Partners In Health

OPERATIONAL RECOMMENDATIONS RESOURCE PACKAGE

GLOBAL FUND COVID-19 RESPONSE MECHANISM (C19RM) 2021
FUNDING REQUEST PROCESS

VERSION 1 | 22 APRIL 2021

Prepared by Partners In Health

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Community Health Impact Coalition

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INTRODUCTION

The prolonged global COVID-19 pandemic is a clear demonstration that health emergencies know no borders and that strengthening health systems globally is the best defense against global public health crises, which quickly can become global economic crises. Governments have recognized over the past year that one of the best investments they can make for achieving a healthier, more secure, and peaceful world is in strengthening their health systems. COVID-19 has exposed the vast inequity within health systems, disproportionately impacting people of color, the poor, and historically marginalized communities the world over.

In the months since the beginning of the pandemic, public health and clinical professionals have gained more tools and knowledge to control the spread and improve outcomes for those infected; despite these advances the virus maintains its foothold throughout the world, marked by the continuation of community spread, the emergence of new variants, and the limitations of immediate vaccine mobilization for all. With unprecedented investments to rapidly mobilize vaccines, there is now a more promising pathway for achieving pandemic control and mitigating the negative economic and social impacts of the pandemic. The Global Fund COVID-19 Response Mechanism (C19RM) 2021 represents an unprecedented opportunity to translate emergency response funding into long term systems improvements to enable countries to be better prepared for future pandemics and reinforce the essential backbone of their health systems so that they can respond to any outbreak—whether it be COVID-19, HIV, TB, Ebola, Malaria, Hepatitis, NCDs, or any other diseases.

As Country Coordinating Mechanisms (CCMs) and National COVID-19 Response Taskforces come together to develop plans for investing these funds to accelerate their COVID-19 response efforts while mitigating the impact of COVID-19 on HIV, TB, and malaria outcomes, this operational guidance will aid country writing teams with program design and source language for developing their funding requests. It is meant to complement and not duplicate existing guidance provided by the Global Fund and other partners.

Each of the 7 toolkits included here within provides a recommended package of objectives, interventions, and cost areas and considers program design considerations and trade-offs.

- Building Emergency and Critical Care (ECC) Capacity to Care for Severely Ill COVID-19 Patients and Strengthen Health Systems
- Building Resilient Oxygen Systems
- Infection Prevention and Control (IPC)
- Infrastructure for Hospital Care and COVID-19 Care
- Laboratory Strengthening in the Context of COVID-19
- Supply Chain and Cold Chain
- Community Health Systems

This guidance is meant to reinforce the importance of investing in existing public health infrastructure rather than creating a vertical, parallel COVID-19 response platform, to raise the standard of care across all levels of the health system from community to primary health center to district hospital to tertiary referral hospitals. The backbone of a resilient health system is a strong primary health care platform that delivers a comprehensive, integrated set of services. While this funding is meant to complement funding from GAVI, UNICEF and others on vaccine deployment, it is essential to ensure that these investments are being planned hand-in-hand with those that are engaged in vaccine deployment planning, to ensure all of the necessary funding for staffing, cold chain, transport, community mobilization, selection of vaccination sites to reach the most vulnerable, and data collection exists.

PIH TECHNICAL TOOLKIT:

BUILDING EMERGENCY AND CRITICAL CARE (ECC) CAPACITY TO CARE FOR SEVERELY ILL COVID-19 PATIENTS AND STRENGTHEN HEALTH SYSTEMS

Partners In Health

VERSION 1 | 22 APRIL 2021

CONTRIBUTORS

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INTRODUCTION

Timely, effective, and high-quality emergency care decreases mortality, connects patients to long term care, and strengthens health systems. By one estimate, well-functioning emergency departments (EDs) could treat the causes of over half of the deaths in low- and middle-income countries (Thind et al.). Despite this, emergency care remains woefully inadequate in most low-income countries.

As confirmed cases of COVID-19 continue to rise, health systems must be equipped to respond to heightened need for emergency and critical care. Severely ill COVID-19 patients require rapid recognition and treatment, making timely access to emergency and critical care (ECC) a decisive factor in survival. Yet, COVID-19 is weakening already-fragile emergency and critical care services in low- and middle-income countries (LMICs), presenting a critical opportunity to make investments in life-saving services.

Improvements in ECC systems through the continuum of care will strengthen identification, urgent diagnosis and prompt treatment of COVID-19 patients and others in need of these essential services. The cross-cutting nature of emergency and critical care means that investments in these systems lead to gains in many disease areas, including respiratory emergencies. When patients initially present to a health facility, they present with a symptom rather than a diagnosis: the hypoxemic COVID-19 patient arrives complaining of shortness of breath, rather than COVID-19 itself. However, patients with TB, congestive heart failure and pneumonia may all present with the same complaint. All need similar diagnostic tests and initial treatments while the diagnosis is determined. Thus, integrated approaches to strengthening the care for one disease area strengthen the care for all. Similarly, most essential equipment, monitoring and medications used in emergency care settings are also utilized in cross-cutting care, so investments in these areas further strengthen systems for responding to all types of emergencies as well as future outbreaks.

Since early 2020, prioritization of COVID-19 has led to siloed response efforts that align efforts and resources away from broader health systems. Yet as patients continue to present to health facilities with severe and at times multiple illnesses, COVID-19 has drawn attention to the importance of an integrated approach to implementing ECC services for COVID-19 and beyond. Currently, many barriers remain: staff training on ECC in many LMICs remains limited, lack of isolation spaces in emergency wards exposes other patients and medical workers to risk of COVID-19 exposure and infection, and lack of supplies and equipment limit the care that can be delivered. These and other conditions must be addressed to be able to respond to all inpatients with critical illness with high-quality, life-saving emergency care. Thoughtful investments to strengthen the emergency and critical care of severely-ill COVID-19 patients will result in stronger long-term emergency and critical care systems for patients of all disease types, including HIV, TB, malaria, non-communicable diseases (NCD), and maternal and child health emergencies.

GOAL

Increase timely access to high-quality emergency and critical care for severely ill patients with COVID-19 and other diseases

ACRONYMS

BEC	Basic Emergency Course
ECC	Emergency and Critical Care
ED	Emergency Department
EWS	Early Warning Systems
HCW	Health Care Worker
HDU	High Dependency Unit
HMIS	Health Management Information System
ICU	Intensive Care Unit
LMIC	Low- and Middle-Income Countries
NCD	Non-Communicable Disease
SOW	Statement of Work
WHO	World Health Organization

OBJECTIVE 1: Align national emergency and critical care strategies and COVID-19 response plans to support immediate COVID-19 response and build long-term health system capacity.

An integrated approach to the development of ECC systems for COVID-19 and beyond is essential to ensuring that short-term investments have long-term value. Aligning national planning efforts between disease areas and types of care is critical.

Strategy 1.1 Form a national task force to align ECC services and protocols with national COVID-19 response frameworks. Include key stakeholders including from Ministries of Health, ECC experts, care delivery teams, relevant health Directorates, and technical working groups.

- Intervention — Collect recent assessments and/or assess the current status of ECC services using standardized assessment tools (See WHO Tools for Strengthening Emergency Care Systems).
- Intervention — Adapt lists of essential emergency and critical care clinical services and processes to develop a context-specific foundational package of ECC services to provide at each health system level (e.g., secondary, referral), inclusive of services for COVID-19. (See WHO Maintaining Essential Health Services during the COVID-19 Outbreak and DCP3 Emergency and Trauma Care Essential Services.)
- Intervention — Adapt or create ECC protocols, focusing on addressing gaps in the current system and desired foundational package of ECC services, as well as COVID-19 considerations (see Objective 3 for additional details on protocols).

Strategy 1.2 Design a strategic implementation plan to guide the integration of short-term interventions (i.e., strengthening services for COVID-19 response) as a foundation for long-term strengthening of ECC systems, including the development or strengthening of EDs, high dependency units (HDUs) and intensive care units (ICUs).

- Intervention — Focus strategic implementation plan around gaps identified between the current state of services and the desired foundational package of ECC services at health facilities. Ensure all necessary inputs are accounted for, including equipment, staff resources and development, and physical infrastructure.
- Intervention — Plan for development of EDs and ICUs by health facility level, focusing on more advanced units at higher-level facilities or those serving larger patient populations.
- Intervention — Review all partner investments to ensure they align with and support government emergency and critical care strategy and implementation.
- Intervention — Designate national policy coordination mechanisms and relevant directorates who will guide and monitor dissemination and implementation of updated ECC protocols.

OBJECTIVE 2: Develop and disseminate emergency and critical care protocols inclusive of the care of patients with COVID-19.

Patients with COVID-19 present similarly to those with a number of other acute conditions, including TB, Malaria, pneumonia, and sepsis. Much of the initial assessment and treatment is similar across these diverse disease areas. Where possible, integrated procedures and protocols are preferred to strengthen the health system long-term.

Strategy 2.1 Develop or adapt existing emergency and critical care protocols that are inclusive of evaluation and treatment of COVID-19, including when and how to test for COVID-19 and TB, when to keep patients in isolation, and when to initiate specific therapeutics such as dexamethasone. Clinical care protocols are extensively detailed elsewhere; key protocols include:

- Intervention — Adapt or develop approach to patients with difficulty in breathing, fever, and shock.

Intervention	Adapt or develop protocols for oxygen therapy and titration.
Intervention	Adapt or develop protocols for advanced respiratory interventions, including non-invasive and mechanical ventilation when applicable.
Intervention	Adapt or develop approach to shock.

See WHO Clinical Care for Severe Acute Respiratory Infection, WHO Tools for Strengthening Emergency Care Systems, WHO COVID-19 Clinical Management: Living Guidance, and WHO/ICRC Basic Emergency Care: Approach to the Acutely Ill and Injured.

Strategy 2.2 Develop or adapt protocols and systems to facilitate the care of severely ill COVID-19 patients.

Intervention	Define criteria for transfer and protocols to facilitate the transfer of patients between different levels of the health facility.
Intervention	Define clear pathways for where critically ill COVID-19 patients are cared for when they arrive at health facilities that both maintain IPC and consider where equipment for the care of critically ill patients is located. Integrated approaches to care are preferred as it is not always clear what disease or diseases a patient has at presentation. In the short term, isolation spaces may not be adequately available within existing EDs or ICUs and protocols may need to be adapted to ensure similar care can be provided in an isolation ward. In the long-term, ED and ICU spaces should be adapted to allow an integrated approach to future respiratory illnesses, including TB.
Intervention	Establish staffing ratios for emergency and critical care areas and adapt these to COVID-19 isolation areas, if separate. Plan for backup and relief staffing in the case of staff illnesses or patient surges.
Intervention	In settings with a single isolation ward, design protocols for when and how patients can move between different acuity levels of the COVID-19 unit.
Intervention	Advocate for and establish national policies and protocols so that emergency and critically ill patients are treated prior to payment. This is critical to encouraging care-seeking behavior, avoiding fatal delays in care, and to protecting patients from the financial burden of ill health. (See WHA Resolution 17.16: Emergency care systems for universal health coverage: ensuring timely care for the acutely ill and injured). Consider a special pooled fund to reimburse health facilities who treat patients prior to payment.

OBJECTIVE 3: Implement acuity-based triage systems at all health facilities to rapidly identify sick patients on arrival.

Acuity-based triage systems ensure that critically ill patients are rapidly identified so they can receive time-sensitive interventions to improve outcomes. In some settings, particularly at smaller primary level facilities, triage may be combined with screening. In others, triage for patients presenting for acute unscheduled care will occur immediately after screening. The priority for triage in both scenarios is to ensure that patients presenting with emergent or urgent conditions are prioritized and directed for early appropriate treatment while still ensuring IPC standards are upheld.

Strategy 3.1: Identify the preferred triage system to use based on setting and staff. Multiple triage tools exist. Some, including the WHO/ICRC/MSF interagency tool and the South African Triage Scale are designed for settings with limited resources and limited provider experience. Others, such as the Emergency Severity Index, rely more on provide experience to determine triage acuity.

Intervention	Consult the WHO/ICRC/MSF Interagency Integrated Triage Tool, published on pages 11-15 of the WHO Clinical Care for Severe Acute Respiratory Infection: Toolkit: COVID-19 Adaptation.

Intervention Consult existing ED triage programs (see the ENA Emergency Severity Index).

Intervention Employ existing triage trainings for health staff in limited resource settings (see South Africa Triage Scale).

Strategy 3.2: Identify and equip spaces for triage at each health facility.

Intervention Identify space for triage at each health facility. Triage space should be easily accessible to arriving patients, have a private area for the triage staff to evaluate patients, and be accessible both to a waiting area and to a resuscitation area for when patients are identified as critically ill.

Intervention Develop essential medical equipment (pulse oximeters, thermometers, blood pressure cuffs, face masks, basic wound care supplies, etc.) that needs to be in the triage room and ensure availability of the equipment at all times.

Intervention Develop and implement a maintenance plan for essential medical equipment to ensure quality of triage and patient care.

Strategy 3.3: Develop and validate forms or registers for triage tracking.

Intervention Engage stakeholders in developing forms and registers through technical working groups or other coordinating bodies, if applicable.

Intervention Adapt existing clinical forms and health management information systems (HMIS) to document triage acuity. If standardized emergency unit forms do not exist, consider developing one that is inclusive of triage acuity, such as the WHO Standardized Clinical Form. See also Objective 9.

Strategy 3.4: Assign and train staff on triage system.

Intervention Designate staff responsible for conducting triage. Dedicated staff are essential for triage systems to function effectively. Triage staff can be a licensed health professional or in some cases an experienced, well-trained lay health professional with immediate back-up from a licensed health professional.

Intervention Develop or adapt a training curriculum on the chosen triage system. In our experience, we recommend focusing particular attention on the evaluation of symptoms and danger signs, which are often less familiar to staff.

Intervention Implement initial triage trainings at all target health facilities. Incorporate practical skills sessions and simulations into the training plan.

Intervention Ensure ongoing mentorship and supportive supervision to support staff and strengthen triage systems.

Intervention Develop supportive supervision checklist.

Intervention Develop mentorship plans.

Intervention Develop a feedback mechanism through debriefing meetings with frontline staff and sharing reports.

Strategy 3.5: Communication via signs/messaging in appropriate language and visuals for non-literate patients on triage.

Intervention Develop posters in local languages to illustrate the purpose and process of triage. Use video or other messaging when possible.

Intervention When possible, post a phone number to call for emergencies (this can be a phone number of the health facility).

Objective 4: Implement systems to identify critically ill patients in inpatient wards, including systems to identify declines in patient condition.

Strategy 4.1: Establish coordinated early warning systems in inpatient areas.

Even with high quality medical care, patients admitted to medical wards have the potential to rapidly deteriorate and develop critical illness. When this happens, delays in clinical response increase the risk of morbidity and mortality. However, patients often show signs of clinical decompensation as much as 48 hours prior to serious clinical events, providing a window of opportunity for interventions to improve patient outcomes. Early Warning Systems (EWS) help inpatient teams recognize early signs of clinical deterioration and initiate additional measures to treat the patient. Use of an EWS enables hospitals to identify patients at higher risk of morbidity and mortality and improve outcomes.

Intervention	Establish criteria for an EWS system. Consider adapting an existing system when possible. Possible criteria for an EWS include level of nursing concern, vital signs, changes in respiratory status, mental status, or urinary output, or abnormal lab values. One example of an EWS is the Modified EWS from Uganda (see Kruisselbrink et al., 2016).
Intervention	Establish workflows for integrating the EWS into the clinical workflow, either through paper checklists or electronic medical record systems
Intervention	Establish protocols for the clinical response when patients trigger the EWS. Possible interventions include increased frequency of vital signs and monitoring, additional laboratory testing, clinician or team re-evaluation, or transfer to a higher acuity area.

Strategy 4.2: Develop protocols and evidence-based practices for multidisciplinary handovers in patient movement between clinical spaces or at shift change.

Strategy 4.3: Develop procedures and protocols for multidisciplinary ward rounds that incorporate reporting of patient status.

Strategy 4.4: Develop protocols to implement evidence-based ICU Liberation Bundle in all units with mechanical ventilators. These intervention pillars are:

Intervention	Assess, Prevent, and Manage Pain
Intervention	Both Spontaneous Awakening Trials (SATs) and Spontaneous Breathing Trials (SBTs).
Intervention	Choice of Analgesia and Sedation
Intervention	Delirium: Assess, Prevent, and Manage
Intervention	Element: Early Mobility and Exercise
Intervention	Family Engagement and Empowerment

Objective 5: Build health care worker capacity to ensure high quality emergency and critical care services.

Strategy 5.1: Address the immediate need to improve health care worker (HCW) capacity to address emergency and critical illness related to COVID-19 and other priority diseases.

Intervention	Ministries of Health and relevant health directorates to conduct initial WHO/ICRC Basic Emergency Course (BEC) for all HCWs in emergency units with the option of including additional HCWs who would require cross training in order to meet facility needs during a surge. Staff

trained should include nurses, clinical officers, and physicians. The BEC course covers many topics relevant to COVID-19, including difficulty in breathing, shock, and altered mental status, while also addressing other causes of these illnesses that providers should consider.

Intervention — Ministries of Health and relevant health directorates to conduct initial critical care training for all inpatient clinicians and nurses (e.g. WHO short critical care course, BASIC course, SCCM Critical Care for Non-ICU Clinicians, pre-existing modular courses, and courses on opencriticalcare.org).

Intervention — Adapt and administer additional trainings specific to COVID-19 to the local context, including trainings on disease epidemiology, symptoms and treatments.

Intervention — Where relevant, train emergency medical service (EMS) and ambulance staff on COVID-19 and other infectious diseases.

(See WHO recommendations for pre-hospital EMS during COVID-19.)

Intervention — Provide ongoing longitudinal mentorship by peer and specialist mentors to support immediate emergency and critical care delivery, including at sites where baseline ECC capacity is limited. Ideally, there will be at least one mentor at each health facility. Additional mentorship can be offered through formal and informal telehealth platforms, including mentorship groups on WhatsApp.

Intervention — Support HCW capacity and clinical care delivery through visual job aids and tools, such as posting the WHO emergency care checklists for medical and trauma resuscitation in emergency departments.

Strategy 5.2: Leverage needed COVID-19 ECC investments to support long-term health systems strengthening for ECC systems, including developing long-term HCW capacity development for ECC care. These investments will help future patients with TB, HIV, Malaria, and other diseases, and build resiliency the event of future outbreaks.

Intervention — Coordinate between health officials and professional/accreditation bodies to establish certification courses and systems for robust and high-quality basic emergency and critical care.

Intervention — Establish continuous professional development courses and requirements for all cadres of HCWs.

Intervention — Establish or revise long-term national curricula for emergency and critical care.

Intervention — Create secondary specialty education tracks (bachelors, masters, etc.) for mid-level providers (nurses, clinical officers, medical assistants, physician assistants, etc.) in emergency and critical care.

Intervention — Create in country residency programs for physicians in emergency medicine and critical care.

Objective 6: Implement systems to allow for the timely transfer of patients with emergency and critical illnesses including COVID-19.

Most tertiary care facilities are concentrated in urban areas and are thus inaccessible to the majority of the population. For this reason, many patients present initially to primary or secondary facilities even when critically ill. Rapid stabilization followed by rapid transfer is critical for severely ill patients with COVID-19 and other illnesses. However, in many LMICs, transfer systems are underdeveloped with multiple barriers to transfer including staff training and available transportation.

Strategy 6.1: Ensure staff recognize when patients require transfer for different illnesses, including for COVID-19, and know how and where to transfer patients in need.

Intervention — Map and define the range of available services at different facilities including COVID-19 isolation spaces.

Intervention Train staff on the levels of care available at different facilities, inclusive of COVID-19 isolation capability as well as availability of advanced interventions.

Intervention Establish, distribute, and train staff on criteria for transfer to higher-level facilities.

Strategy 6.2: Promote communication prior to transfer by establishing functioning communication system for referral, consults and feedback between the community, primary care and secondary/tertiary facilities.

Intervention Ensure fixed means of communication at each facility, either by phone or radio, with phone numbers published and available to other facilities.

Intervention Develop and distribute referral procedures that define expectations for verbal communication prior to transfer as well as expectations for documentation and results to accompany the patient.

Strategy 6.3: Establish effective, immediately-available ambulances for transfers to higher level facilities.

Intervention Procure or distribute a sufficient number of ambulances that are geographically distributed to provide coverage to first and secondary level facilities.

Intervention Plan for needed vehicle maintenance and fuel to ensure that vehicles are functional when needed.

Intervention Train staff to deliver supportive care during transportation.

Strategy 6.4: When health facility capacity is limited, consider systems that allow counter referral of low-acuity patients from higher-level facilities back to lower-level facilities to free space for critically ill patients at higher-level facilities. Counter referral systems are particularly important in times of surge.

Objective 7: Ensure adequate and appropriate emergency and critical care spaces in primary, secondary and tertiary health care levels adapted to COVID-19.

Strategy 7.1: Establish emergency departments at all secondary and tertiary facilities including isolation rooms to care for COVID-19 patients.

When planning for physical space design, dedicated emergency departments should include a trauma and/or resuscitation area, as well as general care beds, isolation areas, and staff working areas. There should be adequate triage and reception space as well as waiting areas that allow for social distancing and have adequate ventilation and social distancing for IPC. Ensuring that EDs and critical care units have sufficient isolation spaces is critical to allowing integrated approaches to disease management in the future.

For guidance on resuscitation areas, see WHO Resuscitation Area Designation Tool.

Strategy 7.2: Leverage needed COVID-19 ECC investments to support long-term health systems strengthening for ECC systems, including developing long-term HCW capacity development for ECC care. These investments will help future patients with TB, HIV, Malaria, and other diseases, and build resiliency the event of future outbreaks.

Strategy 7.3: At primary level facilities, dedicate a resuscitation room for critically ill patients to receive care prior to transfer. Ensure adequate isolation rooms in all primary health care facilities to prevent spread of COVID-19 while patients are awaiting transfer, including toileting facilities separated from other patients and staff.

Intervention Ensure all EDs and critical care spaces have continuous and adequate electricity.

Intervention Ensure al EDs and critical care spaces have adequate water supply for handwashing, patient care, and basic needs.

➔ See PIH infrastructure toolkit for additional details.

Objective 8: Adequate and functioning equipment, supplies and medications are available for the care of emergency and critical patients.

Strategy 8.1: Ensure all necessary emergency and critical care biomedical equipment.

Intervention Define a national list of biomedical equipment needed for each level of facility, including equipment such as pulse oximeters, vital sign machines, and monitoring systems, furniture such as beds where the head of bed can be elevated, oxygen delivery systems and advanced respiratory equipment such as non-invasive and invasive ventilators, and diagnostic equipment such as X-ray equipment and ultrasound. See WHO list of priority medical equipment for COVID-19 and WHO inventory tool – biomedical equipment for COVID-19 case management.

Intervention Assess and identify gaps in biomedical equipment at health facilities, including oxygen delivery systems.

Intervention Procure biomedical equipment to meet identified gaps, focusing efforts on high-impact equipment. Ensure there is a sufficient quantity for isolation spaces and wards.

Intervention Train staff on use of biomedical equipment, including on safe cleaning procedures and on troubleshooting equipment in the event of errors.

Intervention Establish or revise protocols for maintenance of medical equipment. Identify and train technicians responsible for equipment maintenance.

➔ See PIH infrastructure toolkit.

Strategy 8.2: Ensure adequate medications and supplies for emergency and critical care.

Intervention Establish, or review and revise, medication and supply lists for emergency and critical care areas by facility level. Ensure they are inclusive of needed medications for severe COVID-19 treatment, including direct therapeutics such as dexamethasone as well as supportive medications for critical care. See DCP3 Emergency and Trauma Care Essential Services for examples of emergency care medication needed by facility level.

Intervention Ensure stock systems are in place to have supplies available at the ward level.

➔ See PIH supply chain toolkit.

Intervention Ensure functioning oxygen systems are in place and available throughout the ED and critical care spaces

➔ See PIH oxygen toolkit.

Intervention Ensure forecasting systems for supply needs. See WHO COVID-19 essential supplies forecasting tool.
See PIH supply chain toolkit.

