HEALTH SERVICE PROVISION IN UGANDA

Assessing Facility Capacity, Costs of Care, and Patient Perspectives

ACCESS, BOTTLENECKS, COSTS, AND QUITY

IHME INSTITUTE FOR HEALTH METRICS AND EVALUATION
UNIVERSITY OF WASHINGTON

IDRC INFECTIOUS DISEASES RESEARCH COLLABORATION

This report was prepared by the Institute for Health Metrics and Evaluation (IHME) in collaboration with the Infectious Diseases Research Collaboration (IDRC). This work is intended to help policymakers understand the costs of health service delivery, facility-based characteristics of antiretroviral therapy (ART) programs, and health facility performance in Uganda. The numbers may change following peer review. The contents of this publication may not be reproduced in whole or in part without permission from IHME.

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About IHME

The Institute for Health Metrics and Evaluation (IHME) is an independent global health research center at the University of Washington that provides rigorous and comparable measurement of the world's most important health problems and evaluates the strategies used to address them. IHME makes this information freely available so that policymakers have the evidence they need to make informed decisions about how to allocate resources to best improve population health.

To express interest in collaborating or request further information on the Access, Bottlenecks, Costs, and Equity (ABCE) project in Uganda, please contact IHME:

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About this report

Health Service Provision in Uganda: Assessing Facility Capacity, Costs of Care, and Patient Perspectives provides a comprehensive yet detailed assessment of health facility performance in Uganda, including facility capacity for service delivery, costs of care, and patient perspectives on the services they received. This report also has a special focus on facility-based antiretroviral therapy (ART) programs, measuring trends in ART initiation characteristics and capturing experiences reported by patients seeking HIV services. Findings presented in this report were produced through the ABCE project in Uganda, which aims to collate and generate the evidence base for improving the cost-effectiveness and equity of health systems. Analyses were reviewed since the printing of this report in May 2014, and based on the review, cost estimates for Ghana were updated (as shown in Table 10 on page 53). Comparisons of facility-level findings, which were found in the original printing of this report, will be available at a later date.

The ABCE project is funded through the Disease Control Priorities Network (DCPN), which is a multiyear grant from the Bill & Melinda Gates Foundation to comprehensively estimate the costs and cost-effectiveness of a range of health interventions and delivery platforms. Separate grants from the Bill & Melinda Gates Foundation funded the ART-specific components of the ABCE project and the Viral Load Pilot Study.

The ABCE project is a collaborative project between IHME and the Infectious Diseases Research Collaboration (IDRC). At IHME, Christopher Murray, Kelsey Moore, Anne Gasasira, Emmanuela Gakidou, Michael Hanlon, Herbert Duber, Santosh Kumar, and Annie Haakenstad had key roles in the project. At IDRC, the project was led by Jane Achan, the in-country principal investigator (PI), and managed by Gloria Ikilezi. They received further support at IDRC from James Okello, Paul Bazongere, Grace Akalo, Florence Alanyo, Gertrude Abbo and Stella Namuwaya. Data collection was conducted by a team of 25 research associates, largely from IDRC. Robert W. Coombs, of the University of Washington's Department of Laboratory Medicine, led laboratory analyses of blood samples collected for the Viral Load Pilot Study. Analyses were jointly conducted by several researchers at IDRC and IHME, including Benjamin Brooks, Roy Burstein, Ruben Conner, Emily Dansereau, Brendan DeCenso (now of RTI International), Laura Di Giorgio, Samuel Masters (now of UNC-Chapel Hill), Allen Roberts, and Alexandra Wollum. This report was written by Nancy Fullman, with contributions from Herbert Duber, both of IHME.

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We especially thank all of the health facilities and their staff, who generously gave of their time and facilitated the sharing of the facility data that made this study possible. We are also most appreciative of the patients who participated in this work, as they, too, were giving of their time and kindly willing to share their experiences with the field research team.

The quantity and quality of the data collected for the ABCE project in Uganda are a direct reflection of the dedicated field team. It is because of their months of hard work, traveling from facility to facility and interviewing staff and patients, that we are able to present these findings today. We thank the ABCE Uganda field team, which included (listed alphabetically) Gertrude Abbo, Christine Achirochan, Susan Achumo, Francis Ageu, Grace Akalo, Irene Akumu, Florence Alanyo, Michael Asiimwe, Paul Bazongere, Palma Berocwiny, Anita Kagoya, Ann Kakeeto, Patience Kandatwa, Vivien Kayaga, George Kiggundu, Stephen Kyaligonza, David Muwanguzi, Shillah Nakato, Joel Namyeka, Alfred Ojok, James Okello, Mark Opolot, Robert Ogen, Betty Tumushabe, Esther Wanzira, and Ronald Wokulira.

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Acronyms

ABCE	Access, Bottlenecks, Costs, and Equity
ACT	Artemisinin-based combination therapy
AIDS	Acquired immunodeficiency syndrome
ANC	Antenatal care
ART	Antiretroviral therapy
ARV	Antiretroviral (drug)
AZT	Zidovudine (a type of antiretroviral)
BMI	Body mass index
CD4	Cluster of differentiation 4 (cells that fight infection)
CHAI	Clinton Health Access Initiative
CHW	Community health worker
CT	Computed tomography
d4T	Stavudine (a type of antiretroviral)
DBS	Dried blood spot
DCPN	Disease Control Priorities Network
DEA	Data Envelopment Analysis
DHT	District Health Team
DHS	Demographic and Health Survey
ECG	Electrocardiography
EML	Essential Medicines List
GBD	Global Burden of Disease
GHDx	Global Health Data Exchange
HIV	Human immunodeficiency virus
HSSP II	Health Sector Strategic Plan II, 2005/06–2009/10
HSSP III	Health Sector Strategic Plan III, 2010/11–2014/15
iCCM	Integrated community case management
IDRC	Infectious Diseases Research Collaboration
IHME	Institute for Health Metrics and Evaluation
IPTp	Intermittent preventive therapy (during pregnancy)

JCRC	Joint Clinical Research Centre
LRI	Lower respiratory infection
MOH	Ministry of Health
NCD	Non-communicable disease
NGO	Non-governmental organization
PEPFAR	US President's Emergency Plan for AIDS Relief
PMTCT	Prevention of mother-to-child transmission of HIV
SARA	Service Availability and Readiness Assessment
SP	Sulfadoxine/pyrimethamine (Fansidar)
RDT	Rapid diagnostic test
Rh factor	Rhesus factor
TDF	Tenofovir (a type of antiretroviral)
UAC	Uganda AIDS Commission
USD	US dollar
Ushs	Ugandan shillings
VCT	Voluntary counseling and testing
VHT	Village health team
WHO	World Health Organization

Terms and definitions

CD4 cell count: a measure of the number of CD4 cells/mm^3. CD4 cell counts are used to classify stages of HIV or AIDS, with lower levels indicating more advanced progression of the disease.

Constraint: a factor that facilitates or hinders the provision of or access to health services. Constraints exist as both "supply-side," or the capacity of a health facility to provide services, and "demand-side," or patient-based factors that affect health-seeking behaviors (e.g., distance to the nearest health facility, perceived quality of care received from providers).

Data Envelopment Analysis (DEA): an econometric analytic approach used to estimate the efficiency levels of health facilities.

District sampling frame: the list of districts from which the ABCE district sample was drawn. This list was based on the 2011 Demographic and Health Survey (DHS) in Uganda.

Dried blood spot (DBS) technology: an alternative method for measuring HIV viral load by blotting and drying blood samples on filter paper. DBS is viewed as an easier and less expensive mechanism for collecting, storing, and shipping blood samples in comparison with other measures, such as plasma.

Efficiency: a measure that reflects the degree to which health facilities are maximizing the use of the resources available to them in producing services.

Facility sampling frame: the list of health facilities from which the ABCE sample was drawn. This list was based on a facility inventory published by the Ministry of Health of Uganda in 2011.

Inpatient bed-days: the total number of days spent in a facility by an admitted patient. This statistic reflects the duration of an inpatient visit rather than simply its occurrence.

Inpatient visit: a visit in which a patient has been admitted to a facility. An inpatient visit generally involves at least one night spent at the facility, but the metric of a visit does not reflect the duration of stay.

Inputs: tangible items that are needed to provide health services, including facility infrastructure and utilities, medical supplies and equipment, and personnel.

Outpatient equivalent visits: different patient visits, such as inpatient bed-days and births, scaled to equal a comparable number of outpatient visits. This approach to standardizing patient visits is informed by weights generated through Data Envelopment Analysis (DEA), capturing the use of facility resources to produce inpatient bed-days, births, and antiretroviral therapy (ART) visits relative to the production of an outpatient visit. Conversion to outpatient equivalent visits varied by facility, but on average, we estimated the following:

- 1 inpatient bed-day = 3.7 outpatient visits
- 1 birth = 10.5 outpatient visits
- 1 ART visit = 1.7 outpatient visits

Outpatient visit: a visit at which a patient receives care at a facility without being admitted (excluding patients presenting for ART services).

Outputs: volumes of services provided, patients seen, and procedures conducted, including outpatient and inpatient care, ART visits, laboratory and diagnostic tests, and medications.

Platform: a channel or mechanism by which health services are delivered.

User fee: a monetary payment made at a facility in exchange for medical services.

Viral load: a measure of the amount of HIV in a blood sample (copies of HIV ribonucleic acid per milliliter [RNA/mL] of plasma). Viral load is used to measure infection severity and monitor response to treatment.

Health facility types in Uganda[1]

National referral hospitals: These hospitals are intended to serve all Ugandans; act as referral centers for regional referral hospitals; and offer a full range of preventive and curative outpatient services, inpatient care, obstetrics and gynecology, laboratory services, surgery, psychiatry, pathology, radiology, comprehensive specialist services, teaching, and research.

Regional referral hospitals: These hospitals are intended to serve catchment populations up to 2,000,000; act as referral centers for district hospitals; and offer a range of preventive and curative outpatient services, inpatient care, obstetrics and gynecology, laboratory services, a subset of specialty services (e.g., psychiatry, pathology, radiology), higher-level surgical and medical care than what is found at district hospitals, teaching, and research.

District hospitals: Also known as general hospitals, these hospitals are intended to serve catchment populations up to 500,000; support all referrals from health centers and lower levels of care; and offer a range of preventive and curative outpatient services, inpatient care, emergency surgery, obstetrics and gynecology, laboratory services, and other general services. District hospitals also provide in-service training, consultation, and research on behalf of community-based health programs at lower levels of care.

Health center IVs: These facilities are intended to serve as the highest non-hospital referral facilities at the sub-district level, or catchment populations around 100,000; and offer basic preventive and curative outpatient services, inpatient care, second-level referral services (e.g., life-saving medical, surgical, and obstetric services such as blood transfusions and caesarean sections), and physical base for district health teams.

Health center IIIs: These facilities are intended to serve catchment areas up to 20,000 (the sub-county level); provide supervision of and referral services to health center IIs under their management; and offer basic preventive and curative outpatient services and inpatient care (largely through general and maternity wards). Many health center IIIs also provide laboratory services.

Health center IIs: These facilities are intended to serve as basic health centers and interfaces to the formal health sector for communities (populations of about 5,000), largely providing only outpatient care at most locations and an additional subset of services in places with poor access to health center IIIs and health center IVs. An Enrolled Comprehensive Nurse posted at health center IIs provides the key linkage between village health teams and service provision.

Clinics: These facilities are privately owned and managed, largely dispensing medications to individuals for a fee. Clinics also can provide basic outpatient services.

[1] Descriptions of Ugandan health facilities came from multiple sources (MOH 2005, MOH 2010, MOH et al. 2012).

Executive summary

Uganda's Ministry of Health (MOH) states that its mission is to provide the highest level of health services at each level of care and for all people throughout the country. Uganda and development partners have invested in bringing this mission to reality, striving to extend health services to the country's most rural populations and to ensure that quality medical care, such as antiretroviral therapy (ART) services for HIV-positive patients, results in minimal costs for individuals in need of treatment. However, until recently, it has been less of a priority to critically consider the full range of factors that contribute to or hinder the achievement of Uganda's overarching health goals.

Since its inception in 2011, the Access, Bottlenecks, Costs, and Equity (ABCE) project has sought to comprehensively identify what and how components of health service provision – access to services, bottlenecks in delivery, costs of care, and equity in care received – affect health system performance in several countries. Through the ABCE project, multiple sources of data, including facility surveys and patient exit interviews, are linked together to provide a nuanced picture of how facility-based factors (supply-side) and patient perspectives (demand-side) influence optimal health service delivery.

Led by the Infectious Diseases Research Collaboration (IDRC) and the Institute for Health Metrics and Evaluation (IHME), the ABCE project in Uganda is uniquely positioned to inform the evidence base for understanding the country's drivers of access to health services and costs of care. Derived from a nationally representative sample of over 200 facilities, the findings presented in this report provide local governments, international agencies, and development partners alike with actionable information that can help identify areas of success and targets for improving health service provision.

The main topical areas covered in *Health Service Provision in Uganda: Assessing Facility Capacity, Costs of Care, and Patient Perspectives* move from assessing facility-reported capacity for care to quantifying the services actually provided by facilities and the efficiency with which they operate; tracking facility expenditures and the costs associated with different types of service provision; comparing patient perspectives of the care they received across types of facilities; and focusing on HIV-related care. For the latter, we present, for the first time, results from the Viral Load Pilot Study, for which we examined the feasibility of using dried blood spot (DBS) technology, versus plasma measures, to assess ART patient outcomes. It is with this information that we strive to provide the most relevant and actionable information for health system programming and resource allocation in Uganda.

These findings directly address four of the six building blocks of the health system, as designated by the World Health Organization (WHO) and prioritized by the Ugandan MOH: health financing; human resources for health; service delivery; and medical products, vaccines, and technologies. In many ways, these building blocks are inextricably linked together, as optimal service delivery can only occur in environments where adequate medical supplies and human resources are available, and health financing is directly affected by the maximized use of facility-based resources. We largely focus on the intersections among these building blocks in this report, recognizing the multidimensionality of Uganda's health system.

Key findings include the following:

Facility capacity for service provision

Most facilities provided key health services, ranging from immunizations to family planning

- Facilities in Uganda generally reported fairly high availability of key services, especially among facilities that were not privately owned (i.e., public, religious, or those owned by a non-governmental organization [NGO]). Of these facilities, 94% featured a formal immunization program, 85% offered antenatal care (ANC), 83% provided family planning options, and 72% provided HIV/AIDS care in 2012. Further, 93% of facilities, including pharmacies, stocked artemisinin-based combination therapies (ACTs), which are the first-line treatment for malaria. These findings reflect the successful expansion of the country's basic package of health services.

Gaps in service capacity were identified between reported and functional capacity to provide care

- A service capacity gap emerged for the majority of health facilities and across several types of services. Many facilities reported providing a given service but then lacked the full capacity to properly deliver that service, such as lacking functional equipment or stocking out of medications. With antenatal care, for example, only 13% of all facilities reported having the full stock of medications, tests, and medical equipment recommended for the provision of ANC. This gap was particularly striking among health centers, as less than 5% of these primary care facilities were fully equipped to provide ANC.
- The case management of malaria further illustrates the spectrum of service capacity in Uganda. All referral and district hospitals had both ACTs and malaria diagnostics (i.e., laboratory testing or rapid-diagnostic tests [RDTs]), and 95% of health center IVs and 85% of health center IIIs reported concurrent malaria diagnostic and treatment capacity. This finding indicates that a large proportion of Ugandan health facilities are equipped to provide parasitological testing prior to prescribing ACTs for malaria. However, 8% of health centers, across all levels, and clinics had malaria diagnostics but lacked ACTs, suggesting that ACT stock-outs may not be uncommon among these platforms.

Physical infrastructure improved for most facilities, but significant gaps remained, especially for health centers

- In comparison with past studies, a much greater proportion of facilities, across levels of care, featured functional electricity (100% of hospitals, 92% of health center IVs, and 70% health center IIIs) and piped water (100% of referral and district hospitals, 87% of health center IVs, and 66% of health center IIIs). This reflects the country's ongoing investments in addressing physical infrastructure deficiencies at health facilities.
- At the same time, access to functional electricity and improved water sources remained relatively low among health center IIs, at 34% and 49%, respectively. Less than 25% of all health centers had a flush toilet, and 55% of facilities had access to a covered pit latrine. The country's goal was to have all health centers with at least one covered pit latrine by 2010, but these findings indicate that the sanitation and waste systems at primary care facilities fell short of national ambitions.
- Outside of hospitals, the availability of basic communication and transportation was quite low, with less than 15% of health centers reporting access to a phone. Health center IIIs and health center IIs reported minimal access to transportation, emergency or otherwise, which is worrisome given that these facilities often have to refer emergent patients or complex cases to higher levels of care. In combination with inadequate communication systems, it is possible that the transfer of patients in emergency situations from these health centers could be laden with substantial delays and complications.

Availability of recommended equipment and pharmaceuticals was moderately high, but substantially varied within facility types

- Based on WHO equipment guidelines, we found that facilities carried an average of 73% of the equipment recommended for their level of care. Referral and district hospitals generally exceeded private hospitals in terms of equipment availability, with the former two platforms carrying an average of 86% of recommended equipment while four private hospitals reported having less than 50%. Health center IVs and health center IIIs stocked an average of 77% of the recommended equipment, but ranged widely, from 50% to 100%. Health center IIs showed lower levels of equipment availability (an average of 55%), spanning 31% to 81% of the recommended supplies for primary care facilities.
- Most facilities stocked at least 50% of the pharmaceuticals recommended for their level of care by Uganda's Essential Medicines List (EML), but there was a wide range of medication availability across and within facility types. Referral and district hospitals carried an average of 79% of their recommended pharmaceuticals, whereas health centers averaged 64% of the medications. Health center IIIs showed one of the broadest spectrums in pharmaceutical availability, ranging from 23% to 100%.
- Few differences were found in both equipment and pharmaceutical stocks across facilities located in urban and rural areas. However, the within-platform range in performance illustrates the discrepancies that exist between the average facility and the lowest-performing ones.
- Our findings further highlight the frequently observed divide between a given facility's reported capacity for service provision and its functional readiness to fully provide the care patients need. They also capture the intersection between two critical health system building

blocks – service provision and medical products, vaccines, and technologies – and how the availability of facility medical supplies may affect the optimal delivery of health services in Uganda.

Facilities showed higher capacity for treating infectious diseases than non-communicable diseases

- Across platforms, facilities were generally more prepared to diagnose and treat infectious diseases than a subset of non-communicable diseases (NCDs) and injuries. Facilities showed the highest capacity for managing lower respiratory infections (LRIs), HIV/AIDS, and malaria; by contrast, primary care facilities carried less than half of the recommended medical equipment and medications to properly administer care for ischemic heart disease. The provision gap across platforms widened with decreasing levels of care: referral and district hospitals stocked an average of 86% of necessary supplies for infectious diseases and 77% for NCDs (a difference of nine percentage points), whereas health center IVs carried an average of 65% of infectious disease medical supplies and 42% for NCDs (a difference of 23 percentage points).
- Much of these gaps in NCD care likely stemmed from pronounced deficiencies in medical equipment for NCDs. Only 22% of hospitals had an electrocardiography (ECG) machine, which provides vital diagnostic information for ischemic heart disease. Health centers reported relatively low availability of the lab equipment required to test blood glucose (29%), which is needed to diagnose diabetes and monitor blood sugar levels. This suggests that primary care facilities remained largely unprepared to address Uganda's rising rates of diabetes, which more than doubled between 1990 and 2010.

Nurses composed a majority of personnel, and few facilities achieved staffing targets

- In terms of human resources for health, nurses constituted the largest portion of most facilities' total staff. Non-medical staff accounted for 16% to 36% of average personnel composition. Across facilities, an average of 71% of personnel were considered skilled medical staff.
- Based on staffing targets stipulated for a subset of platforms, only seven facilities – one district hospital and six health center IIIs – reached MOH staffing targets. There was no clear relationship between staffing and urbanicity of a facility's location; however, far fewer rural health center IVs achieved the platform's nurse target than their urban equivalents.
- These results may suggest relatively poor performance in achieving recommended personnel numbers, but it is important to note that these staffing guidelines do not consider a facility's patient volume and the types of health services provided. It is possible that staffing guidelines may be more meaningful if both facility type and production levels are considered for target setting.

Facility production of health services

ART patient volumes quickly increased at most facilities; other patient visits were more variable over time

- Between 2007 and 2011, trends in outpatient and inpatient visits across most facility types were fairly consistent, recording gradual, if any, growth in total volume over time; referral hospitals were the clear exception, with an 11% annual rise in outpatient visits and a 4% annual increase in inpatient visits during this time.
- This happened at the same time as dramatic increases were observed in ART patient volumes, with ART visits rapidly increasing 21% annually from 2007 to 2011. This was mostly driven by referral hospitals, whereas district hospitals and private hospitals showed more gradual gains in ART visits. Uganda's growth in ART services is particularly notable given that the country documented minimal changes in staffing numbers and facility expenditures, excluding costs of antiretrovirals (ARVs), during the same time span.

Medical staff in most facilities experienced low patient volumes each day

- Across facility types, there was a wide range in the total patient volume per medical staff and per day. Using the metric of "outpatient equivalent visits," for which inpatient bed-days, births, and ART visits were scaled to equal a comparable number of outpatient visits, we found that facilities averaged five visits per medical staff per day in 2011, ranging from 4.3 visits at health center IIs to seven at clinics. This finding suggests that, despite perceived staffing shortages, most medical personnel in Uganda, especially those working in urban areas, treated a relatively small number of patients each day.

Facilities showed sizeable capacity for larger patient volumes given observed resources

- In generating estimates of facility-based efficiency, or the alignment of facility resources with the number of patients seen or services produced, we found a wide range between the facilities with lowest and highest levels of efficiency across platforms, especially among private hospitals and primary care facilities. Each one of these platforms had multiple facilities with efficiency scores lower than 10% but also featured at least one facility with an efficiency score of 100%. For most facilities, average efficiency scores steadily increased along with levels of care, with health centers posting an average of 32% and referral hospitals having an average of 59%.
- At the same time, just over half of facilities had an efficiency score below 30%, indicating that they had considerable room to expand service production given their observed human resources and physical infrastructure. This finding implies that human resources for health may not be the primary constraint to increasing patient volumes at many facilities. Future work on pinpointing specific factors that heighten or hinder facility efficiency and how efficiency is related to the actual quality of service provision should be considered.
- On average, facilities that provided ART services had much higher efficiency scores (49%) in 2011 than those found across all facilities (31%). This is not an unexpected finding, given that Uganda saw a large increase in ART patient visits without a corresponding rise in medical personnel at facilities. At the same time, this finding still suggests that medical personnel, on average, were not seeing a large number of patients each day.

Uganda has greater potential for service expansion compared to other ABCE countries in sub-Saharan Africa

- Across all facilities in Uganda, we estimated an average efficiency score of 31% for 2011. This level was lower than average efficiency scores found for Zambia (42%) and Kenya (41%), but was slightly higher than the average efficiency score computed for Ghana (27%). Among these other countries, Uganda had relatively few facilities operating at high levels of efficiency, with 5% of all facilities recording an efficiency score of 80% or higher in 2011. Conversely, 10% and 14% of facilities in Kenya and Zambia, respectively, were performing at similarly high levels of efficiency.
- Given the observed resources at facilities, we estimated that Uganda could produce an additional 16 visits per medical staff per day, in terms of outpatient equivalent visits. In general, primary care facilities showed higher levels of potential service expansion than hospitals, with health center IIs demonstrating the largest potential for growth. In comparison with a subset of other countries involved in the ABCE project, Uganda either had similar or slightly higher levels of potential service expansion. We estimated that facilities in Ghana could increase service provision by more than four-fold, rising from an average of four outpatient equivalent visits per medical staff per day to 17; a similar level of gains in service provision, given observed resources, was estimated for Uganda.
- In combination, these findings indicate that many facilities in Uganda could increase service provision, given observed resources, and that the factors related to higher levels of facility efficiency could be ascertained from the country's small cadre of highly efficient facilities. At the same time, it is critical to consider the expansion of services within the context of persistent gaps in medical equipment and pharmaceuticals, especially at lower levels of care; otherwise, the successful escalation of service provision may not have the desired impact on overarching health goals in Uganda.

ART patient volumes could moderately increase given facility resources, especially for referral hospitals

- With a focus on ART service production, we estimated that, given observed facility resources, Uganda had the potential to increase its average annual ART patient volume by 55%, adding an average of 6,367 ART visits per facility. In Uganda, referral hospitals would largely drive the majority of growth in ART volumes, as we estimated that these facilities could each increase average annual ART visits by 58%. These findings suggest that the majority of facilities are positioned to support Uganda's goal of providing universal access to HIV/AIDS treatment and care.
- This potential expansion of ART services has substantial implications for the capacity of Uganda's health system, allowing facilities to further scale up enrollment of new ART patients at minimal added cost, and perhaps most importantly, to provide ongoing ART care to the growing ranks of long-term ART patients. Ongoing work on identifying the linkages between facility efficiency and related ART patient outcomes is crucial.

- Expanded ART service provision was also projected for Kenya and Zambia, but at a greater magnitude than what was estimated for Uganda. Health facilities in Uganda saw an average of 11,632 ART patients in 2011, which was 56% and 34% higher than the average patient volumes recorded in Kenya and Zambia, respectively. This finding likely captures both the large ART patient need in Uganda and the responsiveness of the country's health system to providing high levels of HIV/AIDS care.

Costs of care

- Average facility expenditures, excluding the costs of ARVs, remained relatively stable between 2007 and 2011. Spending on personnel accounted for the vast majority of annual spending across facility types.

Average facility costs per patient markedly varied across facility types

- Across and within facility types, the average facility cost per patient visit varied substantially in 2011. The average cost per outpatient visit was the least expensive output to produce for most facilities, but private hospitals averaged similar – or even lower – costs per ART patient seen, excluding the costs of ARVs, compared to each outpatient visit. The average facility cost per outpatient visit ranged from 6,525 Ugandan shillings (Ushs)[2] ($3)[3] at health center IIs to 72,529 Ushs ($29) at private hospitals. Births accounted for the highest facility cost per visit for nearly all facilities, ranging from an average of 58,037 Ushs ($23) at health center IIIs to 518,699 Ushs ($207) at referral hospitals. Health center IVs were the exception for average cost per birth, such that the average facility cost per inpatient bed-day (157,876 Ushs [$63]) was more than twice the average cost of a birth (64,033 Ushs [$26]).

Uganda had the lowest average facility costs per outpatient visit and ART visit compared to other ABCE countries in sub-Saharan Africa

- In comparison with Ghana, Kenya, and Zambia, the average facility cost per patient in Uganda varied, with Uganda being on the lower end for births (187,703 Ushs [$75]) but on the higher end of average facility costs per inpatient bed-day (102,541 Ushs [$41]). Uganda had the lowest average facility cost per outpatient visit in 2011, at 21,418 Ushs ($8). The average facility cost per ART visit, excluding ARVs, was also the lowest in Uganda (24,582 Ushs [$10]); however, all countries recorded average facility costs between $10 and $20 per ART visit.

Projected annual facility costs per ART patient varied in parallel with rising levels of the health system and ownership

- Across platforms, the average facility cost per ART visit, excluding ARVs, varied substantially, ranging from 12,730 Ushs ($5) per visit at health center IVs to 58,185 Ushs ($23) at private hospitals. On average, the projected annual facility cost of treating a new ART patient, inclusive of ARVs, ranged between 463,798 Ushs ($186) at health center IIIs to 827,455 Ushs ($331) at private hospitals. Once an ART patient was considered an established patient, projected total annual cost, inclusive of ARVs, dropped by approximately 17% across facility types.

Facility-based ART costs were largely driven by ARVs, and visit costs were lower for established patients

- The facility cost of ARVs accounted for a large proportion of projected annual costs across platforms and patient types, but still ranged from 47% of projected annual facility costs for new patients at private hospitals to 82% of projected annual costs for established patients at health center IIIs. The annual visit costs of ART patients incurred by facilities for established patients were roughly one-third the cost of new ART patients, largely driven by the lower frequency of visits and tests compared to new patients and not by the estimated cost of the ARVs.

- These findings suggest that facilities should view annual ARV costs per ART patient, irrespective of their status as a new or established patient, as more stable over time, which has significant program and policy implications for the continued expansion of ART services in Uganda, especially with the implementation of WHO's new initiation eligibility guidelines.

Projected annual ART costs were generally lower for Ugandan facilities in comparison with a subset of other ABCE countries

- In 2011, Ugandan facilities had a slightly lower projected annual cost per ART patient, excluding ARVs (142,576

[2] All Ugandan shillings (Ushs) in this report are reported in 2011 Ushs and were adjusted for inflation.

[3] All reports of US dollars (USD) were estimated based on the 2011 exchange rate of 1 USD ($) equaling 2,500 Ushs.

Ushs [$57]), than Kenyan facilities (151,531 Ushs [$61]) but were much lower than Zambian facilities (258,761 Ushs [$104]). With ARV costs included, Ugandan facilities had a marginally higher projected annual cost per ART patient (501,371 Ushs [$201]) than Kenyan facilities (486,967 Ushs [$195]). ARV costs accounted for a larger proportion of projected annual ART expenditures for Ugandan facilities (72%) than in Kenya and Zambia (69% and 60%, respectively).

