HEALTH SERVICE PROVISION IN ZAMBIA

Assessing Facility Capacity, Costs of Care, and Patient Perspectives

ACCESS, BOTTLENECKS, COSTS, AND EQUITY

IHME INSTITUTE FOR HEALTH METRICS AND EVALUATION
UNIVERSITY OF WASHINGTON

UNIVERSITY OF ZAMBIA

This report was prepared by the Institute for Health Metrics and Evaluation (IHME) in collaboration with the University of Zambia (UNZA). 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 Zambia. 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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Photo credit: Matthew Schneider, Child Health Week in Katete, Zambia, July 2010

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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 Zambia, please contact IHME:

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About this report

Health Service Provision in Zambia: Assessing Facility Capacity, Costs of Care, and Patient Perspectives provides a comprehensive yet detailed assessment of health facility performance in Zambia, 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 and capturing experiences reported by patients seeking HIV services. Findings presented in this report were produced through the ABCE project in Zambia, which aims to collate and generate the evidence base for improving the cost-effectiveness and equity of health systems. This report provides updated results from the preliminary findings shown to and discussed with the Zambian Ministry of Health (MOH) in September 2013. 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 47). 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.

The ABCE project is a collaborative project between IHME and the University of Zambia (UNZA). At IHME, Christopher Murray, Kelsey Moore, Emmanuela Gakidou, Michael Hanlon, Herbert Duber, and Santosh Kumar had key roles in the project. At UNZA, the project was led by Felix Masiye, the in-country principal investigator (PI), and Chrispin Mphuka, and managed by Mashekwa Maboshe. Data collection was conducted by a team of 30 research associates, largely from UNZA. Analyses were jointly conducted by several researchers at UNZA and IHME, including Benjamin Brooks, Roy Burstein, Ruben Conner, Emily Dansereau, Brendan DeCenso (now of RTI International), Kristen Delwiche, Laura Di Giorgio, Samuel Masters (now of UNC-Chapel Hill), Allen Roberts, and Alexandra Wollum. This report was written by Nancy Fullman of IHME.

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The quantity and quality of the data collected for the ABCE project in Zambia 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 Zambia field team, which included (listed alphabetically): Shabany Angolwishe, Charles Banda, Emmanuel Idan Chabu, Benjamin Chibuye, Conrad Chilala, Mumbi G. Chisanga, Lincoln Daka, Emmanuel Kabali, Akabondo Kabechani, Oliver Kaonga, Brenda Kapemfu, Lydia Mapala, Nyuma Mbewe, Rabson Mbewe, Days Mhone, Malindi Msoni, Kennedy Mubanga, Gae Mundundu, Malcom Mupimpila, Clement Mwamba, Tumelo Mwambo, Chuma Mwananyanda, Sabuni Mwimanenwa, Mercy Ndimbwa, Joseph Njobvu, Eletina Phiri, Joel Saidi, Ben Sidono, Wabei Silumbu, Mike Tembo, and Vincent Tembo.

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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)
BCG	Bacillus Calmette-Guérin vaccine
BMI	Body mass index
CD4	Cluster of differentiation 4 (cells that fight infection)
CHAI	Clinton Health Access Initiative
CHAZ	Churches Health Association of Zambia
d4T	Stavudine (a type of antiretroviral)
DCPN	Disease Control Priorities Network
DEA	Data Envelopment Analysis
DHMT	District Health Management Team
DHS	Demographic and Health Survey
DPT	Diphtheria-pertussis-tetanus vaccine
ECG	Electrocardiography
GHDx	Global Health Data Exchange
Hib	*Haemophilus influenzae* type b
HIV	Human immunodeficiency virus
HMIS	Health Management Information System
IHME	Institute for Health Metrics and Evaluation
IUD	Intrauterine device
MOH	Ministry of Health
NAC	National HIV/AIDS/STD/TB Council
NCD	Non-communicable disease
NGO	Non-governmental organization
NHSP	National Health Strategic Plan
OPV	Oral polio vaccine
PEPFAR	US President's Emergency Plan for AIDS Relief
PET/QSDS	Public Expenditure Tracking/Quantitative Service Delivery Survey
PMTCT	Prevention of mother-to-child transmission of HIV
RBM	Roll Back Malaria
RED	Reaching Every District
SBA	Skilled birth attendance
TDF	Tenofovir (a type of antiretroviral)
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNZA	University of Zambia
UTH	University Teaching Hospital
VCT	Voluntary counseling and testing
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/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 by providers).

