



## 1.3 Inappropriate investment and use of equipment and technology



## About the Health Finance and Governance Project

The Health Finance and Governance (HFG) Project works to address some of the greatest challenges facing health systems today. Drawing on the latest research, the project implements strategies to help countries increase their domestic resources for health, manage those precious resources more effectively, and make wise purchasing decisions. The project also assists countries in developing robust governance systems to ensure that financial investments for health achieve their intended results.

With activities in more than 40 countries, HFG collaborates with health stakeholders to protect families from catastrophic health care costs, expand access to priority services – such as maternal and child health care – and ensure equitable population coverage through:

- ▶ Improving financing by mobilizing domestic resources, reducing financial barriers, expanding health insurance, and implementing provider payment systems;
- ▶ Enhancing governance for better health system management and greater accountability and transparency;
- ▶ Improving management and operations systems to advance the delivery and effectiveness of health care, for example, through mobile money and public financial management; and
- ▶ Advancing techniques to measure progress in health systems performance, especially around universal health coverage.

The HFG project (2012-2018) is funded by the U.S. Agency for International Development (USAID) and is led by Abt Associates in collaboration with Avenir Health, Broad Branch Associates, Development Alternatives Inc., the Johns Hopkins Bloomberg School of Public Health, Results for Development Institute, RTI International, and Training Resources Group, Inc. The project is funded under USAID cooperative agreement AID-OAA-A-12-00080.

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## About the Technical Efficiency Guide

Health system stakeholders in low- and middle-income countries are exploring ways to achieve more with available resources, and realize savings that can be used to fill the gap in resources needed to expand effective health coverage to all. Where other guides and tools focus on improving allocative efficiency (“doing the right things”), this guide focuses on technical efficiency (“doing things right”) (WHO 2010). It is intended to **help diagnose and address technical inefficiencies** across health systems.



## 1.3.1 Inappropriate investment and use of equipment and technology

### *What's the inefficiency?*

The procurement, utilization, and maintenance of health care equipment and technology are important for a functioning health system. When these investments are insufficient, supply cannot meet demand, and populations' health needs will not be satisfied. Inappropriate medical devices may be in place, as is the case where there is a mismatch between procured or donated equipment and facility/ health system needs. In other cases, medical devices may be appropriately procured, but underutilized or inappropriately used due to poor maintenance or poor user competence (Rosen et al. 2014). Perry et al. (2011) conducted a thorough inventory of medical equipment across several countries and found that about 40 percent of the equipment was nonfunctional. Inefficiencies result when there is a demand-supply mismatch in the procurement of health equipment and technology, irregular maintenance of available equipment, and resource deficiencies such as skilled technicians. Another study found that over four-fifths of African hospitals surveyed faced challenges finding qualified engineers or technicians locally to provide biomedical engineering services (Cockerell 2014). Available equipment thus sits idle or in various states of dysfunction, indicating that investments in their purchase are wasted rather than productive assets.

In addition, many medical technologies and equipment have not been configured for LMIC settings. Medical equipment developed, tested, and used in developed country settings do not hold up under the more demanding and resource-poor settings found in LMICs (Howitt et al. 2012). Much what is procured for or donated to these countries ends up unused or underused because there are no spare parts for repairs and maintenance, not enough trained technicians to meet the repair needs, and lack of technical support from the manufacturers of the equipment (Cockerell 2014). There might also be an incompatible power source or other specific technical specifications, and the underlying health system may lack of the systemic infrastructure, such as a regular power supply, to support such equipment's optimal use (Howie et. al. 2008).

### *Why does this happen?*

Demand-supply mismatch in the procurement of health equipment and technology can occur when **procurement is uninformed** and where, for example, the wrong capacity equipment is procured or "pushed" by a donor that may not suit the needs or capacities of a facility (WHO 2011a; Perry et al. 2011). For example, neonatal incubators are procured or donated to rural primary health centers that are not set up to deliver or cater to high-risk pregnancies and do not have skilled staff to properly operate these equipment.

