



Commodity security frameworks for health planning

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ABSTRACT

Building functional logistics systems and a healthy supplier base within low- and middle-income countries (LMICs) are key ways of providing steady, predictable supplies of health commodities for unpredictable demands for healthcare and health. Efforts to provide secure supplies of health commodities, whenever and wherever they are needed, however cannot ignore questions of whether there exists an external supportive environment in LMICs. Health planners must focus not just on capacities internal to logistics systems but also on external capacities. Internal and external capacities must be considered together and not in isolation. For this reason, a capacity-oriented commodity security framework, applicable to all therapeutic categories, is presented to help health planners in LMICs identify and evaluate the interrelated root causes of unreliable supplies in their respective countries.

1. Introduction

In any low- to middle-income country, health commodity security is said to exist if all health facilities have the ability to choose, obtain and use the needed health commodities at all times. Expressed differently, health commodity security is the continuous, uninterrupted supply of quality-assured health commodities to users, clients and customers whenever and wherever these commodities are needed.^{1,2} Users, clients and customers in this definition refer to healthcare provider facilities and the words, whenever and wherever, point to the difficulty of providing uninterrupted supply of health commodities for unpredictable healthcare and health demands. One cannot guarantee uninterrupted supply for unpredictable demands by focusing on just a subset of health commodities within a particular category or health commodities belonging to a subset of therapeutic categories. The relevant set of therapeutic categories will vary across low- to middle-income countries (LMICs), with this variation reflecting the (changing) demographic and epidemiologic profiles of these countries. But policy focus in each LMIC must shift away from a subset to all therapeutic categories. We refer to this as aggregate commodity security. It is defined as the continuous, uninterrupted supply of quality-assured health commodities – belonging to all relevant therapeutic categories that match a country's (changing) demographic and epidemiologic profile – to users, clients and customers whenever and wherever these commodities are needed. If in any LMIC, all non-labour health commodities needed can be assigned to 150 therapeutic categories, aggregate commodity security will be the sum of commodity security in each of the 150 different categories. Category-specific commodity security, on the other hand, will be the continuous, uninterrupted supply of commodities within one or more of these categories but not all.

The question is: are health systems in LMICs anywhere near achieving reliable, secure supplies of all health commodities needed? Table 1 below summarizes evidence from a non-systematic review of studies on LMICs. This summary plus the systematic literature review by Mahmic-Kakjano et al.³ indicate suboptimal commodity security in LMICs. Table 1 does not provide a complete picture for all LMICs but if commodity security is assured for some products and not for other products belonging to the same therapeutic category, one can safely conclude there are long-standing problems of assuring aggregate commodity security in LMICs. Even when attempts are made to build integrated logistics systems (i.e., a single logistics pipeline for all products), suboptimal outcomes do appear. A study of the impact of implementing an integrated logistics systems in Ethiopia, using a sample of 31 health facilities in four Wollega zones, showed generally good availability of a basket of essential medicines: on average, 93% for hospitals, 87% for health centres and 70% for health posts. However, for some health facilities, availability of artemether-lumefantrine, ferrous sulphate plus folic acid, mebendazole and oxytocin was <70%. Delivery lead times exceeded two months for some facilities whilst most of the facilities did not have the stipulated 2–4 months of stock-on-hand.⁴ So one key question this commentary hopes to answer is why recent studies in LMICs report the same suboptimal outcomes as reported in previous research. Why are these suboptimal outcomes resistant to intervention(s)? And what do health planners need to achieve health commodity security in LMICs?

Assuring health commodity security in LMICs requires functional logistics systems (for all therapeutic categories) plus a healthy supplier base. Logistics systems are comprised of a set of logistics activities: product selection, quantification, procurement, inventory management and service delivery. They must be *functional* – meaning there are no lapses in executing

Table 1
Studies reporting on availability of health commodities in LMICs.