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

District sampling frame
The list of district categories from which the ABCE district sample was drawn. District categories were created based on district-level averages of household wealth, population density, and coverage of skilled birth attendance (SBA).

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 2010 Ministry of Health (MOH) facility list.

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 occurence.

Inpatient visit
A patient that 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 that:

- 1 inpatient bed-day = 3.7 outpatient visits
- 1 birth = 10.6 outpatient visits
- 1 ART visit = 1.6 outpatient visits

Outpatient visit
A patient who 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.

Facility types in Zambia

Level 3 hospitals
These hospitals are intended to serve catchment populations of at least 800,000; act as referral centers for level 2 hospitals; and offer specialty subservices in internal medicine, surgery, pediatrics, obstetrics and gynecology, intensive care, psychiatry, training, and research.

Level 2 hospitals
These hospitals are intended to serve catchment populations between 200,000 and 800,000; act as referral centers for level 1 hospitals; and offer services in internal medicine, general surgery, pediatrics, obstetrics and gynecology, intensive care, psychiatry, and dental care.

Level 1 hospitals
Also known as district hospitals, these hospitals are intended to serve catchment populations between 80,000 and 200,000; support all referrals from health centers; and offer general medical, surgical, obstetric, and diagnostic services. Nearly all districts are served by level 1 hospitals.

Health centers
These facilities are intended to serve as primary care centers, with urban health centers serving catchment populations between 30,000 and 50,000 and rural health centers serving catchment areas of approximately 10,000 people or a radius of 29 kilometers.

Health posts
These facilities are intended to operate as basic health centers for sparsely populated areas, with rural health posts serving populations of approximately 3,500 people (500 households) and urban health posts serving populations of approximately 7,000 people (1,000 households). The types of health services offered at health posts are basic first aid rather than curative.

Executive summary

The first three guiding principles that underlie Zambia's health priorities and programs – equity of access, affordability, and cost-effectiveness – ultimately shape the ways in which its health system delivers care throughout the country. Zambia and development partners have invested in bringing these principles to reality, striving to extend health services to the country's most rural populations and to ensure that 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 Zambia'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 University of Zambia (UNZA) and the Institute for Health Metrics and Evaluation (IHME), the ABCE project in Zambia is uniquely positioned to inform the evidence base for understanding the country's drivers of health care access and costs of care. 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 Zambia: 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.

Key findings include the following:

Facility capacity for service provision

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

- Health facilities generally reported a high availability of a subset of services, with 88% of all facilities offering family planning, 86% featuring a formal immunization program, and 74% providing HIV/AIDS care. Further, 75% of facilities stocked artemisinin-based combination therapies (ACTs), which is the first-line treatment for malaria.
- A service capacity gap emerged for the majority of health facilities and across several types of services, such that many reported providing a given service but then lacked the full capacity to properly deliver that service, such as missing functional equipment or stocking out of medications. The provision of immunization services is a clear example of this gap, with only 53% of facilities reporting a full stock of key childhood vaccines and maintaining vaccine storage temperatures within the recommend range. This discordance in reported and functional capacity for service provision has substantial programmatic and policy implications for Zambia.

Deficiencies in medical equipment observed at all levels of care

- Most health facilities experienced some kind of medical equipment deficiency, especially in comparison with the nationally required equipment lists for each type of facility. Basic equipment, such as exam tables and blood pressure cuffs, were missing at each level of care, particularly among rural facilities. Private facilities generally had a higher availability of the medical equipment required of their public counterparts, especially for hospitals. Nearly 30% of health posts did not carry any of the medical equipment stipulated for their level of care, while a substantial portion of level 2 and

3 hospitals lacked critical imaging equipment, such as an ultrasound machine (33%) or an X-ray machine (22%). At every level of service provision, these serious equipment shortages could substantially affect the delivery of quality care throughout Zambia.

Facilities may be inadequately equipped to manage chronic conditions

- With a rising burden of non-communicable diseases (NCDs) and related risk factors, Zambia's health system remains relatively unprepared to diagnose and treat some of the most basic conditions. While 82% of hospitals had the capacity to both measure blood pressure and provide antihypertensive medication, only 65% of primary care facilities – health centers and health posts – had both the equipment and pharmaceutical stocks to manage a case of hypertension. High blood pressure is one of the least complex risk factors to diagnose and treat for NCDs, so it is quite possible that even fewer facilities are properly equipped to handle the growing burden of more demanding NCDs, such as ischemic heart disease, diabetes, and stroke.