Strategy 8.3: In all emergency units, resuscitation areas, and critical care spaces, ensure that equipment and supplies are readily available.

Intervention Allocate funding for shelving, cabinets and trolleys to facilitate access to equipment within spaces.

Intervention Establish stock lists and systems for monitoring stock and equipment function including daily

checks of critical equipment.

Objective 9: Ensure monitoring, evaluation and health informatics systems inclusive of emergency and critical care.

Strategy 9.1: Establish national level standard patient screening, emergency unit, outpatient and inpatient charts.

Intervention	Review existing documentation forms, including available national forms and any available facility level forms. For emergency unit forms, standardized forms for medical and trauma care from WHO can be adapted for use (see WHO Standardized Clinical Forms).
Intervention	Ensure planned forms include standardized documentation for the history and physical exam. Forms for ongoing monitoring and patient flow sheets should include spaces for vital signs monitoring, oxygen delivery, early warning systems, and medication administration. Ensure space to document diagnostics and standardized documentation of daily medical and nursing plans inclusive of planned changes in care.
Intervention	Distribute and implement patient forms to all facilities. Budget for and plan for ongoing form distribution to ensure a sufficient supply for ongoing clinical care.

Strategy 9.2: When possible, ensure forms are transferred onto digital electronic patient medical record systems. Support needed investments in hardware and connectivity to support ward level access to electronic medical record systems.

Strategy 9.3: Introduce robust health monitoring information system to show the impact of triage, emergency and critical care on the identification and treatment of severely ill patients.

Intervention	Develop systems for better data management (e.g., CommCare, DHIS2, etc.).
Intervention	Train data officers and frontline health care workers on using data systems.
Intervention	Develop data quality checks and monitoring plans.

Objective 10: Improve leadership and governance for emergency and critical care systems.

Strategy 10.1: Establish a long-term national multidisciplinary committee to monitor ECC system development and progress.

Intervention	Plan for meetings of the multidisciplinary committee at least annually, with period virtual check-ins between annual meetings.
Intervention	Within the multidisciplinary committee, organize technical sub-committees comprising of different cadres in the delivery of health services.
Intervention	Equip and encourage community leaders to voice emergency and critical care needs within the community to direct and strengthen care delivery. Though this process will begin locally, ensure community representation and voices in the national planning process.
Intervention	Define leadership roles and SOWs for multidisciplinary team members (Emergency and Critical Care clinical and nursing experts, community-based organizations, and supply chain, pharmacy and infrastructure representatives, etc.) with national ministry of health structures (care and treatment, emergency care systems, infrastructure and maintenance, etc.) to strengthen and integrate ECC care systems throughout the continuum of care.

Strategy 10.2: Establish district-/county-level multidisciplinary technical working groups charged with coordinating district-level implementation of emergency and critical care services and protocols.

Strategy 10.3: Define and distribute care standards and measure of quality clinical performance at facility level with certification of quality and care.

- Intervention: Incorporate care standards and measures of quality clinical performance within certification courses and systems.
- Intervention: Develop and test efficient and effective service provision arrangements, regulatory frameworks and management systems.

Strategy 10.4: Create leadership and management courses for emergency and critical care leaders for effective facility level leadership and governance.

Resource: WHO Emergency Unit Management Course, contact emergencycare@who.int.

Objective 11: Ensure adequate mental health and psychosocial support for emergency and critical care services, including of patients and staff.

Strategy 11.1: Develop and implement plan for adapting and maintaining mental health and psychosocial support services for patients in emergency and critical care settings.

- Intervention: Develop protocols for communication with patients around positive test results, duration of isolation, and providing psychological and social support during quarantine and isolation.
- Intervention: Support patients and family members coping with severe illness. In particular, consider needs for support for patients in family members in need of palliative care.
- Intervention: Train *all front-line workers* on essential psychosocial care principles, including communication techniques, psychosocial care principles, psychological support, and referral pathways for additional psychological and social needs.
- Intervention: Establish integrated training program to train frontline staff to deliver Psychological First Aid.
- Intervention: Develop supervision and mentorship structure to support frontline staff on Psychological First Aid.
- Intervention: Utilize digital technologies such as a phone helplines or mobile apps as methods of communication.

Strategy 11.2: Provide essential psychological and social support to health care workers to prevent and address burnout with increased workload during COVID-19 response.

- Intervention: Establish dedicated roles to supporting staff wellness and mental health needs in collaboration with human resource and occupational health departments.
- Intervention: Establish peer support structure for staff to conduct group and individual peer support sessions focused on wellness on a regular basis.
- Intervention: Conduct trainings on wellness and recognizing and addressing burnout. Develop an accessible resource library with informational materials, tools, and exercises to support one's own mental health and well-being.
- Intervention: Ensure access to clinical support including mental health services. Establish referral pathways for

staff who require additional mental health services.

KEY COST CONSIDERATIONS

Objective 1:

- Meeting costs for assessments and national strategic planning around short term and long term ECC interventions

Objective 2:

- Meetings costs for emergency and critical care protocol development/adaptation
- Costs for printing and dissemination of protocols

Objective 3:

- Procurement of essential medical equipment:
    - Pulse oximeter
    - Thermometers
    - Blood pressure cuffs
    - Face masks
    - Basic wound care supplies
- Meeting costs for convening Technical Working Groups to develop forms and registers
- Triage training costs for all target health facilities
- Printing of supportive supervision checklists
- Development and printing of posters in local languages on triage practices

Objective 4:

- NA

Objective 5:

- Trainings for nurses, clinical officers, physicians on meeting facility needs during a surge
- Critical care training for all inpatient clinicians and nurses
- Trainings on disease epidemiology, symptoms and treatments
- Train emergency medical service (EMS) and ambulance staff on COVID-19 and other infectious diseases
- Emergency and critical care training in physiology, treatment modalities, procedures, etc.
- Printing of visual job aids and tools
- Adequate numbers of staff for delivery of high quality and comprehensive patient centered care
    - Emergency and critical care staff
    - Include M&E/informatics staff
    - Community-based and primary health care HCW, organizations and leadership
    - National level policy and strategy teams

Objective 6:

- Training of staff on timely transfer of patients with emergency and critical illness including COVID-19
- Phones or radios for transfers or referrals
- Printing of referral procedures for verbal communication prior to transfer, documentations, results to

accompany patients
- Procurement of ambulances
- Vehicle maintenance, fuel
- Training on supportive care during transportation
- Protocols for communication

Objective 7:
- Electricity costs for emergency departments
- Water supply and handwashing infrastructure

Objective 8:
- Biomedical equipment
- Training on use of biomedical equipment (safe cleaning procedures, troubleshooting equipment)
- Shelving, cabinets, trolleys
- PPE and hygiene supplies
- Medical consumables (pulse oximeter, hemoglobin device and cartridges, etc.)
- Infrastructure for triage, emergency care, critical care, and transport of critically ill patients

Objective 9:
- Systems and devices for data collection like mobile devices, hardware, software, etc.
- Training for data officers and frontline health care workers on data systems

Objective 10:
- Costs for virtual check-ins between annual meetings
- Costs for national steering committee meetings

Objective 11:
- Printing of protocols on mental health and psychosocial support
- Training for front line workers on essential psychosocial principles and psychological first aid
- Trainings on wellness and recognizing and addressing burnout

RESOURCES:

Basic Assessment and Support in Intensive Care (BASIC) Course
Disease Control Priorities (DCP3) – Strengthening Health Systems to Provied Emergency Care
ENA Emergency Severity Index Training Courses
Open Critical Care Courses
Kruisselbrink R., Kwizera A, Crowther M, Fox-Robichaud A, O'Shea T, Nakibuuka J, et al. Modified early warning score (MEWS) identifies critical illness among ward patients in a resource restricted setting in Kampala, Uganda: a prospective observational study. PLoS ONE. Feb 2016; 11(3): e0151408. https://doi.org/10.1371/journal.pone.0151408

SCCM Critical Care for Non-ICU Clinicians training portal
SCCM ICU Liberation Bundle (A-F)
South Africa Triage Scale
Thind A, Hsia R, Mabweijano J, et al. Prehospital and Emergency Care. In: Debas HT, Donkor P, Gawande A, et al., editors. Essential Surgery: Disease Control Priorities, Third Edition (Volume 1). Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2015 Apr 2. Chapter 14. Available from: https://www.ncbi.nlm.nih.gov/books/NBK333513/ doi: 10.1596/978-1-4648-0346-8_ch14

WHA Resolution 17.16: Emergency care systems for universal health coverage: ensuring timely care for the acutely ill and injured
WHO Biomedical Equipment for COVID-19 Case Management – Inventory Tool
WHO COVID-19 Clinical Management: Living Guidance
WHO COVID-19 Essential Supplies Forecasting Tool
WHO Clinical Care for Severe Acute Respiratory Infection
WHO Critical Care Training Short Course
WHO List of Priority Medical Devices for COVID-19 Case Management
WHO Maintaining Essential Health Services During the COVID-19 Outbreak
WHO Psychological First Aid: Guide for Field Workers
WHO Resuscitation Area Designation Tool
WHO Standardized Clinical Form
WHO Tools for Strengthening Emergency Care Systems
WHO/ICRC Basic Emergency Care: Approach to the Acutely Ill and Injured
WHO/PAHO COVID-19 Recommendations: Prehospital Emergency Medical Services

PIH TECHNICAL TOOLKIT:
BUILDING RESILIENT OXYGEN SYSTEMS

Build Health International

Partners In Health

VERSION 1 | 22 APRIL 2021

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INTRODUCTION

Medical oxygen is an essential component of treatment for COVID-19 patients who develop severe or critical disease, as well as other illnesses that restrict breathing. Despite tremendous global response to immediate pandemic relief and sustained health system strengthening, oxygen availability and improvements to oxygen systems remain unmet needs. While oxygen has become paramount to the survival of many COVID-19 patients, many low and middle income countries (LMICs) lack capacity to address current oxygen needs. This lack of oxygen has already affected millions of people globally: it is estimated that without medical oxygen, nearly 1 out of every 5 people infected with COVID-19 will die.

Currently, oxygen demand in most LMICs dramatically exceeds supply. Many barriers hinder the availability of oxygen, including a lack of oxygen production equipment, limited electricity supply and infrastructure, and limited technical expertise and funding to maintain existing systems. Finally, there are often difficulties in delivering oxygen to patients in need due to geographic distance from production sites and supply chain issues.

The barriers to oxygen administration extend beyond its physical availability. To effectively treat patients with hypoxemia, healthcare workers (HCWs) must understand the nuances of oxygen delivery methods and the risk of incorrect use. Diagnostics, medications and consumable supplies are required to maximize impact and improve patient outcomes. Emergency care and ICU capacity, human resources, and supply chains must be strengthened to avoid gaps in clinical care and excess mortality. Strong monitoring frameworks are needed for short- and long-term planning. Shortcomings in these areas magnify the scope and scale of the COVID-19 crisis and augment baseline inequities in health outcomes throughout the world.

Oxygen is an essential aspect of clinical care for many diseases, so investments in oxygen strengthen health systems long-term and prepare them for future health crises. Beyond COVID-19, oxygen is a life-saving treatment for diseases including pneumonia, heart disease, tuberculosis, severe malaria and opportunistic infections from HIV, and is critical to reducing neonatal and childhood mortality. Oxygen investment has been associated in reduction of childhood pneumonia mortality, as well as overall mortality.

Many low- and middle-income countries rely on imported oxygen cylinders, which are expensive and must be frequently refilled, or bedside concentrators, which require reliable electricity and can only deliver limited amounts of oxygen. In order to meet current and future oxygen demands, oxygen production capacity must increase. In addition, plans must be made to prevent oxygen insecurity. Oxygen insecurity arises from an over-reliance on any single system without an adequate back-up. In oxygen-insecure settings, a power-outage, mechanical failure, or surge in patients can easily lead oxygen supplies to run out. Effective treatment with medical oxygen requires the right amount at the right time, with close to zero margin for error—oxygen shortages lasting as little as 30 minutes can be catastrophic.

With effective planning, thoughtful investments in infrastructure and maintenance, and deliberate development of human resources, countries can develop resilient long-term oxygen systems that address the immediate COVID-19 crisis and reduce mortality from numerous diseases.

GOAL:

Strengthen all aspects of the oxygen ecosystem, including infrastructure design and maintenance, supply chain, training

and ongoing mentorship, and clinical guideline development to improve the availability of medical oxygen in countries to stop the threat of COVID-19 and ensure continued resilience for the future.

ACRONYMS

LMIC	Low and middle income countries
HCW	Healthcare workers
ICU	Intensive Care Unit
UNICEF	United Nations International Children's Emergency Fund
PSA	Pressure Swing Absorption
EHR	Electronic Health Record
IPC	Infection Prevention Control
PPE	Personal Protective Equipment
WHO	World Health Organization
LPM	Liters Per Minute
PSI	Pound Per Square Inch

OBJECTIVE 1: Completed oxygen needs and availability assessments that define current scope of oxygen supply, quantify needs by level of health system, and establish a road map for future interventions.

It is imperative that oxygen system gaps and opportunities are assessed in order to establish and strengthen oxygen distribution networks. This model enables production capacity to expand while facilitating feasible maintenance.

Strategy 1.1 Performing oxygen needs assessment for all secondary and tertiary hospitals.

See assessment resources from PATH:

- PATH Baseline Assessment Manual
- COVID-19 Facility Assessment Resources

Intervention Conduct stakeholder mapping and review existing stakeholder list from Every Breath Counts. Find out what work has already been done for assessments and planning.
Every Breath Counts COVID-19 LMIC Oxygen Partners

Intervention Assess current oxygen supply sources for each facility, oxygen cylinders, portable oxygen concentrators, PSA plants, or liquid oxygen tanks.

Intervention Assess the oxygen consumption needed for each facility based on the number of beds and services provided.

- See quantification tools from PATH:
- PATH Quantification and Costing Tools
- Open Critical Care Demand Calculator
- OGSI size estimator based on beds and critical care beds
- UNICEF Oxygen System Planning Tool

Intervention Assess electricity availability, reliability and cost.
Constant electricity supply is needed for portable concentrators. PSA plants have substantial power requirements which could necessitate upgrading the electrical service or generator.

- See PIH guidance on Infrastructure and PATH Electricity Planning Guide.

Intervention Assess long term maintenance and operation financing capabilities of stakeholders.

Intervention Assess the oxygen delivery and monitoring equipment available at the ward level in a facility.

Strategy 1.2 Finding local or regional service providers that can supply and service oxygen equipment.

Intervention Conduct stakeholder and supplier mapping. Find out if there are local or regional companies that could provide spare parts and service for key oxygen related equipment. It is important to understand what level of service is available for oxygen equipment before developing an oxygen strategic roadmap. For PSA plants, all facilities will likely require the occasional outsourced labor to repair or service the PSA, even with strong internal training and maintenance programs.

- For package PSA plant providers, see if they offer comprehensive service contracts in your area. Even with robust in house preventative maintenance plans, service provided by manufacturers or manufacturer's representative is often required throughout the life of a PSA plant.
- For PSA, check for locally available service providers for rotary screw air compressors (Atlas Copco, Kaeser, Ingersoll Rand, etc).
- For cylinder filling PSA plants this would include oxygen compressors (RIX, Novair, etc).
- For portable concentrators, check for local or regional distributors of concentrators (Airsep, Devilbiss, Invacare, etc) or service providers.

Strategy 1.3: Reviewing available oxygen production options, understanding the pros and cons of each one, as well as the Capex and Opex costs associated with each option.

Available oxygen production options include:

- Oxygen Cylinders: Large oxygen cylinders can hold around 7000L of usable oxygen, or enough oxygen to supply 5 LPM for almost 24 hrs. They can be refilled by commercial or industrial oxygen suppliers. This is often the most expensive source of oxygen, but some markets may have competitive pricing allowing this option to play a supporting role in an oxygen strategy. If the cost of filling large cylinders (40L water capacity, 7000L oxygen capacity) is greater than $15 per cylinder, then on site oxygen production (PSA) and cylinder filling can be a cheaper alternative.
- Portable Concentrators: These are mobile oxygen concentrators, often on wheels, with common sizes of 0-5 LPM and 0-10 LPM. These machines do not store oxygen so require 24/7 electricity to maintain oxygen flow. They also only deliver oxygen at low pressure making them not suitable for some applications. In general, portable concentrators have the cheapest total cost of ownership even considering a lifetime of 2-3 years. They are not energy efficient at low flows. For example, a 10 LPM concentrator operating at 1 LPM flow will still require 70% of the energy required for the full 10 LPM flow.
    - Note: There are a handful of oxygen concentrators that can deliver 20-30 LPM at 50 psi (3.4 bar) and there are ways to take oxygen produced by a portable concentrator and boost the pressure to 50 psi.
- PSA Plants + Pipeline: PSA plants use the same oxygen production technology found in portable concentrators, just at a larger scale. Oxygen produced from most PSA plants is supplied at 50 psi (3.4 bar). This oxygen can then either supply a pipeline system that delivers oxygen to the bedside through an oxygen outlet and flowmeter, or be used to fill cylinders. PSA plants utilizing a pipeline system can be price competitive long term and offer advantages to patients by providing continuous oxygen supply without the need for moving heavy cylinders or portable concentrators between patients. Oxygen pipeline systems have low maintenance requirements especially compared with cylinder filling systems.
- PSA Plants + Cylinder Filling: PSA plants can also utilize high pressure oxygen compressors to fill oxygen cylinders. The main advantage of high pressure cylinders is they can store large quantities of oxygen and can be transported and used to deliver oxygen without any need for electricity. The oxygen compressor that pressurizes the cylinders is the most costly and difficult piece of equipment to maintain of all PSA plant components.

Pressure considerations

Certain oxygen delivery devices require higher pressure sources (i.e. ~50psi). These include high flow nasal cannula, invasive ventilators (although travel ventilators can often be connected to low pressure sources), and many non-invasive ventilation devices. In order to select an oxygen source it is therefore important to consider the needs of the patients and oxygen delivery devices.

Oxygen Source	Total Cost* Per Equivalent Large Cylinder (7000L O2)
Cylinder Refilling Supplier	$15 - $120
Portable Concentrator	$2.5 - $5
Small PSA + Pipeline	$5 - $10
Large PSA + Pipeline	$4 - $8
Small PSA + Cylinder Filling	$12 - $22
Large PSA + Cylinder Filling	$6 - $10

**These costs are approximations as true costs will vary based on a variety of factors, principally cost of energy and cost of maintenance labor. This calculation looks at cost per equivalent cylinder after 10 years of operation.*

It includes initial purchase, installation, maintenance materials, maintenance & operation labor, cost of energy, and in the case of portable concentrators, the cost of replacing portable concentrators every 3 years. It assumes 24/7 operation.

Additional resources on oxygen production types:

- PATH|CHAI Equipment Market Report
- PATH Costing Tool
- PATH Procurement Guide
- Oxygen sources and distribution for COVID-19 treatment centres

Strategy 1.4: Developing an oxygen strategic roadmap with key stakeholders

There is no one oxygen strategy that is the best for all health facilities or regions. Portable oxygen concentrators are a great solution for low pressure and low flow applications for any facility large or small that has reliable electricity. Any facility that has critical care beds or operating rooms requires oxygen at 50 psi (3.4 bar) that standard portable concentrators cannot provide, so other options need to be considered. Facilities without reliable electricity require oxygen cylinders or an investment into a micro grid system to provide continuous power for critical equipment.

It is important when developing a resilient oxygen strategy to consider equipment redundancy. All equipment, however well maintained, can and will fail from time to time. For severely ill hypoxemic patients, even a brief time without oxygen can be fatal. All facilities should have a backup plan. Large facilities with critical care beds should have fully redundant oxygen supply.

Below we have suggested a framework for medium to long term facility level planning based on our experience.

Suggested framework for medium to long term facility level oxygen planning

	Primary Supply	Backup Supply	Additional Considerations
Tertiary Referral	*Preferred:* Piped from on-site PSA plant *If available:* Piped from liquid oxygen tank	*Preferred:* Piped from cylinder manifold*. Cylinders filled by on site 2nd PSA plant *Alternatively:* Cylinders filled off site & portable concentrators	Emergency departments, operating rooms, and ICUs require high pressure backup (i.e. cylinders)
Secondary Referral	*Preferred:* Piped oxygen from PSA plant *Alternatively:* Piped from cylinder manifold & portable concentrators for low pressure/low flow uses. Cylinders filled off site	*Preferred:* Piped from cylinder manifold*. Cylinders filled off site *Alternatively:* Individual cylinders for high pressure/high flow and portable concentrators for low	Transport network for cylinders

	Alternatively: Individual cylinders for high pressure/high flow use & portable concentrators for low pressure/low flow uses.	pressure/low flow uses.	
Primary** facilities	Individual cylinders filled offsite for high flow, high pressure needs Concentrators for low pressure and flows below 10 LPM	Cylinders* *If electricity is unreliable:* Oxbox or additional cylinders	Transport network for cylinders

**Quantity of cylinders store enough oxygen to cover estimated hospital supply for 48 hours or more depending on the source of cylinders*
***All non-referral centers providing treatment for patients with COVID-19*

While we recommend PSA plants as a means of expanding access to oxygen long term, we recognize that short-term investments should be strategic and expedient. In our experience, PSA plants are most successful when the facility has demonstrated the ability to care for other complex medical equipment. For example, PSA plants are comparable if not simpler when compared with an X-Ray unit. The air compressor component of a PSA plant is quite similar to a diesel generator.

In the short-term, regions should balance existing infrastructure and maintenance capacity with the life-saving value and long-term return on investments in oxygen capacity. For many countries, hybrid models that include expanding access to portable concentrators (coupled with reliable electricity to run them) with strategic investments in larger oxygen infrastructure in select areas may be the best short-term strategy.

For additional resources on oxygen access and reliability, please see: PATH resource on Oxygen Access and Reliability

OBJECTIVE 2: Increased oxygen production, distribution and redundancy

The oxygen roadmap developed in Objective 1 will guide the plan to increase oxygen production, distribution and redundancy. In our experience in responding to COVID-19, the sites that were able to respond to the increased need for oxygen were sites with robust oxygen infrastructure, excess oxygen production capacity, and backup supply (see **Box 1**). This experience leads us to strongly recommend making long term investments into oxygen production and distribution systems, both for COVID-19 and beyond.

Box 1: University Hospital in Mirebalais case study on oxygen response during COVID-19

University Hospital in Mirebalais has a large PSA plant that feeds an oxygen pipeline and portable concentrators for a backup supply. The hospital was able to quickly construct a temporary COVID-19 ward and convert existing areas to COVID-19 wards. To meet the oxygen demand, the hospital deployed its supply of backup portable concentrators, installed a cylinder filling compressor to fill oxygen cylinders with the PSA's excess O2 capacity, and eventually expanded the pipeline network and installed portable oxygen outlets in these temporary COVID-19 wards. Other facilities without this existing robust capacity and backup supply were not able to rapidly meet the oxygen demand due to long lead times caused by unprecedented worldwide demand for any equipment and supplies related to oxygen production and delivery. In addition to lead times for new equipment, commercial oxygen suppliers that some sites relied on were completely overwhelmed leading to massive long term oxygen shortages.

Strategy 2.1 Increase PSA plant capacity in accordance with the country's oxygen road map

Intervention Install PSA plants at secondary and tertiary level hospitals.

Intervention Install PSA plants with cylinder filling capability at tertiary level hospitals to act as a backup supply for pipeline plants and to supply cylinders for surrounding facilities and any COVID-19 treatment centers.

Intervention Purchase large and small oxygen cylinders. Small cylinders allow patients to be transported on oxygen either within or between facilities, and are essential to allowing critically ill COVID-19 patients to reach higher levels of care. Larger cylinders are used in cylinder manifolds connected to piped systems as well as for bedside oxygen delivery for facility based care.

Intervention Purchase extra oxygen cylinders to be kept at facilities as reserve backup supply in the case of PSA breakdown or breakdown in logistics and oxygen supply chain.

Intervention Pair investments in PSA plants with investments in strengthened biomedical capacity and in service contracts and maintenance plans (see also Objective 3).

Intervention Prioritize repairs and expanding capacity for existing PSA plants, particularly those with cylinder filling capacity that can serve more than one facility.