Category	Study*	Findings
Essential medicines	Shrestha et al. ³⁰	Availability of selected essential medicines was found to be non-uniform and insufficient in all regions of Kathmandu valley, Nepal – ranging from 97.9% for 50 mg metformin, 84.1% for 0.1 mg salbutamol aerosol to 0% for 0.05 mg beclomethasone aerosol
Essential medicines	Cameron et al. ³¹	Availability of a basket of 15 essential medicines in the public sector averaged across 36 LMICS ranged from 29.4% to 54.4%. Availability of four commonly used medicines ranged from 76% for 250 mg amoxicillin capsules/tablets, 82.4% for 500 mg ciprofloxacin capsules/tablets, 71.3% for 5 mg glibenclamide capsule/tablets, and 60.8% for 0.1 mg salbutamol inhaler
Medicines for diabetes and hypertension	Robertson et al. ³² (2015)	Availability of antidiabetic and antihypertensive medicines in Tanzania over the period 2012–2013 varied widely in both public and private health facilities: metformin (33–57%), glibenclamide (19–52%), captopril (13–48%), calcium channel blockers (29–57%) and beta blockers (15–50%) and 34% had at least one type of insulin
Medicines	Mhlanga and Suleman ³³	Mean availability of generic medicines in Manzini, Swaziland was 67% (+ / – 22.3%) in the public sector and 77.50% (+ / – 27.7%) in the private sector. Mean availability of original branded medicines was 80% in the public sector, 40% in the private sector. Amlodipine, captopril and glibenclamide was found 80% of public facilities but lower availability for aminophylline (30%) and propranolol (40%)
Essential medicines	Alefan et al. ³⁴	Mean availability of generic medicines in Jordan was high in the public sector (72%) and the private sector (76%). Mean availability of originator branded medicines in the public sector was low (9%) but higher in the private sector (57%). Product-specific availability in public and private outlets varied widely from 0% to >80%
Essential medicines	Khuluza and Haefele-Abah ³⁵	Overall availability of medicines in Malawi was 48.5% in the public sector, 71.1% in retail pharmacies, 62.9% in facilities of the Christian Health Association of Malawi (CHAM) and 57.5% in private clinics. For medicine scheduled to be available at all levels, availability was 47% for primary health facilities, 56% in district facilities and 66% in central hospitals. Medicines restricted to district levels were found in primary health centres (9% availability). Tertiary-level medicines were also found at low levels: 9%, 20% and 60% in primary, district and central facilities. Product-specific availability varied from 0% for ethosuximide to 100% for amoxicillin and cotrimoxazole tablets in all facilities
Antidiabetic medicines	Babar et al. ³⁶	Availability of four antidiabetic medicines (metformin, metformin extended release, gliclazide and insulin) in 51 primary care pharmacies across 17 LMICs showed lowest availability in Georgia (29%) and highest in Pakistan (88%). Availability of generic version of these medicines in Georgia and Saudi Arabia was < 30%. Bangladesh and Nepal had no originator brand medicines; in Armenia, Egypt, India and Tanzania, availability was less than or equal to 30%
Diagnostic tests and essential medicines for cardiovascular diseases and diabetes	Jingi et al. ³⁷	Availability in West Cameroon of diagnostic tests varied from 10% for electrocardiograms to 100% for fasting--blood-sugar tests. Availability of investigation tests varied: 58.3–100% in urban settings as opposed to 41.7–75% in rural areas. Availability of medicines varied: 36.4–59.1% in urban setting and 9.1–50% in rural settings. Availability of medicines in urban informal sector was relatively high of up to 63.6%
Diagnostic tests and essential medicines for cardiovascular diseases and diabetes	Kibirige et al. ³⁸	Availability of medicines in Uganda ranged from 20.1% for unfractionated heparin to 100% for hypoglycaemic agents. None of the insulin types were of high availability but availability of antihypertensive agents was high (> 80%). Availability of diagnostic tests ranged from 6.8% for microalbuminuria tests to 100% for urinalysis. WHO recommended tests for cardiovascular disease and diabetes were high (>80%) with the exception of electrocardiography (54.6%) and lipid profile tests (65.9%)
Diagnostic tests, medical equipment and essential medicines	Nyarko et al. ³⁹	Across 23 health facilities in Ghana surveyed, none of community-based health planning services (CHPS) compounds had functional glucometers, oxygen cylinders or nebulizers with only 11% of health centres having these commodities. None of the health facilities had a functional spacer and all facilities had a blood-pressure--monitoring devices and weighing scales. Almost none of the CHPS compounds and health centres had diagnostic tests. Regional hospitals had all basic diagnostic tests with the exception of serum troponin tests for heart injury. Regional hospitals had almost all essential medicines for non-communicable diseases and none of the CHPS compounds had salbutamol inhalers
Essential medicines	Cameron et al. ⁴⁰	Across 40 developing countries, generic medicines for chronic conditions were less available than for acute conditions in the public sector (36% vs. 53.5%) as well as the private sector (54.7% vs. 66.2%). An inverse (direct) relationship exists between country income levels and availability gaps between medicines for acute and chronic conditions (aggregate commodity security). Average gap in African countries studied was nearly 40%

Notes: * Year of publication in brackets. The table focuses on availability of health commodities and not affordability for reasons of brevity as well as methodological concerns (see Niens et al.^{41,42}) about assessing affordability using the wage of the lowest paid unskilled government workers as the benchmark.

each of the logistics activities individually and together as a unit. Yet securing reliable supplies whenever and wherever they are needed requires more than logistics and suppliers. Health planners must ask whether the external political and socioeconomic environment in their respective countries can support efforts to achieve or improve commodity security. Some might consider a focus on more than logistics systems (and suppliers) as digression to issues that are irrelevant or peripheral to the task of assuring health commodity security. This commentary takes the opposite view that logistics systems, a supplier base and a supportive external environment, are all critical ‘capacities’ that complement each other and should not be considered in isolation. To this end, we present a capacity-oriented commodity security framework (see Table 3) as a tool health planners can use to evaluate the situation in their respective countries and for developing appropriate interventions. The broad perspective taken is in line with existing commodity security frameworks. It helps in examining why the suboptimal outcomes

reported in Table 1 and other studies persist, and the broad range of corrective measures needed in LMICs.

