BMJ Open

Availability of equipment and medications for non-communicable diseases and injuries at public first-referral level hospitals: a cross-sectional analysis of service provision assessments in eight low-income countries

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To cite: Gupta N, Coates MM, Bekele A, *et al*. Availability of equipment and medications for non-communicable diseases and injuries at public first-referral level hospitals: a cross-sectional analysis of service provision assessments in eight low-income countries. *BMJ Open* 2020;**10**:e038842. doi:10.1136/bmjopen-2020-038842

► Prepublication history for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2020-038842).

Received 26 March 2020
Revised 17 June 2020
Accepted 05 August 2020

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ABSTRACT

Context and objectives Non-communicable diseases and injuries (NCDIs) comprise a large share of mortality and morbidity in low-income countries (LICs), many of which occur earlier in life and with greater severity than in higher income settings. Our objective was to assess availability of essential equipment and medications required for a broad range of acute and chronic NCDI conditions.

Design Secondary analysis of existing cross-sectional survey data.

Setting We used data from Service Provision Assessment surveys in Bangladesh, the Democratic Republic of the Congo, Ethiopia, Haiti, Malawi, Nepal, Senegal and Tanzania, focusing on public first-referral level hospitals in each country.

Outcome measures We defined sets of equipment and medications required for diagnosis and management of four acute and nine chronic NCDI conditions and determined availability of these items at the health facilities.

Results Overall, 797 hospitals were included. Medication and equipment availability was highest for acute epilepsy (country estimates ranging from 40% to 95%) and stage 1–2 hypertension (28%–83%). Availability was low for type 1 diabetes (1%–70%), type 2 diabetes (3%–57%), asthma (0%–7%) and acute presentations of diabetes (0%–26%) and asthma (0%–4%). Few hospitals had equipment or medications for heart failure (0%–32%), rheumatic heart disease (0%–23%), hypertensive emergencies (0%–64%) or acute minor surgical conditions (0%–5%). Data for chronic pain were limited to only two countries. Availability of essential medications and equipment was lower than previous facility-reported service availability.

Conclusions Our findings demonstrate low availability of essential equipment and medications for diverse NCDIs at first-referral level hospitals in eight LICs. There is a need for decentralisation and integration of NCDI services in existing care platforms and improved assessment and monitoring to fully achieve universal health coverage.

Strengths and limitations of this study

- ► To our knowledge, this is the first analysis with cross-country comparisons of readiness at first-referral level hospitals for acute and chronic presentations of a broader range of non-communicable diseases and injuries in low-income countries using practical and well-defined clinical criteria.
- ► Valid cross-country analysis was possible by comparing facilities at analogous levels of the health system and using Service Provision Assessment data, which is largely standardised across countries.
- ► The Service Provision Assessment surveys lack longitudinal data, and our analysis does not include information about supply chains, limiting the nature of the description about the availability of medications and equipment.
- ► While we analysed data from eight countries representing a variety of low-income countries geographically, there are many more countries excluded from our analysis.

INTRODUCTION

Non-communicable diseases (NCDs) and injuries (NCDIs) are major drivers of the disease burden in low-income countries (LICs), accounting for 41% of mortality and morbidity in terms of disability-adjusted life years in 2017.[1]

In many LICs, the risk factors, epidemiology and disease conditions that comprise the burden of NCDIs differs from that seen in higher income countries.[2] In these countries, harmful environments, infectious diseases and poor access to timely and high-quality health services are important factors contributing to the burden of NCDs.[3 4]

Health sector interventions to address this burden have been increasingly recognised as both cost-effective and equitable, particularly for severe NCDIs affecting individuals early in life.[2 5] In many LICs, availability of services to diagnose and manage NCDs is low and most often found primarily in urban higher-level hospitals.[4] However, several NCDI interventions may be optimally delivered at first-referral level hospitals, which have been recognised as an essential component of the primary healthcare system.[5] These first-referral hospitals, called district hospitals in some health systems, provide an opportunity to decentralise care, as they are more accessible to patients than tertiary referral hospitals and more capable of providing advanced services than health centres.[6 7] Populations in rural areas, which tend to have higher rates of poverty in LICs,[8] often face challenges accessing healthcare at distant facilities.[9] Although one study has shown low readiness of health facilities in five LICs to deliver general services for cardiovascular disease, diabetes and chronic respiratory diseases,[4] there has been limited multicountry assessment of hospital capacity to deliver a broader range of priority NCDI interventions. Some facility surveys assessing readiness and quality of care for other types of care, such as for maternal health, have found lower quality in facilities located in areas with higher rates of poverty.[10]

In this study, we evaluated the availability of equipment and medications for management and diagnosis of the acute and chronic presentations of a broad range of NCDIs at first-referral level hospitals in eight LICs: Bangladesh, the Democratic Republic of the Congo (DRC), Ethiopia, Haiti, Malawi, Nepal, Senegal and Tanzania. We selected specific NCDIs with potentially severe presentations early in life, including asthma, hypertensive emergencies, heart failure, rheumatic heart disease, type 1 and 2 diabetes, epilepsy, injuries and minor surgical conditions and chronic pain. Given previous findings linking poverty and healthcare quality, we examined whether there were associations between subnational prevalence of extreme poverty and availability of equipment and medications. To the best of our knowledge, the countries we included in this study are the only LICs with comparable, openly available, nationally representative data on NCDI service provision recently collected via a standardised survey.