- These findings are particularly important for ART program financing, as funding for ARVs and non-drug facility services often originate from different sources.

Patient perspectives

Few patients reported medical expenses, especially patients seeking HIV care

- Among patients not seeking HIV services, 23% experienced medical expenses associated with their facility visit, and most of these patients presented at private or NGO-owned facilities. Fewer patients seeking HIV care reported medical expenses (16%), reflecting Uganda's prioritization of providing ART services at minimal cost to patients.
- No ART patient who sought care at a publicly owned health center reported paying medical fees. This finding directly reflects Uganda's prioritization of providing ART services at minimal cost to patients, and suggests that the implementation of the policy that abolished medical fees for ART at public facilities has been successful.
- Transport expenses were the most commonly reported payment associated with facility visits. Across platforms, far more ART patients reported transportation expenses (55%, spending an average of 5,168 Ushs [$2]) than patients who were not seeking HIV care (29%).

Patients usually spent more time waiting to receive care than they spent traveling to facilities

- Across platforms, 69% of non-HIV patients traveled less than one hour to seek care, while 51% received health services within an hour's time. Notably, travel time was much more consistent across facility types, with about 11% of patients traveling longer than two hours for care for all platforms, whereas wait time was much more variable. Nearly half of non-HIV patients waited at least two hours before receiving care at referral hospitals, whereas 45% were seen by a provider within 30 minutes at private hospitals. The expediency with which patients received care increased from health center IVs to health center IIs, with 14% and 34% of patients waiting less than 30 minutes at each facility type, respectively.
- A similar trend was observed for ART patients. However, in comparison with patients who did not seek HIV care, ART patients generally traveled for a longer period of time (58% of patients spent less than one hour traveling for care) and waited longer for services (40% received care within one hour's time).

Patients gave high ratings of health care providers and slightly lower ratings of facility-based qualities

- Across platforms, patients were generally quite satisfied with their overall facility experience. In examining particular components of visit satisfaction, patients gave very high ratings of their interactions with staff and providers, but often gave relatively lower marks for facility characteristics, especially for spaciousness and wait time. ART patients gave particularly low marks for these qualities at health center IIs and health center IIIs, averaging a 2.2 out of 5 for wait time at these facilities.

A focus on HIV-related care: facility-based provision of ART services

Rapid expansion of ART services took place across levels of care

- Uganda experienced a tremendous growth in ART patient volumes from 2007 to 2011, especially at referral hospitals. During this time, referral hospitals more than doubled their average number of annual ART visits, reaching an average of 64,620 ART visits per hospital in 2011. Health center IVs and health center IIIs also saw substantial increases in ART service provision; however, each still averaged fewer than 500 ART visits per facility in 2011.

TDF prescription rates quickly increased

- Between 2008 and 2012, Uganda had decreasing prescription rates of d4T-based regimens at ART initiation, suggesting that the country's ongoing phase-out of d4T has been successful. The proportion of ART initiates who began therapy on a TDF-based regimen rose rapidly, increasing more than six-fold, from 9% in 2008 to 59% in 2012.

Progress was observed in initiating ART patients at earlier stages of disease progression

- In comparison with 2008, a greater proportion of ART patients initiated at lower stages of disease and at higher CD4 cell counts in 2012, with the latter rising 62% from a median of 139 cells/mm^3 in 2008 to 225 cells/mm^3 in 2012. Nonetheless, this level of CD4 is well below the initiation threshold of 350 cells/mm^3 set by Uganda's clinical guidelines. Further, 46% of ART initiates began therapy with a CD4 cell count less than 200 cells/mm^3 in 2012, suggesting that a large portion of HIV-positive individuals did not seek care until they were symptomatic. Assessing these clinical characteristics with more recent data is critical for evaluating the uptake of the new WHO eligibility guidelines.

More improvement is needed in collecting ART patient clinical information

- The availability of patient clinical information at ART initiation steadily improved from 2008 to 2012; in 2012, however, 17% of ART initiates still did not receive a CD4 cell count when they began treatment. Much more progress was seen in recording any clinical information during their second year of therapy, but not at the frequency specified by national guidelines. Less than 1% of patients had a record of their viral load, which is the most direct measure of treatment response. To optimally respond to ART patient needs, the ongoing collection of patient clinical data must be improved.

Most ART patients in care had successful viral suppression of HIV

- Based on data for the Viral Load Pilot Study, we found that the average rate of viral load suppression (a viral load less than 1,000 copies of HIV RNA/mL) for patients was 87% across facilities. This is an encouraging result, as the vast majority of these ART patients experienced successful suppression of HIV.

Measures of CD4 were not consistently indicative of viral suppression

- At the patient level, viral load suppression was highly related to concurrent measures of CD4 cell count. At the same time, 27% of patients with a CD4 cell count less than 100 cells/mm^3, a frequently used indicator for treatment failure, had adequate viral load suppression and thus adequate response to treatment. This finding reiterates findings from previous studies, emphasizing that rather than relying on measures of CD4, viral load testing should be used to determine a patient's response to treatment.

A focus on HIV-related care: facility-based provision of ART services, continued

DBS had poor performance in detecting treatment failure at the patient level

- In comparison with plasma measures of viral load, we found that assessments of DBS generally underestimated viral load for ART patients. The DBS assay was not sensitive enough to detect treatment failure at the patient level. This finding suggests that additional assay development and further testing need to occur before DBS should be considered a fully viable alternative to plasma in tracking patient-level outcomes.
- The broader use of DBS for ART patient viral load measures has been debated in Uganda, but our findings indicate that DBS is not yet an adequate substitute for plasma-based measures of viral load in the monitoring of ART patient outcomes under routine conditions.

Facility costs for ART patients varied by levels of care, with ARVs accounting for the largest proportion of costs

- The average facility cost per ART patient visit, excluding ARVs, was 24,582 Ushs ($10) in 2011, ranging from 12,730 Ushs ($5) at health center IVs to 58,185 Ushs ($23) at private hospitals. On average, the projected annual facility cost per ART patient, without including ARV costs, was 142,576 Ushs ($57), but varied from 75,847 Ushs ($30) for established ART patients at health center IIIs to 422,206 Ushs ($177) for new ART patients at private hospitals. ARVs contributed to a major portion of facility ART costs, resulting in a projection of 501,371 Ushs ($201) per ART patient, inclusive of ARV costs, each year. On average, ARVs accounted for 72% of projected annual facility costs for ART.

ART patients reported high ratings of facilities' services, but had long wait times for care

- Among patients seeking HIV care at public facilities, more than 98% of ART patients experienced no medical expenses, reflecting Uganda's national policy to provide ART services free of charge at publicly owned facilities. However, a large proportion of ART patients incurred transportation expenses associated with their visit, which may be associated with traveling long distances to receive care.
- Across platforms, the majority of HIV patients spent more time waiting for health services than traveling to receive them. Overall, HIV patients gave high ratings of their facility experiences, particularly at private hospitals. However, health center IIIs and health center IIs had some of the lowest ratings, especially for wait time and spaciousness.

With its multidimensional assessment of health service provision, findings from the ABCE project in Uganda provide an in-depth examination of health facility capacity, costs associated with seeking care, and how patients view their interactions with the health system. Uganda's health provision landscape was remarkably heterogeneous across facility types, location, and ownership, and it is likely to continue evolving over time. This highlights the need for continuous and timely assessment of health service delivery, which is critical for identifying areas of successful implementation and quickly responding to service disparities or faltering performance. Expanded analyses would also allow for an even clearer picture of the trends and drivers of facility capacity, efficiencies, and costs of care. With regularly collected and analyzed data, capturing information from health facilities, recipients of care, policymakers, and program managers can yield the evidence base to make informed decisions for achieving optimal health system performance and the equitable provision of cost-effective interventions throughout Uganda.

Introduction

The performance of a country's health system ultimately shapes the health outcomes experienced by its population, influencing the ease or difficulty with which individuals can seek care and facilities can address their needs. At a time when international aid is plateauing (IHME 2014) and the government of Uganda has prioritized expanding many health programs (MOH 2005a, MOH 2010a), identifying health system efficiencies and promoting the delivery of cost-effective interventions has become increasingly important.

Assessing health system performance is crucial to optimal policymaking and resource allocation; however, due to the multidimensionality of health system functions (Murray and Frenk 2000), comprehensive and detailed assessment seldom occurs. Quantifying the building blocks of a health system, which range from governance to medical products and technologies (WHO 2007), is not an easy task, but such data are needed to isolate health system strengths and weaknesses. Thus, rigorously measuring what factors are contributing to or hindering health system performance — access to services, bottlenecks in service delivery, costs of care, and equity in service provision throughout a country — provides crucial information for improving service delivery and population health outcomes.

The Access, Bottlenecks, Costs, and Equity (ABCE) project was launched in 2011 to address these gaps in information. In addition to Uganda, the multipronged, multipartner ABCE project has taken place in six other countries (Colombia, Ghana, Kenya, Lebanon, Zambia, and six states in India), with the goal of rigorously assessing the drivers of health service delivery across a range of settings and health systems. In 2015, the ABCE project will be implemented in two additional countries, Bangladesh and Mozambique. For a subset of these countries, including Uganda, additional work has been conducted to quantify components of facility-based HIV/AIDS programming. The ABCE project strives to answer these critical questions facing policymakers and health stakeholders in each country:

- What health services are provided, and where are they available?
- How much does it cost to produce health services?
- Who is receiving these health services?
- What are the largest barriers to accessing care and who is most affected?

Findings from each country's ABCE work will provide actionable data to inform their own policymaking processes and needs. Further, ongoing cross-country analyses will likely yield more global insights into health service delivery and costs of health care. These nine countries have been purposively selected for the overarching ABCE project as they capture the diversity of health system structures, composition of providers (public and private), and disease burden profiles. In selecting the countries for which antiretroviral therapy (ART) programs were also assessed, we sought to represent a range of ART-specific delivery mechanisms. The ABCE project contributes to the global evidence base on the costs of and capacity for health service provision, aiming to develop data-driven and flexible policy tools that can be adapted to the particular demands of governments, development partners, and international agencies.

The Infectious Diseases Research Collaboration (IDRC) and the Institute for Health Metrics and Evaluation (IHME) compose the core team for the ABCE project in Uganda, and they received vital support and inputs from the Ministry of Health (MOH) and Makerere University to execute multiple phases of data collection, analysis, and interpretation. The core team harnessed information from distinct but linkable sources of data, drawing from a nationally representative sample of Ugandan health facilities to create a large and fine-grained database of facility attributes and capacity, patient characteristics and outcomes, and measures related to ART programs. By capturing the interactions between facility characteristics and patient perceptions of care in Uganda, we have been able to piece together what factors drive or hinder optimal and equitable service provision in rigorous, data-driven ways.

We focus on the facility because health facilities are the main points through which most individuals interact with Uganda's health system or receive care. Understanding the capacities and efficiencies within and across different types of health facilities unveils the differences in health system

performance at the level most critical to patients — the facility level. We believe this information is immensely valuable to governments and development partners, particularly for decisions on budget allocations. By having data on what factors are related to high facility performance and improved health outcomes, policymakers and development partners can then support evidence-driven proposals and fund the replication of these strategies at facilities throughout Uganda. This gap in, and corresponding need for, health facility knowledge is exemplified by Uganda's experiences with HIV/AIDS.

HIV/AIDS remains a leading cause of premature mortality and illness in the country, although Uganda reached its epidemic peak for HIV/AIDS mortality in 1990 (Ortblad et al. 2013). A monumental investment has been made in tackling HIV/AIDS in Uganda, with $1.9 billion dedicated to HIV/AIDS efforts in the country between 1990 and 2011 (Dieleman et al. 2014). The new World Health Organization (WHO) guidelines stipulating that individuals with HIV should start ART at much earlier stages of disease progression (WHO 2013a) are an example of changing ART eligibility guidelines that, in combination with the reality of ART patients living longer, have contributed to growing levels of unmet ART needs (UAC 2012a). Uganda rapidly scaled up its facility-based ART programs over the last decade (UAC 2012a), but patient needs still exceed the supply of service provision. Uganda aims to provide universal access to HIV/AIDS prevention, care, and treatment by 2015 (UAC 2012b), further widening the universe of patients needing ART and HIV services.

Prior to the ABCE project, minimal information had been comprehensively collected on what facility characteristics were related to improved outcomes for ART patients in Uganda (Rosen et al. 2007). By sampling a broad range of facility types with ART programs and collecting a range of patient outcome information (e.g., CD4 cell counts, viral load, program retention rates), we now have the data to better ascertain facility determinants of ART outcomes under routine conditions. Further, Uganda is now considering the large-scale implementation of dried blood spot (DBS) technology to measure viral load suppression for ART patients and monitor their response to treatment. DBS is less expensive and potentially requires less laboratory equipment than plasma-based measures of viral load, but its use under routine conditions for assessing patient-level outcomes has not been systematically studied in Uganda (Johannessen et al. 2009). With the Viral Load Pilot Study, we are in the position to evaluate DBS performance as an indicator, as compared to plasma measures, for ART outcomes.

The ABCE project in Uganda has sought to generate the evidence base for improving the cost-effectiveness and equity of health service provision, as these are clearly stated priorities of the Ugandan MOH (MOH 2010a). In this report, we examine facility capacity across platforms, as well as the efficiencies and costs associated with service provision for each type of facility. These results directly align with four of the six building blocks of the health system (WHO 2007), providing data-driven insights into components that affect health financing, human resources for health, service delivery, and the facility availability of medical supplies in the Ugandan health system. Based on patient exit interviews, we consider the factors that affect patient perceptions of and experiences with the country's health sector. We also link ART program attributes to patient outcomes, ultimately providing a continuum of information on supply-side (facility) and demand-side (patient) constraints related to ART program costs and effectiveness. By considering a range of supply-side factors and demand-side components that influence health service delivery, we have constructed a rigorously comprehensive yet fine-grained and nuanced understanding of what helps and hinders the receipt of health services through facilities in Uganda.

The results discussed in this report are far from exhaustive; rather, they align with identified priorities for health service provision, address explicit goals set forth by national strategic plans, and aim to answer questions about the costs and equity of health care delivery in Uganda.

Findings are organized in the following manner:

Health facility characteristics and performance

This section provides an in-depth examination of health facility capacity across different platforms, specifically covering topics on human resource capacity, facility-based infrastructure and equipment, health service availability, patient volume, facility-based efficiencies, costs associated with service provision, and demand-side factors of health service delivery as captured by patient exit interviews.

Performance of health facility-based ART programs

This section provides an in-depth examination of ART program characteristics and outcomes across facility types, including drug regimens provided and variability of patient retention by platform. Results on ART service costs and efficiencies are also covered, as are findings from the Viral Load Pilot Study.

Access, Bottlenecks, Costs, and Equity

Access

Health services cannot benefit populations if they cannot be accessed; thus, measuring which elements are driving improved access to – or hindering contact with – health facilities is critical. Travel time to facilities, user fees, and cultural preferences are examples of factors that can affect access to health systems.

Bottlenecks

Mere access to health facilities and the services they provide is not sufficient for the delivery of care to populations. People who seek health services may experience supply-side limitations, such as medicine stock-outs, that prevent the receipt of proper care upon arriving at a facility.

Costs

What health services cost can translate into very different financial burdens for consumers and providers of such care. Thus, the ABCE project measures these costs at several levels, quantifying what facilities spend to provide services and patients pay for care.

Equity

Numerous factors can influence the ways in which populations interact with a health system, often either facilitating easier and more frequent use of health services or obstructing the relative ease and frequency with which an individual can use those same services. It is not enough to know how much it costs to scale up a given set of services; it is also necessary to understand the costs of such a scale-up for specific populations and across a host of population-related factors (e.g., distance to health facilities). These factors can often determine whether hard-to-reach populations receive the health services they need. Through the ABCE project, a main objective is to pinpoint which factors affect the access to and use of health services, as well as where and how much these factors manifest themselves.

ABCE study design

For the ABCE project in Uganda, we collected any relevant data that already existed in the country's health system and conducted primary data collection as needed. Primary data collection took place with two complementary approaches:

1 A comprehensive facility survey administered to a nationally representative sample of health facilities in Uganda (the ABCE Facility Survey).

2 Interviews with patients as they exited sampled facilities.

District Health Teams (DHTs) received a modified version of the ABCE Facility Survey. For a subset of facilities that provided ART services, an ART-specific module was also included in the facility survey and the research team extracted clinical records from the charts of HIV-positive patients. Additional exit interviews were conducted for patients seeking HIV services, and blood samples were collected for a sub-sample of patients receiving ART care.

Here we provide an overview of the ABCE study design and primary data collection mechanisms. All ABCE datasets and survey instruments are available online at http://www.healthdata.org/dcpn/uganda.

ABCE Facility Survey

Through the ABCE Facility Survey, direct data collection was conducted from a representative sample of health service platforms and captured information on the following indicators:

- **Inputs:** the availability of tangible items that are needed to provide health services, including infrastructure and utilities, medical supplies and equipment, personnel, and non-medical services.
- **Finances:** expenses incurred, including spending on infrastructure and administration, medical supplies and equipment, and personnel. Facility funding from different sources (e.g., government, development partners) and revenue from service provision were also captured.
- **Outputs:** volume of services and procedures produced, including outpatient and inpatient care, emergency care, laboratory and diagnostic tests, and pharmaceuticals dispensed.
- **Supply-side constraints and bottlenecks:** factors that affected the ease or difficulty with which patients received services they sought, including bed availability, pharmaceutical availability and stock-outs, cold-chain capacity, personnel capacity, and service availability.

Table 1 provides more information on the specific indicators included in the ABCE Facility Survey.

The questions included in the survey given to DHTs were similar to those in the ABCE Facility Survey, but it was a truncated version. Table 2 details the indicators in the DHT Survey.

Sample design. To construct a nationally representative sample of health facilities in Uganda, we used a two-step stratified random sampling process. Districts, from which facilities would be drawn, were grouped by the ten regions designated in the 2011 Demographic and Health Survey (DHS). We randomly sampled two districts per region by urban and rural strata. In the region of Kampala, we only sampled one urban district. Urbanicity was determined by expert input and validated by population density estimates from the 2002 Uganda Population and Housing Census (UBOS 2006).

The second step, which entailed sampling facilities from each selected district, took place across the range of platforms identified in Uganda. For the ABCE project, a "platform" was defined as a channel or mechanism by which health services are delivered. In Uganda, sampled health facilities included national referral hospitals, regional referral hospitals, district hospitals, different levels of health centers (IV, III, and II), clinics, and pharmacies or drug stores, as well as DHTs. The facility sampling frame used for the ABCE project originated from the 2011 MOH facility inventory.

A total of 19 districts were selected through the district sampling frame (nine rural and ten urban), and 273 facilities (excluding DHTs) from those districts were selected through the facility sampling frame:

- All known hospitals within the selected district.
- All health center IVs within the selected district.
- Up to two health center IIIs that fell under the supervision of selected health center IVs.

TABLE 1 Modules included in the ABCE Facility Survey in Uganda

SURVEY MODULE	SURVEY CATEGORY	KEY INDICATORS AND VARIABLES
Module 1: Facility finances and inputs	Inputs	Input funding sources and maintenance information Availability and functionality of medical and non-medical equipment
	Finances	Salary/wages, benefits, and allowances record information Total expenses for infrastructure and utilities; medical supplies and equipment; pharmaceuticals; administration and training; non-medical services, personnel (salaries and wages, benefits, allowances) Performance and performance-based financing questions
	Revenues	User fees; total revenue and source
	Personnel characteristics	Total personnel; volunteer and externally funded personnel; personnel dedicated to HIV/AIDS-specific services Funding sources of personnel; education and training of medical personnel Health services provided and their staffing; administrative and support services and their staffing
Module 2: Facility management and direct observation	Facility management and infrastructure characteristics	Characteristics of patient rooms; electricity, water, and sanitation; facility meeting characteristics Guideline observation
	Direct observation	Latitude, longitude, and elevation of facility Facility hours, characteristics, and location; waiting and examination room characteristics
Module 3: Lab-based consumables, equipment, and capacity	Facility capacity	Lab-based tests available
	Medical consumables and equipment	Lab-based medical consumables and supplies available
Module 4: Pharmaceuticals	Facility capacity	Pharmacy information; cold chain characteristics and supplies
	Pharmacy-based medical consumables and equipment	Drug kit information; buffer stock information Essential pharmaceutical availability, prices, and stock-out information Pharmaceutical ordering system; pharmaceuticals ordered, received, and costs to patients
Module 5: ART pharmaceuticals	Pharmacy-based ART consumables and equipment	Essential ART availability, prices, and stock-out information ART pharmaceutical ordering system; pharmaceuticals ordered, received, and costs to patients
Module 6: General medical consumables, equipment, and capacity	Medical consumables and equipment	Availability and functionality of medical furniture, equipment, and supplies Inventory of procedures for sterilization, sharp items, and infectious waste Inventory of personnel
Module 7: Facility outputs	Facility capacity	Referral and emergency referral infrastructure
	General service provision	Inpatient care and visits; outpatient care and visits; home or outreach visits Care and visits for specific conditions, including emergency visits and HIV care Vaccinations administered Laboratory and diagnostic tests

Note: Indicators for finances, personnel, and outputs reflect the past five fiscal years (2007 to 2011); all other indicators reflect the status at the time of survey.

TABLE 2 Indicators included in the DHT Survey in Uganda

SURVEY MODULE	SURVEY CATEGORY	KEY INDICATORS AND VARIABLES
DHT finances and inputs	Finances	Salary/wages, benefits, and allowances Total expenses for infrastructure and utilities; medical supplies and equipment; pharmaceuticals; administration and training; non-medical services, personnel (salaries and wages, benefits, allowances) DHT-specific program expenses: immunization campaigns, promotional campaigns, medical trainings
	Revenues	Total revenue and source
	Personnel characteristics	Total personnel
DHT direct observation	Latitude, longitude, and elevation of the DHT	
Additional information on sampled facilities within the district, as reported by the DHT	Finances	Financial summary for sampled facilities
	Personnel characteristics	Total personnel at sampled facilities

- Up to three health center IIs that fell under the supervision of selected health center IIIs.
- Two pharmacies or drug stores.
- Up to three clinics.

Within each selected district, we also included the DHT in our sample. All national or regional referral hospitals were included in the final facility sample, irrespective of their location. This means that additional districts were included in the final ABCE sample if national or regional referral hospitals were located in a non-sampled district. However, no other facilities were selected from these non-sampled districts, as they were not drawn from the district sampling frame. Figure 1 depicts this two-step sampling process used in Uganda.

In the results that follow, national and regional referral hospitals are grouped together, unless otherwise indicated, as referral hospitals. Based on facility reports in the ABCE Facility Survey and consultation with the ABCE field team in Uganda, we grouped facilities owned by non-governmental organizations (NGOs) with privately owned facilities. For this report, we note if findings are presented separately for private and NGO-owned facilities.

ART module and clinical chart extraction. Of the facilities offering ART services that were selected for ABCE Facility Survey implementation, we randomly sampled 60 facilities to also receive an additional survey module that collected information on facility-level ART program characteristics, service provision, and costs. This ART-focused module was administered alongside the ABCE Facility Survey at these facilities.

Table 3 provides more information on the ART-specific indicators included in the ABCE Facility Survey.

For a sub-sample of these facilities with ART services, information from up to 250 clinical records for ART patients was extracted. Inclusion criteria permitted the use of records for patients aged 18 years or older who had initiated ART treatment between six and 60 months before the date on which chart data were collected. All patient identifiers were removed, and access to the secure database with patient chart data was limited to specific research team members.

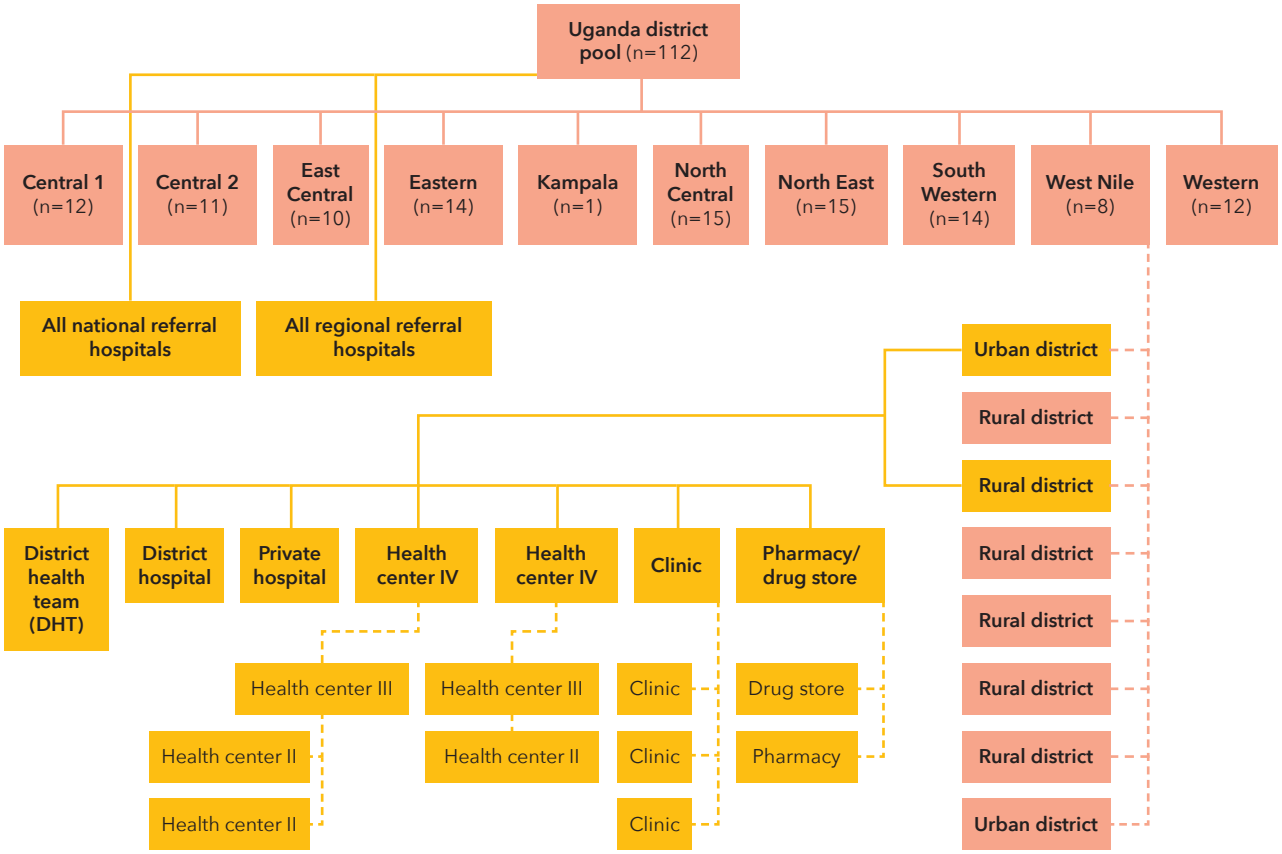
Table 4 details the types of data extracted from clinical charts and electronic record databases. Over 8,000 charts were ultimately extracted across facilities in the ABCE sample.

Patient Exit Interview Survey

Based on a subset of sampled facilities, a maximum of 30 patients or attendants of patients were interviewed per facility. Among facilities that offered ART services, an additional 30 patient exit interviews were conducted in an effort to capture information from patients who had specifically sought HIV care (a total of 60 patient exit interviews). Patient selection was based on a convenience sample.

The main purpose of the Patient Exit Interview Survey was to collect information on patient perceptions of the health services they received and other aspects of their facility visit (e.g., travel time to facility, costs incurred during the facility visit). This information fed into quantifying the "demand-side" constraints to receiving care (as opposed to the facility-based, "supply-side" constraints and bottlenecks measured by the ABCE Facility Survey).

FIGURE 1 Sampling strategy for the ABCE project in Uganda



Note: Boxes that are orange reflect the regions considered for the district sampling frame. Districts that are yellow represent those selected through this district sampling process. Solid lines indicate inclusion from the previous sampling step, while dashed lines indicate that a random selection of districts or facilities took place.

TABLE 3 ART indicators collected in the ABCE Facility Survey in Uganda

SURVEY MODULE	SURVEY CATEGORY	KEY INDICATORS AND VARIABLES
Module 1	Facility capacity	Essential HIV/AIDS-specific pharmaceutical availability and stock-out information
		HIV-related outreach care and prevention services
		HIV care dedicated personnel
Module 3	General service provision	HIV-related medical consumables and care available
		HIV-related tests and services available
		ART services
		HIV-related laboratory and diagnostic tests
Module 7	Service provision	HIV outpatient care
		ART initiations; pre-ART and ART patient visits
		Prevention of mother-to-child transmission (PMTCT) services
		Male circumcision services
		HIV testing and counseling

The questions asked in the Patient Exit Interview Survey were organized into five main categories:

- Expectations for the facility.
- Circumstances of and reasons for the particular facility visit.
- Time and costs associated with the facility visit.
- Satisfaction with services.
- Patient demographic information (e.g., educational attainment).

Table 5 provides more information on the specific questions included in the Patient Exit Interview Survey.

Eligibility for participation in the exit interviews was determined by age (whether the patient was 18 years or older or, if younger than 18 years old, was accompanied by an attendant that met the age requirement) and responsiveness (whether the patient or attendant was able to respond to questions). All data collected through patient exit interviews were kept confidential.