2. Commodity security frameworks, beyond logistics and suppliers

Existing commodity security frameworks suggest LMICs will need more than logistics systems and a healthy supplier base to assure commodity security. There are three of such frameworks, namely that for (1) reproductive health, (2) maternal health and (3) HIV/AIDS. These category-specific frameworks and their components are often presented diagrammatically as concentric circles; details of which will be found elsewhere.^{1,5,6} A useful illustration of how these frameworks can be used is provided in a report by the United Nations Fund for Population Activities (UNFPA)⁷ on reproductive health commodity security in Vanuatu. Observed differences in these frameworks are due to the therapeutic categories for which they were

Table 2
Category-specific commodity security frameworks.

	Reproductive health CS	Maternal health CS	HACS
Core	Client demand: utilization of reproductive health commodities	Equitable access to high-quality maternal health commodities	Treatment, care and prevention of HIV/AIDS, with priority given to PMTCT
	Social marketing	Population awareness; individual patients and family behaviours, communication and decision-making in seeking healthcare	IEC plans and VCT
Internal capacity	Policy development and implementation; forecasting, procurement, distribution, M&E and service delivery. These components are collectively labelled "capacity"	Health supplies, diagnostics and devices required; supply chain strengthening; human resources development; quality assurance; M&E; and service delivery	Logistics, human resources, M&E and service delivery; quality of products and services
External capacity	Coordination Commitment Capital or finance Context	Coordination Advocacy and leadership Finance Policies and regulations	Coordination Leadership Finance Social, policy and legal environment

Source: Dowling et al.⁵; John Snow Inc. (JSI)⁶; Raja.¹

Notes: HACS = HIV/AIDS commodity security; IEC = information, education and communication PMTCT = prevention of mother-to-child transmission; VCT = voluntary counselling and testing; M&E = monitoring and evaluation.

developed. But because these frameworks cannot be extended to other categories, a generic framework applicable to all therapeutic categories is needed.

This commentary sought to develop such a framework using a concept that defines capacity as the possession of financing, policy tools, legal authority, infrastructure, technology or machinery, staff with competence and knowledge to undertake a given task or activity in a supportive environment.⁸ Under this concept, capacity has four characteristics. First, capacity is task-specific: capacity needed for gold mining is different from that needed for oil drilling. Likewise, capacity needed to assure (aggregate) commodity security is somewhat different from the capacity needed for the production of healthcare and health. The latter relies on health workers as well as a secure supply of health commodities. Next, capacity is of two types: capacity internal to the organization or institutions that carry out a specific task and capacity external to these institutions or organizations. External capacity most often refers to the broader social, economic and political environment. Three, capacity, whether internal or external, must be dynamic or adaptive in that it is not fixed and it will not remain fixed. Capacity will need to change over time in response to changes in the nature of the task undertaken. Lastly, the dynamic nature of internal or external capacity rests on what can be referred to as "transition capacity" – the ability to initiate, successfully implement and manage reform or change. This is separate from the day-to-day management and execution of a given task.⁸ An evaluation of the components of existing category-specific frameworks against this concept of capacity (to draw out common themes) is shown in Table 2.

Putting aside the difficulties of implementing change on the ground, the use of commodity security frameworks as health planning tools is fairly straightforward. Imagine a health planner thinking of implementing an HIV/AIDS program (a large component of which is centred on prevention of mother-to-child transmission) for remote communities in Nicaragua. Impact of that program on community health hinges on a secure supply of health commodities for HIV prevention and treatment. Depending on the level of existing demands for these commodities and services (produced using these commodities), Table 2 suggests the health planner must first ask if there is a need to create additional demand via voluntary counselling and testing (VCT) and information, education and communication (IEC) campaigns. The planner will then ask if existing logistics systems in Nicaragua are designed to handle HIV/AIDS commodities and whether these systems are functional. The health planner should also ask whether the quality of these commodities can be assured by an appropriate quality regulation authority; whether there are adequate numbers of logistics staff and health workers – and whether workplans under the health program have provisions for monitoring and evaluation (M&E). Similarly, interventions taken to improve logistics systems in Nicaragua (that HIV/AIDS programs rely on) must have their own M&E plan. These varied considerations will define the set or package of interventions that will allow the HIV/AIDS

program to be successful. The chosen package of interventions must then be supported by good leadership, coordination of interests and plans, and adequate financing or generally speaking a supportive external environment.