METHODS

Study setting and data sources

We used publicly available data from all Service Provision Assessment (SPA) surveys conducted in LICs through 2018. The SPA surveys are nationally representative health facility assessments administered as part of the Demographic and Health Survey (DHS) programme.[11] These surveys were designed to assess human resources, infrastructure, equipment and medications available for maternal and child health (MCH) and priority infectious diseases.[11] In 2012, the SPA questionnaires were updated to include indicators for some NCDIs, including infrastructure, human resources, medications, equipment and guidelines. Survey collectors indicate medications and equipment as available if they directly observe these items on the day of the survey.

Since the initial inclusion of questions on NCDs, SPA surveys had been completed as of 2018 in eight LICs representing a broad range of geography, population size, economic productivity, healthcare expenditure and health system capacity: Bangladesh (2014), the DRC (2017–2018), Ethiopia (2014), Haiti (2013), Malawi (2013–2014), Nepal (2015), Senegal (2016–2017) and Tanzania (2014–2015) (see online supplementary appendix table 1).[12] Bangladesh subsequently graduated to lower-middle-income status in 2015, and Senegal was moved from a lower-middle-income country to an LIC in 2017 and back to a lower-middle-income country in 2020. These countries, excluding Senegal and Bangladesh, together represent 19% of countries classified as LICs by the World Bank for the 2020 fiscal year and 44% of the global population living in LICs.[13 14] The surveys in Haiti and Malawi were facility censuses, intended to capture all health facilities in the country. In Nepal, all public facilities were in the sampling frame and almost all public hospitals were surveyed. All hospitals in Ethiopia were included in the survey collection, along with a representative sample of private clinics and health centres. In Tanzania, all types of facilities were in the sampling frame, and 99% of hospitals were selected for the sample. In the DRC, the survey was done using a stratified random sample to obtain results by province and type of health facility. In Bangladesh, the surveys were conducted on a stratified random sample of facilities to obtain representative estimates by seven administrative divisions and by facility types (including a census of public district hospitals but a sample of public upazila health complexes). The combined 2016 and 2017 surveys in Senegal essentially includes a census of hospitals. Full details on the data from each country can be found in online reports, along with survey instruments.[12] Data from these surveys were obtained from the DHS programme (www.dhsprogram.com).

We build on methods previously developed to assess the quality of primary healthcare using similar datasets.[15 16] The datasets were cleaned and standardised across the countries, categorising facilities as hospitals, health centres and clinics, or other facilities such as dispensaries. Facility weights used in analysis accounted for survey design and nonresponse to ensure representativeness, as oversampling is often done for certain facility types in these surveys. Our assessment focused on public first-referral hospitals. We regarded first-referral level hospitals as the first point of care for patients requiring referral from a primary health centre level, and the names for these facility types varied across countries. We limited our analysis to public sector facilities to optimise evaluation

of health system investment and capacities provided from government sources for the poorest segment of the population, though data are not available within SPA surveys to specify payment source and mechanism for each commodity or service provided. In Nepal, we classified public district hospitals as first-referral level hospitals. In Bangladesh, we classified upazila health complexes as first-referral level hospitals because they are described as hospitals with in-patient beds and surgical care, occupy a lower level than district hospitals in Bangladesh, and have population catchment areas similar to district hospitals in other countries (1 facility per 375 000 population, compared with a range across other countries of 1 facility per ~175 000–560 000). In Malawi and Tanzania, we combined public district hospitals with public rural/community hospitals (Malawi) and district designated hospitals (Tanzania) as first-referral level hospitals. In Haiti, we used the community referral hospital classification. In Senegal, we reported on all public hospitals because more specific categories were not available from the SPA data. In the DRC, we used public hospitals below the provincial/tertiary level, though we could not differentiate between additional categories from the available data. In Ethiopia, we used both primary hospitals and general hospitals given the relatively recent introduction of primary hospitals and similarities in service delivery standards. Additional details can be found in online supplementary appendix table 1.

Data analysis

We analysed the availability of essential equipment and medications required for diagnosis and treatment of nine chronic disease states and four acute presentations of eleven NCDI conditions (table 1). We defined the minimum set of essential equipment and medications for the diagnosis and treatment of each condition using existing guidelines and iterative expert review from a group of public health practitioners, researchers and clinicians familiar with the local contexts. Acute conditions are those that require urgent procedures or hospitalisation, whereas chronic conditions were those requiring longitudinal follow-up for ongoing monitoring and disease management. The availability of the full essential set of functioning equipment and unexpired medications was determined for each facility. We considered equipment available if it was present in general outpatient, NCD or minor surgical areas. Medications were considered available if they were observed present and unexpired. In most cases, the data necessary to create these sets were available. In cases in which a survey question about one of the components of the equipment and medication set for a condition was not answered but the rest of the components were present at the facility, the facility received an 'unknown' classification for that set. If any one of the components was unavailable, then the essential set was classified as unavailable. Surveys in some countries did not contain questions about all of the relevant medications and equipment. In these cases, as well as in countries with >10% missing data for a particular variable, the country was excluded from analysis (see online supplementary appendix table 2 for list of missing variables). Missing variables and 'unknown' classifications for a set of equipment and medications were rare, resulting most frequently from surveys in particular countries excluding certain pain medications or surgical equipment. A total of 21 out of 797 public first-referral hospitals (less than 3%), 20 of these in Bangladesh, did not provide NCD services according to the survey. If these particular facilities were missing data for particular medications or equipment, we assumed the medications or equipment were unavailable. The availability of the essential sets of equipment and medications and their component items were tabulated by geographic units (both by country and by subnational units within countries). We also compared the proportion of facilities that reported diagnosing and managing chronic respiratory diseases, cardiovascular diseases and diabetes with the availability of essential equipment and medications for asthma, diabetes, hypertension (HTN), heart failure and rheumatic heart disease at those same facilities. We reported 95% CI for estimates using standard survey tabulation methods for countries that surveyed a sample of public first-referral hospitals (Bangladesh and the DRC) but not for countries where surveys were intended as a facility census. The surveys from Bangladesh and the DRC sampled a relatively large proportion of the total number of hospitals, so we calculated the 95% CI incorporating a correction for finite population size.