Ministries of health (MOHs) in LMICs are often responsible for procuring medical technologies for the country's health system (WHO 2010). There is usually **no systematic and/or routine prioritization process** to support procurement decisions for new technologies that could add value to the existing health system. Allocative inefficiency contributes to the problem (Diaconu et al. 2017), and poor costing and incomplete consideration of maintenance or user training leads to suboptimal use of medical devices purchased with no regard to the actual need and usability of the setting. In addition, these **technocrats may be persuaded by manufacturing companies to purchase expensive and inappropriate**



**technology** for the facilities they oversee. Some companies may sponsor trips to assess the equipment at their headquarters and pay for research or provide other incentives that get providers and administrators to agree to purchase equipment that may be inappropriate for their settings (Silva et al. 2011).

Eighty percent of the medical equipment in LMICs are donated. **Donated medical equipment could be faulty and may not even be operable or useful in the local setting** (WHO 2011a; Perry et al. 2011). In many cases the equipment does not come with an operating manual or instructions on maintenance. This leaves facilities with medical equipment with short life spans, unable to fulfill facilities' needs and results in taking up space (Mullally 2013; Howitt et al. 2012)

**An operational budget that does not take into account equipment maintenance, training or repair, lack of spare parts, improper storage and transportation, and environmental failures also contributes to this inefficiency** (WHO 2012). While it may be the case that some district health managers make budgetary decisions beyond their purposed authority, other managers do not use the authority they do have to make appropriate decisions on important issues (Alonso-Garbayo et al. 2017) such as maintenance support for medical equipment repairs or training.

**Lack of expertise in the local setting**, for example a technician assistant to provide equipment maintenance and repair, also contributes to the problem (Malkin and Keane 2010). Such a cadre is a low-cost addition to staff because they can be trained to put together fairly simple parts and repairs that require less knowledge than a biomedical engineer (Malkin and Keane 2010). This results in the loss of the facilities' ability to address equipment breakdowns immediately and efficiently.

Although the responsibility for managing equipment and technology at the national, local or facility level varies from one country to the next, the inefficiency that results from shortcomings in this responsibility is usually **due to systemic weaknesses and inadequate investments** at all these levels. Specific systemic weaknesses are evident- insufficient information gathering on the equipment needed or being used, inefficient planning for technology needs and resources during procurement, inappropriate purchasing of equipment and poor installation, inappropriate handling of equipment, and lack of maintenance of staff skill set for use of equipment and technology.

### ***What makes it technically inefficient?***

One implication of this inefficiency is the **financial impact on patients**. Broken equipment or technology that is dysfunctional results in the patient and their family having to purchase what is needed outside the facility, sometimes at a higher price, and **incur travel costs**. This can place a heavy burden on patients and may **increase out-of-pocket spending on health**. Patients undergo extreme economic burdens as a result of having to borrow to pay for their care (Anderson et al. 2017), and these out-of-facility costs are significant in many instances.

Poorly resourced equipment results in **poor service delivery and low-quality patient care that can jeopardize patients' safety**. There can be significant risk to patient health when equipment is misused (Altayyar 2016) or when dysfunctional equipment is used. For example, in a 2012 study, Wilson et al. (2012) found that defective equipment, unavailable equipment, and dysfunctional hospital services were contributory factors resulting in adverse events to patients. Faulty equipment causes patients to **miss or delay needed examinations or treatments** (Diaconu et al. 2014), leading to adverse outcomes or complications.



Lack of maintenance plans also lead to **more serious breakdowns in equipment needing more expensive repairs** or complete replacement.

Inappropriate medical technologies for certain settings in LMICs leads to **idle, unused equipment**. Such investments **misplace resources** critical for procurement of other basic medical devices. The resulting unavailability of useful basic equipment coupled with the redundancy of other inappropriately procured medical equipment within these settings severely reduces the quality of health care provided and wastes facility resources and funds (Diaconu et al. 2014).

The “wrong” equipment also leads to a **greater need for maintenance and training for equipment use**. Seeing that there is already a dearth in skilled technicians who know how to maintain these equipment, the need for more training on its use puts an unnecessary cost burden on the facilities. Additionally, support required from external experts and technicians adds to unsustainable health system costs.