The generic framework developed for this commentary, using the concept of capacity described above, is shown in Table 3. It is labelled as the capacity-oriented commodity security framework. Table 3 should be thought of as a health planning tool that can be applied to any therapeutic category and to evaluate health commodity security in any LMIC. That is, one will arrive at roughly the same set of strategies, policy solutions or package of interventions shown in Table 2 by applying Table 3 to the cases of maternal health, HIV/AIDS and reproductive health. Details of the capacity-oriented framework are presented below.

3. Capacity-oriented commodity security framework

3.1. Core

As with all other commodity security frameworks, Table 3 has at its core demands for health commodities that stem from derived demands for healthcare and health. Depending on whether people have well-informed preferences or not, demand creation may become necessary if the health benefits of (essential) health commodities are undervalued by people who will benefit from such commodities. In such situations, demand creation will aim to provide information (via social marketing or what is generally described as information and education campaigns) and/or subsidize patients' out-of-pocket payments including the costs of accessing healthcare facilities. Notwithstanding, demand-creating measures may not always be enough as people have different preferences for different attributes of health commodities (e.g. the way they are administered). Evidence from Burkina Faso, Niger, Senegal and Uganda⁹ suggest some women who had never used the intramuscular version of a contraceptive (containing depot medroxyprogesterone acetate) were willing to use a subcutaneous version (with similar efficacy and safety profile). The women who preferred the subcutaneous version also had lower discontinuation rates over time. This was the outcome of unsubsidized voluntary and imperfectly informed choices, not coercion. Thus availability of a subcutaneous version of the commodity (that can be self-administered with less pain in non-clinical settings) was enough to increase uptake and usage. In fact, it has been reported that prevalence rate for contraception use is positively correlated with the availability of a richer mix of contraception methods (a correlation coefficient of 0.78).²

So putting demand-creation aside, a logistics system that is responsive to end-user preferences for health commodities is necessary for the expansion and uptake of healthcare services. A client- or user-centred logistics system on its own (via careful selection of commodities preferred by end-users) might be an effective measure for getting people to use under-

Table 3
Capacity-oriented commodity security framework.

	Components
Core	Derived demands for health commodities Demand creation for underutilized or undervalued health commodities
Internal capacity	Logistics system for aggregate commodity security* Plans and programs to improve the logistics system
External capacity	A healthy supplier base* Functional quality regulation authority* Adequate number and geographical spread of healthcare facilities* Appropriate, rational use of health commodities* Commitment from key stakeholders Advocacy, political will and leadership to initiate, design and manage change Coordination of stakeholder efforts, plans and programs Capital financing (= Health insurance and financing) Country context Global environment

Source: Author.

Notes: For brevity, the starred components were not discussed at length. They are however important considerations for health commodity security in LMICs.

utilized health commodities. To do that, logistics systems must have all the necessary internal capacities. Logistics institutions must have the legal authority, infrastructure (warehouses, storage and cold-chain facilities, delivery trucks etc.) and technology (basic accounting, administrative and financing systems; tracking and anti-theft devices; more specialized [computerised] LMIS etc.) to execute all logistics activities. That said, in cases where demand creation is necessary, there should be an existing functional logistics system for continuous supply of the commodities demanded. It appears in rural Malawi provider-initiated HIV VCT in antenatal clinics was so effective that it created the perception that testing was “compulsory”. Demand created by punctilious provision of information, however, was undermined by the limited stocks of nevirapine for prophylaxis of mother-to-child HIV transmission.¹⁰ Health planners should not embark on demand-creation exercises without a functional logistics system.

3.2. Internal capacity

Moving from the core of the framework, we have capacities internal to logistics systems. This refers to activities and functions of a logistics systems: (1) product selection, (2) quantification [forecasting and supply planning] and procurement, (3) inventory management [storage and distribution] and (4) service delivery. See the United States Agency for International Development (USAID) publications referenced^{1,2} for further details. However, the type of logistics system we recommend is one designed for all therapeutic categories. Commodity security then will be the outcome of summing up logistics activities in such a system. That is, if there are no lapses in the execution of each of these logistics activities and they can be made to work well together. Detailed discussions on logistics systems designed for aggregate commodity security and requirements for a healthy supplier base in LMICs (i.e., maintaining multiplicity of suppliers and LMICs' contributing to global health R&D) will be found elsewhere.¹¹ Note that under internal capacity, the framework has “transition capacity” to effect and manage change(s). This is needed for the simple reason that health planners' aversion towards the use of logistics data and LMIS for decision making and reform change, for instance, will leave problems and bottlenecks hidden and unrecognized.