Non-medical staff composed the majority of personnel; urban facilities showed higher levels of skilled staff

- In terms of human resources for health, non-medical personnel constituted the largest portion of most facilities' total staff. Nurses accounted for 29% to 38% of average personnel composition. The distribution of skilled medical personnel largely favored urban facilities across all levels of care but was particularly evident among the highest level of hospitals (levels 2 and 3) and health centers. Among health centers that were publicly owned or run by non-governmental organizations (NGOs), a greater proportion had two or more skilled medical personnel on staff (62%) than a 2009 baseline study reported (47%). However, nearly all facilities that did not meet this staffing goal were located in rural areas. The combination of these findings – relatively high levels of non-medical staff in facilities coupled with an imbalanced distribution of medical personnel across urban and rural areas – has far-reaching implications for potential service expansion in Zambia.

Facility production of health services

ART patient volumes quickly increased; other patient visits remained steady over time

- Between 2006 and 2010, trends in outpatient and inpatient visits were fairly consistent across facility types, gradually rising over time. This is in stark contrast with ART patient volumes, with ART visits rapidly increasing 279% from 2006 to 2010. Zambia'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 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 a range of nearly three visits per medical staff per day at private hospitals to nearly 16 at health posts. With the exception of rural health centers and health posts, all other facilities recorded fewer than seven outpatient equivalent visits per medical staff per day in 2010. This finding suggests that, despite perceived staffing shortages, most medical personnel in Zambia, especially those working in urban areas, treated a relatively small number of patients each day.

Facilities showed considerable 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 the lowest and highest levels of efficiency across platforms, especially among public or NGO-owned facilities. Urban health centers averaged an efficiency score of 40%, with a range of 3% to 100%, while rural health centers scored an average of 42%, ranging from 2% to 100%. At the same time, 70% of facilities had an efficiency score below 50%, indicating that they had considerable room to expand service production given their resources. 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 slightly higher efficiency scores (49%) than those found across all facilities. This is not an unexpected finding, given that Zambia documented a large increase in ART patient visits without a corresponding rise in medical personnel at facilities.

Zambia recorded higher levels of efficiency than other ABCE countries

- Across all facilities in Zambia, we estimated an average efficiency score of 42% for 2010. This level of efficiency was slightly higher than the average efficiency score for Kenya (41%) and far exceeded average efficiency levels computed for Uganda (31%) and Ghana (27%). Among these other countries, Zambia had the greatest proportion of facilities operating at high levels of efficiency, with 14% of all facilities recording an efficiency score of 80% or higher in 2010. Conversely, only 5% of facilities in Uganda and Ghana were performing at similarly high levels of efficiency.

- Given the observed resources at facilities, we estimated that Zambia could produce an additional 13 visits per medical staff per day, in terms of outpatient equivalent visits. In general, private facilities showed higher potential for service expansion than public or NGO-owned facilities at the same level of care. In comparison with a subset of other countries involved in the ABCE project, Zambia either had similar or much lower levels of potential service expansion. By contrast, 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.

- In combination, these findings indicate that many facilities in Zambia could increase service provision, given observed resources, and that the factors related to higher levels of facility efficiency could be easily ascertained from the country's own subset of highly efficient facilities.

ART patient volumes could significantly increase given facility resources

- With a focus on ART service production, we estimated that, given observed facility resources, Zambia had the potential to increase its average annual ART patient volume by 117%, adding an average of 9,063 ART visits per facility. In Zambia, level 2 and 3 hospitals, as well as level 1 hospitals, would likely account for the largest growth in ART patient volumes, as we estimated that these facilities could each increase average annual ART visits by 84% and 211%, respectively, given observed facility resources. These findings suggest that health facilities are positioned to support Zambia's goal of providing universal access to HIV/AIDS treatment and care.

- Expanded ART service provision was also projected for Kenya and Uganda, but at a lower magnitude than what was estimated for Zambia. This potential expansion of ART services has substantial implications for the capacity of Zambia'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.

Costs of care

- Average facility expenditures, excluding the costs of ARVs, remained relatively unchanged between 2006 and 2010. Spending on personnel accounted for the vast majority of annual spending across facility types.