Intervention Allocate funding for needed upgrades for electricity infrastructure, and budget for generator fuel if required.

➔ See PIH infrastructure toolkit for additional details on electricity infrastructure

- See more on PSA plant specifications at: Technical specifications for Pressure Swing Adsorption(PSA) Oxygen Plants (who.int)

Strategy 2.2 Increased piped oxygen availability

We recommend investing in oxygen pipelines because of the major advantages they offer in patient care as well as lower operational costs compared to cylinder filling PSA plants. Cylinder filling oxygen compressors are expensive to maintain and operate, both due to cost of parts and because they often require specialty labor for preventative maintenance which is required every 2 ½ months. Further, piping oxygen to the patient's bedside means staff do not have to transport heavy cylinders and cylinders do not have to be monitored and changed out as they become empty. Oxygen pipelines themselves are relatively easy to maintain with the only maintenance being repairs to the outlets involving changing rubber O-rings. Ideally, pipelines connect to a PSA plant producing oxygen, but they can also be installed so that they connect to oxygen cylinder manifolds. Investing in pipelines is a worthwhile long term investment for all secondary and tertiary hospitals.

Intervention Install oxygen piping network. This should be designed and installed by an experienced oxygen piping contractor. If an international contractor is used, select a contractor that will commit to train local staff on installation and maintenance of the pipeline system. The size of pipe size is

important to avoid pressure losses, and accessible and clearly labeled isolation valves are important for safety and maintenance.

Intervention Ensure sufficient access points within the oxygen pipeline for each patient bed. Add redundancy by purchasing Y blocks for the outlets to add additional in case of account for possible patient surges.

Intervention Train staff on use and safety considerations for oxygen pipeline systems.

Strategy 2.3 Increasing portable concentrator access

Intervention Purchase concentrators that have local distributors and service providers. If none available, purchase concentrators with strong remote service support and spare parts availability. OpenO2 has suggested that Airsep and Devilbiss are showing to be more reliable based on data collected from visits to hospitals in Malawi.

Intervention Fit concentrators with under voltage/surge protection devices. Examples include devices such as ones offered by Sollatek.

Intervention Consider supplemental equipment such as splitters to expand the number of patients who can benefit from portable concentrators in the event of patient surges. See How to set up an oxygen flow splitter from opencriticalcare.org for additional information..

Intervention For facilities that do not have reliable electricity or COVID-19 treatment centers, consider solar microgrid powered portable concentrators such as OxBox concept from BHI.

Intervention Train users on the operation and maintenance of portable concentrators.

Strategy 2.4 Increasing access to cylinders through spoke and hub delivery model

In many countries, oxygen cylinders will remain critical to meeting oxygen supply needs. Cylinders are often used to add redundancy when a primary oxygen source fails. Countries can consider regional hub and spoke distribution models where cylinders are filled in a central location and then distributed regularly to surrounding facilities.

Intervention In areas where commercial cylinder filling suppliers charge high prices (>$40) to fill cylinders, consider investing in PSA oxygen cylinder filling plant as a social enterprise to introduce competition to the marketplace. See Assist International and Hewatele who have been able to do this successfully..

Intervention Select key regional locations for cylinder distribution locations.

Intervention Invest in oxygen delivery trucks fitted for the safe transport of cylinders, as well as in the staff and fuel to operate the delivery truck.
BHI/Tuck school distribution model

OBJECTIVE 3: A comprehensive maintenance ecosystem exists that promotes continuous availability of oxygen, durability of equipment, and quality assurance

A comprehensive oxygen maintenance ecosystem is necessary for short-term oxygen strengthening for COVID-19 as well as long-term stability and reliability of oxygen systems for other diseases including TB, HIV, and Malaria. When procuring and installing oxygen equipment, it is essential to plan for the required maintenance to ensure equipment continues to function over the long term. These investments prevent small issues from escalating into major and/or permanent disruptions in oxygen supply.

Strategy 3.1: Maintenance Training

A comprehensive oxygen maintenance ecosystem is necessary for short-term oxygen strengthening for COVID-19 as well as long-term stability and reliability of oxygen systems for other diseases including TB, HIV, and Malaria. When procuring and installing oxygen equipment, it is essential to plan for the required maintenance to ensure equipment continues to function over the long term. These investments prevent small issues from escalating into major and/or permanent

disruptions in oxygen supply.

Intervention	Train local staff on maintenance for PSA air compressors. Many maintenance tasks can be done by local technicians and mechanics, including oil, oil filter, oil separator, and air filter changes, testing and cleaning condensate drains, and cleaning oil cooler and dryer components.
Intervention	Provide local staff with a hard copy of Air Compressor Troubleshooting Guide. This is a generalized guide that explains overall operation of the compressor, the function of different components, and also provides troubleshooting and solutions for common problems.
Intervention	Train local staff on maintenance for PSA components and general plant maintenance. Specific tasks include testing for leaks, replacing or rebuilding check valves and solenoids, calibration of sensors, etc.
Intervention	Provide maintenance training on oxygen safety: flammability, transporting cylinders, high pressure awareness and safety.
Intervention	Provide maintenance training on pipeline and outlet maintenance: checking for and isolating leaks, replacing o-ring on oxygen outlets and rough in assemblies.
Intervention	Provide maintenance training on oxygen compressor preventive maintenance and repair. The skills for maintaining oxygen compressors is very specialized and not commonly available like in the case of air compressors. To pass on the skills needed, we recommend extensive hands on training. One option would be to incorporate training into a service contract. The oxygen compressor company Novair offers factory training, but Novair compressors are not commonly used by PSA manufacturers.
Intervention	Make sure facilities and biomedical staff have hard and soft copies of all operation, service, and parts manuals for their specific equipment.
Intervention	Develop vendor and technical support contact list for each piece of equipment. Often staff do not realize they can call a phone number and get technical support.

Strategy 3.2: Spare parts and Tools

Intervention	Purchase large quantities of spare parts and consumables for PSA plants. PIH can provide further detailed generalized parts lists on request. We recommend procuring 3 years of consumables and the most commonly used spare parts with the initial plant purchase.
Intervention	Purchase spare parts kits for oxygen cylinder filling compressors.
Intervention	For pipeline systems, purchase spare oxygen outlets, outlet maintenance kits, and spare flowmeters. These components are inexpensive to replace, but when not planned for result in life-threatening disruptions of the oxygen supply.
Intervention	Purchase an oxygen analyzer for all facilities with PSA plants and portable concentrators. We recommend ultrasonic oxygen sensors such as the Maxtec UltraMaxO2 for their longevity. This allows staff to validate oxygen purity and flow rate from all sources.
Intervention	Purchase spare pressure regulators and flowmeters for oxygen cylinders. These components can be damaged during the use and transport of oxygen cylinders and are easily replaced.
Intervention	Purchase at least 1 spare cabinet and 4 product filters for each concentrator. Spare power cables and fuses (if applicable) are also important. For larger quantities of concentrators, also consider stocking spare parts such as circuit board, compressor service kit, capacitor, and solenoid valves.
Intervention	Monitor supply chain data to assure adequate parts and consumables for the amount of oxygen delivered and consumed.

➔ See PIH supply chain toolkit for further information on data systems for stock monitoring

Strategy 3.3: Service contracts

Intervention — If local or regional service providers are identified, consider service contracts for PSA plants. This is often the best way to ensure short term plant reliability while building long term in house maintenance capacity.

Objective 4: Healthcare workers at each facility are able to safely manage hypoxemic COVID-19 patients

Sufficient oxygen supply is only one component in the ecosystem of care that hypoxemic COVID-19 patients require. Health care workers must know when and how to use and titrate oxygen to ensure high quality care and maximize use of oxygen resources. Oxygen, like all medications, can be ineffective when too little is administered and harmful when too much is administered. Empowering a knowledgeable healthcare workforce through training and mentorship will reduce COVID-19 mortality and ensure HCWs will be better equipped to treat life-threatening respiratory illnesses such as pneumonia and TB.

Strategy 4.1: Develop and disseminate national clinical protocols for safe management of hypoxemic COVID-19 patients.

Intervention — Establish content areas to be covered in national guidelines. While some guidelines will be COVID-19 specific (such as the care of severely ill COVID-19 patients), others will be more effective if they take an integrated approach to all disease areas. For example, recognition and initial management of hypoxemia is the same in most disease areas, including COVID-19, tuberculosis, and pneumonia. Examples of important topics to include in protocols are:

- Recognizing hypoxemia
- Care of severe COVID-19 patients, including indications for oxygen therapy and indications for dexamethasone
- Indications for transfer between health facility levels and treatment centers
- Monitoring patients receiving oxygen
- Titrating oxygen therapy
- Care of critically ill patients

Intervention — Adapt existing guidelines to the national context.
Available resources include:

- www.covidprotocols.org
- WHO COVID-19 Clinical management: living guidance
- WHO Clinical care of severe acute respiratory infections – Tool kit

Intervention — Convene interdisciplinary working group to review reference guidelines and draft and validate national guidelines with appropriate adaptations to available resource levels and facility levels when indicated.

Intervention — Publish and distribute protocols to facilities, coupled with trainings to improve HCW knowledge and capacity (see strategy 4.2).

Intervention — Develop and distribute implementation tools to support protocol uptake, such as single page flow charts for key clinical processes including oxygen titration. Consider poster-sized flow charts for display in clinical areas at COVID-19 treatment facilities.

Intervention — For mobile health and point-of-care EHR systems, integrate and implement protocols as job aids and alerts

Strategy 4.2: Develop a national training strategy to train HCWs on the management of hypoxemic COVID-19 patients

Intervention — Adapt and develop a training curriculum for identification, monitoring, and management of hypoxemic patients incorporating national and standardized clinical protocols.
Available resources include:

- WHO Clinical management of patients with COVID-19 - General considerations
- www.opencriticalcare.org
- www.covidprotocols.org.

Content should include:

- Basic pathophysiology and clinical signs of hypoxemia
- Basic epidemiology, pathophysiology, and clinical course of COVID-19
- Patient assessment and indications for oxygen therapy
- Use of pulse oximetry to monitor patients with COVID-19
- Prone positioning for COVID-19
- Oxygen sources (i.e. cylinder, wall oxygen, and concentrator)
- Oxygen administration interfaces (e.g. nasal cannula, simple facemask, non-rebreather facemask)
- Oxygen titration guide by pulse oximetry

Intervention — Adapt and develop a training curriculum for advanced management of hypoxemic patients in emergency departments and intensive care units (if applicable).
Available resources include:

- www.opencriticalcare.org
- www.covidprotocols.org.

Topics to be covered include:

- Respiratory failure (hypoxemic and hyperbaric)
- Non-invasive ventilation
- High flow nasal cannula
- Indications for intubation
- Airway management
- Mechanical ventilation

Intervention — Incorporate hypoxemia management job aids into community and clinical health eHealth applications.

Intervention — Determine mode(s) of content delivery (live remote learning, learning management system, in person lectures, bedside teaching, simulation, etc.). Ideally, training curricula should include didactic based modules as well as clinical mentorship and supervision.

Intervention — Plan for which facilities should receive the basic and advanced curricula.

Strategy 4.3: Identify and train master trainers/clinical mentors

Trainers and clinical mentors are important for initial training delivery as well as for ongoing support of clinical staff. When possible, build the capacity of existing staff to improve long-term health systems strengthening.

Intervention — Conduct a training of the trainers for at least one nurse and one clinician from every target facility. Equip trainers with the needed supplies and tools to carry out training at their own facilities.

Intervention — Facilitate communities of care with ongoing mentorship for facility level trainers. Examples of communities of care include development of WhatsApp groups to address questions and provide continuing support. Encourage mentors to establish similar communities at their own

facilities, as well as to establish ongoing continuing education through case review and discussion.

Intervention Instruct master trainers on effective strategies for bedside teaching. Develop checklists and protocols to facilitate bedside supervision (see PIH Mentorship and Enhanced Supervision for Healthcare and Quality Improvement (MESH-IQ))

Strategy 4.4: Train and mentor HCWs caring for hypoxemic patients

Intervention Deliver trainings from master trainers to all trainees at target facilities. When considering who to train, consider the need to cross-train staff to cover facility needs in the event of surges and/or staff outbreaks.

Intervention Provide ongoing mentorship and support through a longitudinal mentorship system. Plan for refresher training at least annually, or more frequently if needed.

Intervention Periodically monitor training impact through assessments of trainee knowledge and confidence.

Objective 5: Adequate availability of clinical equipment and supplies to care for hypoxemic patients with COVID-19 and other respiratory illnesses

A range of inexpensive diagnostic and therapeutic supplies are needed for COVID-19 patients to benefit from life-saving oxygen therapy. Facilities frequently lack basic essential equipment, limiting the ability to deliver oxygen even when oxygen supply is sufficient. It is essential that healthcare facilities are supported by the necessary equipment, supplies, and supporting systems to diagnose and treat hypoxemia.

Strategy 5.1: Develop and implement oxygen formularies adapted to national guidelines and facility level.

Intervention Convene an interdisciplinary working group to review existing equipment and supply lists and develop a master oxygen formulary list, adapted to national treatment guidelines and to facility level. Lists should include separate components for biomedical equipment (pulse oximeters, vital sign machines, ultrasounds, patient monitors), consumable supplies (oxygen tubing, nasal cannula, and face masks) and medications relevant to the care of severely ill COVID-19 patients (dexamethasone). The biomedical and consumable equipment relevant for the care of severely ill COVID-19 patients is the same as that required for the care of other severely ill hypoxemic patients; for this reason, we recommend a unified approach to oxygen formularies wherever possible, with disease specific adaptations to medications when needed.
Available resources include:

- WHO Model Lists of Essential Medicines
- WHO COVID-19 essential supplies forecasting tool (COVID-ESFT)

Intervention Identify essential equipment on the formulary where equipment redundancy is important in the event of a failure. For example, redundancy in oxygen supply, pulse oximeters, and in basic oxygen delivery equipment is essential to avoiding gaps in treatment of COVID-19 patients in the event of stock outs or equipment failures.

Intervention Implement supply chain forecasting system and create processes for emergency procurement of essential commodities to address stock outs.

➔ See PIH supply chain toolkit for more information on supply chain forecasting and procurement processes

Intervention Assess current needs through a commodity and equipment availability and needs assessment for all facilities. When possible, leverage patient-level data systems such as EMRs for needs assessment analysis, for example, to determine the volume of hypoxic patients.

Strategy 5.2: Facilities implement measures to make equipment immediately available to clinicians caring for COVID-19 patients

Even when supplies and equipment are available at a facility, they are not always immediately accessible to HCWs. For hypoxemic COVID-19 patients, treatment delays can be fatal. Governments and facilities should ensure that equipment is accessible and ready to be used, and remove barriers to equipment use for the care of severely ill patients, including user fees.

Intervention — Implement an organized storage area for essential equipment in all COVID-19 clinical areas. Storage areas should be easily accessible from COVID-19 suspected and confirmed wards, but should be designed with IPC procedures in mind so that equipment and supplies do not become contaminated.

Intervention — Distribute and implement appropriate equipment cleaning and reuse guidelines in facilities. Implement protocols to ensure timely processing of dirty equipment. (e.g. ensuring any equipment cleaned with chlorine is properly washed and dried according to WHO guidelines) WHO guidelines for cleaning and disinfection of environmental surfaces in the context of COVID-19

➔ See PIH IPC guidelines for ensuring infection prevention within facilities

Intervention — Clinicians have access to a simple mechanism for reporting stockouts

➔ See PIH supply chain toolkit for managing and reporting stockouts

Intervention — Where relevant, facilities establish emergency stocks of critical supplies accessible to clinicians off hours, for example, with a back-up supply or medication room containing a small stock of critical consumables or drugs.

COST CONSIDERATIONS:

Objective 1:

- Costs related to oxygen needs assessments (travel costs, meetings costs)
- Oxygen strategic planning meeting or workshop costs

Objective 2:

- PSA plant installation costs
- Large and small oxygen cylinders
- Extra oxygen cylinders for backup supply
- Upgrades for electricity infrastructure
    - Generator fuel (if required)
    - Oxygen piping network installation
    - Materials costs
    - Costs for international contractor
    - Y blocks for outlets
- Training for staff on use and safety for oxygen pipeline systems
- Concentrators (Airsep, Devilbiss for example)
- Voltage/surge protection devices
- Slitters and other supplemental equipment
- Solar microgrid powered portable concentrators
- Trainings for staff on operation and maintenance of portable concentrators
- PSA oxygen cylinder filling plant
- Oxygen delivery trucks, staff, and fuel

Objective 3:

- Trainings on maintenance for PSA air compressors
- Printing and distribution of Aiar Compressor Troubleshooting Guide
- Training on PSA components and general plant maintenance
- Refresher training on oxygen safety
- Refresher training on pipeline and outline maintenance
- Refresher training on oxygen compressor preventive maintenance and repair
- Print and distribute hard copies of operation, service, and parts manuals for specific equipment
- Print and distribute vendor and technical support contact list for equipment
- Spare parts and consumables for PSA plants
- Spare parts kits for oxygen cylinder filling compressors
- Spare oxygen outlets, outlet maintenance kits, spare flowmeters
- Oxygen analyzer for all facilities with PSA plants and portable concentrators
- Spare pressure regulators and flowmeters for oxygen cylinders
- At least 1 spare cabinet and 4 product filters for each concentrator
- Spare power cables and fuses
- Other spare parts (circuit board, compressor service kit, capacitor, solenoid valves)

Objective 4:

- Costs for interdisciplinary working group meetings
- Printing and distribution of clinical protocols for safe management of hypoxemic COVID-19 patients
- Printing / publishing costs for flow charts, posters of clinical processes including oxygen titration
- Print protocols as job aids or other alerts
- Training of trainers/clinical mentors (1 nurse and 1 clinician for every target facility) on caring for hypoxemic patients
- Tools and supplies for trainers on caring for hypoxemic patients
- Development and printing of checklists for supervision
- Costs for trainings from master trainers to all trainees at target facilities on caring for hypoxemic patients
- Refresher trainings on caring for hypoxemic patients
- Costs for monitoring training impact via assessments of trainee knowledge

Objective 5:

- Convene interdisciplinary working group to review existing equipment and supply list (meeting costs)
- Meetings costs for formulary and supply chain forecasting for oxygen
- Costs for storage area for essential equipment

RESOURCES:

- Improved oxygen systems for childhood pneumonia: a multihospital effectiveness study in Papua New Guinea
- PATH Baseline Assessment Manual
- COVID-19 Facility Assessment Resources
- Every Breath Counts COVID-19 LMIC Oxygen Partners
- PATH Quantification and Costing Tools
- Open Critical Care Demand Calculator
- OGSI size estimator based on beds and critical care beds
- UNICEF Oxygen System Planning Tool
- PATH Electricity Planning Guide
- How to set up an oxygen flow splitter
- Every Breath Counts COVID-19 LMIC Oxygen Partners - Google Sheets
- PATH|CHAI Equipment Market Report
- PATH Costing Tool
- PATH Procurement Guide
- Oxygen sources and distribution for COVID-19 treatment centres
- PATH resource on Oxygen Access and Reliability
- WHO PSA Plant Specifications
- Assist International
- Hewatele
- BHI/Tuck school distribution model
- OpenO2
- Sollatek
- OxBox concept from BHI
- WHO technical specifications for oxygen concentrators
- Novair
- Maxtec UltraMaxO2
- www.covidprotocols.org
- COVID-19 Clinical management: living guidance
- Clinical care of severe acute respiratory infections – Tool kit
- Clinical management of patients with COVID-19 - General considerations
- www.opencriticalcare.org
- www.covidprotocols.org
- WHO Model Lists of Essential Medicines
- Cleaning and disinfection of environmental surfaces in the context of COVID-19
- PIH Mentorship and Enhanced Supervision for Healthcare and Quality Improvement (MESH-IQ

CONTRIBUTORS

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INTRODUCTION

Community-based responses COVID-19 must be designed to protect healthcare workers, interrupt the virus, mitigate disruptions to existing health services, and safeguard the most vulnerable from both disease and the financial consequences of illness. Investment in community health coverage is necessary not only for a rapid and effective community response to COVID-19, but will also strengthen global preparedness for the next global health crisis.

Due to their connectedness to communities and health facilities, community health workers (CHWs) are particularly well positioned to promote engagement, awareness and behavior change at the household level. CHW cadres often already provide integrated screening and treatment or care management for HIV, TB, and Malaria. Existing CHWs are now incorporating COVID-19 tasks in their workflow of screening, referral, and linkage to care, and many countries are considering expanding this workforce through "surge" hiring.

Strong community-based responses to COVID-19 have been met with several challenges. Many programs have experienced commodity and equipment shortages, including PPE shortages for CHWs and equipment for disease monitoring (pulse oximeters, non-touch thermometers, etc.). Logistics for patient transportation to facilities have been poor, and access to case and patient-level data has been insufficient, particularly in areas without fully operational digital systems for data. CHWs have been asked to add additional tasks such as contact tracing to their often already-heavy workloads, without being properly compensated or supported with transportation or other logistics.

As first-line responders, CHWs have experienced significant role-related stress during the pandemic, fearing infection, financial uncertainty and burnout. Prioritization of CHW payment, increasing the number of CHWs during health crises, and prioritizing protection of CHWs via adequate PPE, vaccination, and mental health services is essential as countries continue to respond to the COVID-19 pandemic and health crises to come.

GOAL: Engage community members and strengthen community-based systems to save lives by preventing, detecting, and responding to COVID-19 and sustaining essential health services during the pandemic.

ACRONYMS:

ART	Antiretroviral Therapy
CHW	Community Health Worker
IPC	Infection Prevention and Control
PPE	Personal Protective Equipment
RDT	Rapid Diagnostic Test
WHO	World Health Organization

OBJECTIVE 1: Build national institutional capacity to scale up coverage of community health programs during, and beyond, COVID-19.

Strategy 1.1 Align the national COVID-19 response plan with the national community health strategy.

Intervention — Conduct a community-based and participatory rapid needs assessment, attending to both immediate COVID-19 needs and remaining needs for HIV, TB and malaria, and involving key and vulnerable populations (KVPs) in conducting the assessment as well as offering perspectives.

Intervention — Identify how different cadres of community health workers and community-based organizations will provide different activities and interventions for integrated disease areas.

Intervention — Collaborate with community-based organizations, national stakeholders and government structures to identify gaps in coverage of community level human resources. Forecast and plan for increased "surge" hiring at the community level.

Intervention — With participation from CHWs and community-based organizations, develop multilevel curricula for training programs, procedures and protocols for integrated disease screening, referral, linkage and care for all community-based human resources and organizations.

Intervention — Along with existing mechanisms for managing community health at the national level, identify an institutional home for planning the national COVID-19 response plan, preferably with representation from relevant government and ministry of health structures, civil society, community-based organizations and interested stakeholders.

For guidance on scaling high-quality community health worker programs, please see:

- Community Health Academy: Strengthening Community Health Worker Programs

Strategy 1.2: Establish and then strengthen national systems for data collection, data use and quality improvement for community health workers and community level interventions.

Intervention — Review and revise existing key performance indicators to assure they align with the COVID-19 landscape (i.e. burden of disease, access and impact of community health interventions) keeping in mind integration, accessibility and usability of data collection tools.

Intervention — As possible, devise and develop digital tools to serve both patient care workflows (through decision support, checklists, disease identification, etc.) and guide reporting and analytics for evidence-based planning and prioritization.

Intervention — If digital tools are not possible nationwide, devise and develop paper based options that align with digital tools, as above. Support data input from paper to digital systems with strong data quality systems.

Intervention — Establish, or strengthen, the national process for reviewing community health data and developing quality improvement strategies with district level leadership and governance and engaged partners.

For guidance on incorporating digital solutions for COVID-19, please see:

- Johns Hopkins Researchers Publish Assessment of Digital Solutions for COVID-19 Response in Low- and Middle-Income Countries

Strategy 1.3: Conduct a financing gap analysis of resources needed to support a surge in the community health workforce to combat COVID-19, and plan how to sustain key commitments over time

Intervention — Conduct a comprehensive costing exercise for community health and prioritize, with inputs from national technical working groups, forming an approach for securing new funding.