3.3. External capacity

External capacities refer mostly to interactions between social, political and economic spheres within any LMIC. Some might argue these issues are irrelevant or peripheral to the task of assuring health commodity security but a closer inspection suggests otherwise.

Logistics systems are the machinery for assuring commodity security, whether one is dealing with government, private and non-governmental sectors. These sectors – and the health planners working as stewards and leaders within these sectors – can be described as “key stakeholders”. One will then expect these key stakeholders to show commitment to the idea that designing and improving logistics systems for aggregate commodity security is necessary for maintaining and building population health. Without such commitment, there will be no drive (impetus) to change things. For example, there will be little, if any effort to grow or secure financing for capital investments in logistics functions. Left unchecked, the status quo becomes deeply entrenched making it more resistant to change. Commitment to improving the logistics system (the antithesis of corruption and under-the-table, gratuity arrangements), however, requires some form of coordination of interests and views of the key stakeholders, especially where the key stakeholders rely on the same or parts of the same logistics system. Coordinated efforts, even within a sector, relies heavily on policy ownership sharing with front-line logistics staff (as opposed to sole reliance of a small elite group of health planners/technocrats and expatriates). This will be an important factor in getting agreement as to what the best practices should be and the way forward. Coordination of stakeholder interests, however, need not be at odds with arguments by Bornbusch and Bates¹² for multiplicity of logistics systems as a measure to facilitate competition and hedge supply risks. For example, the existence of a competing private or non-government logistics system may be what is needed to initiate attempts to improve public, government-run logistics systems.

Commitment to improving logistics systems and coordinated efforts of key stakeholders, however, cannot produce much without the necessary resources: money needed for capital investments in logistics functions, for day-to-day operation and management of the logistics system plus acquisition of forecasted quantities of health commodities. Since the pot of money needed will be some fraction of financing allocated to the whole health sector, a lot rests on the health financing systems in LMICs. Also important is health planners' ability to build a solid business case for upgrading existing logistics systems. This will determine the size of the fraction of health financing allocated for assuring health commodity security and whether that fraction can be increased.

Development of health financing systems appropriate for LMICs will be crucial. And on this topic, we caution health planners against arguments for individual responsibility in paying for healthcare out-of-pocket.¹³ Most common arguments focus on imperfect information, lack of efforts to get people informed and externalities that could be clinical and/or altruistic in nature. What is often not considered is: irregular and unpredictable demands for health commodities and care translate into irregular or unpredictable streams of revenue from out-of-pocket payments to support capital investments in healthcare delivery infrastructure including logistics systems. Similarly, such irregular and unpredictable demands (and costs involved) mean health commodities and care might be affordable to patients today but not tomorrow even keeping the disposable incomes fixed over time. This is the “access motive” for health insurance financing. Reducing or eliminating the financial risks associated with illness allows people to afford health commodities and care even at a time when the costs of health commodities and care provided exceed their household incomes.¹⁴ Thus commodity security as the continuous supply of health commodities, whenever and wherever they are needed, doesn't fit well with uninsured demands. Compared to individual out-of-pocket payments, collective action, via taxation and/or social or private health insurance schemes, will not only assure a steady stream of revenue for healthcare but also ensure health commodities and care are affordable, most of the time. Exemptions from or removal of out-of-pocket payments at the time when illness strikes will provide some form of insurance protection but without a stable additional stream of revenues. Collectivism via taxation supplemented by social health insurance for formal- and informal-sector workers (augmented by external donor funding) therefore seems the best way forward for LMICs.

More attention however should be given to informal-sector workers since they tend to be a majority in LMICs and yet their enrolment in social health insurance schemes is often low. Evidence from Kenya¹⁵ suggests all

informal-sector workers are not too poor to afford premiums: their mean monthly income ranged from \$16.7 to \$786.5. The study showed some informal-sector workers in urban areas of Kenya (e.g., those in stationery business, repair and maintenance, food vending, shop-keeping, clothing and beauty products trade) and in rural areas (e.g., those in farming, manufacturing and craft and providing some form of medical care) have consistent, stable income flows. A solution, albeit untested, is the use of health insurance accounts (HIA), which are simply savings accounts or vehicles for paying insurance premiums, whether health insurance is subsidized or unsubsidized. These savings accounts will serve as an “informal payroll” from which insurance premiums will be deducted. With fluctuating seasonal incomes that are not on any formal payroll, HIAs should have an overdraft facility, making it possible for informal-sector workers to shift premium payments from periods of low-incomes to periods of high-incomes.¹⁶ HIAs are appropriate for the simple reason that informal-sector workers will know the size of their insurance premiums in relation to their household incomes whether they fall sick or not, but they cannot estimate the costs of their medical bills before they fall sick. If people in the informal sector are willing to build up precautionary savings to pay for unpredictable medical bills that might be catastrophic; they should be (more) willing to build savings to pay for smaller premiums that are usually fixed in a year.