### **What questions can help us diagnose the inefficiency?**

- In your view, are medical equipment maintenance costs appropriate or are they excessive?
  - If they are appropriate, can you tell us if it’s always been this way?
  - If they are excessive can you help us understand the source of these excesses?
  - Are you aware of any strategies the MOH uses to reduce medical equipment maintenance costs?
- Are district/facility managers involved in the procurement decision for medical equipment?
- Are the discussions around maintenance and budgeting for repairs inclusive of providers and those who will be using the equipment?
- Do staff receive formal training maintaining medical equipment as technical assistants?
  - What are resources are required to ensure that this happens?
- Is point of care technology (i.e. medical diagnostic testing at or near the “bedside” or point of care) available in the country?
  - If yes, is it being used effectively?
  - If no, what are the barriers and how can point-of-care technology be implemented?
  - How can it be scaled throughout the country, specifically in areas with unmet need?
- Does the way decisions are made at the local level affect the efficiency of service delivery? (*Also see questions from Module 4.1*)
- Are management responsibilities decentralized?
  - If yes, how has this affected spending on procurement of equipment and technology
  - If no, why not?
- Are health technology assessments used?
  - If yes, is this decentralized to the local level?
  - Is it the appropriate technology for this setting?
  - If no, what type of health technology assessment tools are appropriate for use in this setting?
  - What kind of investments can be made in building this capacity to address inappropriate capital investments?
- Is there a process or specific guide for receiving donations of medical equipment?
- Do receiving facilities and donating organizations/facilities work together to ensure that donations are appropriate?
  - Is this the case for both tools and services? (This might include maintenance contracts or equipment manuals.)



### Whom should we interview?

- ▶ District and subdistrict-level health managers
- ▶ Primary care facility staff (clinical officer, nurse, auxiliary nurse, laboratory technician/assistant, data entry clerk)
- ▶ Facility- or administrative-level procurement manager
- ▶ Facility engineers, technician and other maintenance cadre
- ▶ National Primary Care liaison at the MOH level (point person at the MOH who oversees the district and subdistrict officers responsible for primary care in the community)
- ▶ Patient

### What indicators can help diagnose the inefficiency?

Indicator	Calculation/ Precise Definition	What it measures	Potential sources of data	Source(s) of indicator
1. <b>Percent of facilities with key equipment in working order (e.g. obstetric equipment, x-ray machines, equipment for sterilization)</b>	“Key equipment” depends on specific functional levels of the facility and is defined by the specific minimum service package.	% of equipment that is working and being used for patient care	Office of the hospital managerial staff; health facility assessments (e.g. Service Availability and Readiness Assessments (SARA))	Hutchinson and LaFond 2004  WHO 2008
2. <b>Percent of operation budget for equipment maintenance</b>	Numerator: Total annual budget allocation for routine maintenance and repair of existing equipment Denominator: Total annual health budget  <i>This indicator could be at measured at various administrative levels</i>	Assess resources in support of equipment maintenance	Survey; facility document review	N/A
3. <b>Number of skilled maintenance technicians per facility</b>	N/A	Assess availability of required skillsets in facilities	Survey; facility document review	N/A
4. <b>Frequency of equipment failures</b>	Failure: The condition of not meeting intended performance or safety requirements, and/or a breach of physical integrity.	Number of times the equipment stops working or malfunctions	Facility logs on equipment maintenance; hospital management equipment logbook	WHO 2011b



		A failure is most often identified when a user reports a problem with the device, and when it can corrected by repair and/or calibration.			
5. Usage levels of high-value hospital equipment	Calculate the number of (shifts/hours) in a day when the medical equipment is operating.	Interpretation is based on determination of rates by working group (or other management group), average use compared to similar high-performing facilities, disease burden, etc.	Assess frequency of hospital equipment being used. Levels that are too high or too low might indicate lack of trained staff to operate equipment or that equipment is nonfunctional.	Facility record; document review	Heredia-Ortiz 2013
6. Percent of hospital equipment with instruction manuals	Numerator: Number of equipment with appropriate, accessible, and updated instruction manuals Denominator: All hospital equipment		The % of equipment with instruction manuals that can be used as a guide for equipment use	Office of the managerial hospital staff	WHO 2011c