Average cost per patient markedly varied

- Across and within facility types, the average cost per patient visit varied substantially in 2010. The average cost per outpatient visit was generally the least expensive output to produce across all facilities, but ranged from 19 kwacha[1] ($4)[2] per outpatient visit at health posts to 171 kwacha ($32) at private hospitals. Births accounted for the highest cost per visit at all facility types, ranging from 95 kwacha ($18) at health posts to 3,289 kwacha ($616) at private hospitals. Excluding births, patient costs at level 1 hospitals more closely resembled the per-visit costs found at urban and rural health centers. In comparison with rural health centers, it was generally at least twice as expensive to provide the same type of patient visit at an urban health center.

Zambia generally had low average costs per patient type

- In comparison with Ghana, Kenya, and Uganda, the average cost per visit in Zambia was generally similar or slightly lower. Across Zambian facilities in 2010, the

1 All kwacha in this report are reported in 2010 kwacha and were adjusted for inflation. In accordance with the kwacha rebasing in 2013, we divided all 2010 kwacha by 1,000.

2 All reports of US dollars (USD) were estimated based on the 2010 exchange rate of 1 USD ($) equaling 5.34 kwacha.

average cost per outpatient was 43 kwacha ($8), the average cost per inpatient bed-day was 104 kwacha ($20), and the average cost per birth was 352 kwacha ($66). The average cost per ART visit, excluding ARVs, was higher in Zambia at 79 kwacha ($15) per visit; however, all countries recorded average facility costs between $9 and $18 per ART visit.

Projected annual cost per ART patient varied in parallel with rising levels of the health system

- Across facility types, the average cost per ART visit, excluding ARVs, varied substantially, ranging from 35 kwacha ($7) per visit at rural health centers to 140 kwacha ($26) at level 2 and 3 hospitals. We projected that the annual cost of treating a new ART patient, inclusive of ARVs, ranged between 1,437 kwacha ($269) at rural health centers to 2,616 kwacha ($490) at level 2 and 3 hospitals. Once an ART patient was considered an established patient, average annual facility costs, inclusive of ARVs, generally fell about 35% across platforms.

Projected ART costs to facilities were largely driven by ARVs, and visit costs were notably lower for established patients

- The projected cost of ARVs accounted for a large proportion of average annual costs across platforms and patient types, but still ranged from 41% of total annual costs for new patients at level 2 and 3 hospitals to 86% of total annual costs for established patients at rural health centers. The visit costs of ART patients incurred by facilities were much lower for established patients, largely driven by the lower frequency of visits and tests compared to new patients and not by the cost of the ARVs. These findings suggest that facilities should view projected ARV costs per ART patient, irrespective of their status as a new or established patient, as more stable over time. This in turn has significant program and policy implications for the continued expansion of ART services in Zambia, especially with the implementation of the World Health Organization's (WHO) new initiation eligibility guidelines.

Projected annual ART costs were moderately higher at Zambian facilities than in other ABCE countries

- In 2010, Zambian facilities recorded a higher average annual cost per ART patient, excluding ARVs (458 kwacha [$86]), than Uganda (284 kwacha [$53]) and Kenya (278 kwacha [$52]). With projected ARV costs included, Zambia still averaged a higher annual cost per patient than Kenya and Uganda, but the relative magnitude was lower. This finding suggests that projected ARV costs account for a larger proportion of facilities' annual ART costs in Kenya and Uganda than in Zambia. 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 experienced medical expenses, especially patients seeking HIV care

- Among patients not seeking HIV services, 11% experienced medical expenses associated with their facility visit. While the majority of these patients sought care at private facilities or level 2 and 3 hospitals, a portion of them reported paying user fees at rural health centers. Very few patients seeking HIV care experienced medical expenses, reflecting Zambia's prioritization of providing ART services at minimal cost to patients. Transport expenses, especially to higher levels of care, were the most commonly reported expense associated with facility visits.

Patients waited longer to see a provider than the time spent traveling to receive care

- On average, patients spent more time waiting for care at facilities than the time they spent traveling to them. This was particularly evident among level 2 and 3 hospitals and urban health centers. Previous studies have suggested that long wait times are related to staffing shortages, but based on the facilities included in the ABCE sample, low staffing levels did not appear to be the main driver of long wait times.