Whether these external capacities (commitment, coordination and insurance financing systems) exist depends on the country context that sets limits as to what can be possibly done. For example, health planners who are convinced there is a need for reform change may find their good intentions and plans unravelled by ethnic tensions and the possibility of conflicts – and unrestrained decision space (i.e., zero auditing [checks and balances], zero accountability and widespread corruption). Mistrust of government and health planners works the other way to further undermine the impetus for reform. These contextual issues aside, the macroeconomy and constraints on public expenditures (tied to loans and grants received from Bretton Woods' institutions) will determine how much of societal resources mobilized can be allocated to the health sector. The pot of money available will also depend on whether health planners can argue for a bigger size of the government funding available.

Macroeconomic issues aside, how a country is governed (whether health planners act within decentralized or centralized environments) is important. For example, it has been noted that best practices for the logistics functions of procurement and inventory management (i.e., storage and distribution) are at odds with decentralized decision space.^{17,18} In the late 1990s and early 2000s, the logistics system in Ghana had three tiers/echelons – central, regional and district medical stores. This coupled with decentralized execution of logistics functions meant storage costs accounted for 73% of total logistics-system costs. In addition, underinvestment in transportation meant health facilities had to arrange their own private modes of transport (taxi, public transport etc.) or pay fuel costs for others to deliver the health commodities requested. The multiple tiers, and the fact that non-drug commodities had to be sourced from regional medical stores whilst medicines were sourced from district medical stores created an inefficient system with high transportation costs (20% of the total). In addition, decentralized decision space meant sometimes procurements did not go through the central medical store (CMS). CMS itself sometimes had to source health commodities from private wholesalers and added price margins that were higher than private wholesalers' mark-ups.¹⁹ Besides country-specific experiences, there are other reasons why the logistics functions of procurement and inventory management are at odds with decentralized decision space. Logistics systems can only guarantee uninterrupted supply for unpredictable demands by exploiting the law of large numbers through pooled forecasts to reduce the variances around demand estimates, thereby reducing the number of instances of a mismatch between commodity supply and (insured) demands. This also fits well with pooled procurement arrangements. Health planners can be price-sensitive by using aggregated/ consolidated demands to reduce the unit prices or costs of the mix of competing health commodities chosen at the product selection stage of the logistics cycle. Hence, in decentralized environments,

different communities, districts or regions are better off working together as far as these logistics functions are concerned. There should be explicit agreements to coordinate and consolidate logistics functions with sanctions for deviations.^{17,18} This at least avoids investing limited capital financing available in multiple or duplicate logistics functions and institutions, especially those for inventory management. The outcome of which is zero or underinvestment in each logistics institution or function.

4. Interdependencies matter

Country contexts may differ but what really changes is the extent and nature of the problem. To shed more light on this point, we examined differences between what happens in humanitarian situations and what happens in peaceful (post-conflict) countries. We found little difference in what is needed to assure commodity security. The evidence below indicates variations in health commodity security across LMICs (see for e.g. Table 1) are most likely the outcome of (negative) interactions between the different components of Table 3.

In crisis, humanitarian logistics systems often emerge to replace previous logistics systems that have been severely damaged by the forces of nature or the dogs-of-war. However, such humanitarian efforts do experience problems with health commodity security. Casey et al²⁰ evaluation of the provision of reproductive health services to women and girls in humanitarian settings in Burkina Faso, Democratic Republic of Congo and South Sudan indicated limited availability of needed health commodities (essential drugs, syndromic or laboratory diagnostic tests, condoms etc.). Failure to ensure adequate supplies was further compounded by negative care-seeking patterns that calls for demand creation. Recent research²¹ evaluating humanitarian logistics systems provide additional insights. One, humanitarian logistics system costs (staffing, personal protective equipment and other health commodities, setting up field warehouses, transportation etc.) account for 60–80% of the operating costs of disaster-response agencies. Two, the size of targeted populations and number of beneficiaries are crucial for lowering humanitarian logistics and supply chain costs, which suggests opportunities for short-run spreading of fixed costs and in the long-run exploitation of economies of scale and scope. Three, a country's GDP-per-capita was positively related to lower logistics costs, perhaps because more money is available for capital investments in logistics systems infrastructure and cost-reducing technology. Four, non-governmental organizations (NGOs) appear to have lower logistics costs than UN agencies.²¹ A plausible explanation for this observation is: NGOs' regional focus, as opposed to the country-specific focus of UN agencies, allowed them to gain more experience in implementing and coordinating logistics activities and in dealing with uncertainty in conflict zones. Humanitarian logistics systems in fragile states are no different and to be functional, effective and efficient, they must have the necessary internal and external capacities. The negative impact on public health of failing to get humanitarian logistics systems to work is evident in a recent study²² that reported low immunization coverage rates and outbreaks of vaccine-preventable diseases in conflict-affected countries. Sixteen countries with the highest number of “persons of concern” registered by United National High Commissioner for Refugees account for 67% of global polio cases and 39% of global measles cases over the period 2010–2015.

