

CASE AND COMMENTARY

What Are Criteria for Considering Technologies' Uses and Influences in LMICs' Health Care Infrastructures?

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Abstract

A lack of health technology is an obstacle to health system growth in low- and middle-income countries (LMICs). US-based clinicians participating in global health efforts might sometimes wonder about clinical and ethical standards by which they should judge short- and long-term risks and benefits of bringing technological assistance with them to care for patients in LMICs. These countries are heterogeneous and changing, so establishing an evidence base for clinical and ethical decision making about technology use could be an important priority. This article suggests clinically and ethically relevant criteria according to which health technologies' use and influence can be evaluated.

Case

A United States school has a relationship with a nongovernmental organization (NGO) in a Latin American country to which faculty and fourth-year students travel for a month-long elective in global health.

The Ministry of Health (MoH) in this country has identified maternal mortality as an important problem in the remote region hosting the global health program. Government prenatal protocols call for all pregnant women to undergo 2 ultrasound examinations over the course of their pregnancy. However, there is only one ultrasound machine for the entire region. It is located at a government hospital that is difficult for many women to reach and is often nonfunctional for months at a time. Practically speaking, only a small percentage of pregnant women have any ultrasound screening at all.

Faculty at the school obtain a portable ultrasound machine via a loan from a manufacturer and bring it to the remote clinic. The word spreads, and pregnant women from the surrounding area come to the clinic for their ultrasounds. The students gain expertise with basic transabdominal prenatal ultrasounds, and they are enthusiastic about the experience. It dawns on the students, however, that the well-intentioned provision of ultrasound exams could undermine demand by the community for local, year-round ultrasound capacity at the government hospital. They worry that they could be impeding progress. How should they address this concern?

Commentary

To practitioners from high-income countries (HICs) visiting regions with limited health care resources in low- and middle-income countries (LMICs), the dearth of health care technologies can be even more striking than the variety of exotic local diseases. Many health outcomes are directly dependent on access to health care technologies, and yet barriers to accessing these technologies are numerous and substantial in LMICs. For students and other volunteers, this can result in either an insight-provoking medical experience or a frustrating exercise in delivering care that seems to fall short of what patients deserve.

NGOs and their visiting health care teams have an opportunity to improve health outcomes by providing access to health care technologies. They might work to reinforce existing local health care efforts, bring in specialists not available in-country, or serve as advisors. However, good faith attempts to introduce health care technologies sometimes result in disappointment or waste. It has been suggested that only a fraction of [donated clinical equipment](#) is used as planned.¹ As suggested in the case, some uses can have negative consequences that warrant ethical attention. Socioeconomic, political, and health system factors all play roles in the success or failure of these interventions. One purpose of this commentary is to examine the roles of health technology interventions in LMIC health systems and provide criteria NGOs and practitioners can use to evaluate prospective risks and benefits of devices being considered for use in health care service delivery.

NGOs and Technology

As the primary government health care agency in the case, the MoH is tasked with overseeing the appropriateness of public health evaluation, supply chains, interventions, and clinical guidelines used in local settings. NGOs bring external resources in the form of personnel, knowledge, and equipment that can augment local health care service delivery capacity. Such initiatives require [public-private partnerships](#) that operate transparently and accountably.² NGOs tend to employ resources unilaterally outside health care delivery frameworks established by the MoH, however, which runs the risk of duplicating programs or wasting scarce resources on efforts that may be at cross-purposes with those of the MoH. NGOs thus should play a subsidiary role to MoHs, which derive their authority to define and assign priorities for a national health plan from the nation's sovereignty. It is important to recognize that LMIC MoHs might have few resources to deploy for executing their mandates and could lack administrative mechanisms to oversee NGOs, which should initiate and facilitate communication with MoHs.²

Technology Assessment

This article's focus is on devices as a subset of health technology. Medical devices are defined by the World Health Organization (WHO) as a division of health technology excluding products such as medicines and vaccines that rely solely on immunologic or metabolic mechanisms.³ Devices include a range of technologies, from simple blood pressure monitors to more complex ultrasound and computerized tomography machines. The WHO supports health technology assessment (HTA) of the efficacy and appropriateness of interventions.⁴ HTA is described as "a multidisciplinary process that summarizes information about the medical, social, economic and ethical issues related to the use of a health technology in a systematic, transparent, unbiased, robust manner."⁵ As delineated by the WHO, HTA consists of 3 layers of questions "for the coherent introduction of technologies, especially medical devices, into health systems."⁶ These layers relate to the effectiveness, appropriateness, and implementation of devices. HTAs can be useful in policy creation and decision making about devices. However, formal HTA requires comparative-effectiveness and cost-effectiveness data that can be limited or hard to gather in LMIC settings. Coupled with disparate socioeconomic, cultural, and political settings across LMICs, limited data compromise the execution and applicability of HTAs.

