another country through an existing agreement”.

Academic biosafety training programs within the tool are assumed to occur within an institution training those who work with high-consequence agents.[15] We assume that the tool takes place in an existing and appropriately equipped laboratory facility or other existing academic facility, and estimate costs associated with three full-time instructors and/or faculty, one full-time administrative assistant, and relevant training consumables including disinfection and sterilization equipment, biosafety incident and emergency response kits, and appropriate PPE. By default, the tool assumes a yearly cohort size of 10 students/year, consistent with the size of the Field Epidemiology Training Program.

Points of entry

We assume 3 points of entry per country. At a score of limited capacity (2), we assume a one fully equipped facility in one point of entry per country; at a score of demonstrated capacity (4) we assume one fully equipped facility in each of three points of entry per country. Users of the tool ***can and should*** update multipliers used for points of entry in their country to reflect the actual number of points of entry participating in IHR-related activities, this number varies substantially from country to country, as does the type and size of points of entry.

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[13] For more detail, consult Supplement to: Chaitkin M, McCormick S, Alvarez-Sala Torreano J, et al. Estimating the cost of achieving basic water, sanitation, hygiene, and waste management services in public health-care facilities in the 46 UN designated least-developed countries: a modelling study. Lancet Glob Health 2022; published online April 6. https://doi.org/10.1016/S2214-109X(22)00099-7

[14] “Initially, the maximum recommended program enrollment is five trainees for each class, which means a total of up to ten trainees in the program once the second class starts. This relatively small size ensures that the trainees get adequate supervision and mentoring. As qualified field supervisors are identified or FETP graduates become available to supervise trainees, the size of the class may be increased.”

[15] P.7.2, score 4: “...Country has in place academic training…including institutions that train those who maintain or work with high-consequence agents”

Farms and agricultural sites

By default, we assume two sentinel and/or higher-risk farms/agricultural sites per intermediate area participating in JEE-related activities, for example, for activities related to AMR surveillance (P4.2. Surveillance of AMR) or supply chain security and management (P5.3. Sanitary animal production practices).

Priority diseases

Specific priority diseases vary on a country-by-country basis depending on a country's risk profile and the pathogens endemic to a given region. As placeholder costs, we consider the following priority diseases within the tool, with the assumption that they reflect, generally, order of magnitude cost estimates that can be adjusted on an as-needed basis based on local knowledge of priority diseases within a given jurisdiction:

- Influenza
- Cholera
- HIV/AIDS
- Malaria

Dissemination of results

In the majority of cases, we assume that results and key findings are disseminated electronically, and cost the effort (e.g., part-time salary support for an existing FTE) to generate relevant documents and maintain mailing lists. Print costs are used primarily for activities in which we assume these printed materials are valuable as physical reference documents, for example, printed copies of national reports and guidelines related to AMR (P4.2. Surveillance of AMR), SOPs for antimicrobial stewardship (P4.4. Optimal use of antimicrobial medicines in human health), SOPs for biosecurity and biosafety risk management in national laboratories (P7.1. Whole-of-government biosafety and biosecurity system is in place for human, animal and agriculture facilities), etc.

Default base costs

Default base costs were determined based on a lower-middle income reference country (where possible, Nigeria) based on 2022 USD. Where default base costs were not available in 2022 USD, they were adjusted for inflation based on the US Consumer Price Index as of January 2022[16]. All base costs were rounded to the nearest USD.

Of importance, these costs can and do vary meaningfully from country to country. Users of the tool are *strongly encouraged* to update these cost estimates based on the best, and most recently available, local knowledge. We include default base costs simply to provide an order-of-magnitude reference and a starting place to facilitate additional country-specific research.

Unit costs were categorized to facilitate additional analysis, including based on the categories articulated by Sloan et al[17] (personnel[18], operating[19], transport[20]), and by a more detailed classification scheme developed by the IHR costing data and research team based on detailed review of line items data and publicly available costed NAPHS information. See more information on this for-purpose unit cost classification system in the table below.

Cost category	Cost subcategory	Definition	Examples
Workforce	Salary support and/or stipends, including overhead**	Salaries, benefits, incentives, overhead, and per diems for workers . Also includes costs associated with planning, meetings, and labor for healthcare delivery[21]	Employee salaries (including overhead), stipends, and/or per diems, Disease surveillance program[22]
	Trainings	Training events or conference fees, including the supplies needed to facilitate training. Trainings include simulation exercises for the healthcare and public health workforce.[23]	Training consumables, trainer salaries and overhead, costs associated with conference travel and registration

[16] Based on data from https://www.bls.gov/data/inflation_calculator.htm
[17] Sloan ML, Gleason BL, Squire JS, Koroma FF, Sogbeh SA, Park MJ. Cost Analysis of Health Facility Electronic Integrated Disease Surveillance and Response in One District in Sierra Leone. Health Security. 2020 Jan 1;18(S1):S-64-S-71.
[18] Personnel costs include salaries, benefits, and incentives (Sloan et al)
[19] Operating costs include office supplies, utilities, building and equipment maintenance, rentals (Sloan et al) as well as operating costs for all capacities associated with the JEE
[20] Transport costs include costs associated with fuel and annual vehicle maintenance, vehicles, per diems, and lodging
[21] This includes activities whose predominant cost is workforce effort, for example, developing strategic plans or operating procedures, or writing and reviewing legislation.
[22] This line-item is categorized as “workforce” as the majority of associated costs are related to personnel hours and workforce
[23] The IHR costing tool does not cost any foundational healthcare or public health training (e.g., nursing or medical school) beyond a (default size) 10-person a year FETP program, these trainings are exclusively for the existing workforce and are largely small in scope.