Compared to humanitarian situations, what might happen in apparently peaceful, democratic, disaster-free LMICs is not exactly an improvement. Health commodity security in such contexts is not guaranteed. One simple reason is the impacts of geopolitical tensions and global events (in non-health-commodity and/or financial markets) on LMICs are such that not much can be done to assure commodity security for healthcare provision. It may be that economic and political crisis create windows of opportunity but this assumes such crises do not lead to significant destruction of existing infrastructure for health commodity logistics and healthcare delivery. Otherwise, the windows of opportunity for change arises at precisely the times when not much can be done.⁸ Or if something can be done, this takes the form of short-term solutions rather

than long-term structural changes. As an illustrative example, consider the policy directive by the ruling Chama Cha Mapinduzi (CCM) party in Tanzania for the construction of health facilities (“a medicine dispensary for every village, a health centre for every ward and a hospital for every district”). This unfortunately was not supported by corresponding investments in logistics systems infrastructure and functions. Bad publicity that followed severe medicine stockouts led CCM to adopt a direct delivery model of distributing medicines from central medical stores to health facilities. Direct delivery as a short-term solution was driven by political competition and CCM's attempts to preserve its share of public votes²³ – and it is unclear what long-term structural changes will be made. But the capacity-oriented framework can be used to determine the components of any long-term solution deemed necessary. At least, one would expect health planners in Tanzania to make a case for capital investments in the existing logistics systems to match expansion in the number of healthcare providers and facilities.

Next consider situations where quality regulation authorities do not function as expected. One may observe at most times 100% availability of (unlicensed) health commodities with questionable quality. Or when the lines of responsibility for quality assurance are blurred, as reported in Ghana,²⁴ delays in collecting random samples of health commodities for quality control tests (i.e., long quarantine times) may contribute to longer supply lead times, especially where commodities are sourced from offshore suppliers. Chances are individual members of any pooled procurement arrangement may abandon best practices and start looking for alternative, less efficient means of sourcing health commodities; or to avoid delays and deviations from best practices, quality tests may not be conducted routinely. In addition, consider results of a study²⁵ that showed, using historical data over 11 years from 130 principal recipients of GFATM funding in 53 African countries, an association between stockouts of needed health commodities and delays in sequential disbursement of GFATM funding. Funding delays reported were a consequence of increased frequency of performance reporting (progress reports had to be filed within 90 days as opposed to the usual 180 days). We believe the funding delays that followed these performance reporting requirements had to do with (1) GFATM's concerns about whether funding provided yield the expected outcomes and (2) absence of an organizational culture for M&E – worsened by the absence of basic accounting, managerial and information systems in logistics institutions and health facilities. The absence of capacity, internal to logistics systems, can therefore undermine the effectiveness of donor funding, an external capacity.

Finally, and based on surveys from 75 LMICs, Briggs et al.²⁶ report that unreliable supplies of commodities for reproductive, maternal, new born and child health (RMNCH) are due to deficiencies in “policies” (for e.g., a mismatch between essential medicines lists and standard treatment guidelines due to time lags in updating these reference manuals) and deficiencies in “systems”. Deficiencies in “systems” refer to, for e.g., essential RMNCH medicines not registered in some LMICs or non-renewal of registration licenses. These observations suggest an unhealthy supplier base. Deficiencies in “systems” also refer to the unavailability of logistics data and costed supply or procurement plans, and frequent stockouts at central medical stores; observations that point to the absence of functional logistics systems. Other system deficiencies had to do with existing health financing arrangements. Briggs et al.²⁶ report that in some LMICs exemptions from out-of-pocket payments existed for commodities that were only used in RMNCH (for e.g. oxytocin) whilst RMNCH commodities that had other clinical uses (for e.g. corticosteroids and antibiotics) had no exemptions in place. The higher the number of clinical uses of a health commodity, the greater the potential to mobilize, at the time of illness, more revenues through out-of-pocket payments. But it is easier to achieve the dual objectives of revenue mobilization and financial-risk protection with an insurance arrangement that includes RMNCH commodities in its benefit package. Yet, Briggs et al.²⁶ report that RMNCH commodities provided free-of-charge were equally likely to experience stockouts as those not provided free-of-charge. As evident from Table 3, changing existing health financing

arrangements and/or mobilizing more money will not make much of a difference if, for example, there is little or no capital investments in functional logistics systems.