Intervention Work with partners to ensure technical assistance for implementation readiness, public financial management, supply chain strengthening, and disease surveillance for long-term health system building.

Intervention Create a long-term comprehensive community-based human resource plan so as to ensure proper compensation, supportive supervision and integration into the primary health care model.

For more guidance on community health financing, please see:

- Community Health Academy: Financing Community Health Programs for Scale and Sustainability

OBJECTIVE 2: Protect Community Health Workers on the front lines of COVID-19 response

Strategy 2.1: Provide an adequate and reliable supply of personal protective equipment (PPE)

Intervention Develop and ensure complete and comprehensive CHW registries which are integrated with existing health information systems. This will form the basis for which CHWs may be included in PPE and vaccination projections and distribution. (See CGDev Note "Protecting Community Health Workers: PPE Needs and Recommendations for Policy Action".)

Intervention Improve communication between forecasting groups, decision makers and community-based health workers so as to have a feedback loop on what is working, challenges and future needs. This can be linked to national coordinating mechanisms.

Intervention Quantify CHW PPE needs based on exposure risk of their tasks, not based on formal hierarchy. CHWs conducting contact tracing and home visits in the community as well as any facility-based CHWs should have regular access to a supply of PPE. Forecast PPE needs based on number of health workers and volume of health work, per established care protocols and guidelines.

Intervention Provide clear guidance on mask-reuse if needed, depending on supply (i.e. quarantining/ decontamination of masks, N-95 mask reuse guidance, etc.)

Intervention Provide training on and materials for safe handling of PPE waste. Provide materials and systems for CHWs to dispose of PPE, such as sealable containers or bags for waste collection that CHWs can bring periodically to health facilities.

Strategy 2.2: Provide CHWs with timely access to vaccination.

Intervention Include any CHW with COVID-19 exposure risk, regardless of their title or salary, in the same vaccination priority wave as other health care workers.

Intervention Utilize updated national CHW registry to identify and reach CHWs with COVID-19 vaccination.

Example PPE Packages for Community Health Workers:

For household visits without contact:
- Surgical or cloth face mask (preferably both)
- Hand hygiene kit of soap, alcohol rub

For household visits in contact with household members:
- All items above (mask; hand hygiene kit), plus-
- Face shield
- Gown
- Gloves

For interactions with identified COVID-19 contacts, suspected, or confirmed cases:
- All items above (mask; face shield; gown; gloves; hand hygiene kit), plus -
- Full coveralls
- Consider N95 or similar mask

For interactions with identified COVID-19 contact, suspected or confirmed cases during aerosolizing procedure (nasal swab, nebulizer, etc.):
- N95 mask at all times

For learn more about ongoing international efforts to protect CHWs, please see:

- COVID-19 Action Fund for Africa: CAF-Africa

OBJECTIVE 3: Accelerate community health coverage for COVID-19 at the district or county level by designing programs built to deliver quality and value

Strategy 3.1 Support district level teams to contextualize and successfully implement national level community health strategies.

Intervention	Identify and map active and inactive community governance structures, organizations and networks (e.g. community health teams, community action committees, etc). to participate in district level planning and implementation
Intervention	Create or strengthen multi-stakeholder district platforms for community health planning and review, incorporating members of community-based organizations and networks. Strengthen linkages between communities and formal health systems.
Intervention	Through multi-stakeholder district platform/s, conduct a CHW-AIM assessment of each CHW program to identify the level of functioning and opportunities for improvement.
Intervention	Support community-led development/revision of strategies, plans, tools, resources and messages for social mobilization.
Intervention	Produce implementation plans for district level including activities, integration between work streams and primary facilities and timelines.
Intervention	Contextualize national protocols and job aides to the local community health program.

Strategy 3.2 Ensure hiring of surge capacity CHWs that target the populations most affected by COVID-19, HIV, TB and Malaria

Intervention	Identify coverage gaps. With the multidisciplinary community health technical team described in Strategy 1.1, forecast community-level human resources for health that will be necessary to

sustain baseline services while rising to meet the needs of COVID-19 service delivery (e.g. location, number, distribution, workload, burden of disease, etc.).

Intervention — Plan recruitment to address coverage gaps, including number of CHWs, location, distribution and scope of work. Design recruitment to cover immediate COVID-19 service needs, while simultaneously maintaining and strengthening essential care delivery systems for acute and chronic diseases.

Intervention — Involve community representatives (especially from key and vulnerable populations (KVPs)) in the recruitment of new CHW cadres and staff from the communities in which they live, per national and local strategic plans.

Strategy 3.3 Develop comprehensive and integrated CHW training programs that include initial onboarding and frequent refresher trainings.

Intervention — Develop or adapt existing training programs to incorporate integrated disease approaches and content on COVID-19. Focus on practical knowledge and skills such as training on how to use job aids, treatment protocols and pathways to integrate care.

Intervention — Utilize community voices and recommendations as much as possible, and involve district leaders and primary health care teams.

Intervention — Assess the quality of existing community health training in the country. An ideal program should include: disease based education, linkages to the formal health care system, referral and treatment pathways, psychosocial support with treatment adherence options, initial counseling and conflict management, program indicator input and review with defined deliverables and expectations.

Intervention — Leverage program indicators and qualitative reviews to evaluate ongoing training and support to create relevant and up to date refresher trainings. For example, if the programmatic indicators show poor HIV patient follow up and a decrease in retention in care, utilize refresher trainings to learn about barriers and challenges from community members and CHWs, and then work together to form plans to strengthen pathways and create processes of continuous quality improvement.

For more training resources for CHWs regarding COVID-19 please see:

- Community Health Academy: COVID-19 Digital Classroom Course Series

Strategy 3.4 Fairly compensate existing and surge capacity CHWs for their work, commensurate with their effort and based on national guidelines for workforce payment or compensation.

Intervention — Work with community teams, district leadership and primary health teams to establish or ensure delivery of fair and consistent compensation and incentives for community-based structures, CHW cadres and other staff down to the lowest level.

Intervention — Prioritize remunerating existing and new CHWs via cash (or electronic) payments for full time or part time work, such that they are enabled to have the time available to focus and perform at a high level.

Intervention — Provide financial risk protection to CHWs (i.e. paid sick leave). This is especially relevant during the COVID-19 pandemic, when informally employed are particularly at risk for catastrophic health expenditures. This will also help ensure that CHWs who feel ill do not feel compelled to work, and thus inadvertently expose community members to COVID-19.

Intervention — Provide overtime, hazard or additional overtime payments to CHWs per national guidelines for health care workers. CHWs are likely to take on more tasks during times of health crisis and proper remuneration can help prevent attrition.

Strategy 3.5 Enhance supervision of existing and surge capacity CHWs to ensure they can perform ongoing tasks with excellence and fidelity, while managing increased COVID-19 workload and work adaptations.

Intervention	Provide all CHWs with adequate supervision. If surge capacity CHWs are hired, increase the number of supervisors to maintain adequate ratios. Consider promoting experienced and high performing CHWs to supervisor roles.
Intervention	Define supervision and mentorship activities, including for COVID-19 work flow adaptations. Ensure expectations are documented regarding frequency of communication, elements included in supervision meetings.
Intervention	Clarify how CHWs and supervisors can best be in contact. For example, meetings be conducted remotely via phone or tablet if in-person meetings are not safe or feasible due to COVID-19. Invest in cell phones and data for CHWs to facilitate this remote supervisory contact.
Intervention	Include supervision and mentorship human resources and operational costs in all planning and budgeting exercises. This includes maintaining appropriate ratios during surge capacity hiring, transport logistics for in-person meetings, and procuring supervision tools such as paper or digital tools, cell phones, airtime or data bundles, charging solutions for phones, etc.
Intervention	Describe expectations, tasks, and training plans for each cadre in planning documents. Supervisors should have clarity on their scope of work, when they are scheduled to be on-call, and the tools available to them.
Intervention	Train new supervisors on management, leadership and supervision with feedback, and on how to manage protocols/checklists for supervision so as to give constructive structured feedback. Provide existing supervisors with refreshers on these topics and on COVID-19 tasks and adaptations.
Intervention	Create remote communication pathways between supervisors and CHWs that allow for immediate responses to questions, challenges and issues that arise. For example if a CHW finds someone in the community with suicidal ideation, they should be able to contact their supervisor to collaborate on referral, advising and troubleshooting.

Strategy 3.6 Procure and distribute all diagnostic, treatment, linkage and supplies required for CHWs to safely and effectively carry out their responsibilities.

Intervention	Utilize population and epidemiological data to quantify demand of diagnostic and treatment supplies for CHWs including linkage and primary care system inputs to provide an essential health care package for COVID-19, HIV, NCDs, TB, malaria, childhood illness and malnutrition, etc.
Intervention	Integrate community health forecasting, procurement, and distribution with national and district processes. Identify instances in which local private supply chain systems will be more efficient to procure certain supplies and equipment.
Intervention	Utilize input from community structures, primary health care facilities and CHWs on best practices for monitoring supply and developing local supply chain logistics from primary facilities to community level care.
Intervention	Include PPE and hygiene materials in all CHW supply forecasting, procurement, and distribution.
Intervention	Work with technical teams and CHWs to identify protocols and communication chains on consumption and replenishment of supplies and diagnostics.
Intervention	Equip new CHW with key supplies, communication tools, and other resources needed for their job function and comparable with similar existing roles. For example ▪ job aides and equipment (such as pulse oximetry, stethoscope, simple diagnostic tools, etc) ▪ data collection tools (paper and/or digital) ▪ communication tools (for example: toll free number, cell phone, support help desk) ▪ logistics for travel (transport funds, bicycle, motorbike, etc.)

- appropriate PPE and hygiene materials (see Objective 2 above)

OBJECTIVE 4: Engage and support communities to prevent, detect, and respond to COVID-19 at the community level: the role of community-based organizations and community health workers

Strategy 4.1: Create and support actionable mechanisms for community-based organizations to lead monitoring, advocacy and research

Intervention — Develop community action plans in conjunction with local leaders. Opening up opportunities for community leaders and structures to take the lead in prevention, response, and mobilization efforts (e.g., vaccination campaigns) can prompt a "collective urgency" that can translate into community mobilization and efficacy.

Intervention — The community action plans can best be formed through formal mechanisms for assuring wide representation from community leaders, especially leaders from different sub-communities and key and vulnerable populations (KVPs) that may happen to share a geographic space with others (i.e. the LGBTQ+ community within the community of an impoverished urban space).

Intervention — Avoid CHW tokenism, as per the "Ladder of CHW Participation." CHW advocates can lead community mobilization and participation when they have the opportunity to control how meetings are run, and the power to make substantive decisions. See CHWadvocates.org for more information.

Intervention — Consider recruiting and training persons recovered from COVID-19 as specialized CHWs to deliver psychosocial support and/or advocate for the rights of COVID-19 patients.

Intervention — Incorporate the WHO Global Risk Communication and Community Engagement indicators into country M&E plans and data-driven decision-making.

For more information on community-based health care strategies please see:

- Unicef: Community-based health care, including outreach and campaigns, in the context of the COVID-19 pandemic

Strategy 4.2: Assure reliable information and risk communication is readily available, and informs all other activities

Intervention — Provide an initial orientation for all existing and new CHWs introducing COVID-19, transmission, prevention, signs and symptoms (dispelling rumors within the workforce and preparing CHWs to speak with patients).

Intervention — Empower CHWs to conduct COVID-19 education in the community. Door to door communication can be done safely and effectively if precautions are taken. When adequate physical distancing is possible, it may be effective to utilize existing ongoing outdoor gatherings, such as the distribution of supplies, to conduct outreach and education.

Intervention — Explore the deployment of new digital tools, such as chat-bots for COVID-19 questions, to serve both the general population and CHWs.

For more information, please see:

- GOARN RCCE "Tips for Engaging Communities during COVID-19 in Low-Resource Settings, Remotely and In-Person"

Strategy 4.3: Shield vulnerable communities from health and economic shocks of COVID-19

Intervention — Create neighborhood councils of community leaders, CHWs, and members of key and vulnerable populations (KVPs) to help identify those worst affected by the pandemic (not only those infected), while protecting their privacy and confidentiality.

Intervention — For those identified, provide immediate social support (such as cash transfers, food or rent support) at the household level. A robust and trusted neighborhood council will be critical for

maintaining transparency around, and community support for, such programs.

Intervention — Coordinate plans for social support in the national government COVID-19 response coordinating body, including community-based organizations and funding partners.

Strategy 4.4: Detect and report COVID-19 cases at the community level

Intervention — Train and equip CHWs to screen for COVID-19. This can include verbal screening for COVID-19 symptoms, and referral to care for concerning cases.

Intervention — Consider equipping CHWs who normally provide curative care (i.e. via the iCCM protocols) with rapid-diagnostic tests, in cases where adequate N-95 masks and other PPE are available. Link suspected cases to confirmatory testing within 24 hours where possible.

Intervention — Leverage mHealth platforms and digital tools for use in early detection and containment. Applications include early warning systems, epidemiological surveillance, and contact tracing.

Intervention — Consider incorporating contact tracing training in CHW activities or hiring new dedicated CHW contact tracers (and/or other laypersons if CHWs not available in appropriate numbers). While contract tracing is difficult to sustain after early stages of a pandemic, experience with Ebola suggests that it was more operationally feasible and effective in rural areas. As contact tracing is labor intensive, impact is most likely when CHWs receive substantial supportive supervision, with integrated reporting structures.

Intervention — For CHWs already engaged in surveillance, expand community event-based surveillance to incorporate content on COVID-19. Use mHealth and e-learning platforms and tools to accelerate uptake. See Strategy 1.2 above.

Strategy 4.5: Equip CHWs to respond to potential COVID-19 cases and provide case follow up for confirmed COVID-19 cases.

Intervention — CHWs can Encourage self-isolation for potential mild COVID-19 cases. See example guidance for Home Based Care for COVID-19 in Kenya.

Intervention — Support CHWs to guide caregivers on home based treatment of mild cases and escalate care for severe cases in a timely manner. Provide materials for symptom management such as paracetamol, fluids/ORS.

Intervention — Provide oximeters for home based care of people with potential mild COVID-19. CHWs can encourage and facilitate early referral to care at the first signs of hypoxia. Timely access to treatment such as intravenous steroids and/or oxygen can be life-saving.

Intervention — If CHWs are not available, family members and neighbors can be trained to screen for COVID-19, follow oxygen levels, and call for referral to the health system. In all cases, referrals can be facilitated with transport support, such as transport reimbursement or ambulance services.

For up-to-date information on COVID-19 protocols, please see:

- Brigham and Women's Hospital, PIH, Open Critical: covidprotocols.org

Strategy 4.6: Integrate routine community health services and community case management for Malaria, TB, and HIV with COVID-19 workflows.

Intervention — Modify protocols, guidelines, and training curricula for chronic diseases such as HIV and NCD and infectious diseases such as TB and Malaria in the COVID-19 context

Intervention — In the case of "no touch policy" for CHWs, ensure clear communication and training for CHWs and supervisors on policy and modified protocols in order to ensure the continuation of high quality HIV, TB, Malaria services.

Intervention — Assess if key tasks can be transferred from the primary care facility level to CHW and community-based structures. For example, if adaptations allow people with HIV to visit the health center every 6 months instead of every 3 to minimize risk of COVID-19 exposure, CHWs

might be tasked to follow up for side effects and adherence at 3 month intervals.

Intervention Harness accessible and appropriate, localized mHealth and digital tools and technologies, optimized for low-resource contexts. These tools may be utilized to monitor patients with chronic or acute disease, proactively check-in with caregivers, and assess symptoms and establish care plans when in-person interaction is not possible. Further guidance on adaptations to essential PHC services are outlined in the Core Group Home-Based Care Reference Guide for COVID-19.

Intervention Ensure the continuation of promotional activities in instances where social gatherings, drama, and community meetings are interrupted due to COVID-19. Use of posters, sketches, TV and radio announcements may be appropriate.

For up-to-date information on COVID-19 workflow resources, please see this resources:

- CHW COVID-19 Workflow Resources
- The Global Fund: Mitigation of COVID-19 Effects on HIV, TB, and Malaria Services and Programs
- The Global Fund: Examples of Community, Rights, and Gender-related Investments during COVID-19: Summary of COVID-19 Guidance Notes and Recommendations from Civil Society and Communities

Strategy 4.7: Ensure vaccination campaigns are rooted at the community level

Intervention Involve CHWs in all phases of planning and coordination, especially during the identification of priority groups for vaccination. Activities may include: involvement in national coordinating committees, conducting surveys, developing registers of people in priority groups, mapping communities, etc.

Intervention Plan for continuous community engagement, mobilization, and vaccine confidence interventions (i.e. demand generation, trust-building and educational activities). These often require orientation information, job aides and support tools (i.e., hotlines, national or international information in local context, help desk for questions), travel logistics, funding for community meetings (i.e., with local leaders, forums focus groups).

Intervention Link community leads with national and district planning for vaccination roll-out and follow-up, including logistics for vaccinators, mobilization of target populations, identity verification, patient registration, adverse events monitoring, defaulter verification and follow up.

Intervention If possible, create demand for community vaccination points on specific times and days by registering patients directly and even escorting to vaccination sites when needed. Ensure follow up and registration of second vaccination with paper based or preferably digital tools.

For more guidance on COVID-19 vaccine deployment, please see:

WHO: COVID-19 Vaccine Introduction Toolkit

Objective 5: Implement a community-based mental health and psychosocial response to the COVID-19 pandemic.

Strategy 5.1: Develop and implement plan for adapting and maintaining mental health services in the community.

Intervention Develop infection prevention guidelines and how to maintain safety in home visits.

Intervention Adapt routine mental health and psychosocial support service delivery activities to incorporate infection control.

Intervention Train CHWs to provide additional mental health and psychosocial outreach to the most vulnerable individuals, and refer to additional services as needed.

Intervention Utilize digital technology for remote care delivery including receiving and triaging requests for care, regular proactive check-ins, providing psychological services, and referral pathways.

Strategy 5.2: Establish a plan for psychosocial support of vulnerable groups (including material support) and communities.

Intervention Assist people and their families with accessing information about COVID-19 and the mental health and psychosocial impacts.

Intervention Engage families and caregivers in promoting infection prevention measures.

For more information please see:

- WHO: Mental health and psychosocial considerations during the COVID-19 outbreak

Strategy 5.3: Implement Psychological First Aid (PFA).

Intervention Establish integrated training program to train CHWs and other frontline staff to deliver Psychological First Aid.

Intervention Develop supervision and mentorship structure to support CHWs and other frontline staff on Psychological First Aid.

Strategy 5.4: Develop, strengthen, and/or integrate systems for data collection, monitoring and evaluation, and quality improvement for mental health and psychosocial interventions.

Intervention Establish dedicated roles to supporting CHW and other staff wellness and mental health needs. Dedicate staff time in collaboration with human resources and occupational health departments.

Intervention Establish peer support structure for CHWs. Conduct group and individual peer support sessions focused on wellness on a regular basis.

Intervention Conduct trainings on wellness and recognizing and addressing burnout. Develop an accessible resource library with informational materials, tools, and exercises to support one's own mental health and well-being.

Intervention Ensure access to clinical support including mental health services and establish referral pathways for staff who require additional mental health services.

COST CONSIDERATIONS

Objective 1

- Costs for needs assessment
- Costs for digital tools for patient care workflows (cell phones, tablets, etc)
- Costs for validation and printing ofpaper based data collection and reporting tools
- Costs for costing exercise, including consultant costs if necessary, travel costs, etc

Objective 2

- Objective 2:
- Training on safe handling of PPE waste
- Provision of materials for PPE disposal (sealable containers, bags for waste collection)
- Provision of PPE for CHWs, including:
    - Surgical or cloth face mask
    - Hand hygiene kit of soap, alcohol rub
    - Face shield
    - Gown
    - Gloves
    - Full coveralls

    - N95 mask or similar
- Trainings for tasks, data capture, respectful care, community engagement, integration of services, COVID-19 prevention, monitoring, contact tracing and community-based treatment with referral

Objective 3

- Costs for CHW enumeration (transport, mapping costs, etc)
- Costs for conducting CHW-AIM assessment
- Costs for validation and production of job aids
- Recruit and train additional CHWs to mitigate service disruption
- Trainings on integrated disease approaches and content on COVID-19
- Refresher trainings for CHWs regarding COVID-19
- Costs for remuneration of CHWs via cash or electronic payments
- Costs for paid sick leave for CHWs
- Costs for hazard payment or additional overtime payments to CHW
- Supervision and mentorship costs
- Provision of phones or tablets for remote supervision
- Costs for transport logistics for in-person supervision
- Paper or digital tools for supervision
- Airtime or data bundles
- Charging solutions for phones
- Training costs for new supervisors on management, leadership and supervision
  Refresher trainings for existing supervisors including COVID-19 specific tasks and adaptations
- Commodities - data systems (mobile devices, hardware, software, charing systems), PPE, hygiene supplies, education and job aides (mobile devices, paper, etc), medical equipment and consumables (pulse oximeter, Hemoglobin device and cartridges, etc), medications

Objective 4

- Costs for recruiting and training recovered COVID-19 patients as specialized CHWs to deliver psychosocial support
- Orientation costs for existing and new CHWs introducing COVID-19 topics
- Costs for deployment of new digital tools, including chat-bots
- Trainings for CHWs on COVID-19 screening
- RDTs, N-95 masks for CHWs providing curative services
- Costs for contact training tracing or costs for CHW contact tracer hiring
- Paracetamol, fluids, ORS
- Oximeters
- Posters, sketches, TV and radio announcements

Objective 5

- Training for CHWs on mental health and psychosocial outreach
- Integrated training for CHWs and other frontline staff
- Supervision and mentorship costs for CHWs and other frontline staff
- Training for CHWs and supervisors on wellness and recognizing the signs of burnout

RESOURCES:

Ballard M, Bancroft E, Nesbit J, *et al* Prioritising the role of community health workers in the COVID-19 response. *BMJ Global Health* 2020;**5:**e002550.
CGDev Note "Protecting Community Health Workers: PPE Needs and Recommendations for Policy Action"
CHW Advocates
CHW COVID-19 Workflow Resources
Community Health Academy: COVID-19 Digital Classroom Course Series
Community Health Academy: Financing Community Health Programs for Scale and Sustainability
Community Health Academy: Strengthening Community Health Worker Programs
Community Health Impact Coalition: CHW Assessment and Improvement Matrix (AIM)
Core Group Home-Based Care Reference Guide for COVID-19
GOARN RCCE "Tips for Engaging Communities during COVID-19 in Low-Resource Settings, Remotely and In-Person"
Johns Hopkins Researchers Publish Assessment of Digital Solutions for COVID-19 Response in Low- and Middle-Income Countries
The Global Fund: Mitigation of COVID-19 Effects on HIV, TB, and Malaria Services and Programs
The Global Fund: Examples of Community, Rights, and Gender-related Investments during COVID-19: Summary of COVID-19 Guidance Notes and Recommendations from Civil Society and Communities
Unicef: Community-based health care, including outreach and campaigns, in the context of the COVID-19 pandemic
WHO: Mental health and psychosocial considerations during the COVID-19 outbreak
WHO: Psychological First Aid

PIH TECHNICAL TOOLKIT:
INFECTION PREVENTION AND CONTROL (IPC)

Partners In Health

VERSION 1 | 22 APRIL 2021

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INTRODUCTION

Infection prevention and control (IPC) measures are fundamental to health systems and to reducing health care associated infections, antimicrobial resistance, and the spread of infectious diseases like tuberculosis (TB) and COVID-19 among both patients and staff at health facilities and in communities. IPC measures help address some alarming statistics: nearly 1 in 10 patients get an infection while receiving care, and more than 50% of surgical site infectious can be antibiotic-resistant (WHO guidelines on preventing surgical infections). Effective IPC measures can help reduce surgical site and other infections as well as illness among patients and staff at health facilities, but infectious disease outbreaks like COVID-19 test IPC systems and often require that they evolve to respond to clinical realities so as to effectively reduce risk of exposure and infection.

Pandemics such as COVID-19 draw renewed attention to the importance of national IPC measures and should induce health authorities to adapt policies, protocols, and plans to address these emerging threats with an eye toward preparedness for future outbreaks and health emergencies. While this guidance is informed by World Health Organization (WHO) and other international standards for IPC policies and protocols in the context of COVID-19, it also calls for including clinicians, care delivery teams, and patients from all levels of the health system to have a voice in these processes.