Patients who reported seeking HIV services during their facility visit were then asked about the types of HIV services sought (e.g., counseling, testing, routine check-up, report collection) and their ART status. If a patient indicated that they were currently enrolled in ART, they were asked an additional set of questions to gather ART-specific information, including the following:

- Length of time enrolled in ART.
- State of health since ART initiation.

TABLE 4 Indicators extracted from clinical charts of HIV-positive patients currently enrolled in ART

SURVEY MODULE	SURVEY CATEGORY	KEY INDICATORS AND VARIABLES
Clinical chart extraction	Patient information	Age, sex, height, weight
		Care entry point (i.e., PMTCT, voluntary counseling and testing [VCT])
		Other demographic information
	ART initiation	Pre-ART and ART initiation date
	Care information	Tests conducted, results, and corresponding dates
		ART regimen information
		Opportunistic infections
	Patient outcomes	Alive and retained in care, lost to follow-up, deceased, transferred
		Adherence to treatment, treatment failure

TABLE 5 Types of questions included in the Patient Exit Interview Survey in Uganda

SURVEY CATEGORY	TYPES OF KEY QUESTIONS AND RESPONSE OPTIONS
Direct observation of patient	Sex of patient (or patient's attendant if surveyed)
Direct interview with patient	Scaled-response demographic questions (e.g., level of education attained)
	Scaled-response satisfaction scores (e.g., satisfaction with facility cleanliness: (1) very bad; (2) bad; (3) average; (4) good; (5) very good)
	Open-ended questions for circumstances and reasons for facility visit, as well as visit characteristics (e.g., travel time to facility)
	Reporting costs associated with facility visit (user fees, medications, transportation, tests, other), with an answer of "yes" prompting follow-up questions pertaining to amount

- Whether HIV appointments had ever been missed, and if so, why.
- Ease with which ART drugs were obtained.
- Health complications related to ART regimen.
- Side-effects or consequences experienced since ART initiation (e.g., ability to work, social engagement).

Over 3,900 patients were interviewed as part of the ABCE project in Uganda.

Viral Load Pilot Study

The Viral Load Pilot Study served as an exploratory study to better understand the feasibility and utility of using patient measures of HIV viral load to assess facility-based ART program performance. This arm of the ABCE project in Uganda was purposely designed to complement the data collected through the ABCE Facility Survey, especially the information derived from the ART module and clinical chart extractions performed for ART patients.

Among a convenience sample of 15 facilities that received the ABCE Facility Survey and provided ART, additional clinical chart extractions were completed and blood samples were drawn for a sub-sample of patients who were at least 18 years old and had been enrolled in ART between six and 60 months. These facilities included a combination of hospitals, health center IVs, and health center IIIs.

Patient blood samples were drawn to measure CD4 cell count and HIV viral load, with enough blood drawn to perform a plasma CD4 cell count, plasma viral load analysis, and a DBS viral load assessment. A shorter extraction instrument was used for the charts specifically targeted for this component of the ABCE project, which included up to 250 charts for patients who were enrolled in ART and underwent blood testing.

Data collection for the ABCE project in Uganda

Data collection took place in two phases: (1) from April to October 2012, and (2) from April to August 2013.

Primary data collection with the ABCE Facility Survey occurred between April and October 2012. Prior to survey implementation, IDRC and IHME hosted a one-week training workshop for 25 research associates, where they received extensive training on the electronic data collection software (DatStat), the survey instruments, the Ugandan health system's organization, and interviewing techniques. Following this workshop, a one-week pilot of all survey instruments took place at health facilities outside the ABCE sample. Ongoing training occurred on an as-needed basis throughout the course of data collection.

All collected data went through a thorough verification process between IHME, IDRC, and the ABCE field team. Following data collection, the data were methodically cleaned and re-verified, and securely stored in databases hosted at IHME.

For the Viral Load Pilot Study, data collection occurred between April and August 2013. Blood draw samples were stored and assessed by Joint Clinical Research Centres (JCRCs), while DBS storage, assay development, and analysis

TABLE 6 Facility sample, by platform, for the ABCE project in Uganda

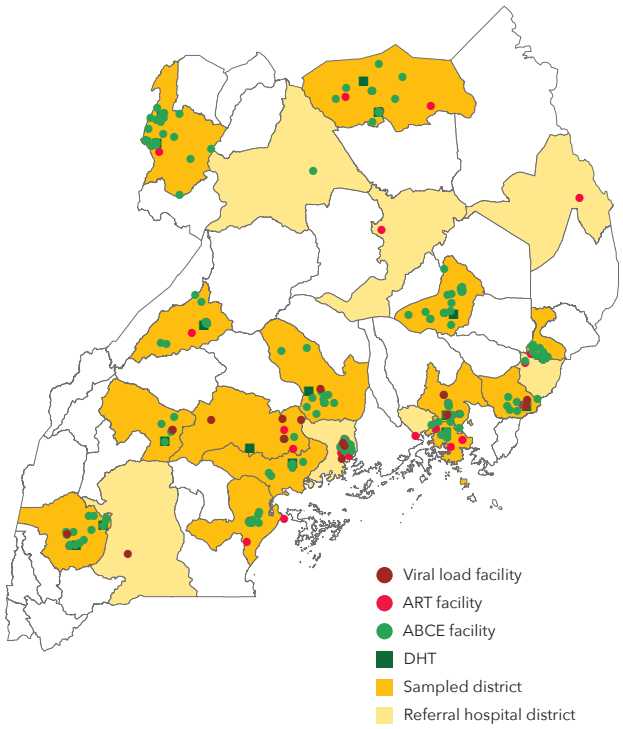
FACILITY TYPE	ORIGINAL SAMPLE	RESPONSE RATE	FINAL SAMPLE
National referral hospitals	2	100%	2
Regional referral hospitals	13	86%	12
District hospitals	11	92%	11
Private hospitals	38	87%	34
Health center IVs	39	97%	38
Health center IIIs	67	79%	53
Health center IIs	50	67%	35
Clinics	15	75%	10
Pharmacies/drug stores	38	N/A	35
District health teams (DHT)	28	N/A	17
Total facilities	**301**	**–**	**247**

were coordinated by IDRC and the University of Washington's Department of Laboratory Medicine in Seattle.

Figure 2 displays the districts and facilities sampled for the ABCE project in Uganda. Table 6 provides information on original and final facility samples. The final sample of hospitals included 14 national and regional referral hospitals, 11 district hospitals, and 34 private hospitals. In cases when facilities reported a different platform classification than what was recorded in the 2011 MOH facility inventory, we deferred to the classification reported by interviewed facility representatives in the ABCE Facility Survey.

Data and corresponding instruments from the ABCE project in Uganda can be found online through IHME's Global Health Data Exchange (GHDx): http://ghdx.healthdata.org.

FIGURE 2 Districts and facilities sampled for the ABCE project in Uganda



DISTRICT	FACILITIES	PERCENT OF FINAL SAMPLE
Arua	16	7%
Buhweju	7	3%
Bushenyi	11	5%
Butambala	8	3.2
Gulu	1	< 1%
Hoima	13	5%
Iganga	13	5%
Jinja	1	< 1%
Kampala	25	10%
Kitgum	11	5%
Kyegegwa	7	3%
Lamwo	9	4%
Lira	1	< 1%
Maracha	11	5%
Masaka	13	5%
Mayuge	13	5%
Mbale	1	< 1%
Mbarara	1	< 1%
Mityana	10	4%
Moroto	1	< 1%
Mubende	1	< 1%
Nakaseke	15	6%
Serere	13	5%
Sironko	14	6%
Soroti	12	5%
Tororo	18	7%
Wakiso	1	< 1%
Total facilities	**247**	**100%**

Main findings
Health facility profiles

The delivery of facility-based health services requires a complex combination of resources, ranging from personnel to physical infrastructure, that vary in their relative importance and cost to facilities. Determining what factors support the provision of services at lower costs and higher levels of efficiency at health facilities is critical information to policymakers, especially as countries like Uganda consider how to expand health system coverage and functions within constrained budgets.

Using the ABCE Uganda facility sample (Table 6), we analyzed five key drivers of health service provision at facilities:

- Facility-based resources (e.g., human resources, infrastructure and equipment, and pharmaceuticals), which are often referred to as facility inputs.
- Patient volumes and services provided at facilities (e.g., outpatient visits, inpatient bed-days), which are also known as facility outputs.
- Patient-reported experiences and their reported costs of care, capturing "demand-side" factors of health service delivery.
- Facility alignment of resources and service production, which reflects efficiency.
- Facility expenditures and production costs for service delivery.

These components build upon each other to create a comprehensive understanding of health facilities in Uganda, highlighting areas of high performance and areas for improvement.

Facility capacity and characteristics

Service availability

Across and within platforms in Uganda (Figure 3), several notable findings emerged for facility-based health service provision. Referral and district hospitals reported providing a wide range of services, including surgical services, internal medicine, and specialty services such as emergency obstetric care and tuberculosis care. Private hospitals generally offered fewer services and were more specialized than referral and district hospitals. HIV/AIDS services were largely available among referral hospitals, district hospitals, and health centers (72%), but a lower proportion of private hospitals (59%) and clinics (20%) reported providing HIV/AIDS care.

In general, referral hospitals, district hospitals, and health centers showed a fairly high availability of priority services that are considered part of a basic package of health services in Uganda (MOH et al. 2012, Okwero et al. 2011), including a formal immunization program (94%), antenatal care (ANC) (85%), and family planning (83%). In accordance with the country's plan to expand maternal and child services to lower levels of care (MOH 2010a), we found that 37% of health center IIs provided routine delivery services. A goal in the *Uganda Health Sector Strategic Plan III (HSSP III), 2010/11–2014/15* was to introduce deliveries to health center IIs (MOH 2010a), and we found that a subset of this platform offered such services two years later. However, progress in service availability was not uniform across platforms. The previous health sector plan stipulated that 100% of regional referral hospitals should have functional accident and emergency units by 2010, but based on the ABCE sample, fewer than 80% of referral hospitals, including both national and regional hospitals, reported having emergency services in 2012. In the ABCE sample, three referral hospitals lacked an accident emergency unit. Availability of emergency services declined in parallel with descending levels of care in the public sector, with 73% of district hospitals, 42% of health center IVs, and 28% of health center IIIs offering emergency services. Fewer than a quarter of private hospitals featured an emergency unit.

Differences in service availability across platforms were not unexpected, as the Ugandan health system is deliberately structured to have varying levels of care, from referral hospitals to health center IIs (MOH 2010a). This is particularly relevant for lower levels of care, as few, if any, health centers IIIs or health center IIs are supposed to offer more specialized services such as chemotherapy or admit inpatients. As a result, a finding that less than 5% of these facilities offer such services is not necessarily cause for concern.

At the same time, substantial variation was found within facility types, reflecting potential gaps in achieving

FIGURE 3 Availability of services in health facilities, by platform, 2012

	REFERRAL HOSPITAL	DISTRICT HOSPITAL	PRIVATE HOSPITAL	HEALTH CENTER IV	HEALTH CENTER III	HEALTH CENTER II	CLINIC
Pharmacy	100	100	88	82	68	54	70
Immunization program	86	100	47	95	94	94	20
Internal medicine	93	91	79	71	68	63	70
Antenatal care	86	100	53	95	96	54	50
Routine delivery services	86	100	53	92	91	37	40
Pediatric	86	91	76	84	58	37	60
Family planning	86	82	41	95	81	74	20
HIV/AIDS care	100	100	59	97	74	23	20
Outreach services	64	73	56	95	89	74	20
Health education outreach	71	82	41	71	74	66	20
Medical ward	86	91	65	68	53	11	30
Emergency obstetric care	86	91	47	68	40	17	10
Pediatric ward	86	100	56	55	34	3	20
Dentistry	93	82	41	58	25	6	10
Tuberculosis and other respiratory diseases	86	100	38	53	19	0	10
Obstetric ward	86	82	47	47	23	3	0
Eye care	93	73	38	37	23	6	10
Laboratory	93	100	50	18	6	0	10
Accident and emergency unit	79	73	24	42	28	9	10
Orthopedic	93	100	29	5	4	0	10
Diagnostic and medical imaging	86	91	47	5	2	0	10
Nutrition	71	64	29	45	19	9	0
Surgery, general	86	82	44	18	6	0	0
Surgical ward	86	82	41	11	6	0	10
Morgue	79	82	32	13	8	0	0
Anesthesiology	79	82	38	5	6	0	0
Psychiatric	86	64	18	13	0	0	10
Surgery, orthopedic	64	82	24	0	2	0	0
Newborn nursery	57	55	35	16	6	0	0
Physical therapy and rehabilitation	71	55	24	3	0	0	0
Occupational therapy	64	55	18	3	4	0	0
Blood donor center	50	36	15	3	0	0	0
Surgery, cardiovascular	29	45	6	0	0	0	0
Surgery, neurological	21	45	0	0	0	0	0
Chemotherapy	21	18	6	5	8	3	0

Note: All values represent the percentage of facilities, by platform, that reported offering a given service at least one day during a typical week.

or maintaining facility capacity requirements outlined in Uganda's strategic health plans (MOH 2005a, MOH 2010a). For example, according to the plans, all health center IVs are supposed to provide individual wards by sex and for children, admit inpatients, and offer surgical services. Of the ABCE sample, only 55% of health center IVs featured pediatric wards, 18% provided basic surgical services, and 11% hosted an inpatient surgical ward. Two referral hospitals reported that they did not host immunization programs.

These findings illustrate many of the areas wherein basic service-provision gaps appear to exist. In the next sections, we delve into the factors that likely affect the availability of these services across platforms.

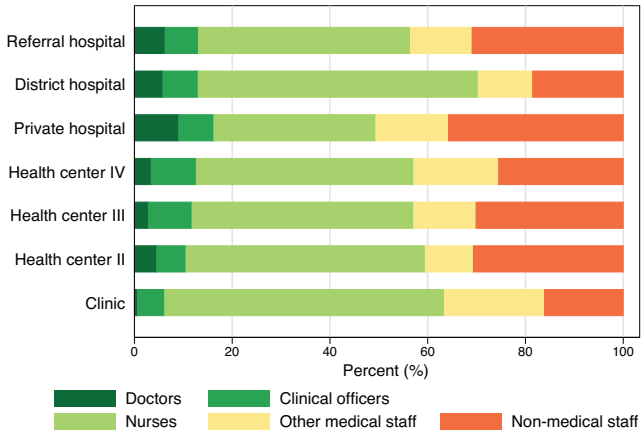
Human resources for health

Uganda has long viewed the challenge of medical staffing as a high priority, especially in terms of having enough skilled personnel and ensuring their equitable distribution to both urban and rural areas (MOH 2005a, MOH 2010a). A facility's staff size and composition can directly affect the types of services it can effectively provide. As a key building block of the health system, human resources for health need to be assessed from multiple dimensions, ranging from the mixture of skilled personnel at facilities to their absolute number throughout Uganda.

Based on the ABCE sample, we found that nurses accounted for the largest proportion of personnel across all facility types, ranging from an average of 33% in private hospitals to 57% in district hospitals (Figure 4). At the other end of the spectrum, doctors and clinical officers averaged less than 16% of facility staff across platforms, with the highest among private hospitals (16%) and the lowest in clinics (6%). Average staff composition was very similar for health center IVs and IIIs.

The *Uganda Health Sector Strategic Plan II (HSSP II), 2005/06–2009/10* set forth national targets for staffing by platform (MOH 2005a), such that district hospitals should have seven doctors, eight clinical officers, and 116 nurses; health center IVs should have two doctors, three clinical officers, and 17 nurses; health center IIIs should have two clinical officers and nine nurses; and health center IIs should have four nurses. Based on facilities in the ABCE sample, achievement of these staffing targets was mixed and generally low across platforms. Of district hospitals, 45% had the recommended number of doctors, 55% reached the national target for clinical officers, and only 9% achieved the nursing target. For health center IVs, 18% had the recommended number of doctors and nurses, and 50% met the target for clinical officers. Forty-five percent of health center IIIs reached the target for clinical officers, while only 15% achieved the nursing target. Of health center IIs, 43% had the recommended number of nurses. Figures 5 and 6 depict the staffing levels among district hospitals and health center IVs, respectively. In general, there was no clear relationship between facility staffing and urbanicity; however, far fewer rural health center IVs met the staffing target for nurses.

FIGURE 4 Composition of facility personnel, by platform, 2011

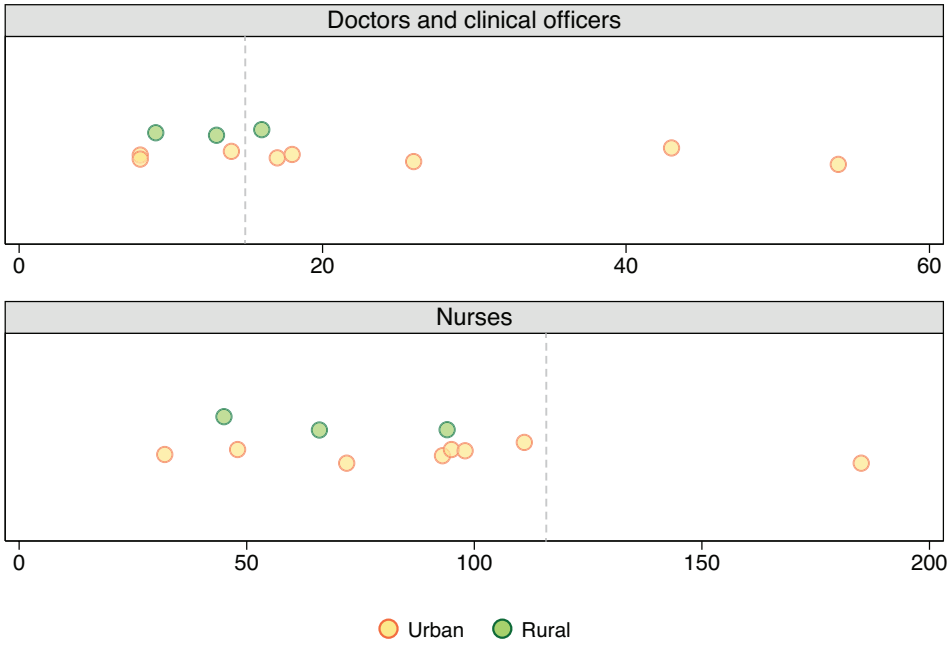


Only one district hospital and six health center IIIs achieved all staffing targets outlined in the HSSP II. No health center IV met all three targets.

In isolation, these results may be cause for concern. However, facility staffing numbers are less meaningful without considering a facility's overall patient volume and production of specific services. For instance, if a facility mostly offers services that do not require a doctor's administration, failing to achieve the doctor staffing target may be less important than having too few nurses. Further, some facilities may have much smaller patient volumes than others, and thus "achieving" staffing targets could leave them with an excess of personnel given their patient loads. While an overstaffed facility has a different set of challenges than an understaffed one, each reflects a poor alignment of facility resources and patient needs. To better understand bottlenecks in service delivery and areas to improve costs, it is important to assess a facility's capacity (inputs) in the context of its patient volume and services (outputs).

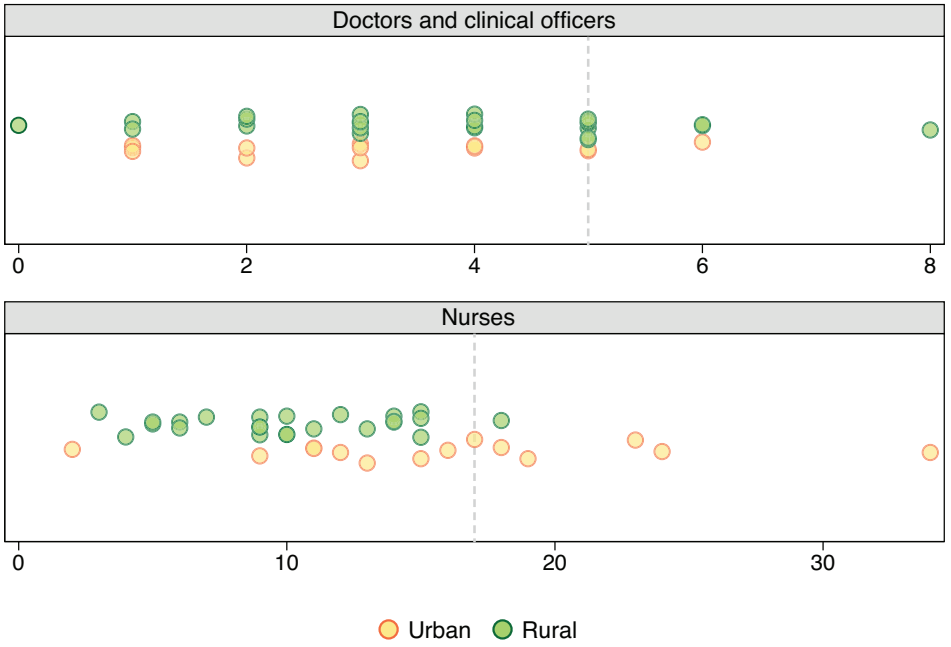
These findings are explored further under the "Efficiency and costs" section, wherein levels of facility-based staffing are compared with the production of different types of health services. In this report, we primarily focus on the delivery of health services by skilled medical personnel, which

FIGURE 5 District hospital achievement of staffing goals for doctors/clinical officers and nurses, 2011



Note: The gray dotted line reflects the staffing target for doctors and clinical officers (summed together), as well as nurses, for district hospitals in Uganda.

FIGURE 6 Health center IV achievement of staffing goals for doctors/clinical officers and nurses, 2011



Note: The gray dotted line reflects the staffing target for doctors and clinical officers (summed together), as well as nurses, for health center IVs in Uganda.

include doctors, clinical officers, nurses, and other medical staff (e.g., lab technicians, pharmacists). It is possible that non-medical staff also contribute to service provision, especially at lower levels of care, but the ABCE project in Uganda is not currently positioned to analyze these scenarios.

Infrastructure and equipment

Health service provision depends on the availability of adequate facility infrastructure, equipment, and supplies (physical capital). In this report, we focus on four essential components of physical capital: power supply, water and sanitation, transportation, and medical equipment, with the latter composed of laboratory, imaging, and other medical equipment. Figure 7 illustrates the range of physical capital, excluding medical equipment, available across platforms.

Power supply. Access to a functional electrical supply varied across platforms. All hospitals, irrespective of level and ownership, had functional electrical connections to the energy grid. Ninety-two percent of health center IVs had functional electricity, with 84% of facilities connected to the energy grid and 8% using a generator. Among smaller facilities, 30% of health center IIIs and 66% of health center IIs lacked functional electricity. Uganda experiences electricity outages with some frequency, especially in rural areas, and having a generator can be as important as having access to the energy grid in the first place. Across platforms, 56% of facilities with functional electricity also had a generator. Three percent of facilities reported solely relying on a generator for power. Inadequate access to consistent electric power has substantial implications for health service provision, particularly for the effective storage of medications, vaccines, and blood samples. These findings reflect progress in expanding energy access to higher levels of care (a 2011 survey found that 86% of sampled hospitals had electricity through the national grid [Linden et al. 2012]), but also highlight the ongoing need to address gaps in functional power among primary care facilities.

FIGURE 7 Availability of physical capital, by platform, 2012

Note: Availability of physical capital was determined by facility ownership or status on the day of visit. All values represent the percentage of facilities, by platform, that had a given type of physical capital.

Water and sanitation. Referral and district hospitals generally had the highest availability of improved water and sanitation sources, with 100% of these hospitals having functional piped water and 92% having sewer infrastructure (with flush toilets). Of private hospitals, 97% had functional piped water and 76% had sewer infrastructure. Notably, 21% of private hospitals had covered pit latrines as their main waste system. The majority of health centers, across levels, provided covered pit latrines, but many still were serviced by uncovered pit latrines (18% of health center IVs, 23% of health center IIIs, and 26% of health center IIs), indicating elevated public health risks for these facilities and their surrounding communities. Access to piped water declined further down the health system, with 49% of health center IIs having functional piped water. In the absence of piped water, facilities generally used wells or boreholes, and hand disinfectant was broadly available across platforms as a supplementary sanitation method.

These findings show a mixture of notable gains and ongoing needs for facility-based water sources and sanitation practices among primary care facilities. In 2000, very few health centers had access to piped water (8%), mostly relying on boreholes or protected springs as their main sources of water (Lindelöw et al. 2003). In 2012, 67% of all health centers had piped water, reflecting substantial improvements in water infrastructure for these facilities. On the other hand, 21% of all health centers featured a flush toilet and 55% of facilities provided a covered pit latrine, falling quite short of the goal of having 100% of health centers with at least one covered pit latrine by 2010 (MOH 2005a).

Transportation and communication. Facility-based transportation and modes of communication varied across platforms. In general, the availability of any kind of vehicle, irrespective of the number of wheels and its emergency capabilities, substantially decreased down the levels of the health system. Notably, the proportion of health center IVs with any vehicle generally equaled or exceeded the proportion of private hospitals with transportation capacity. The majority of lower-level platforms did not have emergency transportation, which means transferring patients under emergency circumstances from these facilities could be fraught with delays and possible complications. This transportation gap and the coordination of transport might be further exacerbated by the relatively low availability of phones, personal or facility-owned, at lower-level facilities. Interestingly, the availability of a functional computer in facilities generally exceeded that of phones, especially in health center IVs (74% had a functional computer and 16% had any kind of phone). Given the broad access to electricity among health center IVs, it is possible that their high availability of computers may assist with recordkeeping and surveillance. Internet connectivity was not assessed, but the field research team reported inconsistent internet access in many areas of Uganda.

These results echo the priorities outlined in the HSSP II, where ambitious goals were set to strengthen the country's referral system (MOH 2005a). The health-sector plan stipulated that all health center IVs and 80% of health center IIIs should have at least one mode of communication by 2010, and that all hospitals and 85% of health center IVs should have ambulances by that time. Updated analyses are needed to assess progress toward these goals, but based on the ABCE sample, we found that most primary care facilities lacked the resources to optimally provide referral services in 2012.

Equipment. For three main types of facility equipment – medical, lab, and imaging – clear differences emerge across levels of health service provision, with Figure 8 summarizing the availability of functional equipment by platform. Similar to our findings on service availability, we recognize that some facilities are unlikely to carry certain types of equipment, especially if their focus is the provision of primary care. Although Figure 8 shows the availability of equipment across all facility types, we aim to describe the findings in terms of their relevancy to different levels of care in Uganda.

In general, hospitals had greater availability of medical equipment, and notable deficits in basic equipment availability were found in the lower levels of care. Lacking scales, blood pressure cuffs, and measuring tape can severely limit the collection of important patient clinical data. The availability of electrocardiography (ECG) machines was poor across all platforms, suggesting that the Ugandan health system is inadequately positioned to address its rising rates of non-communicable diseases (NCDs) (Murray et al. 2012). This service gap is further demonstrated by the relatively low availability of lab equipment to test blood sugar (via glucometers) across health centers. Microscopes and corresponding components were most prevalent among all facilities, including health centers, but additional testing capacity was generally limited, even among hospitals. For instance, 79% of referral hospitals had a hematology counter and 64% had a blood chemistry analyzer. The availability of radiological imaging equipment was largely limited to hospitals, but about 20% of health center IVs and clinics had ultrasound machines. This type of imaging equipment is well suited for lower levels of service, conditional on availability of electricity, and can be particularly

useful for an array of medical applications for facilities that lack other adequate diagnostic imaging instruments.

Focusing on imaging equipment, the MOH set targets for referral hospitals, district hospitals, and health center IVs to achieve by 2010 (MOH 2005a). For example, the MOH specified that all health center IVs should have an ultrasound machine; however, based on the ABCE sample, few met this goal. By comparison, district hospitals performed much better, with 91% having both ultrasound and X-ray machines. Of the referral hospitals in our sample, one hospital lacked an X-ray machine, two hospitals did not have ultrasound, and one hospital had neither. Only national referral hospitals were expected to feature a computed tomography (CT) scan, yet within the ABCE sample, one regional referral hospital also had a CT scan. These findings emphasize the gradual improvements in functional equipment availability at higher levels of care in Uganda, as well as the continued challenge of properly equipping primary care facilities to provide their range of services.

Measuring the availability of individual pieces of equipment sheds light on specific deficits, but assessing a health facility's full stock of necessary or recommended equipment provides a more precise understanding of a facility's service capacity. We used the WHO's Service Availability and Readiness Assessment (SARA) survey as our guideline for what types of equipment should be available in hospitals (40 specific items) and primary care facilities (26 specific items), which are health centers in Uganda (WHO 2013b). Figure 9 illustrates the distribution of SARA scores across platforms. On average, referral hospitals carried 87% of the recommended equipment items, district hospitals had 85%, and private hospitals featured 73%. The relatively poorer performance of private hospitals, when compared with other hospitals, may reflect more frequent specialization of services offered. Of Uganda's primary care facilities, health center IVs averaged 84% of the recommended items and health center IIIs had 72%. Notably, we did not observe a clear relationship between facility location and SARA scores; however, urban facilities recorded the highest individual SARA scores for referral hospitals (98%), district hospitals (95%), private hospitals (98%), health center IVs (100%), and health center IIIs (100%).