To examine a potential association between the availability of NCDI medications and equipment with the prevalence of extreme poverty in subnational regions, we used a modified version of the Multidimensional Poverty Index from the Oxford Poverty and Human Development Initiative (see online supplementary appendix tables 3 and 4).[8] We counted the number of the individual components across our disease-related sets of medications and equipment (table 1) that were available on the day the survey was conducted at each facility, deduplicating items in multiple sets. We assessed the association between the logit-transformed proportion of the total items available in a public first-referral level hospital and the prevalence of extreme poverty in the subnational unit (district or region) where the hospital was located using linear regression. We conducted regressions separately for each country to account for likely differences in governance and health systems. We used different regression specifications to assess the association between the availability of equipment and medications and the prevalence of extreme poverty. In one model specification, we used the prevalence of extreme poverty as a continuous variable, assuming a linear association. For possible non-linear association, we additionally used model specifications categorising extreme poverty prevalence into categorical groups by quartiles and by evenly spaced ranges of prevalence in each country. We also examined the association between the density of public first-referral level hospitals

Table 1 Assigned essential equipment and medications for acute presentations of and chronic care for NCDI conditions at first-referral level hospitals

Disease area	Essential equipment and medications	
	Acute care	**Chronic care**
Asthma	Pulse oximeter, peak flow metre, oxygen, X-ray, salbutamol inhaler, prednisolone, hydrocortisone injection, nebuliser.	Stethoscope, salbutamol inhaler, beclomethasone inhaler, prednisolone.
Hypertension (stage 1 or 2)		Blood pressure apparatus, stethoscope, at least two classes of antihypertensive medications (calcium channel blocker, ACE inhibitor, thiazide diuretic or beta blocker).
Hypertension requiring three antihypertensive classes		Essential equipment and medications for hypertension stage 1 or 2 (above), one additional class of antihypertensive medications.
Hypertension requiring four antihypertensive classes		Essential equipment and medications for hypertension stage 1 or 2 (above), two additional class of antihypertensive medications.
Heart failure		Adult weighing scale, stethoscope, blood pressure apparatus, ACE inhibitor, beta-blocker, furosemide, ultrasound.*
Rheumatic heart disease		Essential equipment and medications for heart failure (above), oral penicillin or benzathine penicillin injection, epinephrine injection.
Diabetes type 1	Blood pressure apparatus, serum blood glucose test, renal function testing, intravenous saline, infusion kit for intravenous fluids, insulin, glucose injection solution.	Serum glucose, insulin.
Diabetes type 2		Serum glucose, metformin or glibenclamide.
Epilepsy	Diazepam injectable.	Diazepam tablet or phenobarbitone or carbamazepine.†
Injury/acute minor surgical conditions	Needle holder, scalpel handle and blades, retractor, surgical scissors, nasogastric tube, tourniquet, oxygen, skin disinfectant, suture, ketamine, lidocaine (5%).	
Pain care		Oral morphine, injectable morphine or injectable pethidine, one non-opioid analgesic (paracetamol, ibuprofen, aspirin or diclofenac).

*We did not make a determination about whether the appropriate ultrasound probes were available for heart failure diagnostic purposes, only whether there was any functional ultrasound machine.
†Epilepsy chronic care not included in results—availability of tablets not included on survey in most countries.
NCDI, non-communicable diseases and injury.

and hospitals per population in subnational areas with the prevalence of extreme poverty using linear regressions, accounting for country differences. Full details for these analyses are described in the appendix.

Data cleaning, formatting and preparation were conducted using Stata/IC V.15.1 (StataCorp), and tabulations and regressions were conducted using R V.3.5.1 (the R Foundation for Statistical Computing).

Patient and public involvement

This research study was conducted without patient or public involvement in the design, execution or dissemination of the study.

RESULTS

Overall, of the 9375 heath facilities across the eight countries which were surveyed, we identified 797 public first-referral level hospitals. Table 2 shows the availability of sets of equipment and medications for condition-specific acute care services, including surgery. The availability at these facilities of the complete set of essential equipment and medications needed for diagnosis and chronic care of specific conditions is shown in table 3.

Overall, medication and equipment availability was highest for acute management of epileptic seizures with diazepam (ranging between 40% and 95% in countries), followed by chronic care of stage 1–2 HTN (ranging between 28% and 83%), although this declined with HTN requiring more classes of medications (ranging between 0% and 34% for 4 classes of medications) (figure 1). Medication and equipment availability was low both for type 2 diabetes (requiring only oral medications) as well as type 1 diabetes requiring insulin. Availability was particularly low for management of acute presentations of diabetes such as diabetic ketoacidosis requiring intravenous fluids and monitoring of blood chemistries. Availability of essential equipment and medications for both acute and chronic presentations of asthma was extremely low in part due to the absence of beclomethasone inhalers at most facilities. Few hospitals had equipment or medications needed to diagnose and manage heart failure and rheumatic heart disease, which required ultrasound equipment. Essential surgical supplies were missing at most hospitals. Most countries had insufficient data to report on the availability of adequate medications to provide treatment of chronic pain.