In clinical settings, COVID-19 poses a high risk to vulnerable patients like those with TB, HIV, and other immunodeficiency and respiratory illnesses, of developing severe disease. Clinicians and staff, too, can be at high risk of infection and transmission without sufficient and proper use of personal protective equipment (PPE) and the protocols, staff, supplies, spaces, and supports necessary to mitigate the spread of COVID-19. These considerations should be incorporated into ongoing national training plans to equip facilities and health care workers (HCW), including community health workers (CHWs), with the tools and systems to detect, respond to, and monitor COVID-19 in inpatient, clinical, and community settings. Supportive systems must also be put in place for HCWs and patients alike, such as psychological and social support for frontline workers experiencing burnout and for COVID-19 patients struggling with isolation. Investing in these systems serves both the immediate need to adapt clinical protocols to better address COVID-19 realities as well as long-term IPC preparedness and health system resiliency in the face of future outbreaks.

Screening, early detection, isolation and contact tracing are central to IPC activities and protocols, especially important during a global pandemic. Challenges such as uneven screening practices, limited number of diagnostic tests, lack of isolation spaces for suspected and confirmed COVID-19 cases, and inadequate contact tracing extend beyond facilities. National IPC response plans must therefore ensure that community members, CHWs, and local leaders are equipped to complement ongoing surveillance and contact tracing activities effectively carry out IPC activities.

GOAL Develop and implement robust IPC programs and practices backed by the appropriate supplies that protect healthcare workers (HCWs) and patients at health facilities.

ACRONYMS

BCC	Behavior Change Communication
CHW	Community Health Worker
HCW	Health Care Worker
HRH	Human Resources for Health
IEC	Information Education and Communication
IPC	Infection Prevention and Control
PIH	Partners In Health
PPE	Personal Protective Equipment
SOP	Standard Operating Procedure
WHO	World Health Organization

OBJECTIVE 1: Conduct IPC assessments to understand the current state of IPC programs and practices and determine future needs.

Strategy 1.1: Assess current IPC practices including availability of equipment, airborne isolation rooms, PPE, and staff knowledge, attitudes and practices.

IPC assessments should include both COVID-19 units and other inpatient and outpatient areas of the health facility. Though many countries have dedicated COVID-19 treatment centers, staff may encounter undiagnosed COVID-19 patients in general wards as well. In addition, IPC in general wards is essential to reducing the spread of nosocomial infections and preventing transmission of other infectious diseases, including TB and Malaria.

Intervention — Ensure that assessment results are accessible within each facility to promote quality improvement as well as aggregated regionally and nationally to identify areas for improvement. See WHO assessments - IPC healthcare facility response for COVID-19 and WHO assessment tool – rapid hospital readiness checklist adapted for COVID-19.

Strategy 1.2: Conduct gap analyses to identify training needs of health care workers.

Intervention — Include voices from all stakeholders, including community members, facility staff, clinicians, and leadership, and from regional and national bodies such as technical working groups. Gaps are often greatest for the end user, so the latter's voices are crucial to include in gap analyses.

OBJECTIVE 2: Adapt and disseminate clinical protocols and standard operating procedures (SOPs) that include COVID-19 considerations.

Strategy 2.1: Adapt regional or national policies and protocols for key IPC processes to include COVID-19 considerations.

Revised protocols should capture standards for COVID-19 wards and also address IPC in other areas of the health facility to strengthen long term IPC and reduce nosocomial infections.

Intervention — Adapt protocols for cleaning requirements for equipment, even if separate equipment is procured for isolation spaces and wards. See disinfection and cleaning guidelines on covidprotocols.org and WHO guidance on cleaning and disinfecting environmental surfaces in health facilities.

Intervention — Adapt protocols for cleaning and transport of ambulances and other emergency transport vehicles. See IPC patient transport, covidprotocols.org, PIH COVID-19 Transport Guidelines, PAHO pre-hospital EMS readiness checklist for COVID-19, and PAHO COVID-19 recommendations for pre-hospital EMS.

Intervention — Adapt protocols for stock outs and inadequate supplies, including protocols around extended use and reuse of respirators, and reusable or washable gowns. See CDC PPE supply burn rate calculator and WHO rational use of PPE for COVID-19 and considerations during severe shortages.

Intervention — Adapt protocols to allow for social distancing in staff, patient, and office spaces including limiting visitors and providing maximum capacity regulation. See IPC visitation policies on covidprotocols.org and Brigham and Women's Hospital (BWH) visitor policies.

Intervention — Specify lab turnaround times in protocols for early detection. See WHO laboratory assessment tool for laboratories implementing SARS-CoV-2 testing.

Intervention — Adapt IPC measures for specimen transportation and handling.

Strategy 2.2: Ensure that facility supplies match protocols and that supply availability is adequate, including hand hygiene stations.

Strategy 2.3: Ensure staffing is sufficient to execute protocols, including increasing numbers of cleaning staff as needed.

Strategy 2.4: Disseminate protocols and ensure designated individual or team to implement protocols at facility level.

OBJECTIVE 3: Design and implement trainings on IPC measures inclusive of COVID-19

Protocols and systems are fundamental building blocks to IPC but cannot be successful without trained and empowered HCWs who can successfully apply IPC principles. To do this, training programs must be adapted to locally-available resources and to different cadres of workers. To strengthen HCW IPC capacity:

Strategy 3.1: Implement targeted trainings developed on key IPC measures and protocols, including on the proper use of particulate respirators, donning and doffing of PPE, handwashing, rational use of PPE, safe COVID-19 vaccine delivery, and environmental cleaning and decontamination.

Intervention	Ensure trainings are accessible to multiple cadres of workers, ranging from cleaning staff to physicians. Content and delivery should be adapted to literacy and baseline knowledge.
Intervention	Ensure trainings are adapted to match locally available equipment, including type of available barrier protection (gown versus apron), type of respirator, and available cleaning and disinfection equipment.
Intervention	Trainings should be inclusive of modifications needed when PPE supplies are scarce, including clustering of patient care activities and safe extended use of respirators and other supplies. In many settings, PPE scarcity remains a reality and will likely continue to be a challenge even with new investments in PPE procurement. It is essential to equip end users with the tools needed to remain safe in these scenarios. See WHO rational use of PPE for COVID-19 and considerations during severe shortages.
Intervention	Trainings should include education to reduce stigma against people with COVID-19 and reduce health care provider concerns or anxiety about infecting themselves or others. See WHO IPC for COVID-19 Virus course, WHO COVID-19 vaccine training for health workers, and WHO COVID-19 vaccine checklist.

Strategy 3.2: Design and conduct post-training knowledge assessments either at the end of a training or by a supervisor or mentor at a later date. Include practical demonstration of IPC topics.

Strategy 3.3 Use training delivery plans that build long-term trainer capacity and support flexible staffing during surges.

Strategy 3.4 Develop and distribute job aids to support implementation of IPC principles. Job aids support retention of key concepts and/or function as easy references for staff to review procedures.

Intervention	Use pictorial depictions when possible. Images should be locally adapted to reflect the working environment and local culture.
Intervention	Post commonly-used job aids so they are clearly visible to staff.
Intervention	Embed job aids in digital health systems when possible. See PAHO medPPE app, PAHO infographic on how to wear a mask safely, PAHO infographic on how to wear a non-medical

fabric mask safely, and PIH guide on testing, contact tracing and community management of COVID-19.

Strategy 3.5: Develop and implement post-training monitoring systems to ensure the application of IPC measures for mitigating the risk of spread of COVID-19.

OBJECTIVE 4: Monitor ongoing IPC practices to support continuous quality improvement

Strategy 4.1: Develop and implement feedback mechanisms at the facility and regional and national levels.

Mechanisms should identify gaps in IPC practices at the facility level and feed those into regional/national decision-making processes to identify training needs, supply needs, or system needs to establish targets for continuous improvement.

Strategy 4.2: Ensure that COVID-19 specific IPC indicators are incorporated into district/national level monitoring and evaluation plans.

Strategy 4.3: Identify, support and empower IPC champions within facilities to support training, ongoing IPC monitoring, and quality improvement.

Intervention	Support IPC champions to provide ongoing monitoring of IPC adherence at facilities. See PIH Mentorship and Enhanced Supervision for Healthcare and Quality Improvement (MESH-IQ).
Intervention	Distribute materials and implement programs to train staff on supportive supervision, a skill set that builds staff capacity across disease areas.
Intervention	Develop locally adapted job aids and checklists to support monitoring of IPC practices including ongoing mentorship of staff.
Intervention	To promote successful change, allocate funds for IPC champions to carry out quality improvement activities and/or implement needed systems changes. Funds can support procurement of supplies identified over time as necessary to support improved IPC practices (for example, a cabinet to hold PPE in, or a bucket for cleaning), and/or additional training or staff development.
Intervention	To maximize impact, promote an integrated approach to monitoring and assessment activities that extends beyond COVID-19 isolation spaces to other wards and disease areas. This protects against the possibility of undiagnosed COVID-19 and also strengthens the health system in the long-term.

OBJECTIVE 5: Identify appropriate screening systems for COVID-19 and other relevant infectious disease (such as TB or Ebola) at entrances of all health facilities including primary health facilities.

See WHO assessment tool – ensuring a safe environment for patients and staff in COVID-19 health-care facilities, WHO IPC capacity assessment: health-care facility response for COVID-19, and PIH COVID-19 patient intake and symptoms screening tool.

Strategy 5.1: Designate and equip spaces for screening at health facility entrances.

Intervention	Ensure hand hygiene stations at screening sites, including plans for drainage and cleanup if needed. Ensure 70% alcohol hand sanitizer or hand washing stations equipped with soap and adequate drainage.

Intervention Provide PPE for screening staff and/or use physical barriers to separate screening staff from patients to reduce infection risk.

Intervention When designating screening spaces, ensure that a separate space is available for screening staff to take breaks, hydrate; that infrastructure for staff and patient comfort and safety is provided, and that space is set up so that IPC protocols are observed. See Transmission Prevention in Facilities in covidprotocols.org.

Intervention Ensure that patients arrive with masks, and/or provide masks if needed. Use visual and verbal education methods to ensure proper mask use by patients.

Strategy 5.2: Ensure adequate staffing for facility screening.

Intervention Account for surge staffing and turnover time needed for screening. Ensure 24-hour coverage for facilities open at night. See WHO COVID-19 Health Workforce Estimator.

Strategy 5.3: Design and implement screening questions for the facility entrance that combine screening for COVID-19 and TB to facilitate disease identification.

Intervention Design and implement protocols where patients who are unable to provide a history or answer screening questions as possible COVID-19 cases and care for them under appropriate precautions and in appropriate isolation spaces. Ensure patients can receive any needed services, including emergency delivery or surgery. See Transmission Prevention in Facilities in covidprotocols.org.

Strategy 5.4: After initial facility-based screening, implement acuity-based triage systems for all patients presenting for acute, unscheduled care.

Strategy 5.5 Deliver facility-based information, education and communication (IEC)/behavior change communication (BCC) for patients and staff.

Intervention Community health educators or existing staff to provide daily facility-based patient education on hand hygiene, mask usage, other information about protective measures for entering health facilities.

Intervention Communication via visual signs/messaging in appropriate language (or multiple languages) and visuals for non-literate patients. Considerations for visual signs and messaging:

- Ensure that illustrations represent community members
- If infrastructure allows, provide video messaging
- Include radio messaging via ‘skit’ or other engaging media
- Provide patients with take-home pamphlets

OBJECTIVE 6: Ensure adequate isolation space for suspected and confirmed COVID-19 cases.

After screening, further patient care should be conducted under appropriate IPC precautions, often in an isolation space where they can receive additional diagnostics and therapeutic interventions. Physical requirements and recommendations for isolation spaces are covered elsewhere (Cross-link to infrastructure toolkit). The operational considerations for an isolation space depend on the facility structure and layout of the isolation space. However, general considerations include:

Strategy 6.1: Ensure acuity-based triage is performed to identify critically ill patients in need of time-sensitive interventions.

Strategy 6.2 Patients should be distributed within isolation spaces. To do this, consider:

Intervention	Needs to separate patients by self-identified gender.
Intervention	Separate cases within an isolation space based on probability of disease when testing is limited or when testing turnaround times are prolonged. This helps promote infection prevention and control.

Strategy 6.3: Designate an area for critically ill patients within the isolation space. A dedicated area for critically ill patients promotes frequent staff monitoring, allows clustering of supplies for critically ill patients, and facilitates patient care.

Intervention	An area for high-acuity patients could be designated with a few beds within one larger isolation space or a separate isolation ward.
Intervention	Ensure staffing ratios for the critical care space are sufficient.
Intervention	Develop lists of essential medical equipment and medical supplies that needs to be in isolation rooms and easily accessible to the critical care area. Ensure availability of the equipment and medical supplies at all time.

Strategy 6.4: Ensure oxygen is immediately available or rapidly accessible throughout the isolation space. COVID-19 patients can become rapidly hypoxemic and need access to oxygen quickly.

Strategy 6.5: Plan for staffing within isolation spaces that reflects the length of time patients will spend there and the needed levels of care, particularly for patients waiting for testing results. In many locations, test results are delayed. In these settings, facilities should plan for inpatient levels of staffing with ratios adjusted based on level of patient acuity.

Strategy 6.6: Develop or adapt protocols for isolating infectious patients while promoting safety and dignity. Isolation protocols should consider the following recommendations:

Intervention	Promote rapid transfer between suspected and confirmed areas once COVID-19 test results return.
Intervention	Ensure sufficient materials in the isolation spaces to care for patients without cross-contaminating equipment between wards.
Intervention	Develop clear guidance for clearing patients from isolation.
Intervention	Include instructions for communicating and supporting with people in isolation, including mental health screening, services, and social support. See Objective 10 below.

Strategy 6.7: Educating family or contacts of patients in isolation about COVID-19 signs, symptoms, and addressing misconceptions.

Intervention	Encourage community members to provide support to individual and family members.
Intervention	Be aware of different emotional reactions related to COVID-19 that a person may experience.

OBJECTIVE 7: Staffing, bed occupancy, and workload considerations

Staff ratios are an often-overlooked consideration in infection prevention and control. When staff-to-patient ratios are too high, staff are pressured to adopt time-saving measures that can undercut IPC efforts – for example, quickly stepping into an isolation room without PPE, or not pausing to perform hand hygiene between patients. High staff-to-

patient ratios also lead to fatigue and burnout, which increases medical errors and IPC lapses. Strategies and interventions to address these areas include:

Strategy 7.1: Plan for the number of staff needed for given wards and facilities, considering how requirements may change under surge conditions

Intervention	Establish target staffing ratios, which will vary by area of hospital. Typically, staff: patient ratios are lower in areas that require critical care or frequent interventions, such as the emergency department, critical care areas, and operative recovery areas.
Intervention	In addition to staffing ratios, consider shift schedules and the possibility of staff illness and/or quarantine when calculating staffing needs.
Intervention	For positions where staff are continuously in PPE (extended use of PPE), consider environmental factors such as ward temperature and the feasibility of prolonged shifts. It may be necessary to increase staffing numbers to allow for more frequent breaks. See WHO technical specifications of PPE for COVID-19 and WHO rational use of PPE for COVID-19 and considerations during severe shortages.

Strategy 7.2: In addition to considering staff numbers in COVID-19 isolation spaces, assess national human resources for health (HRH) guidelines in other units and adapt staffing levels and ratios in the context of COVID-19.

See WHO health workforce policy and management in the context of the COVID-19 pandemic response.

Strategy 7.3: Encourage staffing plans and systems that coordinate across the facility to promote optimal use of staff and promote flexibility in staff placement.

It is common for facilities to have different occupancy levels in different wards, but in many places, daily staffing is fixed. This becomes particularly problematic when staff illnesses or patient surges further imbalance staff-to-patient ratios in different hospital areas.

Intervention	In the short-term, we recommend that hospital and ward leadership to coordinate and track daily staff ratios and bed occupancy. Regional and national leadership can promote this through trainings for hospital leadership and with simple paper-based tools to report and track these metrics.
Intervention	In the long-term, hospital administrators should be empowered to continually monitor staffing, bed occupancy and workload.

Strategy 7.4: Ensure adequate numbers of cross-trained staff so that they can be reassigned to COVID wards as required by patient volume and backlog of open positions.

OBJECTIVE 8: Surveillance and outbreak monitoring, including health care associated infection surveillance.

Pandemic management relies on surveillance and early warning systems to rapidly identify outbreaks and stop disease spread. Surveillance and outbreak monitoring must occur at both the community and facility levels. See WHO assessment tool - ensuring safe environment for patients and staff in COVID-19 health care facilities, WHO surveillance protocol for SARS-CoV-2 infection among health workers, and WHO protocol for assessment of potential risk factors for COVID-19 infection among health care workers in a health care setting.

Strategies to support surveillance and outbreak monitoring include:

Strategy 8.1: Ensure surveillance systems to monitor for new cases of COVID-19 in the community.

Surveillance systems that are integrated across disease types (for example, monitoring for symptoms of COVID-19 and TB) are preferred. Integrate COVID screening into existing home visit data collection, and create a specific data pipeline for rapid reporting on new cases. For more details, see community toolkit.

Strategy 8.2: Implement facility-based surveillance systems for COVID-19 for patients and staff.

Intervention — Implement symptom screening protocols for inpatients in non-COVID-19 isolation wards to assess for new or undiagnosed COVID-19 infection. See WHO guidance on IPC during health care when COVID-19 is suspected or confirmed.

Intervention — Establish surveillance systems for healthcare workers and essential staff. Surveillance systems should incorporate the following elements:

- Establish daily symptom screens for facility staff to screen for symptoms of COVID-19.
- Ensure access to testing for staff as part of COVID-19 surveillance for early detection, isolation, and mitigation of spreading the disease. Develop or adapt protocols for testing after occupational and community exposures, as well as for testing of asymptomatic staff during times of high community spread. See WHO guidance on prevention, identification, and management of health worker infection in the context of COVID-19 and WHO surveillance protocol for SARS-CoV-2 infection among health workers.
- Forecast testing needs to ensure adequate supply of COVID-19 test kits for both inpatients and any health workers who have been exposed to COVID-19 or present symptoms. See WHO COVID-19 essential supplies forecasting tool and WHO assessment tool - diagnostics, therapeutics, vaccine readiness, and other health products for COVID-19.
- Establish temporary housing solutions for staff to mitigate the risk of spread of COVID-19.

Strategy 8.3: Ensure surveillance and testing systems are closely linked to contract tracing systems to promote quarantine and monitoring of newly-identified contacts to limit spread of COVID-19.

The following resources are helpful when establishing or adapting surveillance and contact tracing systems:

- PIH contact tracing key components of successful programs
- PIH COVID-19 Contact Tracing Playbook
- WHO guidance on contact tracing in the context of COVID-19
- The first few X cases and contacts (FFX) investigation protocol for COVID-19

OBJECTIVE 9: Waste management

Waste management is a critical component of IPC. Facility level waste management is covered in the infrastructure toolkit. However, proper waste management begins even before the waste is generated. See WHO guidance on IPC during health care when COVID-19 is suspected or confirmed and The Global Fund Technical Brief on Healthcare Waste Management.

Strategies to promote sustainable and efficient waste management include:

Strategy 9.1: Promote the safe disposal of infectious waste, including the separation of infectious waste from non-infectious waste.

Intervention	Create and/or distribute national policies on waste management. Facilitate the adaptation of policies to SOPs on waste disposal at the facility level.
Intervention	Train hospital staff on waste management, including HCWs, cleaners, and grounds staff.
Intervention	Educate patients on the importance of waste management for infection prevention using posters, talking walls, other IEC strategies.

Strategy 9.2: Provide waste management supplies to health facilities.

Intervention	Ensure color coded pedal bins and disposal bags are available for use within wards to separate infectious and non-infectious waste.
Intervention	Ensure a sufficient supply of sharps containers for needles and scalpels.
Intervention	Ensure color-coded collection bins from wards and trolleys or wheel barrows to transport waste.
Intervention	Provide adequate protection equipment for workers transporting and handling waste.

OBJECTIVE 10: Ensure adequate supplies of personal protective equipment are available to end users at healthcare facilities.

Protecting HCWs from infection requires adequate supplies of appropriate PPE. Unfortunately, in many environments PPE supplies remain limited. PPE specifications and quantification are extremely detailed elsewhere. See WHO COVID-19 essential supplies forecasting tool and WHO technical specifications of PPE for COVID-19.

When considering PPE availability and use, additional principles to consider include:

Strategy 10.1: Plan and implement fit testing for N95 masks.

Strategy 10.2: Ensure that quantification reflects planned staffing levels, including considerations for surges and needs for staff breaks as described above.

Strategy 10.3 Implementation of systems at the ward level to ensure sufficient stock of supplies for end users and systems to ensure timely resupply.

See WHO rational use of PPE for COVID-19 and considerations during severe shortages.

OBJECTIVE 11: Ensure mental health and psychosocial support is available to patients in isolation spaces and to staff dealing with IPC measures during the COVID-19 pandemic.

See WHO Mental health and psychosocial considerations during the COVID-19 outbreak.

Strategy 11.1: Develop and implement plan for adapting and maintaining mental health and psychosocial support services.

Intervention	Develop protocols for communication with patients around duration of isolation, providing psychological and social support during isolation.
Intervention	Develop protocols for communication with patients around duration of isolation, providing psychological and social support during isolation.
Intervention	Train all front-line workers on essential psychosocial care principles, including communication techniques, psychosocial care principles, psychological support, and referral pathways.
Intervention	Establish integrated training program to train frontline staff to deliver Psychological First Aid.
Intervention	Develop supervision and mentorship structure to support frontline staff on Psychological First Aid.

Strategy 11.2: Provide essential psychological and social support to health care workers to prevent and address burnout with increased workload and stress during the COVID-19 pandemic.

Intervention	Establish dedicated roles to supporting staff wellness and mental health needs in collaboration with human resource and occupational health departments.
Intervention	Establish peer support structure for staff to conduct group and individual peer support sessions focused on wellness on a regular basis.
Intervention	Conduct trainings on wellness and recognizing and addressing burnout. Develop an accessible resource library with informational materials, tools, and exercises to support one's own mental health and well-being. See PIH Cross-Site Mental Health Materials.
Intervention	Ensure access to clinical support including mental health services. Establish referral pathways for staff who require additional mental health services.

COST CONSIDERATIONS

Objective 1:

- Survey costs for IPC assessments and gap analyses at facilities
- Meeting costs for IPC assessments at district and national level
- Salary support for assessment coordinator

Objective 2:

- Meeting costs for protocol adaptation and validations
- Physical infrastructure costs to allow social distancing in facilities and/or IPC protocols changes for transport vehicles
- Costs for hand hygiene stations and cleaning supplies to implement IPC protocols
- Costs for additional IPC staff and cleaning staff
- Cost for protocol dissemination (if any)

Objective 3:

- Trainings for IPC measures and protocols for multiple cadres of HCWs (cleaning staff, facility staff, physicians, nurses, etc.)
- Training of trainers
- Printing and distribution of job aids for IPC principles
- Poster board, white board or cork board for posting of IPC job aids and posters in public spaces within facilities
- Cell phones or tablets for IPC protocol digitalization

Objective 4:

- Salary funding for mentor staff providing supportive supervision for IPC practices
- Materials for supportive supervision
- Print locally adapted job aids and checklists
- Funds for IPC champions to carry out quality improvement activities, procurement of supplies (cabinets for PPE, buckets for cleaning, etc.)

Objective 5:

- Set up funds for screening stations with basic infrastructure (open side tent to allow roof for sun protection, desk, thermometer);
- Hand hygiene stations and equipment at screening entrances (pumps, soap, 70% alcohol liquid hand sanitizer)
- PPE for screening staff
- Physical barriers for screening staff
- PPE for patients (masks)
- Surge staffing for screening
- Develop and produce signs/messaging/visuals regarding screening (including posters, pamphlets, video or radio messaging, etc.)