Pharmaceuticals

The ABCE Facility Survey collected data on a wide range of different medications in an effort to measure facility capacity to treat and prevent a broad spectrum of conditions. Specifically, over 20 combinations of antiretrovirals (ARVs) and more than 50 non-ARV medications were included in the facility survey. About 90% of the non-ARV medications were drawn from Uganda's 2012 Essential Medicines List (EML), which recommends the pharmaceuticals that each level of public-sector facility should carry (MOH 2012a). Since up to 50% of Ugandans seek care from the private sector (Lindelöw et al. 2003, Okwero et al. 2011), we viewed comparing the relative EML capacity of private facilities as informative, if not important to better understand what kind of medications patients can expect to be available at facilities of different ownership.

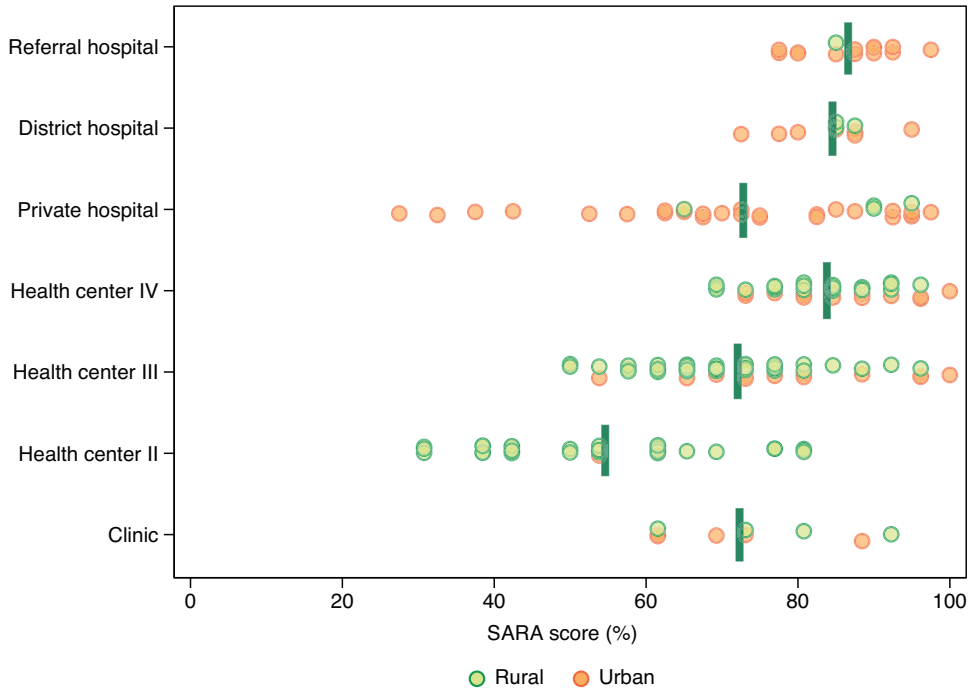
On average, most facilities across platforms stocked at least 50% of the pharmaceuticals recommended by the EML for their service level, but facilities at all levels of care appeared to experience gaps in their pharmaceutical stocks, especially among the lower levels (Figure 10). Referral hospitals stocked an average of 81% of recommended pharmaceuticals (41 out of 51), and district hospitals had 77% (39 out of 51). Pharmaceutical guidelines varied for the different health center levels; even with lower requirements, however, health centers generally stocked a lower proportion of recommended medications (on average, 68% of the 44 EML pharmaceuticals for health center IVs, 61% of the 31 EML pharmaceuticals for health center IIIs, and 63% of the 20 EML pharmaceuticals for health center IIs). Notably, minimal differences were found in pharmaceutical stocks across facilities located in urban and rural areas; in fact, rural facilities showed the highest availability of EML pharmaceuticals for health center IVs (the highest was at 86%) and health center IIIs (at 100%). At the same time, the within-platform range in performance illustrates the discrepancies that exist between the average facility and the lowest performing ones, particularly among the lowest levels of care (health center IIIs and health center IIs).

In terms of the most commonly absent pharmaceuticals, three main results emerged. First, key contraceptive medications were largely missing across platforms (e.g., 68% of health center IIIs did not stock ethinylestradiol/norethisterone, and more than 76% of referral and district hospitals lacked norethisterone). Second, opiate pain medications, such as morphine, were minimally available in district hospitals and health center IVs, with 73% and 87% of facilities lacking morphine, respectively. Third, of the medications assessed by the ABCE Facility Survey, we found that many facilities did not have the pharmaceutical stocks to optimally treat conditions such as diabetes, hypertension, and ischemic heart disease; however, it is important to note that the pharmaceutical list in the ABCE Facility Survey was not exhaustive. Substantial gaps in stocking acetylsalicylic acid (aspirin) were found among health center IIIs and

FIGURE 8 Availability of functional equipment, by platform, 2012

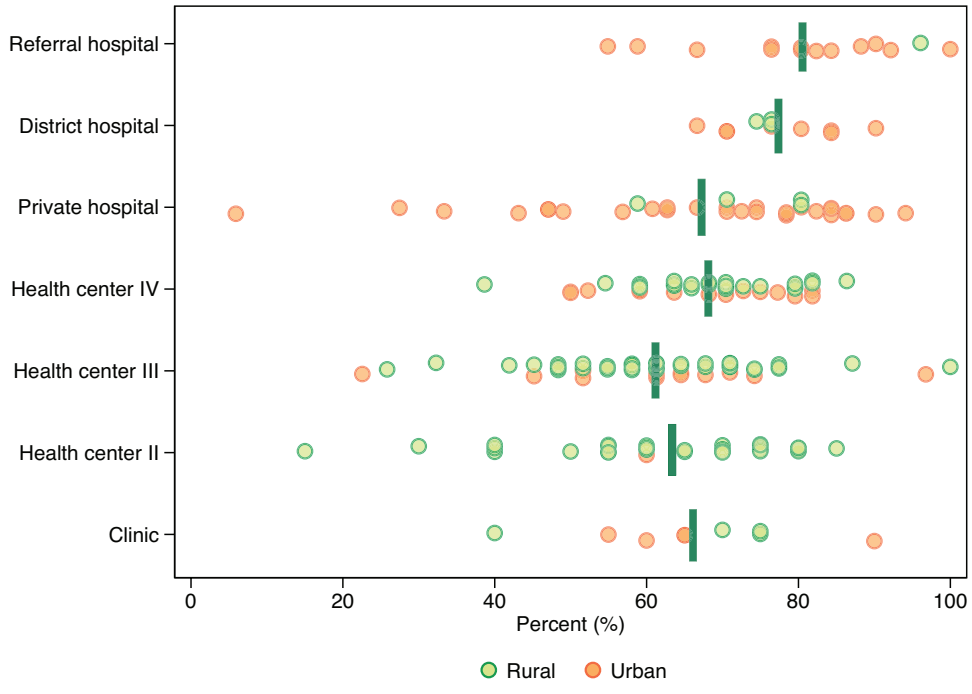
Note: Availability of a particular piece of equipment was determined based on facility ownership on the day of visit. Data on the number of items present in a facility were not collected. All values represent the percentage of facilities, by platform, that had a given piece of equipment.

FIGURE 9 Facility SARA scores for recommended equipment, by platform, 2012



Note: Each circle represents a facility's SARA score in 2012. The vertical line represents the average SARA score across all facilities within a given platform.

FIGURE 10 Facility stocking of EML pharmaceuticals, by platform, 2012



Note: Each circle represents the proportion of EML pharmaceuticals a facility stocked in 2012. The vertical line represents the average proportion of EML pharmaceuticals stocked across all facilities within a given platform. Private hospitals and clinics were included in this figure to compare their relative availability of pharmaceuticals recommended for the public sector. However, it is important to note that these recommendations are not explicitly applicable to these facilities.

health center IIs, with 87% and 74% of facilities, respectively, lacking the medication. Nearly 70% of health center IVs lacked stocks of insulin. Although 82% of district hospitals did not have lisinopril (an antihypertensive), other treatment options for high blood pressure were more widely available; for example, 100% of district hospitals carried captopril and 82% stocked atenolol. As Uganda's rates of NCDs continue to climb (e.g., diabetes burden more than doubled between 1990 and 2010 [Murray et al. 2012]), heightened efforts to acquire and maintain stocks of treatment options for these conditions will become increasingly critical.

In linking these findings to the health system building blocks framework (WHO 2007), we find marked heterogeneity in the availability of medical products and technologies across and within platforms. The functional capacity of a facility relies on several components, ranging from more basic infrastructure such as electricity to an adequate stock of multiple pharmaceuticals and diagnostics. Further work on comprehensively linking facility-based resources to the production of health services and the quality of services received is needed.

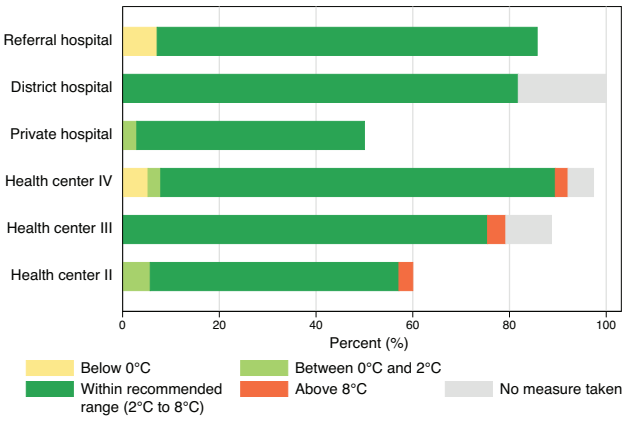
Service provision: a focus on pharmaceuticals and facility capacity

The ABCE Facility Survey collected data on a wide range and large number of different medications in an effort to capture facility capacity to treat and prevent a broad spectrum of conditions. Further, for the production of any given health service, a health facility requires a complex combination of the basic infrastructure, equipment, and pharmaceuticals, with personnel who are adequately trained to administer necessary clinical assessments, tests, and medications. Thus, it is important to consider this intersection of facility resources to best understand facility capacity for care. In this report, we further examined facility capacity for a subset of specific services (immunization, ANC, delivery, and general surgery), as well as case management of specific diseases (lower respiratory infections [LRIs], HIV/AIDS, malaria, meningitis, diabetes, injuries, and ischemic heart disease). We focused on these interventions as they are examples of (1) high-priority health areas for the Ugandan health system, such as broadening access to maternal health services (MOH 2005a) and ensuring parasitological confirmation of malaria cases (MOH 2009); and (2) emerging health concerns, such as the country's capacity to diagnose and treat NCDs. Similar assessments could easily be extended to other interventions and services.

For these analyses of service provision, we only included facilities that reported providing the specific service, excluding facilities that were potentially supposed to provide a given service but did not report providing it in the ABCE Facility Survey. Thus, our findings reflect more of a service capacity "ceiling" across platforms, as we are not reporting on the facilities that likely should provide a given service but have indicated otherwise on the ABCE Facility Survey.

Immunization services. Several factors affect a facility's capacity to provide immunization services, which include having an adequate supply of vaccines, effective storage capacity, and personnel specifically trained in vaccine administration. Many vaccines require sustained cold-chain integrity, which makes monitoring and maintaining the proper storage temperature critical. In fact, Uganda has prioritized increasing cold-chain capacity in its most recent immunization plan, both for existing vaccines and to qualify for the receipt of new immunizations (MOH 2012b). As part of the ABCE Facility Survey, we measured the storage temperature of all facilities that provided routine immunizations, and of those, we found that about 8% had refrigerators operating outside the recommend temperature range (2°C to 8°C) (WHO 2006). Of these facilities, we found that a greater proportion had a storage temperature below the optimal range (5%) than those with temperatures exceeding it (3%) (Figure 11). Health center IIs had the greatest proportion of facilities with storage temperatures outside of the recommended range (14%), whereas no district hospitals had storage temperatures less than 2°C or greater than 8°C. Based on these findings, it is unlikely that 100% of health center IVs and

FIGURE 11 Vaccine storage temperature range, by platform, 2012



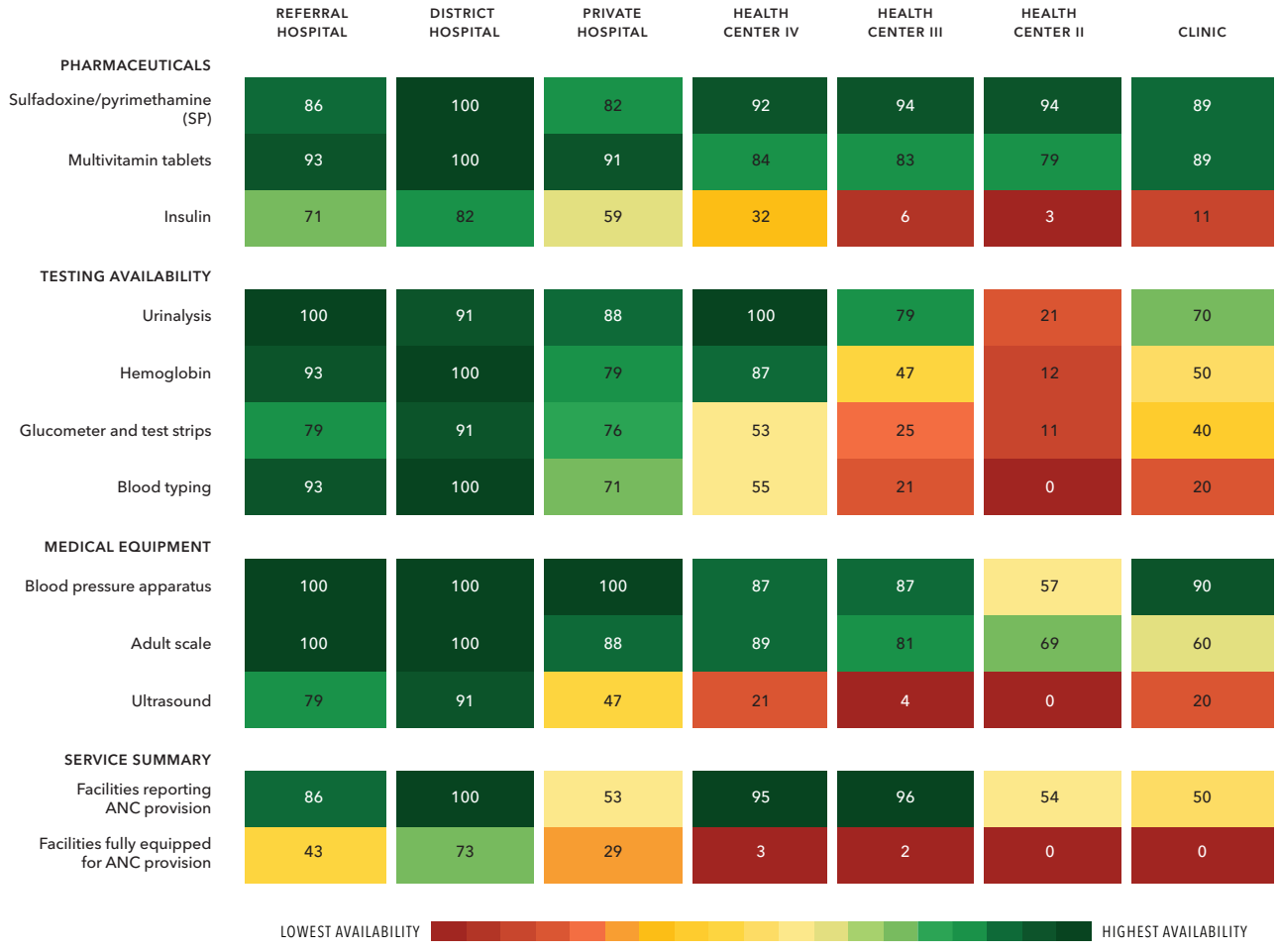
Note: The length of each bar represents the proportion of facilities that reported carrying vaccines (e.g., 60% of health center IIs indicated that they stored vaccines).

health center IIIs had adequate vaccine refrigeration in 2010, which was the target set by the HSSP II (MOH 2005a).

Notably, all of the health center IIIs and health center IIs at which improper storage temperatures were observed also lacked functional electricity. This finding suggests that storage temperatures outside the recommended range could be related to gaps in physical capital, especially at these lower levels of care. At the same time, all referral hospitals and almost every health center IV reported consistent connections to the energy grid, with some percentage of each platform having storage temperatures below the recommended minimum of 2°C (8% of referral hospitals, 6% of private hospitals, and 9% of health center IVs). Freezing vaccines can be as detrimental as storing them at temperatures above the recommended range, and further investigation into what factors may be contributing to these findings is warranted. In terms of staffing and equipment, nearly all facilities reported that personnel had been trained in vaccine administration and immunization equipment was available (disposable syringes and needles).

Antenatal care services. In 2011, it was estimated that 95% of women of reproductive age had at least one ANC visit during pregnancy (UBOS and ICF International Inc. 2012). While this high level of ANC visits is noteworthy, it does not reflect what services were actually provided at each visit, nor does it capture the quality of care received. Through the ABCE Facility Survey, we estimated what proportion of facilities stocked the full range of pharmaceuticals, tests, and medical equipment to conduct a routine ANC visit. It is important to note that this

FIGURE 12 Availability of pharmaceuticals and functional equipment to perform routine ANC visits, by platform, 2012



Note: Availability of a given ANC item was determined by its availability at a facility on the day of visit. All values represent the percentage of facilities, by platform, that had the given ANC item. The service summary section compares the total percentage of facilities reporting that they provided ANC services with the total percentage of facilities that carried all of the recommended pharmaceuticals and functional equipment to provide ANC services.

combination of medications and equipment was not exhaustive, but represented a number of relevant supplies necessary for the provision of ANC.

As shown in Figure 12, hospitals generally had higher availability of the items needed for ANC than health centers, which are supposed to be the main source of ANC service provision in Uganda (MOH 2005a). Outside of hospitals, facility capacity to perform important testing, such as determining Rhesus (Rh) factor through blood typing, remained quite low. Medication for the intermittent preventive treatment of malaria during pregnancy (IPTp) was widely available across platforms, with 91% of facilities stocking sulfadoxine/pyrimethamine (SP). However, fewer facilities beyond referral and district hospitals were equipped to manage non-communicable conditions such as gestational diabetes; 53% of health center IVs had the testing capacity for blood glucose, 32% stocked insulin, and only 18% carried both. Relatively inexpensive medical equipment, such as weight scales and blood pressure equipment, were not as universally available, especially among health centers, as anticipated.

Across the levels of care, we found a widening gap between facility-reported capacity for ANC provision and the fraction of the facilities fully equipped to deliver ANC care. This service-capacity gap meant that many facilities, especially at lower levels of care, reported providing ANC but then lacked at least some of the functional equipment or were stocked out of the medications needed to optimally address the range of patient needs during an ANC visit. Across all facilities, 78% reported providing ANC services, but only 13% had the full stock of medications, tests, and equipment recommended for the optimal provision of care. District hospitals showed the smallest discrepancy, with 100% of facilities reporting that they provided ANC and 73% being fully equipped to provide care. The widest divergence was found at health center IVs and health center IIIs, with 96% of these facilities indicating that they provided ANC services and less than 5% being capable of delivery in accordance with ANC recommendations. These findings do not suggest that these platforms are entirely unable to provide adequate ANC services; it simply means that the vast majority of primary care facilities did not have the pharmaceuticals, diagnostics, and medical equipment recommended in Uganda's guidelines (MOH 2010b).

Routine delivery services. In order to optimally support delivery needs, facilities should stock a full range of pharmaceuticals, medical equipment, tests, and delivery-specific equipment (Nyamtema et al. 2011, Wall et al. 2010). As demonstrated in Figure 13, substantial disparities exist in terms of availability of equipment and medications among facilities that provide birthing services. Pharmaceuticals to treat hypertension, diabetes, and severe pain were often unavailable, even among hospitals. Basic medical equipment was largely available among public hospitals, but considerable equipment deficits were observed at health centers. Delivery-specific equipment, such as forceps and neonatal bag valve masks, was notably lacking across all platforms. This finding is cause for concern, as not having access to adequate delivery equipment can affect both maternal and neonatal outcomes at all levels of care (Nyamtema et al. 2011, Wall et al. 2010). Again, we found a substantial gap between the proportion of facilities, across platforms, that reported providing routine delivery services and those that were fully equipped for their provision.

General surgery services. Among facilities that reported providing general surgery services (24% of all facilities in our sample, excluding pharmacies), referral and district hospitals appeared to have similar, moderately high general surgery capacities (Figure 14). Health center IVs demonstrated lower capacity, with 31% of facilities lacking a scalpel and 23% lacking a retractor. Intubation equipment was generally available in referral hospitals (92%), but far fewer district hospitals (56%), private hospitals (62%), and health center IVs (19%) had this crucial surgical equipment. This equipment gap suggests that many facilities could face significant limitations in performing surgeries that would typically require general anesthesia. Across all platforms, we found that substantially fewer facilities were fully equipped to perform general surgery (5%) than the proportion that reported offering general surgery services. For referral and district hospitals, this service-capacity gap would have been smaller if a greater proportion of them stocked morphine (48% lacked this pain medicine) and could properly test for serum electrolytes (56% did not have the necessary laboratory equipment).

These findings are not novel, as previous work has documented deficiencies in the pharmaceuticals and equipment needed to perform surgical procedures at referral and district hospitals (Linden et al. 2012). It is important to note that, here, we do not distinguish between facilities that were stocked out of narcotics (e.g., morphine) and those that never carried them, a distinction that has considerable implications for hospital-based supply-chain and procurement decisions. Past work has shown that both affect these hospitals, with 14% reporting frequent shortages of narcotics and 40% never stocking them (Linden et al. 2012). It is also crucial to consider the human resources available to perform surgical procedures, as assembling an adequate surgical team is likely to affect patient outcomes. In the ABCE sample,

FIGURE 13 Availability of pharmaceuticals and functional equipment to perform routine delivery services, by platform, 2012

Note: Availability of a given delivery item was determined by its availability at a facility on the day of visit. All values represent the percentage of facilities, by platform, that had the given delivery item and reported providing delivery services. The service summary section compares the total percentage of facilities reporting that they provided routine delivery services with the total percentage of facilities that carried all of the recommended pharmaceuticals and functional equipment to provide routine delivery services.

FIGURE 14 Availability of pharmaceuticals and functional equipment to perform general surgery services, by platform, 2012

Note: Availability of a given surgery item was determined by its availability at a facility on the day of visit. All values represent the percentage of facilities, by platform, that had the given surgery item and reported offering general surgery services. The service summary section compares the total percentage of facilities reporting that they provided general surgery services with the total percentage of facilities that carried all of the recommended pharmaceuticals and functional equipment to provide general surgery services.

all hospitals reporting that they provided general surgery services had a minimum of one doctor (an average of 12, excluding national referral hospitals), two clinical officers (an average of 14), and five nurses (an average of 95, excluding national referral hospitals). We did not capture data on anesthesiologists or anesthesiology assistants, but future work on assessing surgical capacity at health facilities should collect this information. Of the health center IVs with general surgery services, all reported having at least one doctor, two clinical officers, and five nurses.

Disease-specific services. Based on findings from the Global Burden of Diseases, Injuries, and Risk Factors Study 2010 (GBD 2010), we identified a subset of conditions that accounted for the most early death and disability in Uganda for 2010: HIV/AIDS (leading cause); malaria (second-leading cause); lower respiratory infections, or LRIs (third-leading cause); meningitis (fourth-leading cause); and injuries (11th-leading cause) (Murray et al. 2012). Further, we included two conditions that are rapidly causing more health loss in Uganda, as measured by the escalation of disease burden between 1990 and 2010: diabetes (a 109% increase) and ischemic heart disease (a 42% increase) (Murray et al. 2012).

Figure 15 shows the range in facility capacity to optimally diagnose and treat these diseases. For these analyses, we present the average percentage of medical supplies (which include pharmaceuticals and equipment) that facilities stocked at the time of visit. Across all platforms, facilities had the greatest capacity to diagnose and treat LRIs, which is most dependent on stocking antibiotics. Availability of HIV/AIDS and malaria services remained fairly high in hospitals, but was lower among health centers. Further, in comparison to referral hospitals, district hospitals generally stocked a higher proportion of the supplies needed to fully treat LRIs, meningitis, and diabetes. Irrespective of platform type, facilities were generally least equipped to fully manage ischemic heart disease.

Health centers averaged less than 30% of the supplies needed to provide disease-specific services for NCDs; perhaps surprisingly, however, a substantial portion still lacked the full capacity to address some of Uganda's most prevalent infectious diseases. Health center IIIs averaged 51% of the necessary supplies for comprehensive malaria services and lacked an average of nearly 57% of items for meningitis care. Health centers are intended to serve as the core of the country's primary health care delivery system, but such

FIGURE 15 Facility capacity to provide disease-specific services, by platform, 2012

Note: Availability of the medical supplies for disease-specific services was determined by their availability at a facility on the day of visit. All values represent the average percentage of supplies, by platform, that facilities carried at the time of visit. The service summary section compares the average percentage of supplies found at facilities to address a subset of infectious diseases (LRIs, HIV/AIDS, malaria, and meningitis) with the average percentage of supplies found at facilities to address a subset of NCDs (diabetes and ischemic heart disease) and injuries.

service provision may be hindered if these facilities are not equipped to properly handle the illnesses most commonly experienced by Ugandans.

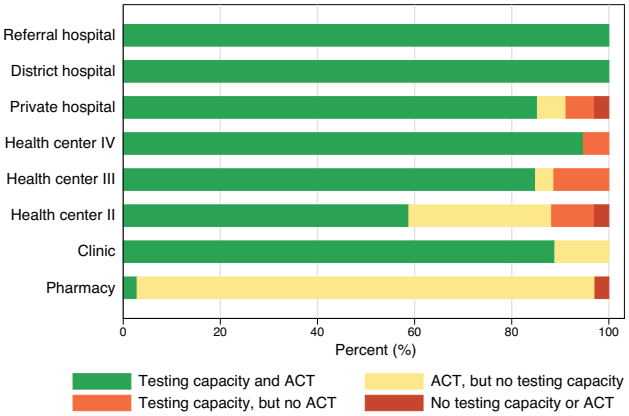
These findings have implications for the country's ongoing expansion of integrated community case management (iCCM), a health practice wherein community health workers (CHWs) provide diagnostic and treatment options for malaria, pneumonia (or LRIs), and diarrheal disease (Kalyango 2013, MOH 2013). The success of iCCM hinges on having the full set of medical supplies to ascertain whether an otherwise vague symptom – fever – is due to malaria or an LRI, and to then treat the ailment accordingly. If lower-level facilities struggle to stock the pharmaceuticals and diagnostics needed for iCCM implementation, the use of these supplies by village health teams (VHTs) and CHWs in the communities they serve may be negatively affected.

A more nuanced examination of the components underlying disease-specific services can identify constraints to care. For example, Uganda's malaria strategic plan for 2010 to 2015 stipulated that all suspected cases of malaria (i.e., individuals presenting with a fever) receive parasitological testing prior to receiving a first-line antimalarial for treatment (MOH 2009). Thus, optimal case management hinges on the concurrent availability of both malaria treatment and diagnostics in facilities. Figure 16 shows the range of this concurrent availability at the time of facility visit in 2012. For referral and district hospitals, 100% of facilities reported having both proper malaria diagnostic equipment (i.e., laboratory testing or rapid-diagnostic tests [RDTs]) and artemisinin-based combination therapies (ACTs) in stock. Notably, health center IVs and health center IIIs posted the next-highest rates of concurrent testing and treatment capacity at 95% and 85%, respectively. Further down the levels of care, fewer facilities had concurrent malaria diagnostic and treatment capacity, with 57% of health center IIs, 80% of clinics, and 3% of pharmacies stocking both at the time of visit.

Across publicly owned facilities, there was a fairly high capacity for diagnosing malaria (91% of all facilities had either RDTs or a microscope), which likely reflects the successful uptake of Uganda's policy for parasitological confirmation of malaria cases (MOH 2009). In fact, a greater proportion of health center IVs, health center IIIs, and clinics had malaria diagnostics but lacked ACTs (8%) than the opposite (stocking ACTs without malaria diagnostics [3%]), suggesting that ACT stock-outs may not be uncommon among these platforms.

Quinine is the first-line treatment for severe malaria in Uganda (MOH 2005b), and we found that 84% of facilities, including pharmacies, carried quinine at the time of visit. All pharmacies and 92% of health center IIIs stocked quinine, while health center IIs reported the lowest availability (35%). Across facilities, including pharmacies, 81% stocked both ACTs and quinine, reflecting their capacity to treat the full range of malaria cases, from uncomplicated to severe, respectively. The country is currently solidifying the *Uganda Malaria Reduction Strategy 2014–2020*, wherein Uganda seeks to provide universal access to malaria prevention and treatment to all populations at risk for malaria. The private sector generally lagged behind the public sector in concurrently providing malaria tests and treatment, representing a potential challenge to Uganda's malaria ambitions, as about 50% of Ugandans seek care from private facilities (Okwero et al. 2011). However, the country is well positioned to learn from the public sector, based on its high capacity to concurrently test for and treat malaria.

FIGURE 16 Facility capacity to test for and treat malaria, by platform, 2012



Note: The availability of ACTs and malaria testing capacity was determined by whether a facility carried each at the time of visit.

Facility outputs

Measuring a facility's patient volume and the number of services delivered, which are known as outputs, is critical to understanding how facility resources align with patient demand for care. Figure 17 illustrates the trends in average outpatient volume across platforms and over time. In Uganda, the number of outpatient visits experienced by referral and district hospitals far exceeded levels found at health clinics. Health center IIs and clinics experienced comparable average outpatient loads. Aside from referral hospitals, most platforms experienced relatively unchanged levels of outpatient visits between 2007 and 2011.