Notably, there was much lower observed availability of essential medications or equipment for NCDIs than the self-reported availability of services for these conditions by the facility (table 4). For chronic respiratory diseases, across six countries (not collected in Bangladesh or Malawi), over 75% of public first-referral hospitals reported diagnosis and management services, though fewer than 7% had the essential medications and equipment available for chronic asthma care and fewer than 4% for care of acute asthma exacerbations. Similarly, at least 66% of public first-referral hospitals in each country reported availability diagnostic and management services for diabetes, with the exceptions of Bangladesh (43%) and Malawi, where diagnosis *or* management was reported in 84% of these hospitals. Compared with this reported service provision, availability of essential medications and equipment were lower for type 1 diabetes (1.3%–70.1%), type 2 diabetes (3.3%–75.2%) and acute care for diabetic ketoacidosis (0%–25.6%). Between 48.8% and 94.3% of the hospitals reported availability of diagnostic and management services for cardiovascular diseases, though availability of essential medications and equipment were lower for HTN (27.7%–82.9%), heart failure (0%–31.6%) and rheumatic heart disease (0%–22.9%).

There was inconsistency in associations between availability of medications and equipment in public first-referral hospitals and prevalence of extreme poverty in corresponding sub-national units, both across countries and between regression approaches (see online supplementary appendix figure 1, tables 5 and 6). For example, there was a negative association in Bangladesh and the DRC, while there was a positive association in Ethiopia and Haiti. These findings also varied across model specifications. The method for grouping hospitals based on prevalence of extreme poverty in sub-national areas affected the estimates of association. Full regression results are shown in online supplementary appendix tables 5 and 6. The density of public first-referral level hospitals per population did not vary by poverty prevalence, though there was evidence that the density of hospitals overall as lower in poorer subnational areas.

DISCUSSION

Our findings demonstrate that availability of essential equipment and medications for acute and chronic services for NCDI conditions across LICs remains extremely low at public first-referral level hospitals. Furthermore, the availability of essential equipment and medications for NCDI services is much lower than facility-reported management and diagnosis of chronic respiratory diseases, diabetes and cardiovascular diseases. Although we found some evidence of associations, both positive and negative, between availability of essential equipment and medications at a public first-referral level hospital and the prevalence of extreme poverty in the corresponding subnational area, results were inconsistent.

Facilities included in this study were more equipped to provide services for the treatment of stages 1 and 2 HTN as compared with other more complex conditions. Previous facility assessments have demonstrated similar levels of medication availability for HTN treatment in LICs,[17 18] and significantly lower availability as compared with high-income countries.[19] The low availability of essential medications and equipment likely contributes to low overall coverage of services for HTN. The Lancet Commission on HTN reported that for countries in sub-Saharan Africa (SSA) with household level surveys, over half of hypertensive adults had not been diagnosed, and

Table 2 Availability of complete essential equipment and medications for acute presentations of NCDIs at public first-referral level hospitals in eight low-income countries

	Percent of facilities with available medications and equipment, % (95% CI)							
	Bangladesh (n=140)	The Democratic Republic of the Congo* (n=283)	Ethiopia (n=117)	Haiti (n=25)	Malawi (n=43)	Nepal (n=76)	Senegal† (n=37)	Tanzania (n=76)
Acute asthma	0 (0, 3)	1 (1, 2)	0	0	0	4	0	0
Functional X-ray machine	24 (17, 31)	31 (29, 33)	64	52	51	86	78	70
Hydrocortisone injection	47 (39, 54)	82 (81, 84)	68	52	26	78	67	80
Micronebuliser in NCD or general outpatient area	59 (52, 67)	6 (5, 7)	6	20	21	37	54	4
Oxygen availability (cylinder or concentrator, plus distribution) in NCD or general outpatient area	54 (47, 62)	10 (9, 11)	14	28	12	12	46	4
Peak flow metre in NCD or general outpatient area	25 (19, 33)	3 (2, 4)	8	16	5	30	33	7
Prednisolone	20 (14, 27)	50 (47, 53)	89	52	77	50	0	76
Pulse oximeter in NCD or general outpatient area	29 (22, 36)	11 (9, 13)	14	8	21	30	52	11
Salbutamol inhaler	19 (14, 26)	38 (35, 41)	82	48	58	91	48	33
Acute diabetes	0 (0, 3)	6 (5, 7)	5	4	26	0	0	17
Blood glucose test equipment	27 (21, 34)	77 (75, 79)	85	40	56	20	9	63
Blood pressure apparatus in NCD or general outpatient area	99 (93, 100)	98 (98, 99)	95	96	79	97	87	84
Infusion kit for intravenous fluids in NCD or general outpatient area	57 (49, 64)	45 (43, 48)	34	32	81	38	8	70
Injectable glucose	11 (7, 18)	70 (67, 73)	24	40	98	92	91	62
Injectable saline solution	72 (64, 78)	69 (67, 72)	96	52	91	95	82	92
Insulin	1 (0, 4)	48 (46, 51)	79	12	58	12	51	89
Liver and kidney function diagnostics (creatinine, electrolytes)	11 (7, 17)	24 (22, 26)	47	60	40	38	93	74
Acute epilepsy	49 (42, 57)	81 (78, 82)	91	40	95	72	85	91
Diazepam injection	49 (42, 57)	81 (78, 82)	91	40	95	72	85	91
Injuries/acute minor surgical conditions‡	NA	2 (2, 3)	5	0	0	4	2	1
Ketamine in minor surgical area	NA	76 (74, 78)	61	20	37	24	3	49
Lidocaine in minor surgical area	NA	80 (77, 83)	97	92	95	93	82	99
Nasogastric tubes in minor surgical area	NA	43 (41, 46)	66	40	14	41	23	30
Needle holder in minor surgical area	NA	98	97	92	100	97	97	95
Oxygen availability (cylinder or concentrator, plus distribution) in NCD or general outpatient area	54 (47, 62)	10 (9, 11)	14	28	12	12	46	4
Retractor in minor surgical area	NA	85 (84, 86)	84	40	44	49	24	41
Scalpel in minor surgical area	NA	86 (83, 88)	92	40	74	86	73	78
Skin disinfectant in minor surgical area	NA	97 (96, 97)	99	88	84	95	97	92
Surgical scissors in minor surgical area	NA	99 (99, 99)	97	96	88	95	98	91