Objective 6:

- Signage and/or barriers within isolation spaces to designate patient areas by acuity and/or gender
- Carts and shelving for equipment and supplies
- Surge staffing for isolation spaces
- Phones or other equipment to allow communication between patients in isolation and their families

- Additional costs may be needed if adaptations to facilities or oxygen infrastructure are needed

Objective 7:

- Surge staff for wards and facilities
- Printed paper-based tools to report and track daily staff ratios and bed occupancy
- Training costs to cross-train staff to allow flexible staffing between different areas of the facility

Objective 8:

- Development and printing of protocols for screening inpatients in non-COVID-19 wards
- Symptom screening materials (questionnaire, thermometer, etc.)
- COVID-19 testing kits
- Temporary housing for staff to mitigate spread of COVID-19

Objective 9:

- Trainings on waste management
- Waste management supplies (color coded pedal bins, disposal bags, sharps containers, color coded collection bins, trolleys or wheel barrows for waste transportation)
- PPR for workers transporting or handling waste
- See infrastructure section for costs for facility level waste management

Objective 10:

- PPE (see WHO COVID-19 Essential Supplies Forecasting Tool and WHO Technical Specifications for Personal Protective Equipment for COVID-19)
- Fit testing kits for N95 masks
- Cabinets and shelving to distribute PPE

Objective 11:

- Development and printing of protocols
- Trainings on psychosocial care principles, communication techniques, etc.
- Digital tools for communication (phones, tablets)
- Trainings on HRH wellness and burnout

RESOURCES:

Brigham and Women's Hospital Visitor Policies
Centers for Disease Control and Prevention (USA) PPE Supply Burn Rate Calculator
Covidprotocols.org – Facilities Management and Operations: Disinfection and Cleaning
Covidprotocols.org – Facilities Management and Operations: Visitation Policies
Covidprotocols.org – Infection Prevention and Control: Transmission Prevention in Facilities
OpenWHO Training Course: COVID-19 Vaccination Training for Health Workers
OpenWHO Training Course: Infection Prevention and Control (IPC) for COVID-19 Virus
PIH COVID-19 Patient Intake and Symptoms Screening Form
PIH COVID-19 Transport Guidelines
PIH Cross-Site Mental Health Materials
PIH Guide: Contact Tracing 101: Key Components of an Effective Program
PIH Guide: Testing, Contact Tracing, and Community Management of COVID-19
PIH Mentorship and Enhanced Supervision for Healthcare and Quality Improvement (MESH-IQ)
The Global Fund Technical Brief: Sustainable Health Care Waste Management
WHO Assessment Tool: COVID-19 Vaccine Checklist for Frontline Health Workers
WHO Assessment Tool: Diagnostics, Therapeutics, Vaccine readiness, and Other Health Products for COVID-19
WHO Assessment Tool: Ensuring a Safe Environment for Patients and Staff in COVID-19 Health-Care Facilities
WHO Assessment Tool: Infection Prevention and Control Health-Care Facility Response for COVID-19
WHO Assessment Tool: Laboratory Assessment Tool for Laboratories Implementing SARS-CoV-2 Testing
WHO Assessment Tool: Rapid Hospital Readiness Checklist: Interim Guidance
WHO Assessment Tool: Surge Planning Support Tool
WHO Cleaning and Disinfection of Environmental Surfaces in the Context of COVID-19
WHO Community-Based Health Care Including Outreach and Campaigns in the Context of the COVID-19 Pandemic
WHO Contact Tracing in the Context of COVID-19
WHO COVID-19 Strategic Preparedness and Response Plan (SPRP 2021)
WHO COVID-19 Essential Supplies Forecasting Tool
WHO Global Guidelines on Preventing Surgical Site Infections, 2nd Edition
WHO Health Workforce Policy and Management in the Context of the COVID-19 Pandemic Response
WHO Home Care for Patients with Suspected or Confirmed COVID-19 and Management of Their Contacts
WHO Infection Prevention and Control During Health Care When COVID-19 is Suspected or Confirmed
WHO Minimum Requirements for Infection Prevention and Control Programmes
WHO Prevention, Identification and Management of Health Worker Infection in the Context of COVID-19
WHO Protocol for Assessment of Potential Risk Factors for COVID-19 Infection Among Health Care Workers in a Health Care Setting
WHO Psychological First Aid: Guide for Field Workers
WHO Rational Use of Personal Protective Equipment for COVID-19 and Considerations During Severe Shortages
WHO Surveillance Protocol for COVID-19 Infection Among Health Workers
WHO Technical Specifications for Personal Protective Equipment for COVID-19
WHO The First Few Cases and Contacts (FFX) Investigation Protocol for COVID-19
WHO/PAHO COVID-19 Recommendations: Prehospital Emergency Medical Services (EMS)
WHO/PAHO Infographic: How to Wear a Mask Safely
WHO/PAHO Infographic: How to Wear a Non-Medical Fabric Mask Safely
WHO/PAHO medPPE App
WHO/PAHO Prehospital Emergency Medical System Readiness: Checklist for COVID-19

PIH TECHNICAL TOOLKIT:
INFRASTRUCTURE FOR HOSPITAL CARE AND COVID-19 CARE

Build Health International

Partners In Health

VERSION 1 | 22 APRIL 2021

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INTRODUCTION

COVID-19 mortality is highest in resource-constrained areas, which tend to have fewer hospitals, beds, ventilators, oxygen, and other resources per capita, making investment in infrastructure an essential component of a comprehensive pandemic response. A well-functioning healthcare system that addresses the needs of all patients cannot exist without well-built and maintained facilities that are adequately supplied and designed to limit the risks of disease exposure. In order to respond to the COVID-19 pandemic and strengthen clinical care administration for all diseases, investments must be made to improve resiliency in core health infrastructure.

Pandemics and health crises often push health facilities to capacity, exposing areas of infrastructural weakness. Poor or insufficient electrical power can lead to lack of additional oxygen concentrators. Without working incinerators, hospitals are unable to safely dispose of biohazardous waste. Water shortages can lead to lack of hand hygiene for staff and patients. Investment in resilient and redundant facilities is essential for the ongoing response to COVID-19, to prepare for future pandemics, and to provide ongoing care for people living with HIV, TB, and those requiring routine maternal and child health services.

Poorly planned or implemented infrastructure affects the ways in which clinical care is administered in many low- and middle- income countries (LMICs). Frequently, poorly designed or laid out infrastructure leads to unnecessary exposure to infectious diseases. Lack of storage spaces cause delays accessing clinical and biomedical supplies, harming patients. Unreliable electricity and unsafe water supplies limit equipment use and care delivery, notably affecting the availability of lifesaving oxygen. Finally, broken facilities prevent the dignified care that is essential to patient and staff wellbeing.

COVID-19 has exposed the need for strategic investments in infrastructure that meet both short emergency response needs and long term health systems strengthening goals. Investing in COVID-19 infrastructure should fulfill two objectives: a) respond to the COVID-19 pandemic by improving care quality and safety and b) address long-term health infrastructure gaps that cause unnecessary morbidity and mortality every day.

GOAL: Improve resiliency in core health infrastructure to allow quality clinical care delivery and reinforce infection prevention and control measures in order to ensure rapid response to COVID-19 and future pandemics

ACRONYMS

LMIC	Low- and middle- income countries
SPD	surge suppression devices
UPS	uninterruptible power supplies
WASH	Water, sanitation and hygiene
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization
DDA	Digital Dosing Advanced
DDE	Digital Dosing Essential
IPC	Infection Prevention and Control

BMET	Biomedical Equipment Technician
MSF	Medecins Sans Frontieres
UVGI	Upper room ultraviolet germicidal irradiation
PPE	Personal Protective Equipment
UV	Ultraviolet

OBJECTIVE 1: Ensure a safe, reliable, and resilient electricity supply at facilities to support routine and critical care of patients with COVID-19, TB, HIV, Malaria and other diseases.

Reliable and plentiful electricity is essential to providing care for COVID-19 and beyond. The assurance of safe, reliable, and resilient electricity supply directly improves oxygen availability. The cheapest oxygen source comes from bedside concentrators, which require 24/7 electricity and often fail due to poor power quality. High quality and reliable electricity availability will also enable cold chain storage and is critical for uninterrupted mechanical ventilation.

Strategy 1.1 Ensure two reliable (defined as 98% uptime) and adequately sized power sources for all secondary and tertiary health care facilities.

In many cases, generator power will be necessary to allow continuous electricity which is essential for bedside oxygen concentrators and many types of medical equipment. For COVID-19 investments, electricity sources should be prioritized for facilities being used as COVID-19 treatment centers and designed so that they can be used long-term. However, given that patients present to a wide range of facilities, investment in electricity will serve to prevent deaths at multiple levels of the healthcare system

Intervention	When solar power is not a short-term possibility, install backup diesel generators to provide an alternative to utility supplied power.
Intervention	Install primary bulk fuel storage tank with enough fuel holding capacity to run the hospital on generator power for a minimum of 5 days, more is preferred and dependent on-site location and susceptibility to natural disasters. Pipe this primary tank to a 2nd tank (see below) with in-line bulk fuel filtration for particulates and water removal. Install fuel metering device. Having a large fuel storage tank can lead to fuel cost savings through bulk purchasing or contracts.
Intervention	Install fuel storage tank sized to hold enough fuel for 48 hours of generator power. Pipe fuel from this tank directly to the generator.
Intervention	Where beneficial, install an automatic or manual transfer switch between primary and secondary power sources.
Intervention	Conduct maintenance training for generators, solar equipment, batteries, and primary electrical distribution equipment.

Strategy 1.2 Ensure safe power distribution from power source to main distribution panel to subpanels

In many older health care facilities in lower- and middle-income countries (LMICs), the primary power distribution system is disorganized and often dangerous. As facilities expand, for example to add surge capacity for COVID-19 care, this power distribution system is rarely retrofitted, resulting in electrical distribution cables that are undersized, circuit breakers that are oversized, poor ground connections, lack of ground fault protection devices, and no protection from lightning strikes. Also, typically there is no documentation or labeling of circuit breakers. These deficiencies lead to dangerous electrical hazards for staff and patients, fire hazards for the facility and equipment damage from low voltage or improper connections. Rectifying these issues can be overwhelming and fall low on priorities in very resource constrained environments, but upgrading power distribution is often an essential first step before other infrastructure improvements can be made to systems such as ventilation, cold chain, and/or oxygen production, all essential needs for COVID-19 treatment and vaccine readiness.

Intervention	Perform electrical assessment. See EMI's Electrical Design Guide & References **EMI Resource Library**
Intervention	Rectify any deficiencies found in system grounding, transformer sizing, wire sizing, wire connections.
Intervention	Produce up to date one line diagram of the electrical system.
Intervention	Where required, install a new main distribution panel or switchboard with properly sized breakers, room for expansion and with spare breakers of various sizes. Label main breakers and subpanels with permanent labels.
Intervention	Install lightning protection system if in an area with frequent storms.

Strategy 1.3: Assess and Improve Power Quality

Poor power quality frequently damages medical and laboratory equipment, including equipment for COVID-19. In many LMICs spare parts for medical and lab equipment are not readily available on the local market and in many cases this damaged equipment is never repaired. Even in a facility with a robust repair program and access to international parts sources, poor power quality results in significant equipment downtime and costly repairs. See Global Good Power Quality Challenges in Low Resource Settings

Intervention	Perform power quality assessment using power analyzer.
Intervention	Install electronic power meter with data logging capability. (example: Power Xpert Meter 2000). This is a simple intervention that can provide a facility valuable data when making decisions about their electrical infrastructure.
Intervention	Based on assessment, install equipment to reduce impact of power quality issues. Interventions essential for COVID-19 response include surge suppression devices (SPD), uninterruptible power supplies (UPS), constant voltage transformers, and voltage regulators. See EMI's Electrical Design Guide & References EMI Resource Library

OBJECTIVE 2: Ensure safe water supply that allows infection prevention and control and safe patient care

One important method for prevention of COVID-19 is handwashing, yet many health care facilities lack adequate hand washing areas for both clinicians and patients. Often facilities have challenges with intermittent water access, lack of adequate treatment of the water, and an insufficient quantity of water.

Strategy 2.1 Support existing national WASH plans.

See UN-Water Global Analysis and Assessment of Sanitation and Drinking Water Reports: National systems to support drinking-water, sanitation and hygiene - Global status report 2019

Strategy 2.2 Ensure health facilities have reliable improved sources of water and resilient supporting infrastructure in-line with WHO/UNICEF's Water and Sanitation for Health Facility Improvement Tool (WASH FIT) framework.

See A practical guide for improving quality of care through water, sanitation and hygiene in health care facilities

Intervention	Conduct well yield tests for existing wells without test data, and drill new boreholes and install pumps as needed
Intervention	Protect existing springs or dug wells
Intervention	Purchase a spare submersible pump to be kept as a backup. This is critical if the facility relies on a borehole for its primary water supply.
Intervention	Construct or install water cistern or water tower with enough capacity to store enough water to supply a health facility for general use and COVID-19 related hand washing stations for a 48 hr period.
Intervention	In facilities that have challenges with water supply, such as areas with little or no groundwater, install water flow metering devices at the main distribution point and multiple secondary branches. By regularly monitoring flow data, water leaks or wastage can be detected quickly to help conserve water. This data also aids a facility in planning and decision making around the facility's water supply. This aligns with sustainable development target 6.4.

Strategy 2.3 Water testing & treatment

Intervention	Test water sources for bacteria & parasites to ensure that COVID-19 patients do not experience secondary infection.
Intervention	Install water treatment equipment to make water potable. We have found that chemical dosing pumps (such as Grundfos DDE or DDA models) offer a simple, robust solution to treat incoming

water to a health facility with chlorine. These pumps require little maintenance and the only challenge is ensuring consistent supply of chlorine and regular testing of the water to ensure there is sufficient residual chlorine in the water.

See WHOs Guidelines for Drinking Water Quality: Guidelines for drinking-water quality, fourth edition

Strategy 2.4 Expand Water Access Points for Staff and Patients

Hand hygiene is one of the fundamental tenets of infection prevention and control, including for COVID-19. At a minimum, hand hygiene should be practiced during the '5 moments for hand hygiene.' Hand hygiene can be performed using alcohol based hand rubs or with soap and water. In many settings, supply of alcohol based hand rubs are unreliable, making soap and water the primary method for cleaning hands.

Intervention	Install additional hand washing points for staff and patients. Permanent hand washing stations will require plumbing and may be more difficult in the short term. However, facilities should identify key locations and plan for long-term hand washing stations in these locations. In the short-term, temporary hand washing stations with adequate drainage can be used. If buckets are used as drainage systems, ensure they can still be moved once full. Ensure drainage systems are designed to avoid larval breeding especially in malaria endemic regions.
Intervention	Ensure access to soap for all.
Intervention	Ensure adequate access for patients and patient families to sanitary and handwashing facilities, with special consideration taken "to meet the needs of women and girls and those in vulnerable situations" as outlined in Sustainable Development Goal 6.2

➔ See PIH IPC toolkit for further information on hand hygiene

For additional information, please see:

- WHO/Unicef WASH in Health Care Facilities Baseline Report
- Core questions and indicators for monitoring WASH in health care facilities in the Sustainable Development Goals
- Sphere Standards
- Water, sanitation, hygiene, and waste management for the COVID-19 virus

OBJECTIVE 3: Develop facilities & biomedical management systems to support procurement, maintenance, and upgrades of essential infrastructure and equipment

Facilities and biomedical equipment are essential for the treatment of COVID-19. Functioning systems are needed to ensure oxygen production and for essential clinical tools including pulse oximeters, vital sign machines, ultrasound and diagnostic equipment as well as advanced critical care equipment such as ventilators.

Strategy 3.1: Equipping and training biomedical staff

Biomedical staff in LMICs are often asked to repair a wide spectrum of equipment without specialized training and often without basic resources like the equipment operation manual. Some evidence suggests that over 60% of broken equipment could be repaired without highly specialized knowledge and without inputs of imported spare parts. See "Evidence-based approach to the maintenance of laboratory and medical equipment in resource-poor settings."

This is particularly true for equipment essential in the treatment of COVID-19 such as bedside oxygen

concentrators, pulse oximeters, and vital sign machines.

Examples of Biomedical Equipment needs for COVID-19:
Pulse oximeters
Vital sign machines
Ultrasound and diagnostic equipment
Advanced critical care equipment (ventilators, non-invasive machines)

Intervention — Purchase a set of tools and test equipment for biomedical use. Not having the right tools when trying to repair an item often leads to damaging the item.

Intervention — Purchase laptop for biomedical staff. This would enable biomedical staff to find and save equipment operation and service manuals, search for spare parts, and access the multitude of online learning resources. It also is an essential tool in being able to document repairs and develop a preventative maintenance plan.

Intervention — Fund training for biomedical staff. These could be:

- Scholarship for biomedical staff to local university BMET courses
- Online training such as offered through Medical Aid International. This particular course also includes tools, optional laptop, equipment manual library, and electronic textbooks.
- Training in management

Strategy 3.2: Equipping and training facilities staff

Facilities staff are responsible for maintaining hospital infrastructure critical to COVID-19: electricity supply, water supply, wastewater treatment systems, incinerators, and mechanical ventilation equipment. They frequently lack the necessary tools, space and training to maintain this infrastructure.

Intervention — Construct or renovate a workshop space for facilities staff. Should include tool boxes, lockable storage area, work benches, shelving for spare parts.

Intervention — Purchase set of tools and spare parts and test equipment for facilities use. Not having the right tools when trying to repair an item often leads to damaging the item.

Intervention — Purchase laptop for facilities management team. Similar to biomedical, this is an essential tool in planning, budgeting, and searching for resources to help with decision making.

Intervention — Fund training for facilities staff. This could be:

- Power distribution
- Generator maintenance
- Electrical safety
- Management

Objective 4: Improve Hospital Waste Management systems to prevent disease transmission and improve occupational safety

Strategy 4.1: Strengthen waste disposal infrastructure

Lack of waste disposal infrastructure can lead to direct health impacts on the community, safety hazards to waste management staff, and damage to the surrounding environment. The treatment of COVID-19 produces a lot of waste in the form of single use, disposable PPE. Many facilities lack or have insufficient waste disposal equipment to effectively deal with this increase in medical waste. Inappropriate waste management promotes disease spread and also poses safety risks, for example when open fires spread to nearby structures.

Guidance exists describing options for waste disposal and types of waste (Global Fund Technical Brief). In our experience, facilities often lack the funds to purchase a diesel fired incinerator and will instead choose to construct a brick incinerator. These locally built incinerators are frequently only a slight improvement over a burn pit either because of poor incinerator design or lack of strong operational systems to make them work effectively. In our experience, diesel fired incinerators, while requiring fuel and some maintenance inputs, are a good investment for hospitals and reach adequate temperatures to be able to safely dispose of biohazardous waste, sharps, and pharmaceutical waste.

Intervention	Support a facility's or region's existing waste management plan including outsourcing if necessary.
Intervention	Purchase and install diesel fired incinerators for secondary and tertiary hospitals. Where a large capacity incineration is needed, consider 2 incinerators for added redundancy. Include a full set of spare parts for oil burners, nozzle, electrode, fuel pumps, thermocouple, solenoid valves, etc.
Intervention	Purchase steel or fiberglass diesel storage tank piped to operate the incinerator.
Intervention	Construct multiple lined ash pits and unlined organic waste pits for the safe disposal of waste
Intervention	Construct a secure and lockable waste disposal area to house the incinerator, waste sorting and storage, ash pits, organic waste pits. When sizing the disposal area, take into account the continued need for future ash pits.

Strategy 4.2: Train and Equip Staff

Intervention	Train facilities staff and hospital waste management team on appropriate waste management practices
Intervention	Encourage protocols that separate infectious waste (bandages, used medical supplies, items with bodily fluids, sharps and syringes) from general waste (packaging, food waste, etc). Separation should begin at the location where waste is generated and continue through disposal steps.

➔ For more information on waste management, see PIH IPC toolkit

Intervention	Purchase appropriate durable PPE for incinerator operators and hospital waste management team.

For additional information, please see:

- Personal Protective Equipment for Waste Handlers and Incinerator Operators
- Safe management of wastes from health-care activities
- Global Fund Technical Brief: Sustainable Health Care Waste Management
- Water, sanitation, hygiene, and waste management for SARS-CoV-2, the virus that causes COVID-19

Objective 5: Provide appropriate isolation spaces to care for patients with COVID-19 and other infectious diseases and improve ventilation at health facilities to prevent spread of COVID-19 and tuberculosis.

Strategy 5.1: Construct or renovate permanent isolation wards suitable for COVID-19 and other infectious diseases

While many health care facilities had some existing isolation spaces, when COVID-19 cases increased, these spaces were either quickly overwhelmed or were in such disrepair that they were not suitable. While it's not possible to build an isolation ward with infinite surge capacity, we recommend investing in permanent isolation wards either through new construction or renovation of old isolation wards. Consider isolation ward designs that guard against multiple modes of disease transmission to allow for flexibility in future outbreaks, for example cholera or ebola, where transmission patterns may differ.

Several good resources exist on the design of COVID-19 isolation wards

- Build Health International
- Construction for Change

Intervention	Design new isolation structures so that they do not rely fully on mechanical ventilation. Things to consider: prevailing wind direction, building orientation, windows, louvers, ceiling fans, roof design, etc. • WHO Natural ventilation for infection control in health-care settings • Heating, Cooling, Lighting: Sustainable Design Methods for Architects
Intervention	Install additional windows or fixed air louvers to increase outside air ventilation and ensure that screens are properly installed and in use on all open windows, especially in malaria-endemic regions.
Intervention	Install side wall or upblast exhaust fans. Have spare fans and belts if used. If good quality exhaust fans are used and the facility has good power quality, exhaust fans are very reliable and require very little maintenance
Intervention	Install "Ball-in-the-Wall" Pressure indicator between positive and negative pressure spaces. This is a simple technology and provides a visual cue on air pressure differential. Also consider magnehelic differential pressure gauges for more accurate quantitative pressure monitoring..
Intervention	For existing isolation facilities, consider replacing low quality exhaust fans with higher quality exhaust fans.

Strategy 5.2: Improve existing hospital ventilation

The WHO has said that: "to help prevent airborne infections, adequate ventilation in health-care facilities in all patient-care areas is necessary"

Intervention	Improve airflow in health facilities at large, prioritizing high traffic areas, crowded areas, or areas where people stay for an extended period of time, such as waiting areas or patient wards.
Intervention	Utilize UV lights to supplement ventilation systems and reduce the spread of COVID-19 and tuberculosis.