Patients reported high ratings for facility providers and lower ratings of facility-based qualities

- Across platforms, patients generally gave high ratings for their overall facility experience; however, a greater proportion of patients, both HIV and non-HIV, reported lower ratings for level 1 hospitals. In examining particular components of visit satisfaction, patients gave very high ratings of their interactions with staff and providers, but often gave lower marks for facility characteristics, especially for wait time.

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

- Zambia experienced a tremendous growth in ART patient volumes from 2006 to 2010, especially at level 2 and 3 hospitals and urban health centers. The latter nearly quadrupled their average number of annual ART visits during this time, reaching an average of 19,572 visits in 2010.
- Between 2007 and 2010, Zambia had decreasing prescription rates of d4T-based regimens at ART initiation, suggesting that the country's ongoing phase-out of d4T since 2006 has been successful.
- In comparison with 2007, a greater proportion of ART patients initiated at lower WHO stages and at higher CD4 cell counts in 2010, with the latter rising from a median of 143 cells/mm^3 in 2007 to 187 cells/mm^3 in 2010. Nonetheless, a large portion of ART initiates began treatment quite late in disease progression in 2010. Assessing these clinical characteristics with more recent data is critical for evaluating the uptake of WHO's new eligibility guidelines.
- The availability of patient clinical information at ART initiation gradually improved from 2006 to 2010, but in 2010, 15% of ART initiates still did not receive a CD4 cell count when they began treatment. Much more progress was seen for recording any clinical information during patients' second year of therapy, but not at the frequency specified by national guidelines. Less than 1% of patients had a record of 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.
- In terms of costs to facilities, the average cost per ART patient, excluding ARVs, was 79 kwacha ($15) in 2010, ranging from 35 kwacha ($7) at rural health centers to 140 kwacha ($26) at level 2 and 3 hospitals. On average, the projected annual cost per ART patient, without including ARV costs, was 458 kwacha ($86), but varied from 140 kwacha ($26) for established ART patients at rural health centers to 1,540 kwacha ($288) for new ART patients at level 2 and 3 hospitals. We projected that ARVs contributed to a major portion of ART costs to facilities, resulting in an estimated average of 1,418 kwacha ($266) per ART patient each year. On average, ARVs accounted for 68% of annual ART costs at facilities.
- Among patients seeking HIV care, more than 80% experienced no medical or transport expenses associated with their visit, reflecting Zambia's national policy to provide ART services free of user charges. Across platforms, the majority of HIV patients spent more time waiting for health services than traveling to receive them. Overall, HIV patients were quite satisfied with the care they received; however, level 1 hospitals 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 Zambia provide an in-depth examination of health facility capacity, costs associated with seeking care, and how patients view their interactions with the health system. Zambia'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, efficiency, and costs of care. With regularly collected and analyzed data, capturing information from both health facilities and the recipients of care, policymakers and program managers can have the evidence base to make informed decisions for achieving optimal health system performance and the equitable provision of cost-effective interventions throughout Zambia.

Introduction

The performance of a country's health system ultimately shapes the health outcomes experienced by its populations, 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 2014a) and the government of Zambia 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, but due to the multidimensionality of health system functions (Murray and Frenk 2000), comprehensive and detailed assessment seldom occurs. 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 Zambia, the multipronged, multipartner ABCE project has taken place in six other countries (Colombia, Ghana, Kenya, Lebanon, Uganda, and six states in India), with the goal of rigorously assessing the drivers of health service delivery across a diversity 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 Zambia, 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 a 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 University of Zambia (UNZA) and the Institute for Health Metrics and Evaluation (IHME) compose the core team for the ABCE project in Zambia, and they received vital support and inputs from the Ministry of Health (MOH) and the Churches Health Association of Zambia (CHAZ) 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 Zambian 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 Zambia, 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, if not the only, points through which most individuals interact with Zambia's health system. 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 Zambia. This gap in, and corresponding need for, health facility knowledge is exemplified by Zambia's experiences with HIV/AIDS.

HIV/AIDS remains a leading cause of premature mortality and illness in the country, although Zambia reached its epidemic peak for HIV/AIDS mortality during the early 2000s (Ortblad et al. 2013). A monumental investment has been made in tackling HIV/AIDS in Zambia, with $1.7 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 2013) 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 (UNAIDS 2012). Zambia rapidly scaled up its facility-based ART programs over the last decade (NAC 2010), but patient needs still exceed the supply of service provision. Zambia also aims to achieve universal access to HIV/AIDS prevention, treatment, and care by 2015 (NAC 2010), further widening the universe of patient need for ART and HIV services.