Continued

Table 2 Continued

	Percent of facilities with available medications and equipment, % (95% CI)							
	Bangladesh (n=140)	The Democratic Republic of the Congo* (n=283)	Ethiopia (n=117)	Haiti (n=25)	Malawi (n=43)	Nepal (n=76)	Senegal† (n=37)	Tanzania (n=76)
Sutures in minor surgical area	NA	85 (83, 87)	93	68	93	78	55	92
Tourniquet in minor surgical area	NA	25 (23, 27)	54	68	26	67	94	34

Numbers reported % (95% CI). Uncertainty not reported for surveys that were intended to include complete census of facilities (all except Bangladesh and the Democratic Republic of the Congo).
*Democratic Republic of the Congo estimates are reported for non-tertiary, non-provincial-level public hospitals.
†Senegal data did not allow for separation of first-referral and higher level hospitals, results reported here for all public hospitals.
‡Most surgical equipment items are missing data in 5%–10% of facilities in Haiti, Malawi and Senegal. Percentages reported in this table exclude facilities with missing data for a given indicator. Overall percentage of surgical medications and equipment availability unaffected by these missing data, as oxygen unavailable in these missing cases, making overall surgical set unavailable.
NA, No data available or >10% missing data; NCDI, non-communicable diseases and injury.

treatment coverage was low, ranging from 7% to 61%.[20] Effective coverage was even lower, ranging from 1% to 31%.[20]

Systematic reviews of heart failure in LICs have identified a high burden of non-ischaemic heart failure and high utilisation of diuretic therapy, though have not assessed systems readiness or medication availability.[21 22] One study utilising a health facility assessment of hospitals in Kenya and Uganda reported higher availability of beta-blockers (98% and 92%, respectively) and furosemide (98% and 94%, respectively), but similar availability of ultrasound equipment and ACE-inhibitors, as compared with that found in our study.[23] The availability of ultrasound has remained a limiting factor for the diagnosis and monitoring of heart failure and has been a focus of health systems diagnostic improvements and training in LICs.[23] Availability of equipment and medications was similarly low for outpatient management of RHD, a common cause of heart failure in LICs. Availability of benzathine penicillin for primary and secondary RHD prophylaxis was highly limited across most countries. Although no detailed health facility reports exist for the availability of benzathine penicillin at primary health facilities across LICs, there have been global concerns for the availability and quality of this essential medication.[24]

Our findings of availability of medications and equipment for diabetes services are consistent with previous reports of low availability of services and low coverage of diabetes services in LICs. In a group of 12 countries in SSA, only 22% of eligible individuals had received blood glucose measurement.[25] Of those meeting biochemical criteria for diabetes, only 36% had previously received blood glucose measurement, 27% had been previously diagnosed, 25% were taking oral diabetes therapy, and 11% were taking insulin.[25]

The availability of medications or services for asthma and other chronic respiratory diseases has not been well studied in low-income settings. Inhaled beta agonists, inhaled corticosteroids and systemic corticosteroids have more recently been included on lists for essential medicines in LICs, and price fluctuations have created a wide range of affordability for these medications.[26]

Care for chronic epilepsy has traditionally been lacking in resource-poor settings.[27] Despite the availability of benzodiazepines for acute management of seizures at the inpatient level, the management of chronic epilepsy and seizure prophylaxis is highly lacking. The SPA survey collects information on a limited number of medications that are used for daily prophylaxis of seizures in epileptic disorders and most countries did not include this in their surveys (only Nepal collected data on carbamazepine and phenobarbital). Others have reported the lack of coverage data, and the highly vulnerable characteristics of patients with epilepsy contribute to poor access to care, utilisation of available services, and poor overall coverage, resulting in high morbidity and mortality from epilepsy.[28] The availability of second-line medications or intensive care for refractory seizures was not available.

Table 3 Availability of complete essential equipment and medications for chronic care of NCDI conditions at public first-referral level hospitals in eight low-income countries