For additional information, please see:

- Upper room ultraviolet germicidal irradiation (UVGI) system
- Roadmap to improve and ensure good indoor ventilation in the context of COVID-19

KEY COST CONSIDERATIONS

Objective 1

- Fuel
- Backup diesel generators
- Bulk fuel storage tanks with in-line bulk fuel filtration for particulates and water removal
- Fuel metering device
- Automatic or manual transfer switch for use between primary and secondary power sources
- Electrical cables
- Solar equipment
- Batteries
- Electrical Disconnects
- Main distribution panel or switchboard with properly sized breakers, labels for breakers
- Lightning protection system

- Power meter with data logging capability (example, Eaton Power Xpert Meter)
- Equipment to reduce impact of power quality issues:
    - Surge suppression devices (SPD)
    - Uninterruptible power supplies (UPS)
    - Constant voltage transformers
    - Voltage regulators

Objective 2

- Borehole drilling
- Water pumps
- Submersible pump for backup
- Water cistern or water tower
- Water flow metering devices
- Water testing devices/equipment
- Water treatment equipment
    - Chemical dosing pumps (such as Grundfos DDE or DDA models)
    - Chlorine storage tank
- Permanent and temporary hand washing stations
- Soap
- Drainage equipment or buckets

Objective 3

- Pulse oximeters
- Vital sign machines
- Ultrasound and diagnostic equipment
- Advanced critical care equipment (ventilators, non-invasive machines)
- Bedside oxygen concentrators
  (consider building an oxygen plant if a major District and/or regional hospital)
- Test benches
- Ultrasonic oxygen analyzer
- Digital Multimeter
- Electrical safety analyzer
- Pressure gauge and adapters
- Tool boxes
- Shelving for spare parts
- Equipment storage
- Tools and test equipment for biomedical staff
- Laptop for biomedical staff
- Trainings for biomedical staff
- Trainings for facilities staff

Objective 4

- Diesel fired incinerator or brick incinerator
- Spare parts for oil burners, nozzle, electrode, fuel pumps, thermocouple, solenoid valves
- Steel or fiberglass diesel storage tank
- Lined ash pits and unlined organic waste pits
- Digging materials
- Training for facilities staff and hospital waste management team on waste management practices

- Durable PPE for incinerator operators and hospital waste management team

Objective 5

- Windows
- Fixed air louvers
- Screens or LLINs
- Side wall or upblast exhaust fans
- Spare fans and belts
- Ball-in-the-wall pressure indicator
- Magnehelic differential pressure gauges
- UVC light fixtures

RESOURCES:

Airflow Direction Incorporated (home page)
Amazon Marketplace: Heating, Cooling, Lighting: Sustainable Design Methods for Architects
Build Health International COVID-19 Infrastructure Resources
Construction for Change COVID-19 Response Unit Prototype
Dwyer Series 2000 Magnehelic Differential Pressure Gauges
Eaton Power Xpert Meter 2000
EMI Resource Library
Global Fund Technical Brief: Sustainable Health Care Waste Management
Grundfos Digital Dosing Pumps
Malkin R., Keane A. Evidence-based approach to the maintenance of laboratory and medical equipment in resource-poor settings. Med Biol Eng Comput [Internet]. 2010 [cited 2021 April 16];48:721-726. Available from http://www2.stat.duke.edu/~banks/130-labs.dir/lab8.dir/Lab8_Malkin_paper.pdf

Medical Aid International - Biomedical Engineering
MSF Upper Room Ultraviolet Germicidal Irradiation (UVGI) System
PATH: Personal Protective Equipment for Waste Handlers and Incinerator Operators
The Global Good Fund: Power Quality Challenges in Low Resource Settings
The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response
WHO Guidelines for Drinking-Water Quality, Fourth Edition
WHO Natural Ventilation for Infection Control in Health-Care Settings
WHO Roadmap to Improve and Ensure Good Indoor Ventilation in the Context of COVID-19
WHO Safe Management of Wastes From Health-Care Activities
WHO UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) 2019 Report
WHO Water and Sanitation for Health Facility Imrpvoement Tool (WASH FIT)
WHO Water Sanitation Hygiene and Waste Management for SARS-CoV-2, the Virus That Causes COVID-19
WHO Water Sanitation Hygiene and Waste Management for the COVID-19 Virus
WHO/UNICEF Core Questions and Indicators for Monitoring WASH in Health Care Facilities in the Sustainable Development Goals
WHO/UNICEF WASH in Health Care Facilities Baseline Report 2019

PIH TECHNICAL TOOLKIT:
LABORATORY STRENGTHENING IN THE CONTEXT OF COVID-19

Partners In Health

VERSION 1 | 22 APRIL 2021

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INTRODUCTION
Functioning laboratories are a key component of effective and sustainable health systems and have played a crucial role in the global COVID-19 response. They are an essential part of rapid detection and confirmation of the virus, which is key both to optimized treatment and isolation of infected patients to prevent disease spread. Laboratories are needed for the diagnosis, prevention, control, and surveillance of diseases while supporting governments and policy makers to implement data-driven policies.

Unfortunately, in many low-and middle-income countries (LMICs), increased COVID-19 testing has put a strain on the already limited infrastructure and capacity of laboratory services, further overwhelming labs that are overburdened, understaffed and under equipped. Increased capacity in laboratory diagnostic response is needed both to continue to curb the spread of COVID-19 and simultaneously detect and curb increasing rates of HIV, TB, and Malaria.

In order to continue to efficiently respond to the pandemic, the gaps and challenges faced when providing laboratory services and diagnostics must be addressed. Resources must be allocated towards training staff and building long-term capacity to ensure resilient systems for future pandemics. Investments in equipment, including lab supplies and reagents, as well as quality control and preventative maintenance, are critical to ensuring staff have the tools needed to carry out their work. Lab infrastructure must be assessed and improved so that labs are appropriately designed, safe, and have access to a reliable source of electricity. Finally, testing supplies, lab standard operating procedures, and testing and lab systems need to be strengthened to build stronger links to clinical care and improve sample transportation and faster result turn-around times. These steps are key to ensuring that results are timely, relevant, and accurate.

GOAL: Improve resiliency in core laboratory and diagnostic infrastructure to allow for timely, accurate detection and reporting and response to COVID-19 and future pandemics.

ACRONYMS

Ag-RDT	Antigen-RDT
RT-PCR	Reverse transcription polymerase chain reaction
FDA	Food and Drug Administration
CE	Conformité Européenne
WHO	World Health Organization
UPS	Uninterruptible power supplies
HVAC	Heating, ventilation, and air conditioning.
IDSR	Integrated Disease Surveillance and Response

OBJECTIVE 1: Strengthen integrated laboratory systems to increase COVID-19 antigen and molecular testing, and support longer term laboratory capacity.

Strategy 1.1 Procure Antigen-RDT (Ag-RDT) and molecular tests for COVID-19 diagnosis, screening, and surveillance.

The choice of test depends on the reason for testing: diagnosis (identify current infection), screening (to identify infected persons who are asymptomatic) or surveillance (to monitor population-level infection and disease). Other factors to take into account include test capacity (point-of care, or high throughput), turn-around time and disease prevalence.

Intervention If necessary, conduct an in-depth needs assessment and gap analysis of the laboratories using the tool developed by WHO for developing plans to strengthen laboratories: Laboratory assessment tool for laboratories implementing SARS-CoV-2 testing (who.int)

Intervention Ag-RDT: Select tests that are approved by FDA, CE or WHO (Emergency Use Listing) and have demonstrated performance >80% Sensitivity and >97% Specificity. Select tests that are user friendly, affordable, offer good quality and shelf life, and vendors with good distribution and technical support.

Intervention Molecular Tests: Choose those tests that are approved by FDA or CE or WHO (Emergency Use Listing).

Intervention Request quality certification documents and studies, ideally validated by a third party. New products have come to market rapidly during the pandemic, underlining the importance of quality assurance.

➔ See PIH Supply Chain toolkit for more information on procurement and distribution of diagnostic tests

Intervention Roll out initial and refresher training of end users at all levels of the health system, both laboratory and clinical staff. Consider resources developed by ASLM-African Society for Laboratory Medicine.

More resources on COVID-19 diagnosis and clinical management can be found at: COVID Testing - COVID-19 Protocols (covidprotocols.org)

Strategy 1.2 Strengthen specimen transport networks for molecular testing

Intervention Building upon any networks established and maintained by corresponding MOHs and National Labs, conduct mapping of laboratory network. Identify available in-country molecular and specialized testing to serve as referral labs.

Intervention Decentralize sample collection by training teams of lower-level staff in the health system.

Intervention If logistics networks are not already established, conduct mapping of private sector transportation providers with capabilities for safe specimen transport. Consider contracting a range of transport options at different levels, scaled to the anticipated volume of samples, including motorcycle, car, and truck transport.

Intervention Provide training to sample collectors on proper collection and handling of clinical samples.

Intervention Provide sample collectors and drivers with adequate PPE and plan for surge staffing as needed

Strategy 1.3: Strengthen building blocks of the laboratory information system to respond to COVID-19 and future pandemics

Laboratory information systems should be developed to include COVID-19 results reporting while strengthening results reporting for other disease areas.

Intervention Involve both clinical and laboratory teams in design or improvement of COVID-19 reporting systems- including forms and work flow- to ensure that results can be utilized for clinical management. Results must follow the patient and reach the correct facility or care team. This is

particularly important when digital results systems do not exist. For example, if samples are collected in a hospital intake area, but patients are quickly moved to one of several wards, there must be associated workflow to ensure results make their way to the patient's new ward and care team.

Intervention Create test order forms for end users and result reporting forms for laboratory staff, in both digital and paper formats.

Intervention Ensure that lab communication is adapted to minimize turnaround time in reporting of results, leveraging shared data systems and electronic notification when possible.

Intervention Create COVID-19 modules in any existing clinical or epidemiologic platforms such as Electronic Health Records, Electronic Medical Records, and mHealth outreach tools. Where possible, link laboratory information systems to clinical information management systems and ensure care providers can act upon laboratory results.

Intervention Increase data analysis and epidemiological capacity locally. Consider training or hiring additional staff to address surges in data analysis and epidemiological surveillance needs.

Strategy 1.4 Enhance laboratory equipment management systems.

Intervention Adapt or develop programs for equipment use and maintenance following international guidelines with training for operation and maintenance for their use, and develop an annual plan for any equipment requiring certification.

Intervention Provide all relevant equipment documentation to end users and biomedical technicians: user manual, service manual, parts manual, spare parts vendor contact information, and technical support contact information (phone & email).

Intervention When selecting new equipment for purchase, consider the availability of qualified local and regional service providers. Consider service contracts for complex lab equipment where available.

Intervention Install uninterruptible power supplies (UPSs) for sensitive equipment to improve power quality, provide some surge protection, and provide backup power in case of power failure.

Intervention Provide training to facilities and laboratory staff on the maintenance of HVAC and refrigeration equipment. Purchase the necessary tools for service and repair of this equipment.

Intervention Purchase adequate equipment to ensure redundancy of critical systems in case of equipment breakdown (e.g. cold chain, ventilation, air conditioning)

Intervention Strengthen or develop an annual plan for equipment in the lab that includes daily, monthly, and annual servicing, maintenance, and warranty extensions as applicable.

➔ See PIH Infrastructure toolkit for more information on equipment management

OBJECTIVE 2: Strengthen laboratory human resources by training and supporting existing staff and incorporating temporary staff

Strategy 2.1 Proactively support the health and performance of all laboratory staff.

Intervention Forecast, procure, and distribute adequate PPE for all laboratory staff. Train laboratory staff on proper PPE allocation and usage.

Intervention Consider staggering laboratory personnel with different hours to minimize risk of infection and contact in the context of COVID-19.

Intervention Consider hiring and training new laboratory staff to allow for greater volume of services and adequate breaks for all staff. Recruit key trained personnel including but not limited to laboratory technicians and microbiologists. This will help retain staff, reduce risk, and reduce

errors. Anticipate that periods of high demand will require additional staffing and may lead to higher turnover of staff.

Intervention — For laboratory personnel who are exposed to COVID-19, provide social support such as assistance to isolate, access to food, and psychosocial support.

Strategy 2.2 Deploy a cyclical training strategy in order to train new hires and continually reinforce and refresh skills of existing staff.

Intervention — As part of the national COVID-19 strategy, convene national, district, and major hospital laboratory and clinical representatives to update the tools and systems for diagnostic testing and lab operations. This may include lab manuals, Standard Operations Procedures (SOPs), algorithms, and training materials following national and international standards in alignment with new and innovative technologies.

Intervention — Identify highly competent and motivated members of the laboratory workforce to serve as lead trainers. Engage lead trainers to carry out virtual trainings for COVID-19 procedures at all levels of the lab system, enhancing their leadership skills for future projects.

Intervention — Provide laboratory personnel with opportunities for continued learning, expanding their knowledge and skills. Key topics include: rapid diagnostic testing, molecular testing, microbiology procedures, operation of lab equipment, workflow management, biosafety practices, and quality assurance.

Intervention — Provide regular refresher trainings and tools for self-evaluation of skills to allow laboratory staff to identify their gaps in knowledge or skills and continue building key competencies.

Intervention — Train clinical teams on how to interpret test results and ensure rapid test results are built into clinical care algorithms.

Intervention — Provide additional training to select laboratory personnel on integrated disease surveillance (IDSR) strategy, using the IDSR training curriculum modules.

COST CONSIDERATIONS

Objective 1:

- FA, CE or WHO approved Ag-RDT tests
- FDA, CE or WHO approved molecular tests
- Third party documentation for quality assurance
- Refresher training for all staff and end users on COVID-19 Ag-RDT and molecular test use
- Contract costs for transportation of specimens
- Purchase of vehicles for transport (motorcycle, cars, trucks, etc)
  Fuel for specimen transfer
- PPE for sample collectors and drivers
- Validation and printing of test order forms and reporting forms
- Costs for consultant if needed for integration of COVID-19 modules into digital health platforms
- Training costs for data analysis and epidemiological surveillance
- Hiring of data analysis and/or epidemiological surveillance staff as needed
- Costs for purchase and installation of UPS
- Training on maintenance of HVAC and refrigeration equipment
- Purchase of tools for maintenance of HVAC and refrigeration equipment
- Purchase of backup equipment (cold chain, ventilation, HVAC)

Objective 2:

- Procurement costs for PPE
- Distribution costs for PPE
- Training on PPE allocation and usage
- Hiring and training of new laboratory staff during times of surge
- Costs for convening stakeholders for tool, procedure, and training material updates
- Incentives for training of trainers
- Trainings for laboratory personnel on rapid diagnostic testing, molecular testing, microbiology procedures, operation of lab equipment, workflow management, biosafety practices, quality assurance
- Refresher trainings for laboratory staff
- Trainings for clinical teams on interpretation of test results
- Trainings for laboratory staff on integrated disease surveillance strategy

RESOURCES:

ASLM-African Society for Laboratory Medicine
Assessment tool for laboratories implementing COVID-19 virus testing: Interim Guidance (who.int)
COVID-19 Strategic Preparedness and Response Plan Operational Planning Guideline (who.int))
COVID-19 Target product profiles for priority diagnostics to support response to the COVID-19 pandemic v.1.0 (who.int)
Diagnostic testing for SARS-CoV-2 (who.int)
Genomic sequencing of SARS-CoV-2: a guide to implementation for maximum impact on public health (who.int)
Global Fund COVID-19 Response Mechanism Informational Note
Guidance for laboratories shipping specimens to WHO reference laboratories that provide confirmatory testing for COVID-19 virus: interim guidance, 2 March 2020
https://www.who.int/publications/i/item/antigen-detection-in-the-diagnosis-of-sars-cov-2infection-using-rapid-immunoassays
Laboratory assessment tool for laboratories implementing SARS-CoV-2 testing (who.int)
Laboratory assessment tool for laboratories implementing SARS-CoV-2 testing (who.int)
Laboratory biosafety guidance related to coronavirus disease (COVID-19) (who.int)
Laboratory testing strategy recommendations for COVID-19: interim guidance, 21 March 2020 (who.int)
SARS-CoV-2 antigen-detecting rapid diagnostic tests: an implementation guide (who.int)
SARS-CoV-2 genomic sequencing for public health goals: Interim guidance, 8 January 2021 (who.int)
WHO reference laboratories providing confirmatory testing for COVID-19
WHO | Quality assurance
SLMTA | Strengthening Laboratory Management Toward Accreditation

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INTRODUCTION

Without a well-functioning supply chain, providers cannot deliver high quality care to patients. Healthcare commodities must be available in the right quantities and at the place and time to facilitate fast, accurate response to COVID-19 and other health crises. A successful supply chain is an equitable one-- one that ensures the most vulnerable patients can access the care they need. Not only does an effective supply chain save lives, but the supply chain function can bring value to stakeholders by identifying cost savings, ensuring the availability of high quality goods, investing in the local economy, anticipating and planning for uncertainty, responsibly managing resources to avoid waste, continually identifying new efficiencies and process improvements, and contributing to emergency preparedness and response.

A successful supply chain is built upon well-trained staff, infrastructure and a fleet to safely store and transport items, information systems that provide access to data along each part of the supply chain, and policies and procedures that are responsive to the needs of the health system. As has been apparent in the fight against COVID-19, supply chain systems are key components of a successful emergency response. Gaps in supply chain resilience hamper the ability of countries and continents to respond. However, the best way to limit the impact of emergencies, whether a natural disaster or an infectious disease, is to make thoughtful and long-term investments in supply chain systems so that when the next emergency occurs, the building blocks of a successful response are already in place.

GOAL:

Ensure health commodities, including supplies, medications, and equipment, are available to comprehensively care for patients with COVID-19 and other illnesses while building a resilient supply chain to respond to current and future emergencies.

ACRONYMS:

PPE	Personal Protective Equipment
INN	International Nonproprietary Names
USAID	United States Agency for International Development
PCR	Polymerase Chain Reaction
FEFO	First-Expired-First-Out
SOP	Standard Operating Procedure
ARV	Antiretroviral

OBJECTIVE 1: Countries have Strategic Sourcing Implemented and Formularies Developed that include items needed for the COVID-19 response

Preparing and responding to COVID-19 requires an adequately planned formulary. The creation and maintenance of a formulary, or the list of items that should always be available for care delivery, forms the basis of stock out prevention efforts, beginning with sourcing strategies built around the consistent provision of these commodities.

Strategy 1.1 Develop and maintain a formulary inclusive of items needed for COVID-19 response

The medical formulary should include medications, consumables, equipment, and spare parts for clinical/biomedical equipment. Emergency preparedness items, such as those needed for COVID-19 response, can be part of the routine medical formulary (e.g. Intravenous fluids, or basic Personal Protective equipment (PPE)) - or can be items only available during a defined emergency response period. Items added for an emergency response should be derived from the response plan and noted as such in the formulary. Formularies can be national or local.

Intervention — Review the existing formulary and ensure items needed for COVID-19 response are included in the revised formulary.

Selected formulary items should be driven by the planned clinical interventions, usage guidelines, and consistent with any national or regional standard treatment guidelines and Essential Medication Lists. Medical and pharmacy staff should evaluate possible items, selecting only those for formulary inclusion that are efficacious, safe, affordable, and of adequate quality. Consideration should also be given to temperature storage requirements, in-country regularity approval and familiarity of providers with imported items. Consideration should be given to formulary items where supply may become affected due to a sudden increased global demand or product shortages, and alternative/substitutes identified.

For COVID-19 specific formulary selection guidance see:

- WHO Operational Support & Logistics Disease Commodity Packages, COVID-19
- COVID-19 Response Mechanism Information Note (pages 10-12 and Annex 1)

Intervention — Develop and implement processes to manage the formulary list to ensure continued relevance over time:

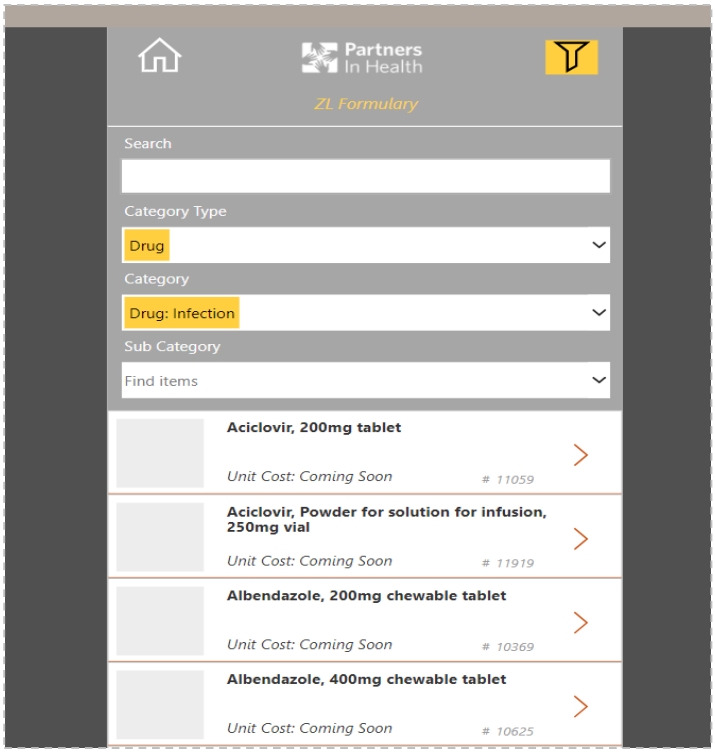
Consult with all stakeholders and establish responsible parties for the ongoing formulary management, e.g. a Formulary Committee. The Committee should identify the relevant specifications of each commodity. International nonproprietary names (INN)/generic names should be used for all medications. Medical consumables should be named with precision to ensure that items are suitable for their intended use, e.g. Face masks used by Healthcare workers in the COVID-19 setting should be of EN 14883 Type IIR.

The Committee should also have the authority to make final formulary decisions and put systems in place to periodically review and maintain the formulary in response to changing clinical guidelines and needs of the patient population.

Intervention — Make the formulary accessible and dynamic to maximize value to end users:
The Formulary should be made widely available to all staff through an electronic portal or printed copy. An electronic portal is optimal as all staff can access the latest changes in real time

(See **Figure 1)**. A system should also be in place for staff to submit new formulary suggestions that will be reviewed by the Committee.

Figure 1. Screenshot from the PIH Global Formulary app- an electronic portal available to all staff to allow access to the current formulary list



- Available resources include:
  - https://www.who.int/medicines/technical_briefing/tbs/02-PG_Formulary-Management_final-08.pdf?ua=1
  - WHO Model List of Essential Medications

Strategy 1.2 Optimize procurement procedures to build a resilient procurement process:
Once a minimum quality standard is identified in the Formulary, the objective of the sourcing function is to purchase items and services that offer the best value, meet quality requirements, and establish a diverse set of procurement options to minimize stock outs. These strategies respond directly to the supply chain challenges presented by COVID-19 and also sets up systems to respond reliably to ongoing care delivery needs as well as future emergencies.

For Global Fund COVID-19 procurement details, please see:

- **Annex 1** in the Global Fund COVID-19 Response Mechanism Information Note.
- Health Product Supply - COVID-19 - The Global Fund to Fight AIDS, Tuberculosis and Malaria
- Procurement Advice - COVID-19 - The Global Fund to Fight AIDS, Tuberculosis and Malaria

General considerations for procurement procedures include:

Intervention	Establish clear vendor vetting processes and mitigate pandemic-related delays. Identify vetting criteria, including alignment with quality assurance guidelines, and create

	systems to track vendor qualification status and vendor performance. Considering wide-spread export restrictions and high global demand for similar products during the pandemic, it is important to work closely with suppliers to understand possible hurdles or delays.
Intervention	Identify a diverse pool of qualified vendors to reduce risk caused by unprecedented global demand It is essential to ensure fair and open competition to the greatest extent possible. Put systems in place through which new suppliers can be solicited and assessed. Consider multiple ship from locations and countries of origin to decrease risks caused by unpredictable global demand, as was demonstrated so clearly during the COVID-19 pandemic. Whenever possible, include qualified domestic vendors to support the local economy. Take advantage of international pooled procurement opportunities.
Intervention	Review procurement policies to decrease administrative barriers and to streamline COVID-19 related procurement Inefficient and burdensome procurement procedures can cause unnecessary purchasing delays and lack of compliance with internal protocols. Work with stakeholders to map the process and identify solutions to bottlenecks, including for regulatory approvals, bidding procedures, and purchase approvals. To facilitate expedited procurement decisions required during an emergency response, establish clear emergency procurement protocols.
Intervention	For all equipment procurement, include resources to ensure the long-term functioning of units, including service agreements, training of biomedical and clinical staff, and regular procurement of spare parts.
Intervention	Invest in staff capacity to mitigate the impact of COVID-19 on procurement activities Expertise and experience are essential for a successful sourcing function. Invest in capacity building/training and retention of sourcing staff to ensure that staff regularly use all tools available to optimize procurement. During periods of supply chain disruption, such as the one currently experienced due to COVID-19, ordering, troubleshooting delays, and doing shipment planning amidst changing availability of products and shipping routes takes more time from procurement staff. Therefore, it is recommended to add procurement staff capacity to mitigate the impact of COVID-19 on procurement activities, as well as to move sourcing initiatives forward such as the review of procurement policies and the diversification of the vendor pool. For more information see p. 54-60, Center for Global Health: Tackling the Triple Transition in Global Health Procurement

Strategy 1.3: Invest in regionally and domestically produced health products where possible.

The COVID-19 response revealed the challenges of a global supply chain characterized by manufacturing capacity for critical items such as PPE and diagnostics concentrated within a limited number of countries, and quality standards that are poorly defined and difficult to navigate. This status quo results in supply chains that are quickly halted by border closures and congested or limited freight routes, and that create distribution of much-needed commodities when countries with a higher purchasing power can afford the resulting price inflation. To address these limitations for future emergency responses, as well as for the growth of local economies, investment in local manufacturing and quality assurance must increase.