FIGURE 17 Average number of outpatient visits, by platform, 2007–2011

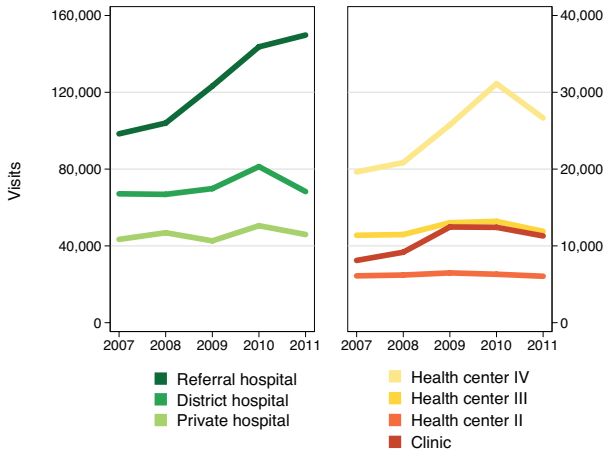


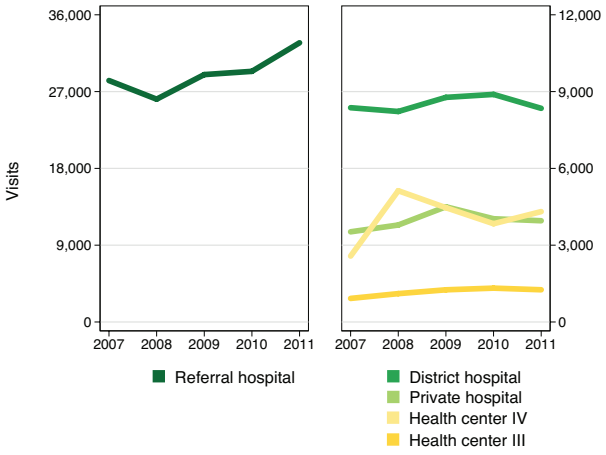
Figure 18 depicts the trends in average inpatient visits across platforms. Referral hospitals and health center IVs recorded overall increases in average inpatient visits between 2007 and 2011, whereas the other platforms showed more stagnated trends for inpatient visits. In terms of inpatient outputs, the patient volumes of health center IVs appeared to be more similar to those of private hospitals than health center IIIs.

Among sampled facilities that provided ART services, we found that average ART visits increased rapidly across platforms between 2007 and 2011 (Figure 19). This finding corresponds with Uganda's expansion of ART services, especially after support of ARVs and corresponding treatment programs from the US President's Emergency Plan for AIDS Relief (PEPFAR) started in 2004 (PEPFAR 2014).

Overall, we found that facilities increased average ART patient visits by 115%, from 5,146 in 2007 to 11,065 in 2011. This growth was largely driven by referral hospitals, which recorded a 103% increase in ART visits between 2007 and 2011, providing an average of 64,620 ART visits in 2011. The decline in visits between 2008 and 2009 is likely to be a facility recordkeeping issue rather than a true decline. Notes from the ABCE field team also suggest that the drop may have been driven by recommendations to seek care at health centers, as referral hospitals were overwhelmed with patients during the late 2000s. Health center IVs and health center IIIs also documented a large rise in ART patient visits, but their relative patient volumes were very small compared to those found in hospitals. Average ART visits remained more stable among district and private hospitals over time.

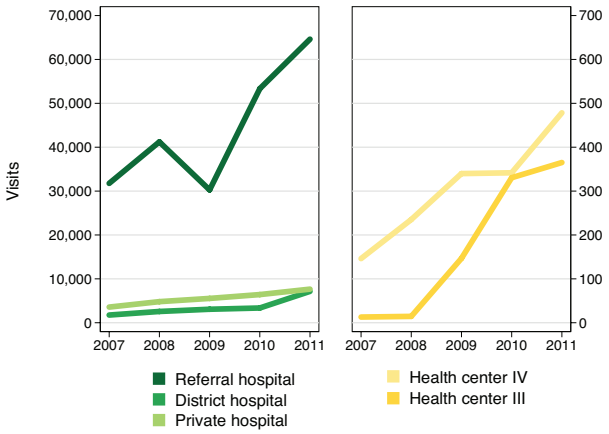
Inpatient visits generally entail more service demands than outpatient visits, including ongoing occupancy of facility resources such as beds. In Figure 20, bed occupancy rates are displayed for all facilities reporting inpatient services in 2011. A facility's occupancy rate was calculated by dividing the number of reported inpatient bed-days for 2011 by the number of beds within a facility, multiplied by 365 (days). Hospitals generally had higher occupancy rates than health centers, with referral and district hospitals recording average occupancy rates hovering around 50% and health center IIIs and IVs having rates of 19% and 31%,

FIGURE 18 Average number of inpatient visits, by platform, 2007–2011



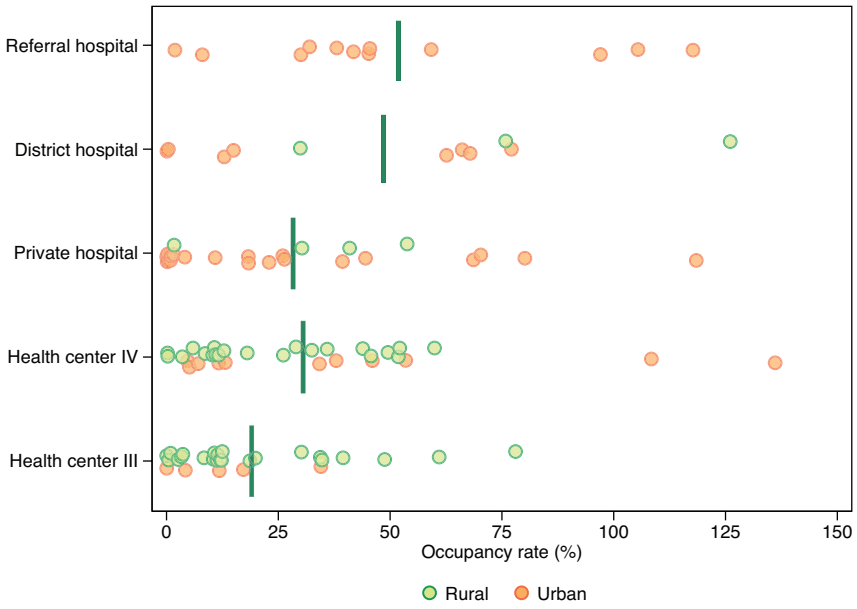
Note: One district hospital was omitted from this figure, as its reported drop in inpatient visits affected the average computed across the platform. This facility reported 22,000 inpatient visits in 2010 and 4,700 inpatient visits in 2011.

FIGURE 19 Average number of ART visits, by platform, 2007–2011



Note: Health center IIs were omitted from this figure because there was only one facility that reported providing ART. In 2011, this facility had 54 ART visits.

FIGURE 20 Facility occupancy rates across platforms, 2011



Note: Each circle represents a facility's occupancy rate in 2011. The vertical line represents the average occupancy rate across all facilities within a given platform. These averages were computed without two facilities that had occupancy rates exceeding 200%.

respectively. Notably, private hospitals had average occupancy rates that more closely resembled those of health centers than average rates observed for referral and district hospitals. Across platforms, urban facilities showed slightly higher occupancy rates than their rural counterparts; however, rural district hospitals and health center IIIs generally had higher occupancy rates than urban facilities within each platform. Of the health center IIIs in the ABCE sample, 58% reported providing inpatient services. Six facilities had occupancy rates exceeding 100%: two referral hospitals (at rates of 118% and 105%); one district hospital (at 126%), one private hospital (at 118%), and two health center IVs (at rates of 136% and 108%). It is possible that these facilities are admitting more patients than the number of available beds they offer.

It is important to note that the ABCE Facility Survey did not capture information on the length of inpatient stays, which can affect occupancy rates and their interpretation. This is a key indicator to monitor and include in future work.

Patient perspectives

A facility's availability of and capacity to deliver services is only half of the health care provision equation; the other half depends upon patients seeking those health services. Many factors can affect patients' decisions to seek care, ranging from associated visit costs to how patients view the care they receive. These "demand-side" constraints can be more quantifiable (e.g., distance from facility) or intangible (e.g., perceived respectfulness of the health care provider), but each can have the same impact on whether patients seek care at particular facilities or have contact with the health system at all.

Using data collected from the Patient Exit Interview Surveys, we examined the characteristics of patients who presented at health facilities and their perspectives on the care they received. Table 7 provides an overview of the interviewed patients who were not seeking HIV-related care; perspectives provided by patients seeking HIV care will be covered later in this report. The majority of patients were women and were younger than 30 years old, and most of the patients, or their caregivers if patients were younger than 18 years old, had attained at least a primary education. Across platforms, patient composition was generally comparable. However, a greater proportion of interviewed patients at hospitals had attained a post-primary education (51% for referral and district hospitals and 63% for private hospitals) than patients presenting at health centers (30%).

TABLE 7 Characteristics of patients interviewed after receiving non-HIV care at facilities, 2012

CHARACTERISTIC	REFERRAL HOSPITAL	DISTRICT HOSPITAL	PRIVATE HOSPITAL	HEALTH CENTER IV	HEALTH CENTER III	HEALTH CENTER II	ALL FACILITIES
Total patient sample	**319**	**254**	**566**	**899**	**1,282**	**582**	**3,902**
Percent female	58%	59%	57%	57%	65%	68%	61%
Educational attainment							
None or pre-primary	18%	16%	17%	31%	25%	23%	24%
Primary	34%	30%	20%	39%	44%	53%	39%
Post-primary	48%	54%	63%	30%	32%	25%	37%
Patient age (years)							
≤ 5	8%	13%	10%	15%	16%	20%	15%
6–17	4%	5%	6%	5%	5%	5%	5%
18–29	37%	46%	45%	37%	42%	40%	41%
30–39	24%	17%	18%	22%	19%	16%	19%
40–49	13%	11%	10%	13%	10%	8%	11%
≥ 50	13%	8%	11%	8%	8%	11%	9%
Self-reported overall health							
Poor	14%	13%	11%	13%	13%	8%	12%
Fair	41%	33%	43%	46%	48%	40%	44%
Good	42%	46%	42%	36%	35%	49%	40%
Very good	4%	8%	4%	4%	4%	3%	4%
Excellent	0%	0%	1%	0%	0%	0%	0%
Self-rated urgency of visit							
Not urgent	66%	66%	69%	46%	53%	54%	56%
Somewhat	24%	24%	21%	34%	31%	34%	30%
Very	9%	10%	10%	20%	16%	12%	15%

Note: Educational attainment refers to the patient's level of education or the attendant's educational attainment if the interviewed patient was younger than 18 years old.

Out-of-pocket expenditures

Patients who seek care from public facilities in Uganda are supposed to pay minimal medical expenses; in fact, the Ugandan government abolished user fees for lower levels of care (health centers) and general wings of publicly owned hospitals in 2001 (Orem et al. 2011). Patient reports from the facilities in the ABCE sample aligned with this policy, such that medical care provided at most public facilities resulted in few, if any, out-of-pocket expenditures (Figure 21). We found that the majority of patients (97%) reported no medical expenses across publicly owned facilities, with only 8% of patients paying for medical care at public hospitals and 2% at health centers. Patients reported medical fees at two publicly owned health centers. These fees were reported as mainly general all-inclusive fees, cards, tests/procedures, medication fees, and user fees. On the other hand, 82% of patients seeking care at private facilities reported paying medical expenses. Eighty-five percent of patients at private hospitals incurred medical expenses, and 77% of patients presenting at private health centers paid for medical services.

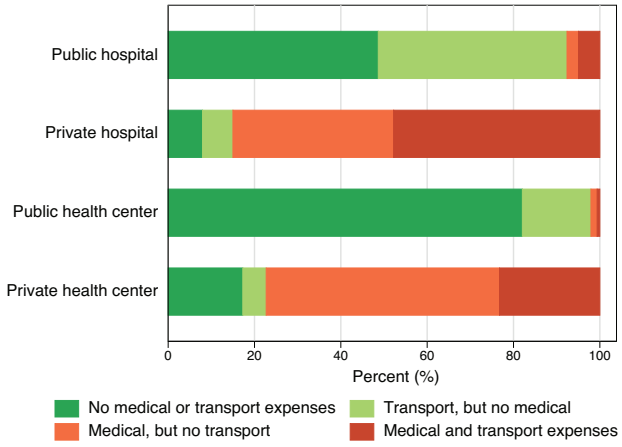
Many patients presenting at hospitals, both publicly and privately owned, experienced the additional financial burden of transportation costs. Across all hospitals, about 50% of patients reported incurring a transport-related expense prior to receiving care. This finding may be explained by patients traveling long distances to access specialty care at these facilities. At health centers, about 20% of patients reported transportation expenses associated with their visit. This finding is not surprising, especially since many facilities serve large catchment areas and patients are generally expected to cover their own transportation costs when they seek health services. Rates of transportation expenses did not substantially differ across facility ownership but were somewhat more common at private facilities.

About 50% of patients receiving services at private hospitals reported incurring both medical and transportation expenses, followed by 23% of patients who sought care at private health centers. Fewer than 5% of patients presenting at public hospitals and health centers experienced both medical and transportation expenses.

The majority of patients who were not seeking HIV services at public facilities experienced minimal, if any, expenses associated with their visits; for those patients who did pay, there was variation in the expenses they incurred. Figure 22 depicts the proportion of patients who experienced different levels of medical expenses at each sampled facility and across facility types and ownership. Of the patients who reported paying medical expenses at public facilities, 75% of them spent less than 10,000 Ushs ($4). At private facilities, many patients spent at least 20,000 Ushs ($8) for care.

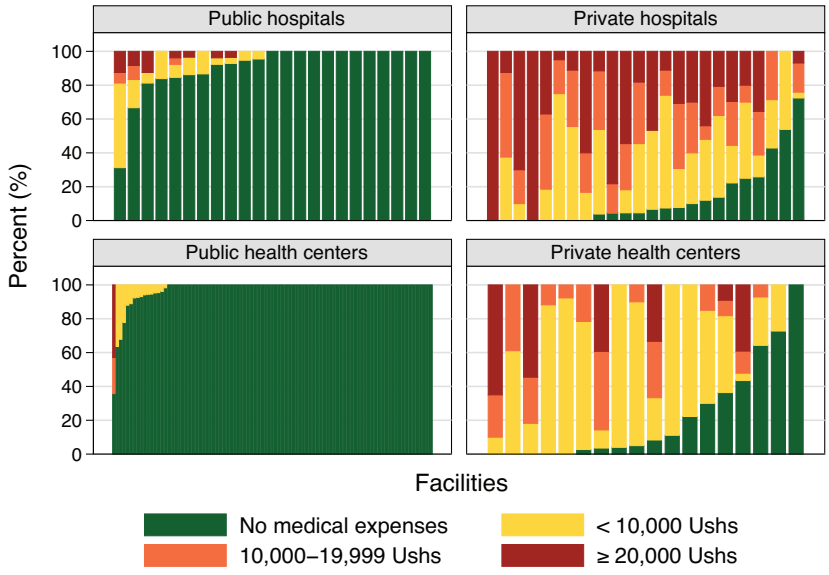
Among public facilities, 43% of patients reported paying at least 20,000 Ushs ($8) in medical expenses at a publicly

FIGURE 21 Patient expenses associated with facility visit, by platform ownership, 2012



Note: Patients are grouped in mutually exclusive categories of expenses associated with their facility visits. The sum of the light green and red portions of each bar represents the percentage of patients who experienced any kind of transportation expense, irrespective of medical expenses. The sum of the orange and red portions of each bar represents the percentage of patients who experienced any kind of medical expense, irrespective of transportation expenses. Facilities owned by NGOs were grouped with private hospitals and health centers.

FIGURE 22 Levels of medical expenses incurred by patients not seeking HIV services, by platform ownership, 2012



Note: Each bar represents a facility and the proportion of patients who paid different levels of medical expenses. Facilities owned by NGOs were grouped with private hospitals and health centers.

FIGURE 23 Patient travel times to facilities, by platform, 2012

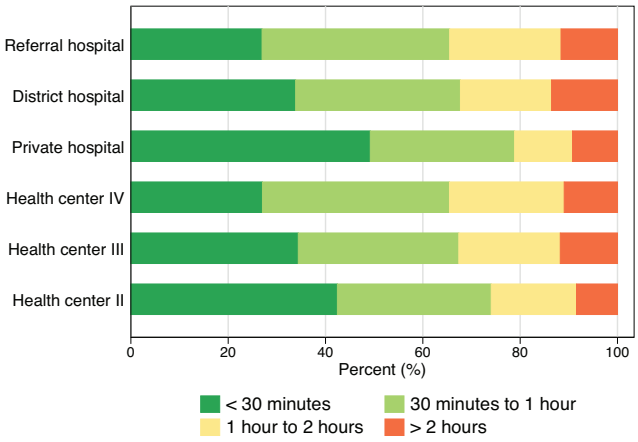
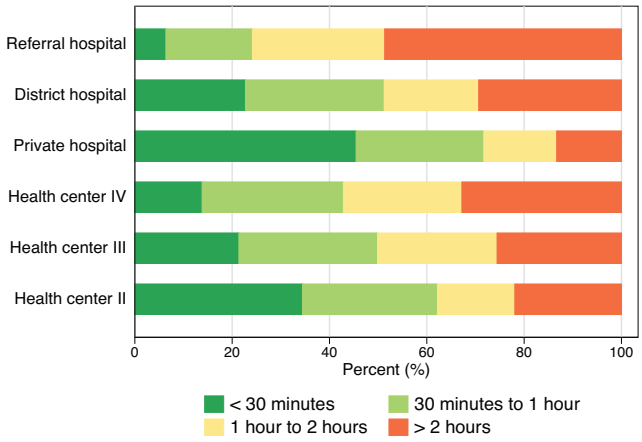


FIGURE 24 Patient wait times at facilities, by platform, 2012



owned health center III in the Eastern region of Uganda. Seventy percent of patients seeking care at a private hospital in the West Nile region experienced medical expenses associated with their visit, but most of them paid less than 10,000 Ushs ($4).

Travel and wait times

The amount of time patients spend traveling to facilities and then waiting for services can substantially affect healthcare-seeking behaviors. Among interviewed patients, we found that travel times (Figure 23) and wait times (Figure 24) varied by platform. It is important to note that patients only reported on the time spent traveling to facilities, not the time needed for round-trip visits. In general, patients at hospitals experienced slightly longer travel times than those seeking care at health centers. For a given platform, patients who went to urban facilities appeared to spend less time traveling than patients who received care at rural facilities. This finding is not unexpected, as the closest public hospital for many patients, particularly those in rural areas, is often far away. Further, patients traveling on roads outside of urban centers may experience poor road conditions, especially during the rainy season, which can significantly extend travel times, even to facilities that are relatively close. Overall, the majority of patients spent less than one hour traveling for care (69%), and these findings did not differ by patients' reported levels of urgency for care.

In terms of wait time at facilities, 40% of patients had to wait more than two hours before receiving care at referral and district hospitals, whereas 45% of patients at private hospitals experienced wait times of less than 30 minutes. Wait times varied across the three levels of health centers, with one-third of patients at health center IVs waiting for more than two hours before receiving care and 34% of patients reporting wait times less than 30 minutes at health center IIs. In general, more patients spent less than an hour traveling to facilities (69%) than those who spent less than an hour waiting for care (51%). These findings suggest that patient travel times may be less of barrier to accessing care than wait times.

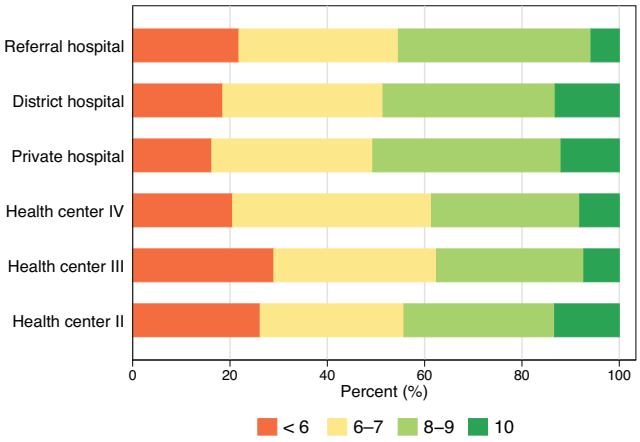
Longer wait times at facilities have been attributed to staffing shortages in the past (Okello et al. 1998); however, our findings from the ABCE project in Uganda are less conclusive.

Patient satisfaction with care. Overall, interviewed patients gave high ratings for the care they received across platforms (Figure 25). A greater proportion of patients at private hospitals reported very high ratings (8 or higher out of 10) than other platforms, but not overwhelmingly so. Except for district and private hospitals, all platforms had at least 20% of patients rating their experience below a score of 6 out of 10. We did not find different ratings among patients who reported that their facility visit was urgent; however, we may not have interviewed patients presenting at the highest levels of urgency, as interviews were only conducted with patients who were discharged from care or were capable of leaving the facility.

Figure 26 provides a more in-depth examination of patient ratings of facility characteristics and visit experiences. Overall, private hospitals had higher average ratings across all visit indicators. Patients generally gave higher average ratings for staff interactions across platforms than the average scores associated with facility characteristics. This contrast was most evident among referral hospitals, with patients reporting relatively low ratings for wait time (an

average of 2.3 out of 5) and spaciousness (an average of 3.2 out of 5) and relatively high ratings for the respectfulness of the medical provider and non-medical staff (an average of 4 and 3.8, respectively, out of 5).

FIGURE 25 Patient ratings of facilities, by platform, 2012



Note: Facility ratings were reported along a scale of 0 to 10, with 0 as the worst facility possible and 10 as the best facility possible.

Efficiency and costs

The costs of health service provision and the efficiency with which care is delivered by health facilities go hand-in-hand. An efficient health facility is one in which facility resources (e.g., beds, personnel) are used at full capacity, producing a high volume of patient visits and services without straining its resources. Conversely, an inefficient health facility is one wherein resources are not fully maximized, leaving usable beds empty or medical staff seeing very few patients per day.

Analytical approach

We used an analytical technique known as Data Envelopment Analysis (DEA) to assess the relationship between facility inputs and outputs (Di Giorgio et al. 2014). Based on this analysis, an efficiency score was estimated for each facility, capturing a facility's use of its resources, such as current staffing (i.e., doctors, clinical officers, nurses, and other medical staff) and the availability of capital inputs (e.g., facility beds) to produce care. Service provision was categorized into four groups: outpatient visits, inpatient bed-days, births, and ART visits. Efficiency scores ranged

FIGURE 26 Average patient ratings of facility visit indicators, by platform, 2012

	REFERRAL HOSPITAL	DISTRICT HOSPITAL	PRIVATE HOSPITAL	HEALTH CENTER IV	HEALTH CENTER III	HEALTH CENTER II
Overall rating	**7.0**	**7.3**	**7.3**	**7.0**	**6.8**	**7.0**
STAFF INTERACTIONS						
Non-medical staff respectfulness	3.8	4.1	4.2	3.9	3.9	4.0
Medical provider respectfulness	4.0	4.1	4.3	4.0	4.0	4.1
Clarity of provider explanations	4.0	4.1	4.2	3.9	3.9	3.9
Time to ask questions	3.8	4.0	4.1	3.7	3.7	3.7
FACILITY CHARACTERISTICS						
Cleanliness	3.9	4.0	4.2	3.8	3.9	3.8
Privacy	3.9	4.2	4.3	3.9	3.9	3.9
Spaciousness	2.8	3.0	3.3	2.8	2.8	3.1
Wait time	2.3	2.6	3.5	2.7	2.8	3.3

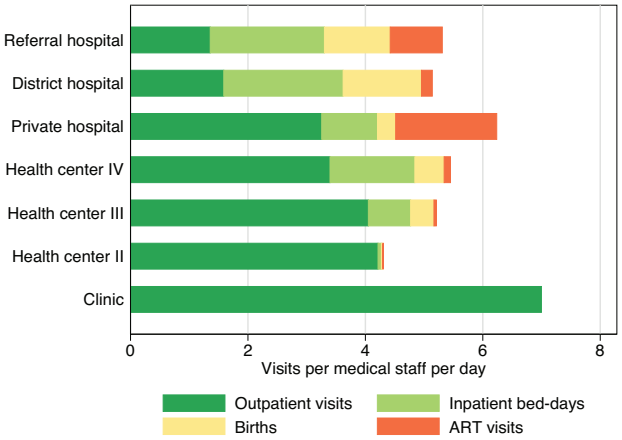
LOWEST RATINGS — HIGHEST RATINGS

Note: Average ratings are on a scale of 0 to 10, with 0 as the worst facility possible and 10 as the best facility possible. Average ratings of staff interactions and facility characteristics are on a scale of 1 to 5, with 1 being "very bad" and 5 being "very good."

from 0% to 100%, with a score of 100% indicating that a facility achieved the highest level of production, relative to comparably sized facilities in the ABCE sample.

Recognizing that each type of visit requires a different amount of facility resources (e.g., on average, an inpatient bed-day uses more resources and more complex types of equipment and services than an outpatient visit), we applied weights generated through DEA to rescale each facility's mixture of outputs to "outpatient equivalent visits." All outputs were scaled to equal a comparable number of outpatient visits, creating a standard metric across facilities with different levels of service production. The conversion to outpatient equivalent visits varied by facility; on average, however, we estimated that one inpatient bed-day was equivalent to 3.7 outpatient visits; one birth was equivalent to 10.5 outpatient visits; and one ART visit was equivalent to 1.7 outpatient visits. As a result, a hospital reporting high levels of inpatient bed-days could be appropriately compared to a health center that largely produced outpatient visits.

FIGURE 27 Range and composition of average output production across platforms, 2011



Note: All visits are reported in outpatient equivalent visits estimated at the facility level. Conversion to outpatient equivalent visits varied across facilities; on average, one inpatient bed-day was equivalent to 3.7 outpatient visits, one birth was equivalent to 10.5 outpatient visits, and one ART visit was equivalent to 1.7 outpatient visits.

Efficiency

Both across and within platforms, we found a sizeable range in health-service production and efficiency scores among Ugandan health facilities. In terms of total visits, the average number of outpatient equivalent visits experienced by each facility's medical staff per day ranged from 4.3 visits in health center IIs to seven at clinics (Figure 27). Across all platforms, facilities averaged five visits per medical staff per day in 2011. Notably, referral hospitals, district hospitals, health center IVs, and health center IIIs had very similar total visits per medical staff each day.

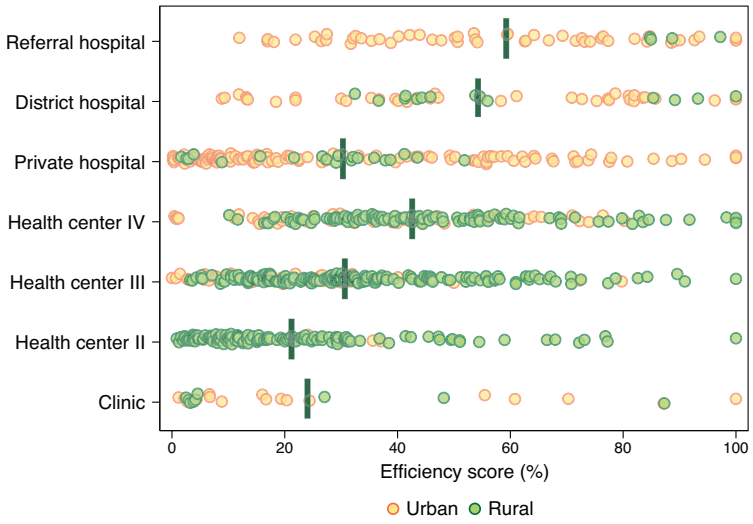
Beyond total volume, output composition varied across platforms. As expected, outpatient visits accounted for the overwhelming majority of the patients seen per medical staff per day at health centers. Private hospitals saw the largest volume of ART-specific visits, measured in outpatient equivalent visits, averaging 1.7 visits per medical staff per day; referral and district hospitals had the next-highest volumes. For inpatient bed-days, as reported in outpatient equivalent visits, referral and district hospitals had the highest outputs per medical staff per day (about 1.5), with inpatient bed-days accounting for a large proportion of each of these platforms' total output volume.

In estimating efficiency scores for all facilities, two main findings emerged. First, efficiency scores were generally quite low across all health facilities, with just over 50% of facilities scoring 30% or lower. Second, the range between the facilities with highest and lowest efficiency scores was quite large within platforms. This finding suggests that a substantial performance gap may exist between the average facility and facilities with the highest efficiency scores. Figure 28 depicts this range of facility efficiency scores across platforms.

Larger facilities (referral and district hospitals) generally had higher efficiency scores than smaller facilities (health centers), but there was considerable overlap at each end of the efficiency spectrum. Across platforms, at least one facility recorded an efficiency score of 100%, and among each type of hospital, multiple facilities posted efficiency scores of 100%. On the other hand, multiple facilities, especially among health centers, had efficiency scores close to 0%. Notably, a greater proportion of urban hospitals appeared to have higher efficiency scores than rural hospitals, whereas rural health centers generally had higher efficiency scores than their urban equivalents. For example, rural health center IVs averaged an efficiency score of 46%, with a range of 10% to 100%, and urban health center IVs scored an average of 36%, ranging from less than 1% to 80%.