	Per cent of facilities with available medications and equipment, % (95% CI)							
	Bangladesh (n=140)	The Democratic Republic of the Congo* (n=283)	Ethiopia (n=117)	Haiti (n=25)	Malawi (n=43)	Nepal (n=76)	Senegal† (n=37)	Tanzania (n=76)
Asthma	0 (0, 3)	1 (1, 2)	7	4	5	5	0	0
Beclomethasone inhaler	5 (2, 10)	2 (1, 2)	8	8	5	9	3	0
Prednisolone	20 (14, 27)	50 (47, 53)	89	52	77	50	0	76
Salbutamol inhaler	19 (14, 26)	38 (35, 41)	82	48	58	91	48	33
Stethoscope in NCD or general outpatient area	100 (98, 100)	98 (97, 98)	99	96	95	99	83	96
Hypertension (stage 1 or 2)	31 (24, 39)	28 (25, 30)	83	76	44	45	38	70
At least two of: calcium channel blocker, ACE inhibitor, thiazide, atenolol	33 (26, 40)	28 (26, 30)	89	84	53	46	48	83
Blood pressure apparatus in NCD or general outpatient area	99 (93, 100)	98 (98, 99)	95	96	79	97	87	84
Stethoscope in NCD or general outpatient area	100 (98, 100)	98 (97, 98)	99	96	95	99	83	96
Hypertension requiring three antihypertensive classes	6 (3, 12)	9 (8, 10)	64	56	26	12	2	51
At least three of: calcium channel blocker, ACE inhibitor, thiazide, atenolol	8 (5, 14)	9 (8, 10)	69	60	28	12	2	57
Blood pressure apparatus in NCD or general outpatient area	99 (93, 100)	98 (98, 99)	95	96	79	97	87	84
Stethoscope in NCD or general outpatient area	100 (98, 100)	98 (97, 98)	99	96	95	99	83	96
Hypertension requiring 4 antihypertensive classes	2 (1, 7)	2 (1, 3)	34	20	12	0	0	9
All of: calcium channel blocker, ACE inhibitor, thiazide, atenolol	3 (1, 7)	2 (1, 3)	34	20	12	0	0	14
Blood pressure apparatus in NCD or general outpatient area	99 (93, 100)	98 (98, 99)	95	96	79	97	87	84
Stethoscope in NCD or general outpatient area	100 (98, 100)	98 (97, 98)	99	96	95	99	83	96
Heart failure	1 (0, 5)	6 (5, 7)	26	8	12	0	5	32
Adult scale in NCD or general outpatient area	84 (77, 89)	97 (96, 97)	71	84	72	95	74	86
Atenolol or other beta-blocker	55 (47, 62)	10 (9, 11)	69	56	21	57	5	70
Blood pressure apparatus in NCD or general outpatient area	99 (93, 100)	98 (98, 99)	95	96	79	97	87	84
Captopril, enalapril or other ACE inhibitor	14 (9, 21)	38 (35, 40)	80	88	49	0	71	78
Furosemide	22 (16, 29)	84 (81, 86)	92	64	63	93	86	78
Stethoscope in NCD or general outpatient area	100 (98, 100)	98 (97, 98)	99	96	95	99	83	96
Ultrasound equipment	5 (2, 9)	62 (59, 64)	57	52	51	62	8	68
Rheumatic heart disease	0 (0, 0)	2 (2, 3)	19	0	9	NA	0	23
Essential heart failure medications and equipment	1 (0, 5)	6 (5, 7)	26	8	12	0	5	32

Continued

Table 3 Continued

	Per cent of facilities with available medications and equipment, % (95% CI)							
	Bangladesh (n=140)	The Democratic Republic of the Congo* (n=283)	Ethiopia (n=117)	Haiti (n=25)	Malawi (n=43)	Nepal (n=76)	Senegal† (n=37)	Tanzania (n=76)
Benzathine penicillin	14 (9, 21)	53 (50, 56)	87	36	100	NA	53	82
Oral penicillin‡	NA	NA	NA	NA	NA	NA	NA	NA
Injectable epinephrine	2 (1, 5)	29 (27, 32)	70	8	88	63	56	75
Type 1 diabetes	1 (0, 4)	38 (36, 41)	70	8	44	3	5	58
Blood glucose test equipment	27 (21, 34)	77 (75, 79)	85	40	56	20	9	63
Insulin	1 (0, 4)	48 (46, 51)	79	12	58	12	51	89
Type 2 diabetes	9 (5, 14)	40 (37, 42)	75	32	42	14	3	57
Blood glucose test equipment	27 (21, 34)	77 (75, 79)	85	40	56	20	9	63
Metformin or glibenclamide	27 (21, 35)	49 (46, 51)	86	76	58	61	34	88
Pain care	NA	NA	NA	NA	58	NA	NA	54
Injectable morphine or pethidine	NA	NA	NA	NA	58	NA	NA	54
Oral pain medication (paracetamol, ibuprofen, aspirin or diclofenac)	100 (97, 100)	100 (97, 100)	100	100	100	99	NA	100

Numbers reported % (95% CI). Uncertainty not reported for surveys that were intended to include complete census of facilities (all except Bangladesh and the Democratic Republic of the Congo).

*Democratic Republic of the Congo estimates are reported for non-tertiary, non-provincial-level public hospitals.

†Senegal data did not allow for separation of first-referral and higher level hospitals, results reported here for all public hospitals.

‡For oral penicillin, question not asked on most surveys (Tanzania, Senegal, Nepal, Haiti) and high missingness proportion in Bangladesh and Malawi. We, therefore, do not report proportions here. For creating rheumatic heart disease combined set, it did not affect results, as only one facility had missing data for oral penicillin when other necessary components available (heart failure set, epinephrine).

NA, No data available or >10% missing data; NCDI, non-communicable diseases and injury.