**What are some examples of the inefficiency?**

- ▶ Inability to deliver adequate care: In Jimma zone, southwest Ethiopia, more than a third of the medical devices were found to be nonfunctional. Factors influencing device utilization were a lack of training on device use, poor skills of maintenance experts, and procurement of poor-quality devices due to cheaper prices (Ademe et al. 2016). Nonfunctional medical equipment negatively impacts the delivery of quality care.
- ▶ Inappropriate donations for the setting: After the earthquake in 2010, a study in Haiti found that of the medical donations received, only 30 percent worked and 14 percent of those could not be repaired. Additionally, some devices could not work at the facilities because they required a higher electrical voltage than what was standard in Haiti (Dzwonczyk and Riha 2012). This may lead to time-consuming attempts to find a solution that distracts resources from other life-saving interventions and resources.
- ▶ Improving use of dialysis-related devices through human resources: Responding to the increasing disposition of donated dialysis-related devices when they break down in developing countries of Southeast Asia, Japan provided technical assistance on the maintenance and repair of donated dialysis devices as well as training and building a cadre of technicians in country that will support the continued use of these devices. These efforts produces immediate and long term results: dialysis therapy is now provided with purified dialysate, and trained technicians are available to keep devices maintained in the future (Naramura et al. 2017).
- ▶ Framework for medical device prioritization: The Republic of South Sudan developed a framework for prioritizing medical equipment at the facility level to reduce waste from



procurement of expensive and inappropriate equipment that cannot be supported by the local environment (Lilford et al. 2015).

## Materials for Team Leading Next Steps

While beyond the scope of the Technical Efficiency Guide process, the sections below share some ideas that may be a useful starting point for the team responsible for leading next steps, if inefficiencies covered in this module are prioritized. If the country/region needs more detailed information, these leaders can consider using some of the tools and resources listed. If they want to brainstorm areas for potential efficiency gain, they can browse the table with high-level ideas to consider.

### Additional tools and resources

- ▶ WHO has initiated a technical series on medical devices, the first of how human resources play a role in the “life cycle of a medical device” (WHO 2017): [http://www.who.int/medical\\_devices/publications/hr\\_med\\_dev\\_bio-engineers/en/](http://www.who.int/medical_devices/publications/hr_med_dev_bio-engineers/en/)
- ▶ WHO provides a set of maintenance guides that can support local organizations and engineers ensure the long-term use of medical equipment (WHO 2012): [http://www.who.int/medical\\_devices/publications/medical-equipment-maintenance/en/](http://www.who.int/medical_devices/publications/medical-equipment-maintenance/en/)
- ▶ WHO provides a set of core medical equipment fact sheets that aim to raise awareness about the equipment’s existence and functionality (WHO 2011): [http://apps.who.int/iris/bitstream/10665/95788/1/WHO\\_HSS\\_EHT\\_DIM\\_11.03\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/95788/1/WHO_HSS_EHT_DIM_11.03_eng.pdf).

### Potential areas for efficiency gain

Cause of inefficiency	Potential activity areas	Resources
<b>Lack of qualified staff to support maintenance of equipment</b>	Develop a local cadre of low-skilled workers, train them to work as technical assistants to do repair and maintenance of medical equipment	Malkin and Keane, 2010
<b>Lack of staff training on the proper use of medical equipment</b>	Assess facility needs to ensure equipment procured is in line with training received by staff	Diaconu et al., 2017
<b>Donated medical equipment</b>	Donors and recipients should work together to identify specific facility needs and beneficial and appropriate technologies	Mullally, 2013
<b>Allocative inefficiency</b>	Implementation of health technology assessment tools to enable efficient use of resources and provide evidence for strong health technology policies	Kriza et al., 2014





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