Table 8 compares facility characteristics of the "most efficient" facilities (those that ranked among the top 10% of efficiency scores across all years) to the "least efficient" facilities (those that ranked among the lowest 10%) by platform. Some factors appear to be related to higher efficiency scores across platforms (facilities with higher levels of outputs generally have higher efficiency scores), but few characteristics were truly universal. The health center IIs

FIGURE 28 Range of efficiency scores, by platform, 2007–2011



Note: Each circle represents a facility's efficiency score for a given year between 2007 and 2011. The vertical line represents the average efficiency score across all facilities and years within a given platform.

TABLE 8 Facility characteristics across efficiency score performance, by platform, 2011

	REFERRAL HOSPITAL		DISTRICT HOSPITAL		PRIVATE HOSPITAL		HEALTH CENTER IV		HEALTH CENTER III		HEALTH CENTER II		CLINIC	
INDICATOR	TOP 10%	LOWEST 10%	TOP 10%	LOWEST 10%	TOP 10%	LOWEST 10%	TOP 10%	LOWEST 10%	TOP 10%	LOWEST 10%	TOP 10%	LOWEST 10%	TOP 10%	LOWEST 10%
Average efficiency score	**82**	**12**	**92**	**13**	**88**	**2**	**67**	**8**	**72**	**5**	**51**	**2**	**61**	**3**
Average outputs														
Outpatient visits	50,084	26,732	110,587	5,754	18,985	395	19,385	11,756	23,096	4,991	7,329	4,557	55,126	533
Inpatient bed-days	179,209	4,837	47,748	5,247	16,098	56	5,052	589	2,031	4	N/A	N/A	N/A	N/A
Births	5,328	388	4,550	169	3,084	15	839	38	605	1	N/A	N/A	N/A	N/A
ART visits	5,145	81	664	362	27,372	N/A	827	56	60	N/A	N/A	N/A	N/A	N/A
Total outputs	239,766	32,039	163,206	11,532	58,117	443	25,896	8,262	25,756	4,992	7,329	4,557	55,126	533
Average inputs														
Beds	417	165	153	106	50	11	32	9	25	8	N/A	N/A	N/A	N/A
Doctors	36	8	8	3	8	2	1	1	0	1	0	0	1	0
Nurses	197	76	89	40	34	5	14	11	10	6	2	5	2	4
Other medical staff	49	19	15	7	17	2	6	4	1	2	0	1	2	0
Non-medical staff	66	35	20	15	72	5	6	8	5	6	1	2	9	0
Total number of facilities	**1**	**1**	**2**	**2**	**3**	**3**	**4**	**3**	**5**	**5**	**3**	**3**	**1**	**1**

Note: "N/A" under outputs indicates that the facility or facilities reported that they did not provide a given service or insufficient data were available. For births, "N/A" was applied if the facility reported zero births over the last five years. For beds, "N/A" reflects that the facility or facilities did not offer inpatient services. If a facility indicated that they did not provide a given service, it was not included in calculating the average number of annual outputs for the given service.

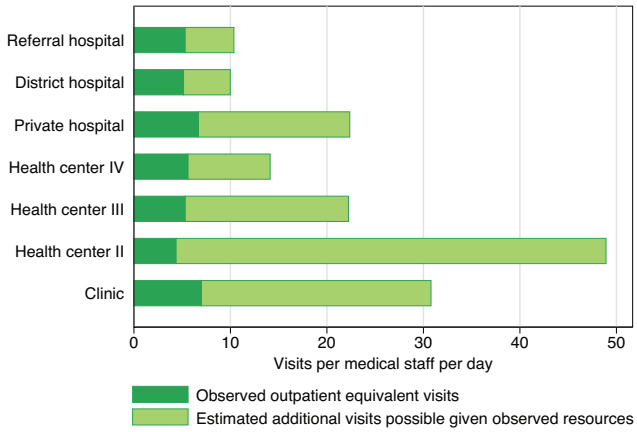
with the lowest efficiency scores, for example, had larger average staff sizes than the health center IIs with the highest efficiency scores. Referral hospitals with the highest efficiency scores averaged larger volumes of ART visits than the least efficient, while district hospitals with the lowest efficiency scores averaged slightly more ART visits than those with the highest scores. In general, facilities with the highest efficiency scores, irrespective of platform type, also averaged more personnel per facility than those with the lowest efficiency scores. In sum, the efficiency with which health facilities operate in Uganda is likely affected by several factors, including but certainly not limited to facility-based capital and patient volumes.

As shown in Figure 28, a large portion of health facilities in Uganda had low efficiency scores. Given observed levels of facility-based resources (beds and personnel), it would appear that many facilities had the capacity to handle much larger patient volumes than they reported. Figure 29 displays this gap in potential efficiency performance across platforms, depicting the possible gains in total service provision that could be achieved if every facility in the ABCE sample operated at optimal efficiency.

We found that all types of facilities could expand their outputs substantially given their observed resources. Based on our analyses, the lowest levels of care had the greatest potential for increasing service provision without expanding current resources. Overall, based on our estimation of efficiency, a large portion of Ugandan health facilities could increase the volume of patients seen and services provided with the resources available to them. This finding challenges previous perceptions of service expansion in Uganda, as past research points to health personnel as a significant, if not the greatest, constraint to increasing health system outputs (MOH et al. 2012, Okwero et al. 2011). Our results suggest otherwise, as most facilities in the ABCE sample had the potential to bolster service production given their reported staffing of skilled personnel and physical capital.

Compared to the other sub-Saharan African countries currently included in the ABCE project, we found that, on average, Uganda performed at lower levels of efficiency (Table 9). In Uganda, the average efficiency score across all facilities was 31% in 2011, which was lower than the average scores for Kenya (41%) and Zambia (42%). Uganda's average efficiency score across facilities was slightly higher than Ghana's (27%). Uganda featured one of the lowest percentages of facilities operating at high levels of efficiency, with 5% of all facilities recording an efficiency score of 80% or

FIGURE 29 Observed and estimated additional visits that could be produced given observed facility resources, 2011



Note: All visits are reported in outpatient equivalent visits estimated at the facility level. Conversion to outpatient equivalent visits varied across facilities; on average, one inpatient bed-day was equivalent to 3.7 outpatient visits, one birth was equivalent to 10.5 outpatient visits, and one ART visit was equivalent to 1.7 outpatient visits. Using outpatient equivalent visits, we estimated the average additional visits facilities could have produced, given observed inputs, in 2011.

TABLE 9 Average efficiency scores and estimated additional outpatient equivalent visits, given observed facility resources, by country

INDICATOR	UGANDA	GHANA	KENYA	ZAMBIA
Average efficiency score, across platforms	31%	27%	41%	42%
Average observed outpatient equivalent visits per medical staff per day	5	4	7	8
Average estimated additional visits given observed facility resources	16	13	12	13

Note: All visits are reported in outpatient equivalent visits estimated at the facility level. Conversion to outpatient equivalent visits varied across facilities; on average, one inpatient bed-day was equivalent to 3.7 outpatient visits, one birth was equivalent to 10.5 outpatient visits, and one ART visit was equivalent to 1.7 outpatient visits.

higher in 2011. By comparison, 10% of Kenyan and 14% of Zambian health facilities performed at a similar level.

Under a scenario in which all facilities operated as efficiently as the most efficient facilities in the ABCE sample, we estimated that facilities in Uganda could add an average of 16 visits per medical staff per day, as measured in outpatient equivalent visits. This represents a four-fold increase in patient volume, which was only slightly exceeded by Ghana. Kenya and Zambia also demonstrated potential for service expansion, but at a lesser magnitude.

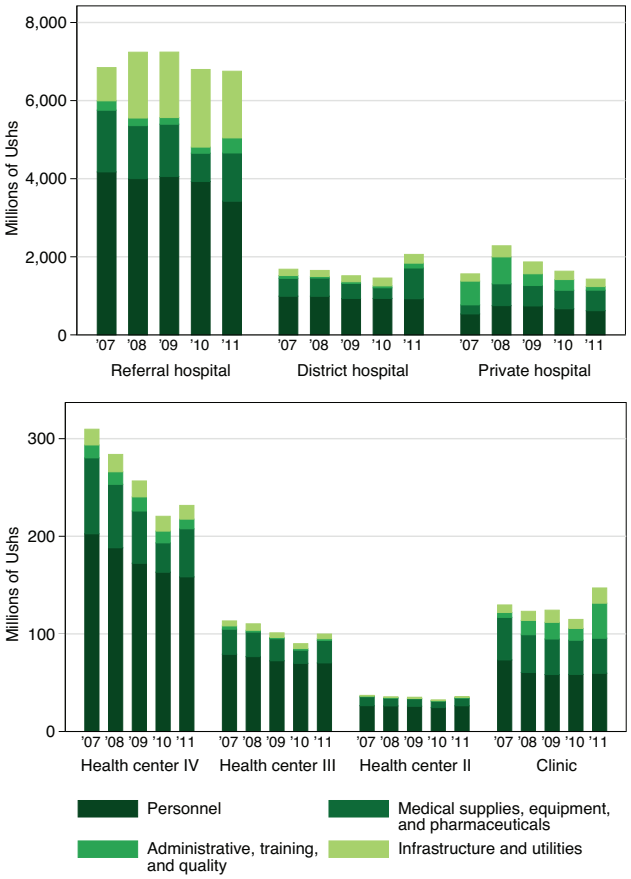
These findings provide a data-driven understanding of facility capacity and how health facilities have used their resources in Uganda; at the same time, they are not without limitations. Efficiency scores quantify the relationship between what a facility has and what it produces, but these measures do not fully explain where inefficiencies originate, why a given facility scores higher than another, or what levels of efficiency are truly ideal. It is conceivable that always operating at full capacity could actually have negative effects on service provision, such as longer wait times, high rates of staff burnout and turnover, and compromised quality of care. These factors, as well as less tangible characteristics such as facility management, are all important drivers of health service provision, and future work should also assess these factors alongside measures of efficiency.

Costs of care

In terms of annual total expenditures, trends in average facility spending varied by platform between 2007 and 2011 (Figure 30). District hospitals and clinics recorded slightly higher levels of average expenditures in 2011 than in 2007, which appeared to be driven by increased spending on medical supplies (excluding ARVs) and administrative needs, respectively. Other platforms, particularly referral hospitals and health center IIs, experienced minimal changes in average annual spending between 2007 and 2011. On average, referral hospitals spent more funds on infrastructure and utilities than any other platform. It is important to note that the downward trend in expenditures at health center IVs is more likely related to abrupt changes in inflation than a true decrease in spending.

Figure 31 shows the average composition of expenditure types across platforms for 2011. Hospitals generally spent a greater proportion of their total expenditures on medical supplies and pharmaceuticals than health centers; however, the average percentage of spending on medical supplies and medications at referral hospitals was similar to lower levels of care. This finding can be mostly attributed to the larger proportion of average expenditures (23%) that

FIGURE 30 Average total expenditure and type of expenditure across platforms, 2007–2011

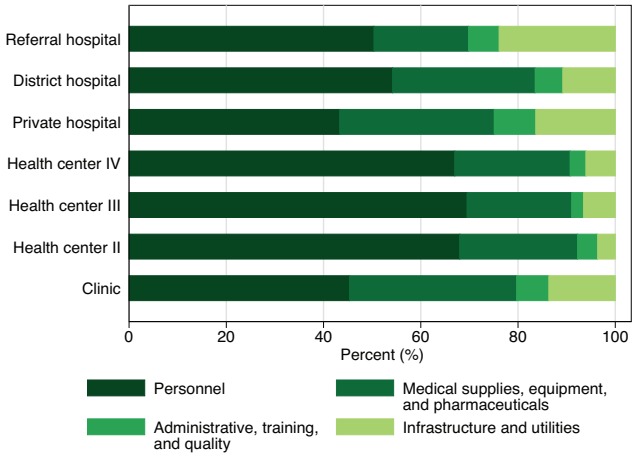


Note: Expenditures on ARVs were not included for the average annual estimates of facility spending on medical supplies, equipment, and pharmaceuticals.

referral hospitals allocated to infrastructure and utilities. It is important to note that expenditures on medical supplies and pharmaceuticals excluded the costs of ARVs. Personnel costs accounted for the majority of average expenditures among health centers, with 68% of average spending at health center IIs allocated to personnel. On average, spending on administration and training accounted for no more than 8% across platforms, with about 6% among hospitals; health center IIIs had the lowest level at 2%.

Costs by visit type and services provided. To estimate the costs of service provision, we used information generated through DEA to determine expenditures for each of the four types of facility output (outpatient visits, inpatient bed-days, births, and ART visits) and then divided output-specific spending by the number of outputs produced by a facility. This measure of facility-level cost per output accounts for the "costs of inefficiency," as we used reports of actual expenditures rather than proposed costs. All cost

FIGURE 31 Average percentage of expenditure type across platforms, 2011



Note: Expenditures on ARVs were not included for estimates of facility spending on medical supplies, equipment, and pharmaceuticals.

data were adjusted for inflation and are presented in 2011 Ugandan shillings (Ushs). All US dollar estimates were based on the 2011 exchange rate of 2,500 Ushs per $1.

As illustrated by Figure 32, across nearly all platforms, outpatient visits cost the least to provide and births were the most expensive. The exception was private hospitals, at which the average cost of an ART visit in 2011, excluding costs of ARVs, was nearly 15,000 Ushs ($6) less than the average cost of an outpatient visit at the same facility type. Private hospitals spent the most per patient visit across all services they provided, with the exception of births; for the latter, referral hospitals spent the most, averaging 518,699 Ushs ($207) per birth produced. Overall, health center IIIs generally provided the least expensive services across visit types; the exception was the average cost per ART visit, excluding ARVs, which was lowest at health center IVs (12,730 Ushs [$5]). Notably, health center IVs averaged the second most expensive provision of inpatient bed-days, costing almost twice as much as referral hospitals per inpatient bed-day.

In comparison with Ghana, Kenya, and Zambia, the average cost per patient in Uganda varied (Table 10). For ART visits, exclusive of ARV costs, Uganda recorded the lowest average cost per visit at facilities, at just under 25,000 Ushs ($10) across facility types in Uganda. Average cost per ART visit, exclusive of ARVs, was slightly more expensive in Kenya (26,126 Ushs [$10]), and Uganda had much lower facility costs than what was estimated for Ghana and Zambia (48,952 Ushs [$20] and 44,614 Ushs [$18], respectively). Uganda's average cost per inpatient bed-day was on the higher end, at 102,541 Ushs ($41), whereas the country's average facility cost per outpatient visit was the lowest across countries, at 21,148 Ushs ($8).

Figure 33 compares the average percentage of total expenditures among facilities that provided ART services with those who did not in 2011. Of the facilities that did not provide ART services, an average of at least two-thirds of all expenditures was allocated to outpatient care. This finding likely reflects the large volume of outpatients that these

FIGURE 32 Average facility cost per visit, across output types and by platform, 2011

		REFERRAL HOSPITAL	DISTRICT HOSPITAL	PRIVATE HOSPITAL	HEALTH CENTER IV	HEALTH CENTER III	HEALTH CENTER II	CLINIC
Outpatient visit	**(2011 Ushs)**	**28,731**	**15,390**	**72,529**	**7,827**	**7,425**	**6,525**	**30,281**
	(2011 USD)	$11	$6	$29	$3	$3	$3	$12
Inpatient bed-day	**(2011 Ushs)**	**79,087**	**42,364**	**175,991**	**157,876**	**26,749**		
	(2011 USD)	$32	$17	$70	$63	$11		
Birth	**(2011 Ushs)**	**518,699**	**366,211**	**368,463**	**64,033**	**58,037**		
	(2011 USD)	$207	$146	$147	$26	$23		
ART visit	**(2011 Ushs)**	**45,526**	**26,058**	**58,185**	**12,730**	**15,479**		
(excluding ARVs)	(2011 USD)	$18	$10	$23	$5	$6		

HIGHEST COST — LOWEST COST

Note: The facility cost of an ART visit excludes costs of ARVs (but includes other medications) provided to the patient. All cost estimates are in 2011 Ushs, with 2,500 Ushs equaling 1 USD. Based on the ABCE sample, only one health center II had ART patients in 2011. The average cost per ART at this facility, excluding costs of ARVs, was 13,915 Ushs ($6). Three health center IIs reported having inpatient services, with their average cost per inpatient bed-day being 25,818 Ushs ($10).

TABLE 10 Average facility cost per visit across output types, for a subset of ABCE countries, 2011

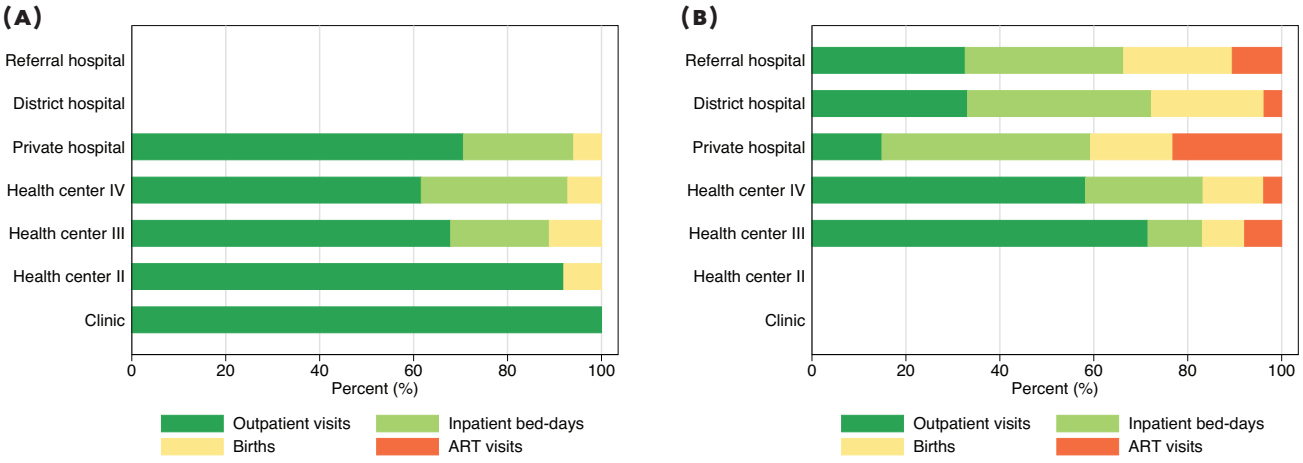
OUTPUT TYPE		UGANDA	GHANA	KENYA	ZAMBIA*
Average cost per outpatient visit	**(in 2011 Ushs)** (in 2011 USD)	**21,148** $8	**36,345** $15	**24,516** $10	**21,704** $9
Average cost per inpatient bed-day	**(in 2011 Ushs)** (in 2011 USD)	**102,541** $41	**101,888** $41	**103,375** $41	**51,997** $21
Average cost per birth	**(in 2011 Ushs)** (in 2011 USD)	**187,703** $75	**360,398** $144	**265,432** $106	**157,277** $63
Average cost per ART visit (excluding ARVs)	**(in 2011 Ushs)** (in 2011 USD)	**24,582** $10	**48,952** $20	**26,126** $10	**44,614** $18

* The last year of financial data collected in Zambia was 2010, so we collated information from the costs of each output type we observed at facilities from 2006 to 2010 and estimated costs for 2011 at the facility level. We then converted the average cost per visit into 2011 USD to correspond with the financial data collected for Kenya and Uganda.

Note: The lowest average cost per output type is highlighted in green, and the highest average cost per output type is highlighted in red. The facility cost of an ART visit excludes the cost of ARVs (but includes other medications) provided to the patient. All cost estimates are in 2011 Ushs, with 2,500 Ushs equaling 1 USD.

facilities experienced. Among facilities that provided ART services, outpatient spending still accounted for the largest proportion of expenditures for health centers, but expenditure composition was more diverse for hospitals. In hospitals, inpatient bed-days accounted for a larger proportion of total expenditures than outpatient spending. ART visits contributed to an average of 27% of total facility costs among private hospitals, 11% for referral hospitals, and 4% for district hospitals. For lower-level platforms, an average of 4% of health center IV spending was allocated to ART visits and 8% for health center IIIs. Notably, among facilities that provided ART services, the percentage of total expenditures allocated to births was generally higher than that of facilities that did not provide ART services.

FIGURE 33 Average percentage of total expenditures, by platform, for (A) facilities that did not provide ART services, and (B) facilities that provided ART services, 2011



Note: The facility cost of an ART visit excludes the cost of ARVs provided to the patient. All referral and district hospitals in the ABCE facility sample provided ART services in 2011, whereas no clinics reported providing ART services. There was only one health center II that provided ART services in the ABCE sample, so it was omitted from the figure. This facility reported that 81% of total expenditures were due to outpatient visits, 13% for inpatient bed-days, 5% for births, and 1% for ART visits in 2011. Three health center IIs reported having inpatient services, recording an average of 76% of total spending on outpatient visits and 16% on inpatient bed-days.

Main findings
Facility-based ART services

Since 1990, HIV/AIDS has been the underlying cause of least 14% of the early death and disability experienced by Ugandans (Murray et al. 2012), prompting the country to significantly expand its HIV/AIDS-specific services over the last two decades. Nonetheless, unmet need remains high, and the patient population requiring ART continues to grow as HIV-attributable mortality declines and treatment eligibility changes (WHO 2013a). At a time when international aid for HIV/AIDS programs is no longer escalating (IHME 2014), it is becoming increasingly important to understand what components of facility-based ART programs are associated with better outcomes at lower costs. In this section, we draw from multiple sources of data to provide a thorough yet nuanced assessment of facilities that provide ART. We present on the following:

- Facility characteristics, as measured by the ART module in the ABCE Facility Survey.
- A review of charts for patients who initiated ART between 2008 and 2012, as measured by clinical chart extractions.
- Facility effectiveness of monitoring patients.
- Patient outcomes, including program retention and viral load suppression, as measured by clinical chart extractions and blood samples.
- Reported experiences and costs of care by ART patients, capturing "demand-side" factors of health system performance.
- Linkages between the cost and efficiency of ART services and patient characteristics, outcomes, and satisfaction.

Facility capacity and characteristics

Table 11 provides an overview of the sampled facilities that provide ART services. The final sample included 47 facilities from 22 districts, and featured a good mixture of facilities based on ownership, urbanicity, and platform type. These facilities saw an average of 3,693 ART patients in 2011, with patient loads ranging from 44 to 18,707 for the year. On average, these facilities had offered ART services for five years.

In terms of services offered, PMTCT and HIV testing and counseling were nearly universal among the sampled facilities; however, one referral hospital did not have HIV testing and counseling available, and another referral hospital did not report having PMTCT. Nutritional supplementation programs were much more common among hospitals (67% reported having these programs) than health centers (28%). A greater proportion of hospitals offered male circumcision services (72%) than health centers (50%), which may be related to the availability of personnel with enough training to perform the procedure. Nearly all health centers had outreach services (94%), far exceeding the proportion of hospitals that provided this service (66%). Details of what exactly outreach services entail are not as clear, but this finding has potential implications for the mechanisms by which facilities reach patients and promote earlier ART initiation, treatment adherence, and prevention efforts.

Patient characteristics

Among the ART patients for whom chart information was extracted (Table 12), 61% were female and married. The median patient age was 36 years old, and more than half of patients began ART in 2010 or 2011.

Patient drug regimens over time. Between 2008 and 2012, there was a rapid transition away from d4T-based drug regimens and toward those with a tenofovir (TDF)-based regimen in both hospitals and health centers (Figure 34). This trend is explained by changes in WHO's and Uganda's national guidelines. In 2008, 9% of patients initiated ART with a TDF-based therapy; by 2012, however, 59% of patients began ART on TDF.

TDF regimens are generally associated with higher patient tolerance and are considered more convenient than zidovudine (AZT)-based therapies due to TDF's delivery as a single, daily combination pill. However, TDF tends to be more expensive than AZT, which is an important consideration given Uganda's growing patient population and declining donor funding.

It is important to note that we found substantial variation in TDF prescription practices across facilities (Figure 35). In 2011 and 2012, prescription rates of TDF at ART initiation ranged from 2% to 85%. Health centers generally

TABLE 11 Characteristics of facilities that provide ART, by platform, 2012

INDICATOR	REFERRAL HOSPITAL	DISTRICT HOSPITAL	PRIVATE HOSPITAL	HEALTH CENTER IV	HEALTH CENTER III	ALL FACILITIES
Number of facilities	**11**	**8**	**10**	**13**	**5**	**47**
Location						
Rural	9%	25%	30%	46%	80%	34%
Semi-urban	0%	13%	40%	31%	0%	19%
Urban	91%	63%	30%	23%	20%	47%
HIV services						
Male circumcision	73%	75%	70%	54%	40%	64%
PMTCT	91%	100%	100%	100%	100%	98%
HIV testing and counseling	91%	100%	100%	92%	100%	96%
Nutrition supplements for HIV-positive patients	82%	43%	67%	23%	40%	51%
Outreach services	55%	75%	70%	100%	80%	77%
Staff and guidelines						
Nurse-led care	9%	38%	20%	38%	40%	28%
General HIV training in the last year	50%	83%	75%	63%	67%	66%
HIV testing and counseling training in the last year	50%	83%	75%	38%	67%	60%
HIV guidelines	100%	100%	100%	100%	80%	98%

TABLE 12 Characteristics of ART patients at initiation, by platform, 2008–2012

CHARACTERISTIC	REFERRAL HOSPITAL	DISTRICT HOSPITAL	PRIVATE HOSPITAL	HEALTH CENTER IV	HEALTH CENTER III	ALL PLATFORMS
Number of charts	**1,940**	**1,604**	**1,855**	**1,923**	**869**	**8,233**
Percent female	61%	58%	62%	62%	67%	61%
Median age (years)	35	36	37	35	37	36
Ever married	83%	77%	84%	73%	78%	78%
Year of ART initiation						
2008	16%	14%	11%	10%	5%	12%
2009	18%	19%	15%	15%	14%	16%
2010	20%	25%	24%	24%	24%	23%
2011	35%	33%	29%	37%	29%	33%
2012	11%	9%	21%	14%	28%	16%

FIGURE 34 ART regimen at initiation, 2008–2012

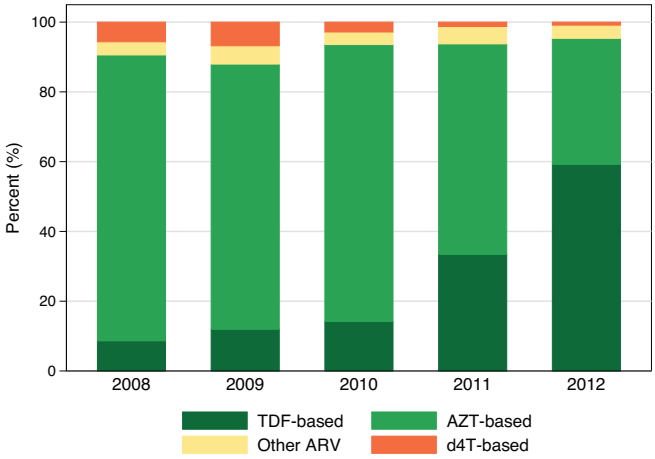
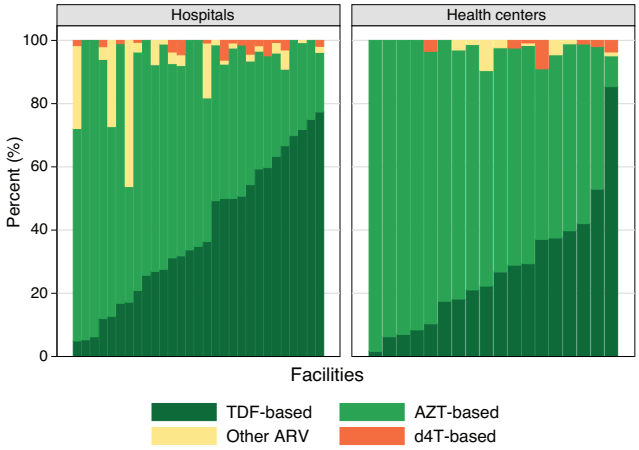


FIGURE 35 ART regimen at initiation, by facility, 2011–2012



Note: Each bar represents a facility and the proportion of patients who initiated ART on a given regimen in 2011 to 2012.

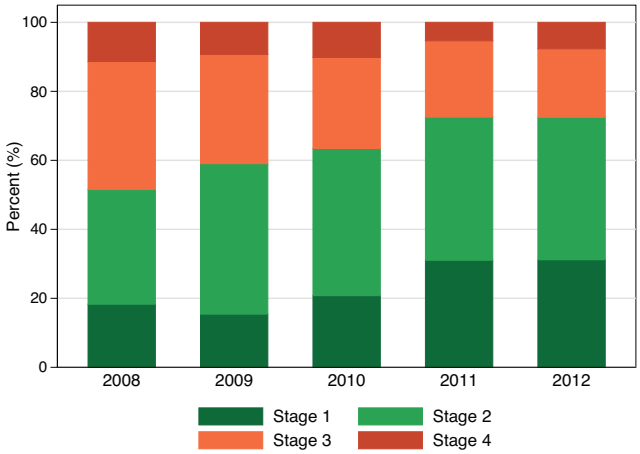
appeared to have lower TDF prescription rates than hospitals; this finding is not surprising given the costs associated with TDF-based therapies. At the same time, a few facilities still initiated a portion of ART patients on d4T-based regimens in 2011 and 2012 (e.g., 6% at a regional referral hospital and 9% at a health center IV). Further examination of why these facilities were prescribing d4T to ART initiates is warranted.