	Consultant fees and travel expenses	Fees for domestic and international consultants, including any per diems and travel (domestic and international)	Consultant per diems and travel
Physical infrastructure	Laboratories and laboratory equipment	Laboratory space (purchased or leased) and laboratory equipment	Purchased or leased laboratory space, laboratory equipment, consumables, and upkeep, and biosecurity supplies (e.g., gate monitors, biometric locks)
	Healthcare facilities	Healthcare facility space (purchased or leased), including including treatment centers and the construction or airborne isolation rooms	Purchased or leased healthcare facility space, cost to construct or equip airborne isolation rooms
	Office or other facility space**	Office space, which may or may not be specialized (e.g., emergency operations centers and other coordinating centers). Includes costs of renting or purchasing and retrofitting physical office space.	Purchased or leased office space that is not primarily used for laboratory analysis or to provide in-person patient care, including for emergency operations centers, poison control centers[24]
	Warehouses or storage facilities	Warehouse or other storage space, including, for instance, storage space for a strategic national stockpile or other stockpile of national or international importance	Purchased or leased warehouse space
	Remote monitoring equipment	Equipment for remote monitoring, including including biological, chemical, or radiological remote sensing equipment that could be used for remote monitoring	
Digital infrastructure	Data analysis and analytics infrastructure	Digital or computational resources required for data collection, analysis, or reporting, including infrastructure to collect survey data online or via phone	Computer software licenses, Inventory management systems, Chemical information database annual subscription fee,
	Computing resources	Computing resources, including web hosting or cloud computing resources, laptop computers, or tablets	Website hosting service, Website domain registration
Civil infrastructure	Transportation and transport fees, including	Transportation resources and resources to ensure a secure cold chain, including packaging and supplies	Vehicles and vehicle maintenance, including motorcycles, motorbikes, and

[24] American Association of Poison Control Centers. America's Poison Control Centers [Internet]. [cited 2023 Jan 13]. Available from: https://www.aapcc.org/; note that many US poison control centers function primarily as call centers and do not directly provide patient care from the control center facility

	cold chain**	needed to ship materials and/or specimen referral systems	ambulances. Transport fees and shipping supplies, including packaging for infectious substances
	Water resources and WASH	Water infrastructure and resources, including costs associated with water, sanitation, and hygiene (WASH) resources	Per capita annual WASH costs
Media fees	Airtime or publication fees	Fees associated with the printing and dissemination of information via print (e.g., newsletters, magazines, newspapers, printed documents), radio, television, or online, or to host a national hotline	National television and radio airtime, advertisements in national newspaper, Hotline service plan, cost of other printed materials for dissemination
	Media subscriptions	Subscriptions for various types of media including print (e.g., newsletters, magazines, newspapers), radio, or television	Media subscription fees for newspapers, newsletters
Medical countermeasures and supplies for healthcare delivery	Medical countermeasures	Select medical countermeasures, including vaccines, antivirals, antimicrobials, and other biologics, drugs, or devices that may be used in the event of a potential public health emergency[25]	Contents of the strategic national stockpile, vaccine doses
	Basic supplies for infection prevention and control (IPC)	Basic supplies to support activities related to infection prevention and control	Disinfection, decontamination, and vector control kit, Antiseptic Liquid Soap, air filtration equipment
	Basic supplies for outbreak investigation and response	Basic supplies for outbreak investigation and response, including supplies for vector control and sample collection and rapid response tests	Specimen collection kit, Outbreak investigation kit, Simple first aid kit, Cooler with ice packs
	Personal protective equipment	Personal protective equipment, including supplies for biosafety incidents and emergency response	Gloves (disposable), googles, face shields, masks (including N95s), gowns, boot covers, chemical PPE

[25] US Food and Drug Administration. What are Medical Countermeasures? [Internet]. FDA. FDA; 2022 [cited 2023 Jan 13]. Available from: https://www.fda.gov/emergency-preparedness-and-response/about-mcmi/what-are-medical-countermeasures

			biosafety incident and emergency response kit
Operating costs	Office materials	Office materials and general office equipment, including pens, paper, pencils, printed materials, and other operating costs	Fax machine, printer/copier
	Meeting expenses	Meeting expenses, in particular, the marginal cost of office space for a meeting and/or the cost to rent space for a meeting	Meeting space