5. Conclusions and recommendations

The link between capacities internal and external to logistics systems is analogous to that of a coach and horse: what can practically be done to improve logistics system and/or build a healthy supplier base will depend on external capacities within any LMIC. Interdependencies between components of commodity security frameworks matter – and a narrow focus on one or two components of Table 3 will not reverse the suboptimal outcomes shown in Table 1. The persistent inability to assure health commodity security in LMICs is the cumulative impacts of negative interactions between the components in Table 3. Getting these components to fit together is the challenge ahead. It follows that surveys and analyses that do not take full account of these interactions will unsurprisingly produce recommendations that vary according to the components researchers focus on. Researchers, policy analysts and health planners might come up with different sets or packages of interventions depending on what is considered irrelevant, trivial or peripheral to the task of assuring commodity security.

Privett and Gonsalvez,²⁷ for instance, have proposed a “dependency model” that highlight top ten issues to be addressed for the improvement of global health supply chains. (1) Product-level issues of expiration and temperature control; (2) facility-level issues of shortage avoidance, shipment visibility, warehouse, order and inventory management; and (3) lack of coordination, human resources, demand information and again shipment visibility. We have categorized these issues as capacities internal to the logistics system. Pastakia et al.²⁸ categorize factors needed to build reliable supply systems for non-communicable disease into two groups: (1) resource mobilization and (2) resource utilization. Factors falling under “resource mobilization” include lack of dependable financing, lack of adequate human resources and lack of adequate physical assets and infrastructure. Factors falling under “resource utilization” include weak procurement processes, rigid and complex supply chain platforms (i.e., lack of standardization and harmonization of efforts), supply chain integrity and vulnerabilities (e.g. problems of maintaining product quality); and poor availability and use of information. These set of factors refer to both internal and external capacities but do not cover all the components listed in Table 3. Abeshu and Geleta²⁸ suggest (1) knowledge, attitudes and practices of patients, (2) information, education and communication, (3) logistics factors, (4) provider and service-delivery-environment related factors, and (5) health system factors – are what is needed to assure commodity security for reproductive health commodities. The first and second set of factors are related to or needed for demand-creation; the third set of factors presumably refer to capacities internal to the logistics system, whilst the fourth and fifth sets of factors are capacities external to the logistic system. Yadav²⁹ discusses root causes of underperforming supply chains in developing countries that include: poor quality assurance; multiple tiers/echelons in logistics systems and the bullwhip effect this creates (i.e., amplification of variances around demand forecasts as one moves across multiple tiers/echelons); long resupply intervals that puts greater pressure on having accurate demand estimates; diffuse accountability and decentralized execution of logistics functions; lack of logistics data for planning; human resource constraints (skill mix and incentives); lack of interest in funding operating costs and uncertain financing, from domestic sources or donors, for procurement. The root causes identified by Yadav²⁹ and the key strategies (priorities) discussed are all related to internal and external capacities in Table 3.

The capacity-oriented framework therefore provides a coherent way for health planners to diagnose unsatisfactory commodity security in their respective countries. The framework with its focus on internal and external capacity allows for more detailed analyses of what needs to be done. This is important since failure to achieve aggregate commodity security cannot, within any time period or over time, be attributed to a singular set of factors, even if there are commonalities among LMICs. The underlying causes

of problems of commodity security could be several and country-specific, being dictated by the progress made and failures that remain. Likewise, the set of key strategies, package of interventions or reforms, the components of Table 3 call for, will vary with country contexts. For this reason, we do not make specific recommendations as to what the key strategies are or should be in any LMIC. We leave policy choices and decisions in the hands of health planners – and conclude with the following general recommendations.

Health planners must adopt a systems approach: they must move away from a focus on a specific or singular cause of insecure supplies of health commodities and consider interdependencies with other (visible or unrecognized) bottlenecks. Admittedly, there are several factors directly or indirectly related to the components of Table 3; but the inherent complexities and difficulties should not be an excuse for inaction. Health commodity security, in any LMIC, will be the outcome of building functional logistics systems designed for all therapeutic categories if this is supported by a healthy supplier base and the other internal and external capacities listed in Table 3. Therefore what is crucially needed in LMICs is consistency and repeated efforts: ‘small’ incremental reforms that complement each other. To this end, health planners and program managers concerned with health commodity security in LMICs should not simply use the capacity-oriented framework to diagnose the root causes of unreliable supplies – and to design reforms that fall within their mandates or jurisdictions. They should also use the framework to identify and engage in multi-sectorial partnerships with the overarching aim of assuring aggregate commodity security. Finally, future research should consider using the capacity-oriented framework to evaluate health commodity security in specific LMICs and for comparative analyses of the situation in these countries. This will provide more evidence as to the nature of the interdependencies between different components of the framework.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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