While originally created to direct health technology policy development, the domains in the Table below (based on the WHO's HTA domains) can inform ethical review of any potential NGO device and can be used as a checklist for assessing technologies. Simple, cheap, and effective devices like thermometers and blood pressure cuffs scarcely need evaluation. Likewise, point-of-service tests like hemoglobinometers, glucometers, and urine pregnancy tests are almost always appropriate. However, laboratory tests for malaria, hepatitis, HIV, and cervical cancer require more consideration, as capacity to follow up with patients who have positive findings can often be compromised. Surgical instrumentation and supplies, ultrasound machines, and more advanced radiology equipment require thorough, critical consideration.⁷

Table. Health Technology Reflection Guide ^a	
Domains	Questions
Effectiveness	<ol style="list-style-type: none">1. Is this intervention effective for the specific problem regardless of the country and health care setting?2. Are there other technologies that could address this problem as effectively?3. What are predicted costs of purchasing, implementing, and maintaining this device?4. Who will bear costs of this intervention?5. Are costs worth expected benefits to the patients, local clinicians, and the nongovernmental organization?

Appropriateness	<ol style="list-style-type: none"> 1. Does this device respond to needs that have been explicitly stated by patients and local clinicians? 2. Does this intervention support existing health system goals as described by national, regional, and local health plans? 3. Will this device be delivered with any required ancillary materials? 4. How are device donations regulated by local institutional and national guidelines? 5. How do local clinicians expect this intervention to influence service provision in their facility and region? 6. If the device is used for diagnostics, what is the capacity for follow-up care? 7. Which alternatives exist that could also address this problem?
Implementation	<ol style="list-style-type: none"> 1. Which local staff member or department has agreed to be responsible for the device once it arrives at a facility? 2. Is there sufficient and appropriate physical space to house this device? 3. How will local clinicians be trained to use this technology proficiently? 4. If implementing a new device, which tracking, maintenance, and repair systems need to be in place? 5. Is there adequate security to avoid misuse or theft? 6. Is the supply chain capable of sourcing repair parts for this device? 7. Does the local facility have financial means to maintain this device? 8. Is this device still supported by a manufacturer? 9. Will the manufacturer provide technical advice or support to local clinicians? 10. Do local clinicians foresee problems with this device?
<p>^a Questions based on World Health Organization. Health technology assessment of medical devices.⁶</p>	

It should be noted that properly responding to each item in this guide necessitates engaging local clinicians and government leaders. In lieu of formal HTA, this guide can be used by NGOs to initiate a partnership with an MoH. This guide can also be used to periodically re-evaluate devices and technologies already in use, to consider whether and how resource distribution is enhanced or undermined by using a device or technology, and to help avoid “socialization for scarcity,”⁸ which happens when NGOs and MoHs fail to pursue innovation when systemic barriers are perceived to be too challenging.

Ultrasound Technology

The students in this case are to be commended for wondering about broader implications of transient prenatal ultrasound screening. If we assume that the screening intervention is justified according to the criteria in the Table and that visiting faculty members instruct local clinicians on using portable ultrasound machines, then pressure from local clinicians could influence the MoH most. Accurate dating of pregnancies would allow women to plan travel to a local maternity waiting home. Detecting multiple gestation and breech presentation would help identify high-risk pregnancies and facilitate timely transfer to a local level 1 hospital, which could be far away. As discussed below, if we further assume that the region's expected reduction in maternal mortality approaches MoH goals, United Nations (UN) Sustainable Development Goal 3,⁹ and Global Surgery 2030 goals,¹⁰ then the NGO in this case would have implemented a health technology intervention that motivates existing health system priorities and withstands ethical scrutiny.

International Mandates

The proposed criteria in the Table enable evaluation of NGO device interventions within the context of a local health system and international mandates, such as those of the WHO. Ideally, a host nation's MoH incorporates WHO mandates in its policies and practices. However, in practice, their adoption may be incomplete. In such cases, NGOs should be aware of WHO mandates and evaluate their programs and technologies accordingly. In the absence of MoH guidance or capacity, the criteria offered in the Table can help influence decisions about which technologies and interventions are delivered and how and when they are introduced.

The highest-level mandates are 17 UN Sustainable Development Goals (SDGs). These 17 goals, which were adopted by the UN General Assembly in 2015, describe international development priorities through 2030.⁹ SDG 3 relates to health care and seeks to "ensure healthy lives and promote well-being for all at all ages."⁹ Of the 9 targets within SDG 3, 2 relate to devices: reducing maternal mortality (SDG 3.1) and reducing death and injury from road accidents (SDG 3.6). Both imply the need for surgical and diagnostic capacity building, which also requires technology.

The Global Surgery 2030 recommendations are the result of an extensive collaborative effort to address the global burden of surgical disease. The Lancet Commission on Global Surgery (LCoGS) elaborated quantifiable surgical system development goals to be achieved by 2030. The LCoGS proposed 2-hour access to a facility capable of performing 3 Bellwether Procedures (Caesarean delivery, laparotomy, and treatment of open fracture) as a core indicator of progress in health and surgical system development.¹⁰ The LCoGS observed that hospitals capable of performing Bellwether Procedures not only have the personnel and infrastructure needed to care for most surgical patients but also sufficient staff and devices to provide multiple services.¹⁰ Bellwether capacity indicates

elevated levels of local nonsurgical care as well by signaling inpatient care capacity, emergency room clinician skills, imaging technology, and laboratory services. Thus, technologies that enable progress toward developing Bellwether capacity strengthen an entire health system rather than simply providing care that targets the surgical system needed to address only specific needs or conditions.¹⁰

Conclusion

Criteria for evaluating health care technologies are essential if NGOs are to ethically and sustainably introduce such technologies in LMICs. The evaluative framework offered here can serve as a foundation for transparency and accountability in public-private partnerships that seek to motivate local, national, and international health care and development goals.

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