Clinical characteristics. Between 2008 and 2012, there was steady shift toward earlier initiation of ART based on changes in WHO and national treatment guidelines (MOH 2011, WHO 2013a). In 2008, 51% of patients initiating ART were classified as WHO stage 1 or 2, but this increased to 72% initiating at the same stages in 2012 (Figure 36). Nonetheless, a portion of Ugandan patients still began ART fairly late in disease progression in 2012, with 28% starting treatment at stage 3 or 4.

Further, we observed substantial variation in WHO stage at ART initiation across facilities (Figure 37). For both hospitals and health centers, about 30% of ART patients began treatment at stage 1 in 2011 and 2012. At the same time, a few hospitals had over 90% of ART patients who initiated at stage 1 or 2. At two health centers, about 90% of ART patients began treatment at stage 1 or stage 2. It is important to assess more recent data to determine whether more shifts in ART initiation and WHO staging have occurred since ABCE clinical chart extraction.

There also was a gradual trend toward initiating ART at a higher CD4 cell count, as illustrated by Figure 38. In 2008, 65% of patients began ART with a CD4 cell count lower than 200 cells/mm^3, whereas 46% of patients initiated ART with a CD4 cell count under 200 cells/mm^3 in 2012.

FIGURE 36 WHO stage at initiation, 2008–2012



Note: WHO staging classifies HIV disease progression on the basis of clinical characteristics rather than biological measures, such as CD4 cell count and viral load assessments, and is often used in resource-constrained settings.

A summary of WHO clinical staging guidelines is below:

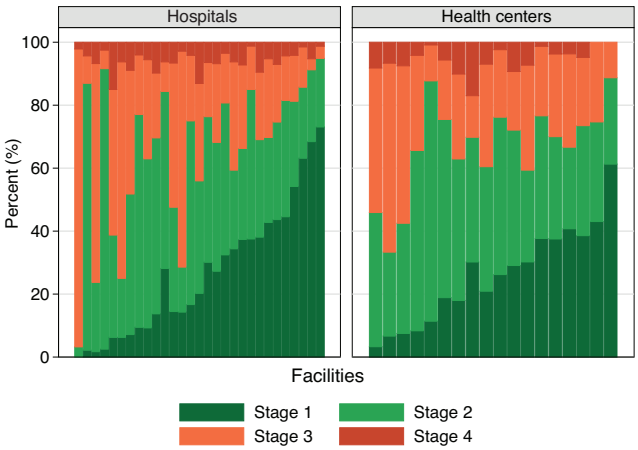
- Stage 1: patients are largely asymptomatic but usually experience persistently large or swollen lymph nodes.
- Stage 2: patients experience moderate levels of unexplained weight loss, recurrent respiratory infections, and often report a range of other moderate ailments (e.g., skin infections, oral ulcerations).
- Stage 3: patients have severe levels of unexplained weight loss, chronic diarrhea, anemia, persistent fever, or acute infections and ailments (e.g., pulmonary tuberculosis).
- Stage 4: patients experience HIV wasting syndrome, recurrent pneumonia, or a multitude of severe infections and organ dysfunction (e.g., HIV-associated cardiomyopathy).

From 2008 to 2012, median CD4 cell count at initiation increased by 62%, from 139 cells/mm³ in 2008 to 225 cells/mm³ in 2012. Nevertheless, this level of CD4 cell count remained well below the 350 cells/mm³ initiation threshold set by Uganda's guidelines in 2011 (MOH 2011). This finding suggests that the majority of HIV-positive individuals are seeking care once they are symptomatic. Further, consistently between 2008 and 2012, about 20% of patients initiated ART with a CD4 cell count lower than 50 cells/mm³. This lack of progress in identifying HIV-positive individuals well before CD4 cell counts drop to such low levels warrants further attention.

Availability of clinical information for monitoring patients

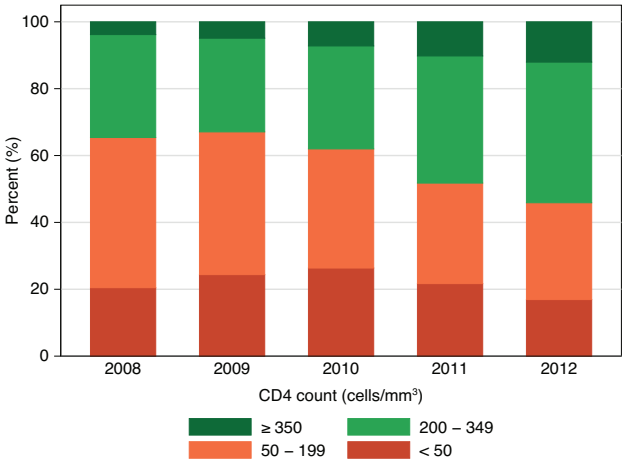
The ability to risk-stratify patients at the time of ART initiation based on CD4 cell count, WHO stage, and body mass index (BMI) is critical for determining the need for and prioritization of more intensive care. Unfortunately, it is not uncommon for patients to lack these measures at ART initiation and during the course of treatment. As shown by Table 13, 17% of ART patients did not have CD4 cell counts recorded at initiation, 10% were not assigned a WHO stage, 6% lacked a weight measurement, and 81% did not have their height recorded in 2012. Measuring a patient's height is relatively easy and low cost, yet this information was not routinely obtained. Data on height and weight are essential for computing BMI, which can be an early predictor of poor outcomes when it is below 16.5 (van der Sande et al. 2004).

FIGURE 37 WHO stage at initiation, by facility, 2011–2012



Note: Each bar represents a facility and the proportion of patients who initiated at a given WHO stage in 2011 and 2012.

FIGURE 38 CD4 cell count at initiation, 2008–2012



Note: These trends in CD4 cell counts reflect levels found for ART patients who had a CD4 cell count measure at initiation (84% of patient charts across all years).

It is important to note, however, that testing rates remained stable or increased over time, which suggests that recordkeeping has increased in parallel with rapidly rising ART patient volumes. Records of viral load, which is the most direct measure of an ART patient's response to therapy, were available for less than 1% of our patient sample. At the time of chart extraction, recording measures of viral load for ART patients was not part of the country's standard ART practices. However, since we completed data collection, the wider use of viral load for monitoring patient outcomes has been promoted.

After ART initiation, patients infrequently received follow-up measures of CD4 cell counts. Among patients who began ART in 2011 and remained in care for at least two years, only 53% received a follow-up CD4 test during their second year of treatment; this finding is cause for concern given Uganda's national guidelines that call for CD4 testing for ART patients every six months (MOH 2010b). At the same time, there have been improvements to the frequency of CD4 follow-up tests over time, with a 56% increase in second-year testing between cohorts initiating in 2008 and 2012.

It is possible that the frequency of CD4 testing is related to a facility's on-site lab capacity, as some of the facilities in the sample had to ship specimens elsewhere for analysis (17% of hospitals and 22% of health centers). Among 2011 initiates, follow-up CD4 testing during the second year of treatment was less common among facilities without on-site analysis capacity (32%) than those with lab capacity (56%), but no differences were found for CD4 measurement at initiation.

TABLE 13 Facility availability of patient clinical information, by initiation year, 2008–2012

INDICATOR	2008	2009	2010	2011	2012
Recorded at initiation*					
CD4 cell count	81%	80%	75%	82%	83%
Weight	92%	92%	94%	95%	94%
Height available by time of initiation	14%	14%	19%	18%	19%
WHO stage	84%	89%	89%	90%	90%
Recorded during second year of treatment**					
CD4 cell count	34%	36%	39%	53%	N/A
Weight	83%	88%	93%	97%	N/A
Height available by end of second year	22%	20%	23%	21%	N/A
Ever recorded					
CD4 cell count	87%	87%	84%	89%	87%
Weight	97%	97%	97%	98%	98%
Height available at any point	22%	20%	23%	21%	23%

* Three months prior to and one month after ART initiation.
** Between 13 and 24 months after ART initiation.

In sum, there has been progress in obtaining and storing ART patient clinical information, but more improvement is needed to optimally track outcomes and respond to patient needs.

Patient outcomes

After 12 months of treatment, more than 80% of patients in our facility sample were retained in care. This retention rate is much higher than previously published cohort data (Fox and Rosen 2010, Rosen et al. 2007), which may indicate some degree of selection bias among our facility sample. We sought to retrieve all available ART patient charts, but it is possible that many facilities discarded records for deceased or defaulted ART patients. This possibility makes it challenging to accurately assess the effectiveness of a facility's ART provision.

Nonetheless, patients in our sample who initiated ART at WHO stage 4 showed much lower program retention rates at 12 months (74% among patients initiating in 2011) than patients who began treatment at WHO stage 1 (92%), which is consistent with previous studies (Lawn et al. 2008, Mugisha et al. 2014). This finding reflects the importance of diagnosing HIV early and starting treatment before symptoms are present. Retention rates varied substantially across facilities, ranging from 33% to 100%, but this finding may more accurately reflect recordkeeping practices than patient outcomes.

Measures of viral load. A patient's HIV viral load, as measured by the copies of HIV RNA/mL of blood plasma, is viewed as the most direct measure of treatment response (Phillips et al. 2001), and lower levels have been strongly associated with reduced mortality and HIV transmission (Castilla et al. 2005). We collected blood samples from 3,091 patients currently enrolled in ART programs at 15 of the sampled facilities (nine hospitals and six health centers). On average, patients involved in the Viral Load Pilot Study had similar characteristics as those included the broader extraction of clinical charts (median age of 37 at initiation and 66% female).

Across facilities, the average rate of viral suppression (i.e., a viral load of less than 1,000 copies) was 87%. This finding is quite encouraging, as the vast majority of ART patients in this sample showed successful suppression of HIV. All facilities had viral suppression rates exceeding 75% (Figure 39), but levels varied by facility. For example, at one referral hospital, 76% of patients achieved viral suppression, whereas 96% of patients had a viral load of less than 1,000 copies at another hospital. We found no correlation between average rates of viral load suppression and facility-level retention rates, but this may have resulted from the issues associated with measuring facility-level retention rates.

At the patient level, rates of viral suppression were highly correlated with the concurrent measure of CD4 cell count but were not associated with CD4 cell count at initiation. This

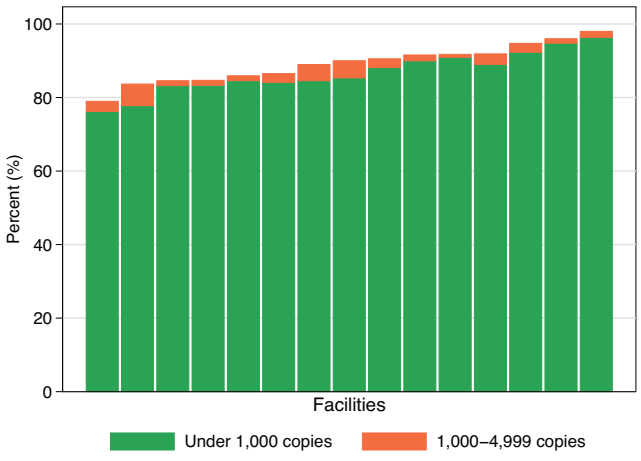
finding was not unexpected given that viral load measures were taken only for patients who had been on treatment for a minimum of six months. At the same time, we found that 27% of patients with CD4 cell counts below 100 cells/mm³, which has been used as an indicator of treatment failure, had adequate viral suppression and thus an adequate response to treatment, as stipulated by 2013 guidelines (Figure 40).

This finding has substantial ramifications for treatment decision-making, especially in terms of determining whether or when ART patients should be switched to more expensive second-line drug regimens. Conversely, we found that 6% of patients with high CD4 cell counts (greater than 350 cells/mm³) had viral loads exceeding 1,000 copies. Based on current clinical standards, these patients with high CD4 cell counts but sub-standard viral suppression would remain on their current ART regimens without adherence counseling or other interventions to prevent potential treatment failure. While measuring CD4 cell counts is a preferred method of monitoring ART patient outcomes than clinical measures alone, its usefulness for assessing treatment response may be inferior to that of viral load measures.

DBS for measuring viral load. Uganda has been considering the revision of its national guidelines to include routinely collecting viral load measures as a key component of ART patient monitoring. Further, there is an active discussion about using DBS to measure viral load in lieu of plasma-based assessments, largely due to the logistical and financial advantages of DBS use. Through the Viral Load Pilot Study, we collected blood samples from ART patients who sought care at facilities and had been enrolled in ART for at least six months, testing their viral load levels using both DBS and plasma. We found that DBS samples generally underestimated viral load for ART patients, such that a DBS sample for the same patient would suggest adequate viral suppression, or less than 1,000 copies, when the patient's plasma-based measure would indicate otherwise. The DBS assay used in the Viral Load Pilot Study was not sensitive enough to detect treatment failure at the patient level, which suggests that broader adoption of DBS testing may be problematic at this point. Our study approach differed from previously published literature in that we collected data from a much larger number of ART patients and did so under "real-world conditions" rather than in a laboratory environment with ideal storage and testing capacity (Rottinghaus et al. 2012).

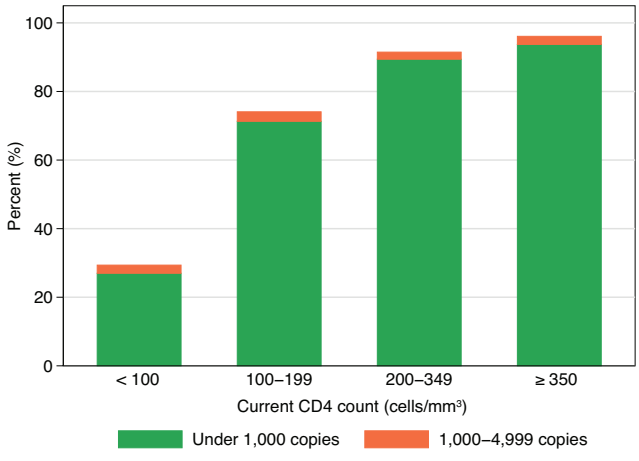
With its recent clinical guidelines stipulating that viral suppression occurs at less than 1,000 copies rather than 5,000 (WHO 2013a), Uganda has elevated the standards of care needed to ensure effective treatment for ART patients. This is likely to be a benefit to ART patients and communities (Castilla et al. 2005), but it also places a greater emphasis on routinely collecting accurate data on patient outcomes. Currently available assays, including the one used in the Viral Load Pilot Study, have not demonstrated high enough levels of sensitivity and specificity to accurately classify an individual patient's viral load status under routine conditions. Based on our findings, further work on assay development

FIGURE 39 Patient-level viral load suppression, by facility, 2013



Note: The length of each bar represents the proportion of patients with adequate viral suppression of HIV, based on most recent guidelines (less than 1,000 copies [WHO 2013a]) and earlier guidelines (less than 5,000 copies) [WHO 2010b]).

FIGURE 40 Patient-level viral load suppression, by CD4 cell count grouping, 2013



Note: The length of each bar represents the proportion of patients with adequate viral suppression of HIV, based on most recent guidelines (less than 1,000 copies [WHO 2013a]) and earlier guidelines (less than 5,000 copies [WHO 2010b])

and testing is needed before DBS can be considered a viable substitute for plasma in tracking patient-level outcomes outside of laboratory settings. In the interim, we recommend that patients' viral suppression be assessed through plasma-based measures.

Patient perspectives

In addition to patients who did not seek HIV-specific care, we conducted the Patient Exit Interview Survey with 890 patients who reported current use of ARTs. Their demographic profiles were very similar to the interviewed non-ART patients, with the majority of patients being female (64%) and having attained at least a primary education (76%).

Out-of-pocket expenditures. Among ART patients interviewed, only 16% reported any medical expenses associated with their facility visit. Nearly all of these expenses were incurred at private facilities as general fees (Figure 41). These findings align with Uganda's national policy of

TABLE 14 Characteristics of patients who sought HIV care, reported current enrollment in ART, and were interviewed after receiving care at facilities, 2012

CHARACTERISTIC	REFERRAL HOSPITAL	DISTRICT HOSPITAL	PRIVATE HOSPITAL	HEALTH CENTER IV	HEALTH CENTER III	ALL FACILITIES
Total patient sample	**240**	**170**	**173**	**228**	**79**	**890**
Percent female	72%	59%	58%	63%	66%	64%
Educational attainment						
None or pre-primary	23%	18%	24%	27%	28%	24%
Primary	45%	43%	32%	40%	43%	41%
Post-primary	33%	39%	43%	33%	29%	36%
Patient age (years)						
≤ 5	0%	1%	2%	1%	1%	1%
6–17	1%	1%	1%	1%	0%	1%
18–29	30%	14%	17%	19%	25%	21%
30–39	34%	38%	40%	36%	38%	37%
40–49	21%	35%	29%	28%	19%	27%
≥ 50	13%	11%	11%	15%	16%	13%
Self-reported overall health						
Poor	1%	2%	5%	1%	5%	2%
Fair	27%	28%	23%	28%	34%	27%
Good	63%	63%	57%	49%	48%	57%
Very good	8%	6%	15%	19%	10%	12%
Excellent	1%	0%	1%	4%	3%	1%
Self-rated urgency of visit						
Not urgent	53%	41%	55%	56%	44%	51%
Somewhat	27%	38%	18%	12%	33%	24%
Very	20%	21%	27%	32%	23%	25%

Note: Educational attainment refers to the patient's level of education or the respondent's educational attainment if the interviewed patient was younger than 18 years old. Hospitals owned by NGOs were grouped with private hospitals.

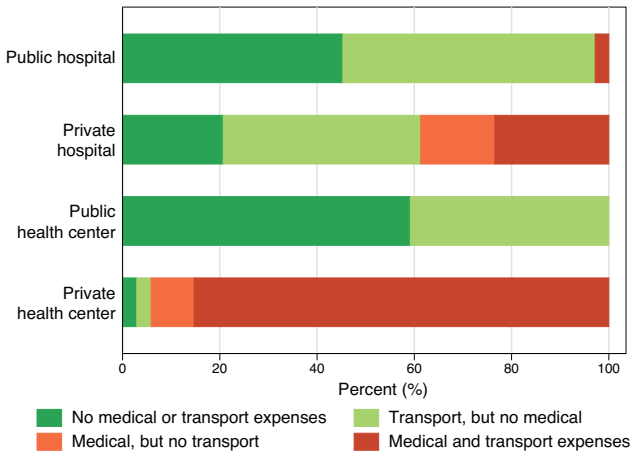
providing free ART care in public facilities since 2003 (UAC 2003). In fact, less than 2% of ART patients who received care at public facilities incurred medical expenses (with no patients paying user fees at these facilities), whereas 45% patients at private facilities paid for medical services. By comparison, more than 50% of ART patients experienced transportation expenses, especially at private hospitals (64%).

Among ART patients seeking care at private facilities, 31% reported incurring both medical and transportation expenses; this was particularly pronounced at health centers, with 85% of patients paying both types of expenses. Only 3% of patients presenting at public hospitals indicated that they paid medical and transportation expenses.

Travel and wait times. Of patients seeking ART services, 17% reported traveling more than two hours to the facility at which they received care (Figure 42). Transit times for ART patients were fairly comparable across platforms. A greater proportion of patients spent more than two hours in transit to rural hospitals (31%) than those seeking care at urban hospitals (13%).

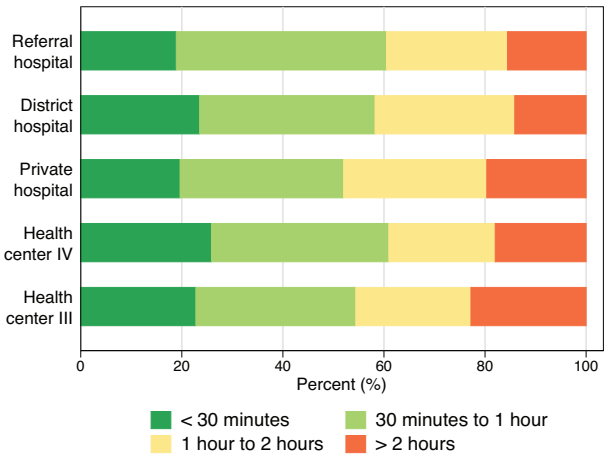
In comparison with patients who did not seek HIV care, a greater proportion of ART patients spent more than two hours traveling to facilities, and far fewer experienced travel times less than 30 minutes. This finding was most pronounced at health center IIIs, with 12% of non-HIV patients traveling more than two hours and 23% of ART patients reporting the same travel times.

FIGURE 41 ART patient expenses associated with facility visit, by platform, 2012



Note: Patients are grouped in mutually exclusive categories of expenses associated with their facility visits. The sum of the light green and red portions of each bar represents the percentage of patients who incurred any kind of transportation payment, irrespective of medical expenses. The sum of the orange and red portions of each bar represents the percentage of patients who incurred any kind of medical payment, irrespective of transportation expenses. Facilities owned by NGOs were grouped with private hospitals and health centers.

FIGURE 42 ART patient travel times to facilities, by platform, 2012



Overall, ART patients experienced relatively long wait times at facilities (Figure 43), and often spent more time waiting than non-ART patients at similar facilities. About 40% of ART patients waited over two hours to receive care at referral hospitals, and 54% of ART patients spent more than two hours waiting for services at health center IIIs. This is in stark contrast with reported wait times among non-HIV patients at health center IIIs, with 50% receiving care within one hour and 25% reporting wait times longer than two hours. At private hospitals, 41% of ART patients received care within an hour, whereas 70% of non-HIV patients at these facilities waited for the same amount of time. More than half of ART patients who presented at district hospitals received care within one hour, and fewer ART patients waited longer than two hours (20%) at district hospitals than non-ART patients (29%).

Patient satisfaction with care. Similar to the experiences reported by non-ART patients, patients seeking ART services generally gave high ratings of the facility-based care they received (Figure 44). Nearly 70% of ART patients gave at least an average rating of 8 out of a possible 10. Health center IIIs had the lowest percentage of ART patients who gave such high ratings (51%), and also experienced the largest proportion of ratings below a 6 (21%).

At the same time, variation was found across facility ownership (Figure 45). Private hospitals averaged the highest ratings, with a rating of 8.6 out of 10, whereas referral and district hospitals recorded averages of 8.2 and 8.1, respectively. In general, ART patients gave higher ratings (8.1) than non-ART patients (7.0). This finding may not be surprising, given the resources that often support

FIGURE 43 ART patient wait times at facilities, by platform, 2012

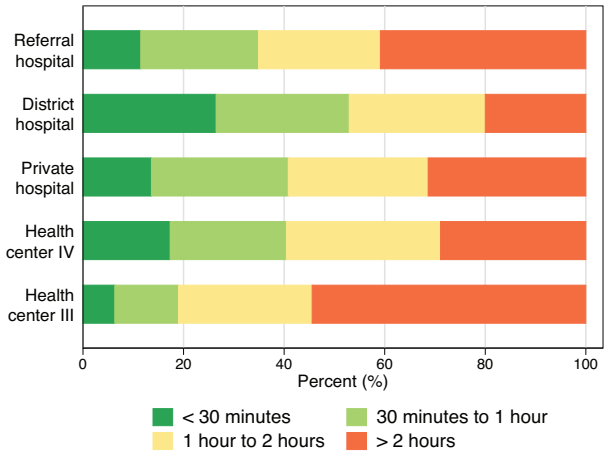
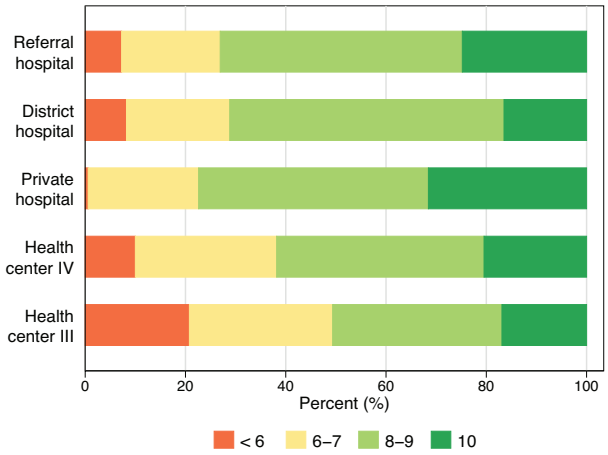


FIGURE 44 ART patient ratings of facilities, by platform, 2012



Note: Ratings were reported along a scale of 0 to 10, with 0 as the worst facility possible and 10 as the best facility possible.

ART programs at facilities as well as the likely alignment of patient expectations for care (receipt of ARTs) with the services they actually receive. Patients who present at facilities for less specific reasons (e.g., a fever) may be less satisfied with the care they receive if treatment does not align as well with their expectations (e.g., not receiving antimalarials for fever treatment, despite a negative test for malaria).

Across facility types, ART patients gave an average rating of at least "good" or higher for facility spaciousness, interactions with medical and non-medical staff, privacy during examinations, clarity of provider explanations, and having enough time to ask questions of their care providers. These ratings were similar, if not slightly higher, than the ratings given by non-ART patients. Average ratings of wait times were generally lower among ART patients, falling to or below a rating of "moderate" across platforms. In fact, each end of the health system – referral hospitals and health center IIIs – had the lowest average scores for wait time. Private hospitals

FIGURE 45 Average ART patient ratings of facility visit indicators, by platform, 2012

	REFERRAL HOSPITAL	DISTRICT HOSPITAL	PRIVATE HOSPITAL	HEALTH CENTER IV	HEALTH CENTER III
Overall rating	8.2	8.1	8.6	8.0	7.5
STAFF INTERACTIONS					
Non-medical staff respectfulness	4.1	4.2	4.3	4.3	3.9
Medical provider respectfulness	4.2	4.3	4.3	4.3	4.2
Clarity of provider questions	4.3	4.3	4.4	4.3	4.0
Time to ask questions	4.2	4.3	4.3	4.3	3.9
FACILITY CHARACTERISTICS					
Cleanliness	4.2	4.1	4.4	4.2	3.6
Privacy	4.3	4.2	4.4	4.2	3.9
Spaciousness	3.4	3.3	3.8	3.5	2.8
Wait time	2.8	3.0	3.0	3.2	2.1

LOWEST RATINGS — HIGHEST RATINGS

Note: Average ratings are on a scale of 0 to 10. Average ratings of staff interactions and facility characteristics are on a scale of 1 to 5, with 1 being "very bad" and 5 being "very good."

averaged higher ratings than the other platforms across all dimensions of care, with the greatest disparities recorded for facility wait time and spaciousness.

Efficiency and costs

Efficiency

In this section, we focus only on the facilities that reported providing ART services. These facilities were included in the previous section on efficiency, but due to the continued scale-up of ART provision in Uganda and the perceived burden of ART programs on facility resources (BMGF and Mckinsey & Co. 2005), it is of policy relevance to consider the efficiency levels for this subset of facilities (Figure 46).

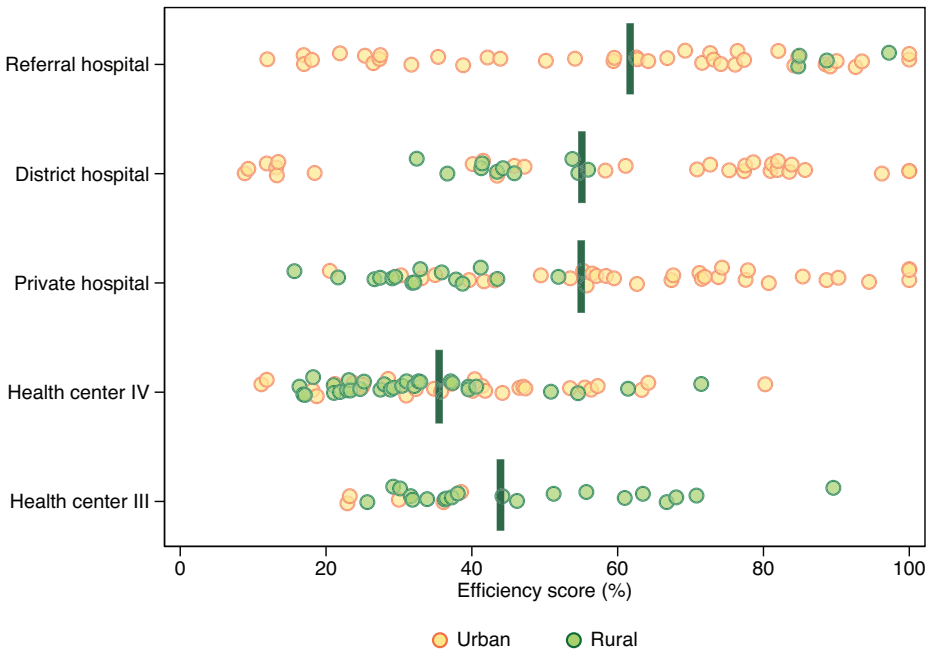
We found that facility efficiency was not significantly related to patient retention rates or the proportion of patients with viral load suppression. Across platforms, urban facilities generally had higher efficiency scores than their rural equivalents. This was most evident at district hospitals, for which nearly all rural facilities fell below the platform average of 55%. However, the opposite finding emerged for health center IIIs, for which all urban facilities had efficiency scores of less than 40%. Referral and district hospitals in urban areas posted efficiency scores at both extremes, ranging from 9% to 100%.