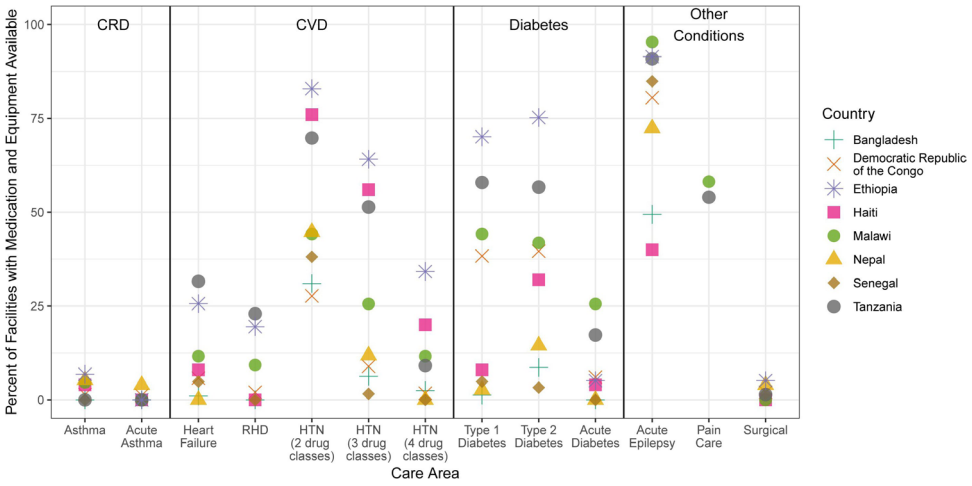

Figure 1 Availability of complete essential equipment and medications for acute presentations and chronic care of NCDI conditions at public first-referral level hospitals in eight low-income countries. CRD, chronic respiratory disease; CVD, cardiovascular disease; HTN, hypertension; NCDI, non-communicable diseases and injury; RHD, rheumatic heart disease.

The extremely low availability of surgical equipment and medications for care of injuries and acute minor surgical conditions is consistent with previous reports.[29] Recent modelling estimates have suggested that coverage of adequate surgical services in SSA and South Asia is less than 5% with sporadic and variable availability of individual tracer items.[30] The ability of surgical interventions to offer one-time curative treatment leads to the high cost-effectiveness and financial risk protection offered by surgical interventions in low-income health systems.[31] Additionally, there are limited data collected in the SPA survey regarding the availability of palliative care services or essential medications, and the data collected were limited only to medications for pain, such as analgesics and opiates. The availability of injectable morphine was collected in only three of the eight countries and availability of oral morphine in only two of the eight countries. This is consistent with the dearth of development in palliative care policies and implementation in LICs, particularly in SSA and a dramatic gap in the availability of morphine and other essential medications for palliative care.[32 33]

Countries did vary in their level of availability of essential equipment and medications for the conditions analysed. Senegal displayed consistently lower rates of availability of equipment and medications than the other countries. In contrast, Ethiopia and Tanzania displayed considerably higher rates than other countries across many conditions, including most notably for HTN, diabetes care and heart failure. In these two countries, there was a relatively early recognition and coordinated approach to NCDs, including strategic and costed operational planning, strong civil society engagement and leadership, progressive outreach from well-established tertiary centres and a strong and well-organised primary care network.[34 35]

This study has several limitations. First, the essential equipment and medications for NCDI services defined here does not include presence of well-trained and supervised human resources, a cornerstone for healthcare delivery and one that has been well established to be lacking for NCDs in SSA.[36] The availability of essential equipment and medications presented in this analysis may, therefore, overestimate the overall service availability for the corresponding condition. Second, certain equipment and medications may have been observed within the health facility, but these items may not necessarily be accessible to the unit providing NCDI services within the facility (ie, ultrasound may be reserved for obstetrics) or affordable by the patients. We minimised this possibility by including equipment and medications from general outpatient, NCD and minor surgical areas. Additionally, medication availability may fluctuate; however, the date of data collection is randomly assigned and should not bias our findings. Third, the components of these sets of equipment and medications may not be comprehensive of all items needed for care associated with each disease condition, but rather represent a core number of elements measured within the available survey tools. Fourth, availability of supplies and equipment is not always associated with quality care.[37] While there are no data available capturing nationally representative observations of the quality of NCDI services, previous studies in the field of MCH suggest that poor quality care can exist even in the presence of necessary supplies.[38] Fifth, there is some incomplete data for specific disease conditions in certain countries reflecting adaptation of the SPA questionnaire by country teams. Sixth, the year of survey data collection varied among countries, which may limit direct comparison, and the results may underestimate current levels of availability if substantial improvements have been made following the data collection period, particularly in countries with older surveys. Finally, the level of geographical specificity for extreme poverty prevalence estimates limited the design of the analysis examining associations between poverty and the availability of medications and equipment. Further study is warranted, both with more specific data about populations in de facto catchment areas of facilities and process information about how factors like supply chains and planning affects variation in availability across facilities.

Table 4 Observed equipment and medication availability for selected NCDIs compared with self-reported service availability at public first-referral hospitals

		Per cent of facilities with available medications and equipment, % (95% CI)							
		Bangladesh (n=140)	The Democratic Republic of the Congo* (n=283)	Ethiopia (n=117)	Haiti (n=25)	Malawi† (n=43)	Nepal (n=76)	Senegal‡ (n=37)	Tanzania (n=76)
Self-reported diagnosis and management	**Chronic respiratory disease**	**NA**	**87 (85, 89)**	**95**	**96**	**93†**	**96**	**92**	**75**
Observed medication and equipment availability	Asthma	0 (0, 3)	1 (1, 2)	7	4	5	5	0	0
	Asthma acute care	0 (0, 3)	1 (1, 2)	0	0	0	4	0	0
Self-reported diagnosis and management	**Diabetes**	**43 (36, 51)**	**89 (87, 90)**	**83**	**92**	**84†**	**84**	**86**	**75**
Observed medication and equipment availability	Diabetes type 1	1 (0, 5)	38 (36, 41)	70	8	44	3	5	58
	Diabetes type 2	9 (5, 15)	40 (37, 42)	75	32	42	14	3	57
	Diabetes acute care	0 (0, 3)	6 (5, 7)	5	4	26	0	0	17
Self-reported diagnosis and management	**Cardiovascular disease**	**49 (41, 56)**	**94 (93, 95)**	**93**	**92**	**98†**	**91**	**92**	**73**
Observed medication and equipment availability	Hypertension stage 1 or 2	31 (24, 39)	28 (25, 30)	83	76	44	45	38	70
	Heart failure	1 (0, 5)	6 (5, 7)	26	8	12	0	5	32
	Rheumatic heart disease	0 (0, 3)	2 (2, 3)	19	0	9	NA	0	23