Intervention	Identify critical commodities that are the most feasible and strategic to produce locally. For example, hand sanitizer and PPE, as opposed to pharmaceuticals, are relatively easy to manufacture and store, and are needed for routine healthcare delivery as well as emergency response. Create a road map to add items that are more complex to produce in the future, but begin with commodities for which a local supply chain will be post impactful and feasible.
Intervention	Establish policies to attract investment in local manufacturing: Put in place clear regulations, standards, and economic incentives.
Intervention	Build local capacity for quality assurance testing: Locally produced commodities must align with international quality standards. This adherence requires well-monitored laboratory capacity and expertise.
Intervention	Increase production capacity of local suppliers: When conducting strategic sourcing, the options available locally that can ensure the required quality and availability may be limited. Implement incentives and direct capacity building initiatives to address any gaps identified and increase the number of qualified local sources. Gaps may include appropriate and controlled storage conditions, stock management protocols, and enforcement of quality standards.

OBJECTIVE 2: Transport, Handling and Storage of Materials is optimized to ensure safe, accurate, and timely delivery and storage of products

The high volume of commodities needed for the COVID-19 response highlights the need to ensure timely, safe, and accurate management and storage of materials.

Strategy 2.1 Optimize management of warehouse space to preserve product lifespan, ensure accurate delivery, and maximize efficiency

Efficient and accurate warehouse management is critical for day to day operations during an emergency. Lessons learned and efficiencies gained during an emergency response can be applied to supply chain management activities in the future for routine healthcare delivery and health systems strengthening.

Warehousing and storage are more than just shelving products. To have viable products available for distribution, all products require procedures for safe storage that maximize their shelf life and make them readily available for distribution. Proper storage spaces and procedures can help ensure that the correct products, with their quality maintained, are issued by a storage facility.

See USAID Logistics Handbook for more details: [The Logistics Handbook | USAID Global Health Supply Chain Program (ghsupplychain.org)]

Intervention	Evaluate storage volume requirements to prepare for high quantities of emergency items. Identifying an adequate volume of storage space for the items required to respond to emergencies such as COVID-19 can be a challenge. Conduct an audit of available storage space and identify needs for long-term and short-term expansion of storage facilities based on estimates of stock volumes required at different phases of the emergency response and health system strengthening efforts.
Intervention	Address infrastructure needs and create maintenance plans for warehouses in order to prevent damage to materials and maintain quality of stock. Build and refurbish additional long-term and short-term warehouse space as needed based on storage space evaluation. Consider adding surge capacity including leasing space and temporary

structures. For all new and existing storages spaces, ensure the appropriate infrastructure is available to promote good inventory management and avoid spoilage of commodities. Infrastructure components should include electricity, internet, air conditioning, refrigeration, a cleanly environment, and security, as well as facility maintenance plans, service contracts, and procurement plans for spare parts.

Intervention — Procure and maintain needed equipment for warehouse management to promote staff safety and efficiency.
Appropriate and safe equipment such as pallet jacks, fork lifts, and stable shelving should be put in place, as well as procurement plans for spare parts and service contracts when possible.

Intervention — Establish clear protocols and train staff on materials handling and storage procedures:
Procedures should include visual inspection of incoming items, regular cycle counts, security protocols, safety protocols, expiry date management, quarantine procedures, protocols for the storage of special items (e.g. narcotics, flammables, hazardous materials, and items requiring temperature control), facility and equipment maintenance, data entry, and records filing. As new commodities or high volumes of commodities enter the supply chain, ensure procedures are updated and staff trained accordingly. For example, some countries added new PCR testing supplies required for COVID-19 diagnostics to their formularies. Training warehouse staff to maintain specific temperature ranges for these items is essential for ensuring the quality of testing.

Some examples of materials handling policies are:
Visual inspection – the process of examining products and their packaging by eye to look for obvious problems with product quality.

- Inspect for physical tears, water or oil stains, broken or crumbled pills or tablets, torn packets, etc
- Cartons unlabeled with description, date of expiration or labeling illegible
- Changes in color of tablets/pills
- Missing or empty boxes

Storage procedures

- Clean and disinfect storerooms regularly. This helps avoid rodents and insects
- Store supplies in dry, well-lit, well-ventilated storeroom out of direct sunlight
    - Extreme heat and exposure to direct sunlight can degrade and shorten shelf life of medical supplies and medicines
- Secure storeroom from water penetration
    - Repair leaky roofs and windows
- Store supplies off the floor on pallets at least 10cm high and 1ft away from walls
- Ensure fire safety equipment is available and accessible and personnel trained to use it
- Store latex products away from fluorescent lights and electric motors
- Maintain cold storage including a cold chain for commodities that require it
- Keep narcotics and other controlled substances in a locked place
- Store flammable products separately from other products
- Stack cartons no more than 2.5m (8ft) high
- Store medical supplies away from chemicals, old files, office supplies, and other materials
- Arrange cartons so that arrows point up
- Ensure identification labels and expiry dates are clearly visible

- Implement first expiry, first out (FEFO) to avoid loss to expiry
- Separate and dispose of damaged or expired products immediately
    - Check local pharmacy board policies for destruction procedures

Intervention — Implement internal audits and data-informed process improvement systems, as well as regular refresher trainings:
Storage spaces should be routinely monitored for compliance with internal storage and safety procedures and opportunities identified for continuous improvement.

Intervention — Design spaces to be secure and accessible to protect staff working in storage facilities and to prevent loss
Storage spaces should be located in secure compounds with security personnel, and security standards should not prevent items from being accessed when they are needed, especially in the case of emergencies. Ensure systems are in place for staff to obtain needed items. Some spaces, for example at a hospital with an emergency department, may require 24-hour access to pharmaceuticals and supplies.

Intervention — Invest in staff capacity to adequately support warehouse operations:
Hire and train staff, including staff to maintain the space and equipment, staff to accurately receive inbound shipments, conduct inventory counts, pick and pack outgoing shipments, and staff to record data associated with all of these transactions.

Strategy 2.2 Develop strong systems to safely handle special materials (including items requiring temperature control, hazardous materials and flammables, and narcotics)

Intervention — Identify staff at each level of the supply chain to be responsible for correct cold storage procedures.
For example, a logistician at the central supply store must download temperature logger data to ensure there was no gap in cold chain. A Pharmacist at the District Hospital level must log daily temperature checks. Responsibilities of staff responsible for cold chain should include reporting breakdowns of equipment, temperature irregularities, general maintenance checks on equipment, and logging temperatures in the morning and afternoon. Consider hiring additional staff if new initiatives, such as those related to diagnostics of vaccination for COVID-19, greatly increase the volume of cold chain items managed in the supply chain.

Intervention — Implement SOPs, including staff training, for cold chain management:
This should include training on how to correctly identify items requiring special handling, pack cold chain commodities for transport, monitor cold chain adherence, and report on cold chain breaches.

Intervention — Procure and maintain cold chain equipment to preserve cold chain supplies
Cold chain equipment should be fit for purpose, e.g. of medical grade, and sufficient redundancy should be built into the cold chain system. This includes passive cold chain options, generator back up, and maintaining at least 10-15% "empty space" to allow for emergency response. All equipment should have a preventative maintenance schedule that is monitored regularly. Temperature monitoring devices should be used throughout all stages of the cold chain, especially when moving cold chain from one facility to another. Examples include Vaccine vial monitors, thermometers, freezer indicators and log tags.

Intervention — Incorporate special materials handling requirements into procurement planning and storage space design:
Storage space for items requiring special handling is often limited. At the same time, international shipping of these items is more expensive with fewer routes. These considerations must be balanced when planning the timing of international shipments and designing adequate

spaces for storage. Storage facilities should have designated spaces for cold chain equipment, hazardous materials storage and flammables cabinets, as well as cages for narcotics and other controlled substances. Ensure that storage facilities have proper ventilation and electricity to support these requirements. Consider surge capacity for the storage of these special items during an emergency response, including leasing space and equipment.

Strategy 2.3 Waste management:

The use of PPE and supplies required for COVID-19 treatment, testing, and vaccinations mean the generation of more waste, much of it hazardous. Therefore, increased capacity is needed for waste management. In addition to taking steps to minimize waste, plan for safe disposal of medications, supplies and equipment when needed.

Intervention	Track shelf life requirements in order to minimize risk of waste: Communicate minimum shelf life requirements with suppliers at time requesting quotation and at time of order; ensure in-kind donations are approved and responsive to shelf life requirements.
Intervention	Work with pharmacy board/national drug regulations board to understand and adhere to waste management practices for drugs and medical supplies
Intervention	Keep accurate inventory records for all items lost to expiry.
Intervention	Create system to retract or destroy expired goods distributed to end users
Intervention	Segregate and label expired or damaged goods so they are not used or confused for other batches
Intervention	Ensure space for proper storage of expired and damaged goods until they can be safely disposed of
Intervention	Evaluate incineration or other waste disposal capacity. Procure additional equipment to meet increased volume due to COVID-19, including redundancy in the event of broken equipment. Create and implement maintenance plans for all equipment and consider hiring staff to manage the equipment and ensure compliance with waste disposal requirements. Create a procurement road map and budget to replace equipment at end of life.

➔ For more information on incineration and waste management, please see PIH Infrastructure toolkit

Strategy 2.4 Ensure timely, efficient, and adequate transportation for distribution of goods to end-users:

Managing the fleet and distribution systems is essential for ensuring the needed items get to the final destination on time. It is critical to match the increased volume of items required for the COVID-19 response, including high-volume items like PPE, to the capacity of the distribution system.

Intervention	Implement a distribution schedule and consider the volumes of items required at each facility or in each region. Design distribution routes based on the size of vehicles, the road conditions, patient volume and burden of disease, and the feasible frequency of deliveries. Consolidate types of deliveries when possible to reduce transportation costs. Ensure goods are organized for each facility and well-labeled, as to avoid any mix-ups with distribution.
Intervention	Evaluate gaps in the fleet and procure vehicles if needed to appropriately handle the volume of goods required for COVID-19 and routine care delivery. Optimize vehicle type to align with route requirements, including volume and road quality. A combination of box trucks, four-wheel drive vehicles, and motor bikes may be required, but makes/models are ideally standardized to facilitate maintenance. Create a procurement road

map and budget to ensure redundancy and vehicle replacement at end of life. Procure spare parts and create maintenance plans to ensure vehicles remain functional.

Intervention — Maintain fleet to ensure that delivery of materials is not interrupted:
Depending on the availability of mechanics in-country, consider hiring mechanics and training staff on comprehensive vehicle maintenance. If vehicle maintenance will be covered by a third party, budget for preventative and ad hoc maintenance.

Intervention — Invest in staff capacity for the distribution system:
Hire and train drivers and fleet manager to adequately staff the distribution system.

Intervention — Invest in road infrastructure to increase the ease and equity of materials distribution:
Create policies that attract investments in road infrastructure improvements.

OBJECTIVE 3: Develop Data Management and Systems that ensure high-quality data that can be used for real-time decision making as well as supply forecasting

Strategy 3.1: ***Establish data systems designed for real-time decision making:***

Supply chain data is required to save lives, but is often not available or not visible due to a lack of electronic systems or staff and infrastructure to support those systems. Data systems, especially at the last mile, are often built around reporting requirements instead of the need for data-informed decision making at each level of the health system. Data that are readily available can be used to track demand trends over various stages of the pandemic and beyond and can be used for decisions affecting order frequency and volume, distribution optimization, stock out prevention, and emergency preparedness. Data systems also promote improved governance and accountability by using data visibility to deter diversion and avoid waste.

Intervention — Optimize current data management processes:
Current processes, including those based on paper systems, form the foundation for successful transition of some or all of these processes to electronic data systems.

Intervention — Evaluate current supply chain data systems and create a road map to fill gaps:

With input from internal and external stakeholders, create a road map and budget that provides supply chain staff at each level of the health system with the tools they need to execute their work and make decisions, and also provides visibility at the central level to provide management support. A road map should include a plan for implementing the required IT infrastructure, capacity building for staff, and processes to effectively use the data for supply chain improvements. A phased approach to replacing paper systems with electronic systems can have a large impact and also be beneficial in that it allows for adjustments along the way, especially as new technologies and software systems become available.

When selecting software, consider open source software when possible. Open source software does not have license fees. However, total cost of ownership must still be considered, including as configuration, hosting, license fees, staffing (consider data entry, data management, IT support, for example) and hardware. It is unlikely that one software solution will address all needs, so consider building interfaces between systems to optimize work flows.

Intervention — Implement the road map to fill gaps in supply chain data systems.
Consider creating a team responsible for managing the data system implementation, adjusting the road map as needed, and ensuring staff are trained.

Implementation teams can include contractors in combination with existing team members, and will include some short-term project management to assess the needs and scope, determine the best solution, identify resources needed, create the roadmap, and implement the system.

For implementation medium to long term (minimum 1 week) in-person support from a 'super-user', or more-experienced staff is highly recommended at each point of rollout to address various real-life situations as they are encountered in the new system. Train the trainer sessions can also be effective, if staffing, budget, or COVID risk reduction measures cannot allow for proximity of super-users during and after rollout.

Additional staff needed to implement the road map might include data entry clerks, IT specialists, and staff focused on implementing data-informed process improvements.

Strategy 3.2: ***Ensure high quality data through data quality management:***

Data must be of high quality to inform good decisions. Staff must also trust the data and the processes that are in place to achieve high data quality. It is therefore essential to invest in data quality management alongside investments in electronic systems.

Intervention	Establish performance metrics: Create key performance indicators to measure the supply chain successes and areas for improvement.
Intervention	Conduct internal audits: Audit data quality regularly and monitor operational indicators.
Intervention	Implement process improvements: Use findings to implement process improvements to improve data quality and supply chain practices.
Intervention	Invest in staff capacity building and retention: Conduct refresher trainings for staff entering and using data. Decentralize knowledge of systems by creating super users at each level of the supply chain and across geographical areas. Hire staff dedicated to data quality management and conducting internal audits.

Strategy 3.3: ***Implement Forecasting systems to ensure supply availability***

Forecasts estimate the quantities of each product that a program will dispense to users for a specific period of time in the future. Forecasting has an enormous impact on the entire supply chain system. It affects not only the quantity of supplies available, but the ability to appropriately plan budgets, transportation and storage needs, staffing levels and in-kind donation requests. Commonly, forecasts are based on consumption data rather than real need. When a supply chain system experiences frequent stock outs, using historical consumption data to predict needed quantities will continue the pattern of supply scarcity and will not provide an opportunity to make adjustments to prevent shortages. Instead, forecasts must be informed by an understanding of demand, or the quantities of each item needed to deliver care. This need is affected by prescribing practices, burden of disease, demographics, and seasonality. Systematically collecting data on real demand based on requests for items rather than consumption, and using these data to correct for past shortages, can realign the availability of health commodities and decrease stock out rates. A health system that has all required items in stock is best prepared to respond to emergencies.

Intervention	Establish systems to collect demand data to avoid stock outs or shortages at critical moments: It is critical to establish systems that collect demand data rather than only consumption data or quantities distributed to facilities as shortages/stock outs will lead to under-ordering or mistrust

of data. Data collection must include quantities that were requested but could not be fulfilled from stock to detect the "real" demand.

To detect a robust demand signal, it is helpful to put systems in place that make it easy for clinicians to request what they need. One example of this is a stock list system. Stock lists are lists of items and quantities needed for a certain period of time at a facility or a ward within a facility. Stock lists are optimized over time based on patient volume and morbidity. These lists form the basis of requests from a ward to a pharmacy or from a facility to a central store. The location manager enters their inventory and the fulfilling location replenishes up to the levels indicated on the stock list. Each request contains a comprehensive list of items, decreasing the number of ad hoc requests and promoting a consistent demand signal to inform forecasts.

Intervention — Collect the data required for forecasting, including stock on order, stock on hand, expiry risk, and demand per facility.
Data can be pulled from electronic purchasing and inventory management systems, demographic data, and clinical projections.

Intervention — Incorporate clinical, programmatic, and demographic data into forecasts:
Relying on demand data, which is historical data, improves forecast accuracy but can still contain gaps, especially in a rapidly changing pandemic. For example, forecasts must take into account changing clinical protocols, program expansions or additions, emergency preparedness and response, and changing demographics and burden of disease in order to facilitate universal health care. Incorporate feedback from clinical and programmatic staff into the forecasting methodology.

Intervention — Create a dynamic forecast which can be flexible to changes in clinical and public health recommendations:
Keep calculations dynamic so that quantification can be adjusted as clinical recommendations or data inputs change. For example, there may be a recommendation that clinicians use one new mask per day, then the recommendation is updated to one new mask per week. A dynamic calculation would allow for one input to be updated and inform the final output.

Intervention — Procure buffer stock:
A forecast informed by demand, supported by systems optimizing data quality, and incorporating clinical feedback will become more and more accurate over time. As a stop-gap measure, procurement of buffer stock can be used for stock out prevention. Apply buffer percentages according to item categories and patient care impact.

Objective 4: Build and maintain systems for emergency preparedness

Strategy 4.1: Establish emergency response protocols:

Experiences from responding to COVID-19 can be used to revise or newly establish emergency response protocols to be implemented in future emergencies.

Intervention — Conduct an after action review of the COVID-19 response with internal and external stakeholders.

Intervention — Revise existing protocols or establish new protocols where needed to respond to future emergencies, including infectious diseases, natural disasters, and other types of emergencies. Suggestions for points to consider when developing emergency protocols for supply chain management can be found at covidprotocols.org.

Strategy 4.2: Establish and manage an in-country emergency stockpile:
As we have learned from COVID-19, emergencies, and especially those that have a global or regional impact on supply chains, affect the ability to import items in a timely manner. Having stock already in the country allows governments to respond with the urgency required for an emergency response.

Intervention	Define the list of commodities, including medications, supplies, and medical and non-medical equipment, to keep in a stockpile.
Intervention	Consider partnerships for regional, as opposed to country-level, stockpiles.
Intervention	Conduct a competitive bid to identify suppliers for each commodity and execute procurement. Consider established long-term agreements for automatic replenishment of items that have limited shelf lives.
Intervention	Establish management systems to maintain the items in the stockpile, including distributing items with limited shelf lives for use at health facilities, replenishing distributed stock, and regularly checking and maintaining equipment as well as the conditions of the storage facility.

Objective 5: Active partner management maximizes impact through efficient and integrated supply chain approaches

Strategy 5.1*: Create or optimize a governance structure for partner and in-kind donation management:*
If uncoordinated, partners' efforts can be inefficient and inequitable, fail to address government priorities and fail to equitably reach all districts or populations. During an emergency response, when new partners are often able to provide support, it is particularly important to have established protocols for donor engagement and coordination.

For more information see USAID Logistics Management Units manual: Logistics Management Units | USAID Global Health Supply Chain Program (ghsupplychain.org)

Intervention	Map existing long-term partner procurement commitments and identify material gaps. Gaps can be geographical, material, or for technical expertise. For material gaps, use clinical guidance, expected case load, and expected demographic patterns to create a needs list and compare this list against what is available in the existing supply chain. Ensure needs lists include needs for ancillary staff and not only healthcare workers. For example, PPE should be provided for cleaners, drivers, and other cadres of workers who could come into contact with high-risk areas.
Intervention	Identify and empower a coordinating mechanism that can direct partners to meet government priorities and address gaps so their support is provided where it is needed most.
Intervention	Enact a review process for offered in-kind donation and educate donors about acceptability of donations and required processes. The review process should include a review of specifications, shelf life, and quality assurance documentation such a certificate of analysis. Ensure donations meet desired specifications before shipments are approved.

Strategy 5.2: Avoid vertical supply chains in order to increase value for money and prioritize efficiency across the supply chain

Intervention	Pool procurement across programs to secure the best pricing and the most efficient logistics.

Intervention	Collaborate with stakeholders to evaluate and implement best practices best practices, create platforms for information sharing and cross-training, and standardize supply chain workflows when possible. For example, USAID's supply chain investments have produced visible results, ensuring that patients have ongoing access to lifesaving medications, such as ARVs. These vertical programs can be leveraged and results replicated across the health system, covering a comprehensive formulary of essential medicines and supplies, ensuring strong supply chain management and holistic access for patients.
Intervention	Identify efficiencies that can be gained by managing supply chains horizontally instead of vertically, including space and staffing. Reallocate to optimize use of resources. Centralizing processes for stock management, ordering, and logistics for all item types can leverage lessons learned and also free up human and financial resources for further investment in the health system

COST CONSIDERATIONS

Objective 1:

- Meetings costs for convening Formulary Committee (formulary review and revision)
- Training on procurement tools and mitigating the impact of COVID-19 on procurement activities
- Incentives to build capacity to increase the number of qualified local sources

Objective 2:

- Costs related to storage space audit (transportation, forms, etc)
- Costs for constructing or refurbishing long termand short term warehouse spaces
- Costs for surge capacity buildings (leased space, temporary structures)
- Costs for electricity, internet, air conditioning, refrigeration, cleaning, security, maintenance, service contracts, spare parts
- Equipment for warehouse management: pallet jacks, fork lifts, stable shelving, spare parts, service contracts
- Design, validate, and print procedures for warehouse management
- Training costs for staff to maintain warehouse space and equipment, receive shipments, conduct inventory counts, pick and pack shipments, etc.
- Training costs for cold chain management
- Cold chain equipment: generator back up, temperature monitoring devices (e.g. vaccine vial monitors, thermometers, freezer indicators, log tags, etc)
- Hazardous materials storage
- Designated space for cold chain equipment
- Flammables cabinets
- Cages for narcotics and other controlled substances
- Space for proper storage of expired/damaged goods
- Incineration costs
- Vehicles for distribution, depending on context (box trucks, four wheel drive vehicles, motor biked, etc), spare parts and maintenance for vehicles
- Costs for fleet maintenance: mechanics, trainings for vehicle maintenance, preventative and ad hoc maintenance costs
- Trainings for drivers and fleet manager

Objective 3:

- Meetings costs for stakeholder supply chain data system road map
- Software costs

- Hosting, licensing fees
- Data entry staff
- Data management staff
- IT support staff
- Data management hardware
- Short term contractors or consultant to improve data management
- Training of trainers, trainings of data management users
- Refresher trainings for staff entering and using data
- Buffer stock for stockout prevention

Objective 4:

- Meeting costs for after action review of the COVID-19 response and revision of protocols
- Meeting costs for partner procurement mapping
- Costs for convening coordinating mechanism

RESOURCES:

Center for Global Health: Tackling the Triple Transition in Global Health Procurement
COVID-19 Response Mechanism Information Note
covidprotocols.org.
eEML - Electronic Essential Medicines List (essentialmeds.org)
Essential resource planning (who.int)
F&Q: WHO COVID-19 essential supplies forecasting tool (COVID-19-ESFT)
Guidelines for Assessing Costs in a Logistics System: An Example of Transport Cost Analysis, 2004 (jsi.com)
Health Product Supply - COVID-19 - The Global Fund to Fight AIDS, Tuberculosis and Malaria
https://www.who.int/medicines/technical_briefing/tbs/02-PG_Formulary-Management_final-08.pdf?ua=1
JSI_Supply_Chain_Manager's_Handbook_Final-1.pdf
Logistics Management Units | USAID Global Health Supply Chain Program (ghsupplychain.org)
Logistics Management Units | USAID Global Health Supply Chain Program (ghsupplychain.org)
Logistics Management Units | USAID Global Health Supply Chain Program (ghsupplychain.org)
Microsoft Word - 02-PG_Formulary Management_final 08 (who.int)
Procurement Advice - COVID-19 - The Global Fund to Fight AIDS, Tuberculosis and Malaria
Quantification Analytics Tool User Manual | USAID Global Health Supply Chain Program (ghsupplychain.org)
Quantification of Health Commodities | USAID Global Health Supply Chain Program (ghsupplychain.org)
Tackling the Triple Transition in Global Health Procurement | Center For Global Development (cgdev.org)
The Logistics Handbook | USAID Global Health Supply Chain Program (ghsupplychain.org)
The Logistics Handbook | USAID Global Health Supply Chain Program (ghsupplychain.org)
WHO COVID-19 essential supplies forecasting tool (COVID-ESFT)
WHO Model List of Essential Medications
WHO Operational Support & Logistics Disease Commodity Packages, COVID-19