In computing average efficiency scores by platform for facilities with ART services, we found that they were often higher than the average scores estimated for all sampled facilities. For instance, the average efficiency score for health center IIIs with ART services was 44%, whereas the average score for all health centers, irrespective of ART provision, was 32%. However, health center IVs that provided ART had, on average, lower efficiency scores (36%) than the average efficiency score found across all health center IVs (43%).

Given their observed levels of facility-based resources, it would appear that many facilities have the capacity to have much larger ART patient volumes than they currently do. Figure 47 shows this gap in potential efficiency performance across platforms, illustrating the possible gains in patient volumes that could be produced if facilities with ART operated as efficiently as those with the highest efficiency scores. We estimate that all platforms could increase annual ART visits, with some platforms revealing much more capacity for expansion than others.

It is important to note that absolute magnitude of expansion greatly varied between hospitals and health centers. Although we estimated that health centers could potentially more than double their annual ART visits given their current resources, the absolute number of gained

FIGURE 46 Range of efficiency scores for facilities providing ART services, 2007–2011



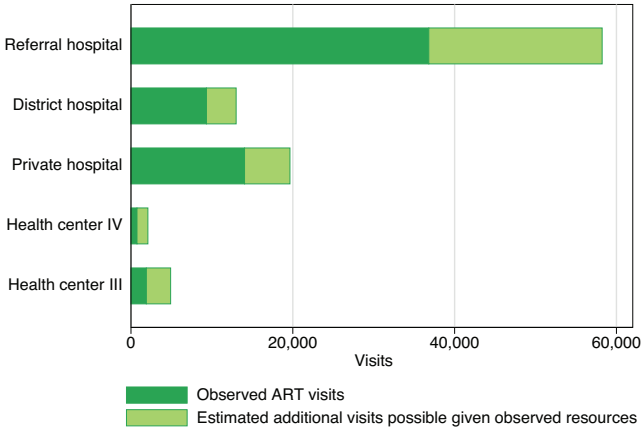
Note: Each circle represents a facility's efficiency score for a given year between 2007 and 2011. The vertical line represents the average efficiency score across all facilities that provide ART services within a given platform.

visits remains between 1,000 and 3,000. By comparison, we determined that referral hospitals could increase ART volumes by "only" 58%, which would translate to an average of over 20,000 more ART visits each year. As a result, it is necessary to consider both relative and absolute facility capacity when assessing potential for service expansion.

These findings may be a reflection of many factors that we have not analyzed, including a poor distribution of personnel and facility resources, lower demand for ART services than anticipated, or inadequate stocking of essential supplies, namely ARVs. Nonetheless, these results suggest that staffing of ART facilities does not appear to be a major constraint to service provision and that the expansion of services, particularly with lowered CD4 thresholds for ART initiation (WHO 2013a), may be feasible without incurring additional personnel costs.

Similar to Uganda, we found that Kenya and Zambia also showed substantial, if not greater, potential for ART service provision given the facility resources observed through the ABCE project (Table 15). If all facilities, across platform and ownership, elevated their efficiency levels such that their patient volumes more closely aligned with the number of available medical staff and beds, we estimated an average increase of 55% in annual ART visits in Uganda (an average gain of 6,367 ART visits per facility), a 69% rise in Kenya (an average gain of 3,499 ART visits per facility), and a 117% increase in Zambia (an average gain of 9,063 ART visits per facility). Notably, health facilities in Uganda had an average of 11,632 ART patient visits in 2011, which was 56% and 34% higher than the average volumes found for Kenya and Zambia, respectively. These findings, in combination, likely reflect both the large volume of HIV-positive patients requiring care in Uganda and the country's responsiveness to scaling up ART services.

FIGURE 47 Estimated potential annual ART visits given observed facility inputs, by platform, 2011



This potential expansion of ART services, at minimal added cost to facilities, has substantial implications for the capacity of Uganda's health system to expand enrollment of new ART patients, and perhaps most importantly, to provide ongoing ART care to the growing ranks of long-term ART patients. Further, this finding is of particular relevance to Uganda's goal of providing universal access to HIV/AIDS treatment and prevention by 2015 (UAC 2012b).

Costs of care

ART programs are expensive, and it is important to systematically determine the annual costs per ART patient for planning purposes. Factors that may affect ART costs by facility include staffing numbers and composition, availability of testing, and facility efficiency. Further, facility costs of ART care per patient may decrease as patients accrue more years of treatment, as more established patients require less frequent facility visits.

TABLE 15 Average efficiency scores and estimated additional ART visits given observed facility resources, by country

ART INDICATOR	UGANDA	KENYA	ZAMBIA
Average efficiency score for facilities that provide ART services	49%	51%	49%
Average annual ART visits, observed	11,632	5,070	7,727
Average additional ART visits, estimated based on observed facility resources	6,367	3,499	9,063
Estimated percent gain in ART patient visits	55%	69%	117%

Analytical approach. Our analysis for projecting costs of ART care used four streams of data:

1 The average cost per ART visit, excluding ARVs, calculated from the ABCE sample;

2 The average number of annual visits observed for new and established ART patients in 2011, as extracted from clinical charts;

3 The ARV regimens of ART patients in 2011 extracted from clinical charts; and

4 The ceiling ARV prices published by the Clinton Health Access Initiative (CHAI) in 2011 (CHAI 2011).

Based on facility data collected through the ABCE Facility Survey and ART patient data extracted from clinical charts, we estimated the average facility cost per ART visit, excluding the cost of ARVs, for 2011. We then multiplied the average visit cost by the average number of annual visits observed for new and established ART patients across platforms in 2011.

Using the ART patient data extracted from clinical charts, we calculated the relative proportion of ART patients who were prescribed TDF-, d4T-, and AZT-based regimens. We then applied the ceiling prices for each ARV published by CHAI for 2011 to the mix of ARV regimens observed in the ABCE sample (CHAI 2011). These estimates of ARV costs were then added to the estimated visit costs to arrive at our projected total annual ART costs for established and new patients.

Table 16 details projected ART costs by patient type (new and established) and across platforms. We found that average facility cost per visit, excluding ARVs, substantially varied across platforms, from 12,730 Ushs ($5) at health center IVs to 58,185 Ushs ($23) at private hospitals.

In general, we estimated that ARVs accounted for a large portion of projected annual costs, but the proportion varied across patient types and platforms. For example, to treat a new ART patient for one year, we estimated that the facility cost of ARVs accounted for 47% of projected total treatment costs at private hospitals, compared to 78% of total projected treatment costs at health center IVs. The proportion of total facility costs that are accounted for by ARVs is much higher for established patients, ranging from 53% at private hospitals to 82% at health center IIIs. This finding is not surprising since it is the frequency of visits, not ARV dosing needs, that generally changes the most for established patients. However, its implications are significant, as it highlights the importance of capturing both

TABLE 16 Projected facility costs, by ART patient type and platform, for 2011

INDICATOR		REFERRAL HOSPITAL	DISTRICT HOSPITAL	PRIVATE HOSPITAL	HEALTH CENTER IV	HEALTH CENTER III
Average cost per visit (excluding ARVs)	**(in 2011 Ushs)**	**45,526**	**26,058**	**58,185**	**12,730**	**15,479**
	(in 2011 USD)	$18	$10	$23	$5	$6
New ART patients						
Average number of annual visits		7.3	7.1	7.6	8.6	7.2
Projected annual visit costs	**(in 2011 Ushs)**	**332,340**	**185,012**	**442,206**	**109,478**	**111,449**
	(in 2011 USD)	$133	$74	$177	$44	$45
Projected annual total costs* (including ARVs)	**(in 2011 Ushs)**	**703,707**	**542,129**	**827,455**	**490,833**	**463,798**
	(in 2011 USD)	$281	$217	$331	$196	$186
Established ART patients						
Average number of annual visits		4.9	4.7	5.4	6.6	4.9
Projected annual visit costs	**(in 2011 Ushs)**	**223,077**	**122,473**	**314,199**	**84,018**	**75,847**
	(in 2011 USD)	$89	$49	$126	$34	$30
Projected annual total costs (including ARVs)	**(in 2011 Ushs)**	**570,488**	**456,545**	**664,310**	**433,127**	**411,726**
	(in 2011 USD)	$228	$183	$266	$173	$165

* ARV costs were projected based on the drug regimens observed through the ABCE sample and multiplying these values by the ceiling prices for each ARV published by CHAI for 2011 (CHAI 2011).

Note: Established ART patients are patients who have been on ART for a minimum of one year. We had insufficient data to estimate annual total costs of ART patients for health center IIs. All cost estimates are in 2011 Ushs, with 2,500 Ushs equaling 1 USD.

TABLE 17 Projected facility costs per ART patient, across a subset of ABCE countries, for 2011

INDICATOR		UGANDA	KENYA	ZAMBIA*
Average cost per ART visit (excluding ARVs)	**(in 2011 Ushs)**	**24,582**	**26,126**	**44,614**
	(in 2011 USD)	$10	$10	$18
Average number of annual ART visits per patient		5.8	5.8	5.8**
Projected annual cost per patient (excluding ARVs)	**(in 2011 Ushs)**	**142,576**	**151,531**	**258,761**
	(in 2011 USD)	$57	$61	$104
Projected annual cost of ARVs	**(in 2011 Ushs)**	**358,795**	**335,436**	**387,250**
	(in 2011 USD)	$144	$134	$155
Projected annual cost per patient (including ARVs)	**(in 2011 Ushs)**	**501,371**	**486,967**	**646,011**
	(in 2011 USD)	$201	$195	$258

* The last year of financial data collected in Zambia was 2010, so we collated information from the costs of each output type we observed at facilities from 2006 to 2010 and estimated costs for 2011 at the facility level. We then converted the average cost per visit into 2011 USD to correspond with the financial data collected for Kenya and Uganda.
** We had insufficient data to estimate the average number of ART visits patients had in 2011 for Zambia. As a result, we used the average number of annual ART visits observed in 2011, across both new and established patients in Kenya and Uganda, for Zambia.

Note: ARV costs were projected based on the drug regimens observed for each country in the ABCE project and multiplying these values by the ceiling prices for each ARV published by CHAI for 2011 (CHAI 2011). All cost projections are in 2011 Ushs, with 2,500 Ushs equaling 1 USD.

visit and ARV costs across patient types for resource planning. After patients have been enrolled in ART for at least one year, for example, the projected annual visit cost per ART patient dropped by about 30%, largely due to the less frequent visit schedule for established patients. Since the facility cost of ARVs stayed more or less constant over years of treatment, the projected total annual cost per ART patient declines by 12% to 20% as patients move from being new patients to being established patients. In sum, our findings suggest that for planning purposes, projected annual ARV costs per ART patient can be viewed as more stable over time, whereas the visit costs associated with ART services are found to be much lower for established patients than for new patients; as a result, ART programs that have a higher proportion of established patients may appear to have lower total costs compared to programs that have a larger proportion of new patients.

In comparison with Kenya and Zambia (Table 17), we projected that average ART facility costs were either comparable or lower in Uganda. Across platforms and facility ownership, the average facility cost per ART visit in Uganda, excluding the costs of ARVs, was slightly lower (24,582 Ushs [$10]) than the average ART visit in Kenya (26,126 Ushs [$10]) and much lower than the average ART visit in Zambia (44,614 [$18]) for 2011.

In terms of annual projections, we estimated that the average annual facility cost per ART patient, excluding ARVs, ranged from 142,576 Ushs in Uganda ($57) to 258,761 Ushs in Zambia ($104); this finding was based on the average number of annual ART patient visits observed in Kenya and Uganda (5.8 visits), and then applying this average to Zambia. When projected ARV costs were included in our estimates, we found that the differences in projected annual costs per ART patient across countries decreased. Kenyan facilities had the lowest projected total annual cost (486,967 Ushs per ART patient, per year, or $195), with Uganda following closely behind at just over 500,000 Ushs ($201). Zambian facilities had the highest projected total annual cost (646,011 Ushs per ART patient, or $258).

Our results suggest that the projected costs of ARVs account for a smaller proportion of total ART costs at facilities in Kenya and Zambia (69% and 60%, respectively) than in Uganda (72%). Funding for ARV and non-ARV components of ART programs can originate from different sources, with the former often supported by development partners in the past. With shifting financing structures (e.g., the Global Fund to Fight AIDS, Tuberculosis and Malaria's new funding model) and the flat-lining levels of international aid (Dieleman et al. 2014), it is increasingly important to pinpoint which components of ART programs may be affected by an evolving funding landscape.

Conclusions and policy implications

To achieve its mission of providing "the highest possible level of health to all people in Uganda" (MOH 2010a), Uganda has strived to enact policies and implement programs that promote greater access to health services, support the delivery of cost-effective interventions, and equitably provide high-quality care throughout the country. Our findings show that these goals are ambitious but attainable, if the country focuses on rigorously measuring health facility performance and costs of services across and within levels of care, and if it can align the different dimensions of health service provision to support optimal health system performance.

Facility capacity for service provision

Optimal health service delivery, one of the key building blocks of the health system (WHO 2007), is linked to facility capacity to deliver the services needed – and demanded – by individuals. If a health system has the appropriate balance of skilled staff and supplies to meet the health needs of its population, then a strong foundation exists to support the delivery of cost-effective and equitable services. The availability of a subset of health services, such as immunization, family planning, and ANC, was generally high across facility types in Uganda. Such broad access reflects the prioritization – and execution – of expanding these services throughout the country.

The widespread availability of both malaria diagnostics and first-line treatment exemplifies this success. With 84% of facilities having both the capacity to test for and treat malaria with an ACT, Uganda has set the groundwork for ensuring that every case of malaria is parasitologically confirmed, as specified in its malaria program targets (MOH 2009).

At the same time, substantial gaps in reported service availability and the actual capacity to provide those services emerged. While nearly 80% of all facilities, across platforms, indicated that they provided ANC services, far fewer facilities had the full stock of medical supplies and pharmaceuticals to optimally provide ANC.

Uganda has indicated a strong interest in expanding iCCM (Kalyango 2013, MOH 2013), especially to more rural and hard-to-reach populations, but the success of such integrated care depends on having access to the full set of diagnostics and medications to distinguish one febrile illness from another and to treat them accordingly. On average, about half of the supplies needed for optimal case management of malaria, LRIs, and meningitis were available at health centers, which generally serve as the base for iCCM supplies for communities.

These findings are not novel (MOH et al. 2012), but their persistence among facilities and across service types is cause for concern. Closing this service-delivery gap and bolstering the effective provision of health care warrants further policy consideration, particularly as Uganda debates strategies to achieve universal health coverage.

In comparison with previous studies (MOH and WHO 2006, Adair-Rohani et al. 2013), we found many more facilities featured functional electricity and piped water, even among lower levels of care. This likely reflects Uganda's investments in improving facility infrastructure, a priority that has been clearly stated in past national health strategic plans (MOH 2005a, MOH 2010a). However, less progress was observed for improved sanitation, as a large portion of health center IIIs and health center IIs still did not have access to a flush toilet or covered pit latrine. Outside of hospitals, the availability of basic modes of communication and transportation was fairly low, which could negatively affect the transfer of patients in emergency situations to higher levels of care.

Based on WHO equipment guidelines (WHO 2013b), referral and district hospitals generally featured a high availability of the equipment recommended for their level of care (86%). Health centers stocked an average of 55% to 84% of the recommended equipment for primary care facilities, but the full range of equipment stocks across these facilities was quite wide (31% to 100%). Similar findings emerged for pharmaceutical availability, based on the 2012 EML (MOH 2012a), such that referral and district hospitals averaged stocking about 80% of the recommended medications, and health centers demonstrated a wide spectrum in pharmaceutical availability (23% to 100%), particularly health center IIIs. In combination, these findings indicate that marked discrepancies in facility stocking of medical supplies exist at the level of primary care service provision. Equity is a stated social value of the HSSP III (MOH 2010a), and these results further emphasize the growing need to

address some of the gaps observed among facilities focused on primary care.

Uganda increasingly grapples with the health burdens associated with NCDs (Murray et al. 2012), and the country remains largely unprepared to properly diagnose and treat these conditions. Facilities generally demonstrated the highest capacity for managing LRIs, HIV/AIDS, and malaria, but carried less than half of the recommended medical equipment and pharmaceuticals to properly provide care for a subset of NCDs and injuries. In comparison with most communicable conditions, NCDs and related risk factors require much more sophisticated equipment and medications to optimally diagnose and treat (e.g., ECG machines that provide diagnostic information for ischemic heart disease), and far fewer facilities had the capacity to properly manage these conditions (e.g., 22% of hospitals had an ECG machine). Further, less than 30% of health centers had the capacity to test levels of blood sugar, suggesting that primary care facilities remain largely unprepared to address the country's burgeoning diabetes burden (Murray et al. 2012).

Across facilities, nurses were generally the most prevalent type of staff, and about 70% of facility employees were considered skilled medical personnel. We found that relatively few facilities employed the number and mixture of medical personnel recommended by the HSSP II (MOH 2005a). While we found some exceptions, urban facilities largely had higher levels of skilled medical personnel than their rural counterparts. Uganda has long viewed staffing its rural facilities as an important challenge to overcome (MOH 2005a), and our findings reinforce the continued need to address the equitable distribution of human resources for health across the country.

Facility production of health services

With ART visits as the clear exception, average patient volumes generally remained steady between 2007 and 2011 across most platforms. Shortages in human resources and overcrowding of facilities are viewed as widespread in Uganda (MOH 2010a), but we found that most facilities averaged fewer than six visits per medical staff each day in 2011. These visits are observed in outpatient equivalent visits, which means that many health personnel may see even fewer patients per day given that inpatient and ART visits equate to multiple outpatient visits. Outpatients largely accounted for the greatest proportion of daily visits per medical staff, while each medical staff generally provided less than one ART visit per day.

Efficiency scores reflect the relationship between facility-based resources and the facility's total patient volume each year. Based on the ABCE sample, the average health facility in Uganda had an efficiency score of 31%. With this information, we estimated that facilities could substantially increase the number of patients seen and services provided each year – by an average of 16 additional outpatient equivalent visits – based on their observed levels of medical personnel and resources in 2011.

While these findings generally contrast with more prevalent views of health facility capacity in Uganda, we found that a subset of facilities, particularly in rural areas, were operating close to or at maximum capacity given their observed resources and patient volumes. It is quite possible that these facilities may be considered understaffed or can supply fewer beds than patient demands require. Nonetheless, based on the ABCE sample, these conditions were more often the exception than the rule, with the vast majority of facilities seeing fewer patients than their resources could potentially support.

The policy implications of these efficiency results are both numerous and diverse, and they should be viewed with a few caveats. A given facility's efficiency score captures the relationship between observed patient volume and facility-based resources (personnel and beds), but it does not reflect the expediency with which patients are seen (e.g., some facilities with the highest efficiency scores had a high proportion of patients waiting more than two hours before receiving care); the optimal provision of services (e.g., one health center with a very high efficiency score only stocked 71% of the recommended pharmaceuticals for its level of care); and demand for the care received. These are all critical components of health service delivery, and they should be thoroughly considered alongside measures of efficiency. On the other hand, quantifying facility-based levels of efficiency provides a data-driven, rather than strictly anecdotal, understanding of how much Ugandan health facilities could potentially expand service provision without necessarily increasing personnel or bed capacity in parallel.

In harnessing the wealth of data collected in other countries in sub-Saharan Africa, we found that Ghana, Kenya, and Zambia also demonstrated substantial potential for service expansion. In Uganda, the average facility efficiency score was lower than that of Kenya and Zambia, suggesting that Uganda has the facility-based capacity, given observed resources, to markedly increase service delivery more than the other sub-Saharan African countries currently included in the ABCE project.

We projected that Uganda could increase annual ART patient volumes, given observed facility resources, potentially expanding ART visits by an average of 55% if facilities

operated at optimal efficiency levels. This suggests that further progress toward universal access to HIV/AIDS treatment and care, a goal set to be reached by 2015 (UAC 2012b), could be achieved with observed facility resources. Expanded ART service provision was also projected for Kenya and Zambia, suggesting that all three countries had the physical capacity to receive many more new ART initiates and continue to provide care for established patients without necessarily straining resources. However, we estimated that the magnitude of potential ART expansion was much higher for Kenya and Zambia; this may reflect the great need and demand for ART services in Uganda, as well as the country's responsiveness in providing an already substantial volume of ART care.

These findings are particularly relevant to ongoing policy debates in Uganda and other countries with high burdens of HIV/AIDS, as there is substantial concern about whether health systems can accommodate an anticipated influx of newly eligible ART patients per the updated WHO guidelines. At the same time, more work is needed to pinpoint the relationship between the potential for increased service provision and the quality of care provided in such expansion scenarios.

Costs of care

The average facility cost per patient visit differed substantially across platforms and types of visit. Outpatient and ART visits, excluding the cost of ARVs, were generally the least expensive, but their average costs varied widely across platforms. For example, the average facility cost of an outpatient visit at a private hospital was nearly three times as high as an outpatient visit at a referral hospital. Births were by far the most expensive output to produce across all platforms, incurring a minimum of five times the cost of the average outpatient visit to facilities. Identifying these differences in patient costs is critical for isolating areas for improved cost-effectiveness and expansion of less costly services, especially for hard-to-reach populations.

In comparison with Ghana, Kenya, and Zambia, the average facility cost per patient generally varied in Uganda. Uganda posted the lowest average cost per ART visit, excluding ARVs, at just under 25,000 Ushs ($10) per visit, as well as the lowest average facility cost per outpatient visit (21,148 Ushs [$8]). These results offer insights into each country's health financing landscape, a key building block to health system performance, in terms of cost to facilities and service production across outputs. While these costs do not reflect the quality of care received or the specific services provided for each visit, they enable a compelling comparison of overall health care expenses across these countries. Future studies should aim to capture information on the quality of services provided, as it is a critical indicator of the likely impact of care on patient outcomes.

Patient perspectives

Reflecting Uganda's priority of removing cost barriers to health services (MOH 2005a, MOH 2010a), the majority of interviewed patients reported not incurring medical expenses associated with their facility visit. This finding was particularly pronounced among ART patients, which again aligns with the country's national policies. We found that no ART patients who sought care from publicly owned health centers reported medical expenses, which likely illustrates Uganda's successful implementation and provision of ART services at no cost to patients in the public sector.

Across services sought (HIV and non-HIV), a greater proportion of patients experienced wait times exceeding two hours than the percentage of patients who spent the same time traveling to receive care. Past studies point to staffing shortages as the main driver of extended wait times at Ugandan facilities (Okwero et al. 2011), but staffing levels observed in the ABCE sample suggest it is unlikely that inadequate human resources were the main driver of reported long wait times. Further investigation into the facility factors contributing to delays in patient care is warranted, especially as these constraints may affect overall service production.

In general, satisfaction with care was high among Ugandan patients, both for those seeking HIV services and those who were not; notably, ART patients generally reported higher ratings of facilities than non-HIV patients. Patients rated interactions with their providers quite highly, regularly rating characteristics of facility staff more highly than the characteristics of the health facility itself. Facility wait times and spaciousness received the lowest ratings across facility types, but there was no clear relationship between individual patients' reports of overall satisfaction and the amount of time they spent waiting for care. The high levels of patient satisfaction with facility staff may be related to Uganda's efforts to improve the training and retention of medical staff (MOH 2010a). Conversely, the relatively lower ratings of facility-based qualities could reflect some of the deficiencies in facility infrastructure and physical capital we observed in the ABCE sample.

At present, it is not clear which factors are most salient to patient decision-making and care-seeking behaviors (e.g., whether having to pay a user fee and having to wait for two hours before receiving free care are equivalent trade-offs). Additional work on pinpointing these demand-side

drivers of accessing health services is needed, especially as governments consider the range of policy options for increasing coverage of care.

Facility-based provision of ART services

To meet the demands of the ongoing HIV/AIDS burden in Uganda, the country's health system must find ways to optimize in terms of capacity, efficiency, and cost. The country can work to replicate some of the successes it has seen in some aspects of HIV care to meet the challenges it has seen in other areas. Uganda has shown a rapid shift away from d4T prescriptions at initiation toward those with a TDF backbone, a significant success. Similarly, from 2008 to 2012, Uganda documented progress in initiating ART patients at earlier stages of disease progression, both in terms of WHO staging and CD4 cell counts. However, a portion of patients in 2012 still began treatment well after they started to experience symptoms. It is possible that more recent progress has been made, especially with the adoption of new ART eligibility guidelines, but further assessment is needed.

As ART patient volumes continue to rise, it is increasingly important for Uganda to improve its monitoring of patient clinical data. The country demonstrated improvement in collecting patient data at initiation between 2008 and 2012, but too many ART patients still did not receive measures of their CD4 cell counts at initiation in 2012. Further, very few patients received viral load measurements, which could make the prompt identification of treatment failure very challenging. Uganda has since promoted the broader use of viral load measures for ART patient monitoring, and thus updated analyses are needed. Greater investment in ART patient recordkeeping and data collection ought to be considered.

Uganda has sought to update and advance its ART clinical guidelines in parallel with the latest revisions from WHO (WHO 2013a), and the country's HIV/AIDS program should be applauded for striving to keep its treatment recommendations on pace with the ongoing advancements in medicine and epidemiological evidence. To that point, an active debate has emerged about whether DBS could be used, rather than plasma, to routinely collect viral load data for ART patients for outcome monitoring (e.g., treatment failure, successful viral suppression of HIV). DBS is financially and logistically advantageous for this use, but based on findings from the Viral Load Pilot Study, it is not yet a viable alternative to plasma measures of viral load under routine conditions. Currently available DBS assays are not sensitive enough to detect treatment failure at the patient level, particularly under routine conditions; it is likely that other assays may have inadequate performance under routine conditions as well. Until more advancements occur for DBS assay development and testing, plasma-based measures of viral load remain the optimal way to assess patient responsiveness to ART.

While facilities that provide ART services generally had higher efficiency scores than those that did not, we still found that some facilities could potentially expand service provision given their observed levels of staffing and beds. This was particularly evident among district hospitals, private hospitals, and health center IVs located in rural areas. These findings suggest that rising demands for ART services, resulting from HIV-positive patients living longer and lower eligibility requirements for ART initiation (WHO 2013), could likely be met at most facilities in Uganda without significantly straining their facility-based resources.

Under a fully efficient scenario of ART service provision, we estimated that facilities in Uganda could provide more than 6,300 additional ART visits per year given the facility-based resources observed in 2011. These estimated potential gains could increase the observed number of ART visits by over 50%, with minimal additional costs to facilities in terms of personnel and beds. We also estimated substantial gains in ART patient volumes in Kenya and Zambia, but they were projected to expand services by a much greater magnitude. Further work on identifying the specific factors contributing to or hindering facility efficiency and assessing the quality of care received under a range of efficiency conditions should be conducted.

In estimating annual costs per ART patient across facility types, three main findings surfaced. First, ARVs accounted for a large proportion of projected annual ART costs, ranging from 47% to 78% of total costs for new ART patients and up to 82% of total costs for established patients. Second, projected annual facility costs, both including and excluding the costs of ARVs, declined after ART patients became established (i.e., had been enrolled in an ART program for at least one year). This result was consistent across platforms, indicating that facilities should anticipate lower expenditures on ART if their program composition shifts toward more established ART patients. Third, while overall facility costs of ART services decreased with established patients, reductions in spending were more associated with non-drug costs, while ARV expenditures remained more stable.

These findings highlight the importance of considering overall cost and cost composition of ART patients across facility types. Further, they imply that spending on ARVs should be viewed as a more stable cost over time, whereas visit spending may be more variable at facilities, especially

if the ratio of new to established ART patients shifts toward the latter. At a time when international funding for HIV/AIDS treatment is stagnating or declining in Uganda (Dieleman et al. 2014), considering more sustainable and diverse financing mechanisms for ARVs is likely to become increasingly critical.

Drawing from the global ABCE project, we found that the average facility cost per ART visit in Uganda, excluding the costs of ARVs, was slightly lower than the equivalent visit in Kenya and much lower than in Zambia. Projected annual facility costs per ART patient in Uganda, both with and without ARVs, were generally comparable to those found in Kenya and much lower than costs estimated for Zambia; however, the projected cost of ARVs accounted for a higher proportion of the annual facility cost per patient in Uganda (72%) than in Kenya and Zambia (69% and 60%, respectively). These findings indicate that the sustained financing of ARVs will remain a high priority in Uganda, as their costs drive a large portion of ART expenses. Further, Uganda could be more affected by potential shifts in international aid for ARVs than other countries. Identifying the particular components of non-ARV costs for ART programs that are contributing to or impeding the cost-effective provision of HIV/AIDS care in Uganda should be of high priority for future work.

Summary

The ABCE project was designed to provide policymakers and funders with new insights into health systems to drive improvements. We hope these findings will not only prove useful to policymaking in Uganda, but also inform global efforts to address factors that hinder the delivery of or access to health services. It is with this type of information that the individual building blocks of health system performance, and their critical interactions with each other, can be strengthened. More efforts like the ABCE project in Uganda are needed to continue many of the positive trends highlighted in this report and to overcome the challenges identified. Analyses that take into account a broader set of the country's facilities would undoubtedly provide an even clearer picture of levels and trends in capacity, efficiency, and cost. Continued monitoring of the strength and efficiency of service provision is critical for optimal health system performance and the equitable provision of cost-effective interventions throughout Uganda.

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