Numbers reported % (95% CI). Uncertainty not reported for surveys that were intended to include complete census of facilities (all except Bangladesh and the Democratic Republic of the Congo).
*Democratic Republic of the Congo estimates are reported for non-tertiary, non-provincial-level public hospitals.
†Malawi only reported Diagnosis or management instead of Diagnosis and management for self-reported measures.
‡Senegal data did not allow for separation of first-referral and higher level hospitals, results reported here for all hospitals.
NA, no data available; NCDI, non-communicable diseases and injury.

Our findings have several implications to improve service availability of NCDIs in LICs. There is a need to prioritise decentralisation of a broad set of cost-effective and equitable interventions at first-referral level hospitals to increase care availability. Such interventions may include those typically confined to referral and university teaching hospitals and densely populated urban areas, such as chronic care delivery for severe NCDIs including heart failure, type 1 diabetes, advanced asthma and palliative care. Our finding that the density of hospitals per population is lower in poorer subnational areas, while the distribution of first-referral hospitals is more equitable, suggests that decentralisation of services can create more equitable access. Collaborations to develop such service packages have recently been launched.[39] Several studies have reported promising outcomes for task-shifting and task sharing of essential NCD services to support decentralisation and increase availability of such services.[40–42] Integration of NCD services with existing HIV and MCH services has been suggested as a cost-effective and important step towards increasing the availability of services in a universal health coverage (UHC) package, particularly at the primary care level.[43] Coordination of governance and policy making for NCDI health sector interventions would also provide opportunities for integration of staff, training, guidelines, and supply chains required for adequate service delivery.[44] Health financing for integrated platforms of NCDI service delivery within a UHC framework will be essential to improve basic availability of services. A high priority package for essential interventions for NCDIs within UHC has been proposed, and may provide reasonable cost estimates required to increase coverage of health sector services for NCDIs, including cross-cutting approaches to mental health, surgery, palliative care and rehabilitation.[5]

The strengthening of health facility monitoring and extension of core NCDI indicators is highly needed.[45] Although some readiness indices exist within standardised surveys, such as SPA and the Service Availability and Readiness Assessment (WHO), these are typically limited to outpatient management of HTN, type 2 diabetes and asthma. These surveys do not measure readiness for acute complications or inpatient needs, rely in part on reported (rather than observed) measures and do not identify minimum requirements for service delivery. An appropriate monitoring framework for NCDIs will need to include a greater number of tracer items that reflect current clinical guidelines, other NCDI conditions currently not represented in existing monitoring frameworks but represent a large burden of disease (ie, cancer, epilepsy, mental health, renal failure, liver cirrhosis, palliative care surgical services) and domains such as organisation, management, access, availability and quality of effective services.[46] Additional examination of costing data, procurement processes and the supply chain could identify the drivers of stockouts.

Our findings demonstrate variable but overall low availability of the minimum required equipment and medications to provide adequate diagnostic and therapeutic interventions for nine chronic conditions and four acute presentations of chronic conditions at first-referral level hospitals in eight LICs in three different regions. This observed availability of medications and equipment is substantially lower than self-reported diagnosis and management of chronic diseases by facilities in these countries. The provision of cost-effective and equitable health sector interventions for the diagnosis and management of both acute and chronic presentations of NCDIs are highly needed at first-referral level hospitals in LICs. The strengthening of these services through the public sector can help to keep patients from facing high costs for medicines and procedures. There is a need for progressive decentralisation of services for these conditions to first-referral level facilities, integration of such services in existing platforms of care, and improved assessment and monitoring of delivery of services in LICs to fully achieve targets established for UHC.

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Acknowledgements The authors would like to thank Gisela Robles Aguilar for estimation of subnational poverty prevalence, as well as Mamka Anyona for assistance with initial data analysis and Chris Noble for support with manuscript preparation. Gene F. Kwan was supported in part from the National Institutes of Health (1K23HL140133).

Contributors GB initiated the study. NG, MMC and GB designed the analysis. NG conducted the literature search. ADG and MMC conducted data cleaning. MMC conducted data analysis. NG, MMC and GB drafted the manuscript. All authors (GB, NG, MMC, AB, RD, DLF, ADG, TG, BMK, GFK, AML, JKM, MTM, MNM, MKM, PHP, WWD and EW) contributed to data interpretation and critical evaluation and revision of the study manuscript.

Funding This study was funded by the Leona M. and Harry B. Helmsley Charitable Trust.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The study protocol was reviewed and determined non-human subject research by the Institutional Review Board of the Harvard Faculty of Medicine.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data from the Service Provision Assessment surveys are available in a public, open access repository through the DHS Program: http://dhsprogram.com/data/available-datasets.cfm.

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