Prior to the ABCE project, minimal information had been comprehensively collected on what facility factors were related to improved outcomes for ART patients in Zambia (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, program retention rates), we now have the data to better ascertain facility determinants of ART outcomes under routine conditions.

The ABCE project in Zambia has sought to generate the evidence base for improving the cost-effectiveness and equity of health service provision, as these are priorities of the Zambian MOH. 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. Based on patient exit interviews, we consider the factors that affect patient perceptions of and experiences with Zambia's health system. 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 Zambia.

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 Zambia. 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 resources for health, facility-based infrastructure and equipment, health service availability, patient volume, facility-based efficiency, facility 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 efficiency are also covered.

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 Zambia, 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 Zambia (the ABCE Facility Survey).
2. Interviews with patients as they exited sampled facilities.

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 also conducted with patients seeking HIV 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 www.healthdata.org/dcpn/zambia.

ABCE Facility Survey

Through the ABCE Facility Survey, direct data collection was conducted from a nationally 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. To minimize data collection error, the ABCE Facility Survey used similar accounting and reporting forms used by publicly owned health facilities. These forms were modeled after the reporting documents used by the Zambian Health Management Information System (HMIS).

Sample design. To construct a nationally representative sample of health facilities in Zambia, we used a two-step stratified random sampling process. Districts, from which facilities would be drawn, were grouped into 21 unique categories based on their average levels of household wealth (three categories: poorest, middle, and wealthiest); population density (rural, semi-dense, and dense); and coverage of skilled birth attendance (SBA) (low, middle, and high). District-level estimates of average household wealth and SBA were derived from the 2007 Demographic and Health Survey (DHS). One district was randomly selected from each wealth-population-SBA category; Lusaka district was automatically included, in addition to these 21 randomly sampled districts, due to its size and relevance to Zambia's health service provision.

The second step, which entailed sampling facilities from each selected district, took place across the range of platforms identified in Zambia. For the ABCE project, a "platform" was defined as a channel or mechanism by which health services are delivered. In Zambia, sampled health facilities included level 3 hospitals, level 2 hospitals, level 1 hospitals, health centers (public, private, and non-governmental organization [NGO]), health posts, and pharmacies or drug stores. The facility sampling frame used for the ABCE project originated from the 2010 MOH facility list. No national list of pharmacies and drug stores existed at the time of sampling, so facilities within this platform were selected using a convenience sampling approach.

TABLE 1 Modules included in the ABCE Facility Survey

SURVEY MODULE	SURVEY CATEGORY	KEY INDICATORS AND VARIABLES
Module 1: Facility finances and inputs	Inputs	Facility funding sources Availability and functionality of non-medical equipment and maintenance information
	Finances	Salary/wages, benefits, and allowances Total expenses for infrastructure and utilities; medical supplies and equipment; pharmaceuticals; administration and training; non-medical services; personnel Performance indicators and performance-based financing
	Revenue	Total facility revenue and source (including user fees)
	Personnel characteristics	Total personnel including volunteer personnel; personnel dedicated to HIV/AIDS-specific services Funding sources of personnel Education and training of medical personnel Health and administrative/support services provided 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 Lab-based medical consumables and supplies available
Module 4: Pharmacy-based consumables, equipment, and capacity	Facility capacity	Pharmacy information, cold-chain characteristics, and general pharmacy supplies available Drug kit availability and acquisition information Buffer stock availability Essential pharmaceutical availability, prices, and stock-out information
Module 5: General medical consumables, equipment, and capacity	Facility capacity	Availability and functionality of medical furniture and equipment Inventory of items for sterilization, sharp items, and infectious waste Pharmaceutical ordering system information, pharmaceuticals ordered/received, and cost to patients Personnel inventory (day of survey)
Module 6: Facility outputs	Facility capacity	Referral and emergency referral infrastructure
	Service provision	Inpatient care and visits; outpatient care and visits; home or outreach visits Care and visits for specific conditions, including emergency visits Vaccinations administered Laboratory and diagnostic tests conducted

Note: Indicators for finances, personnel, and outputs reflect the past five fiscal years (2006 to 2010); all other indicators reflect the status at the time of survey.

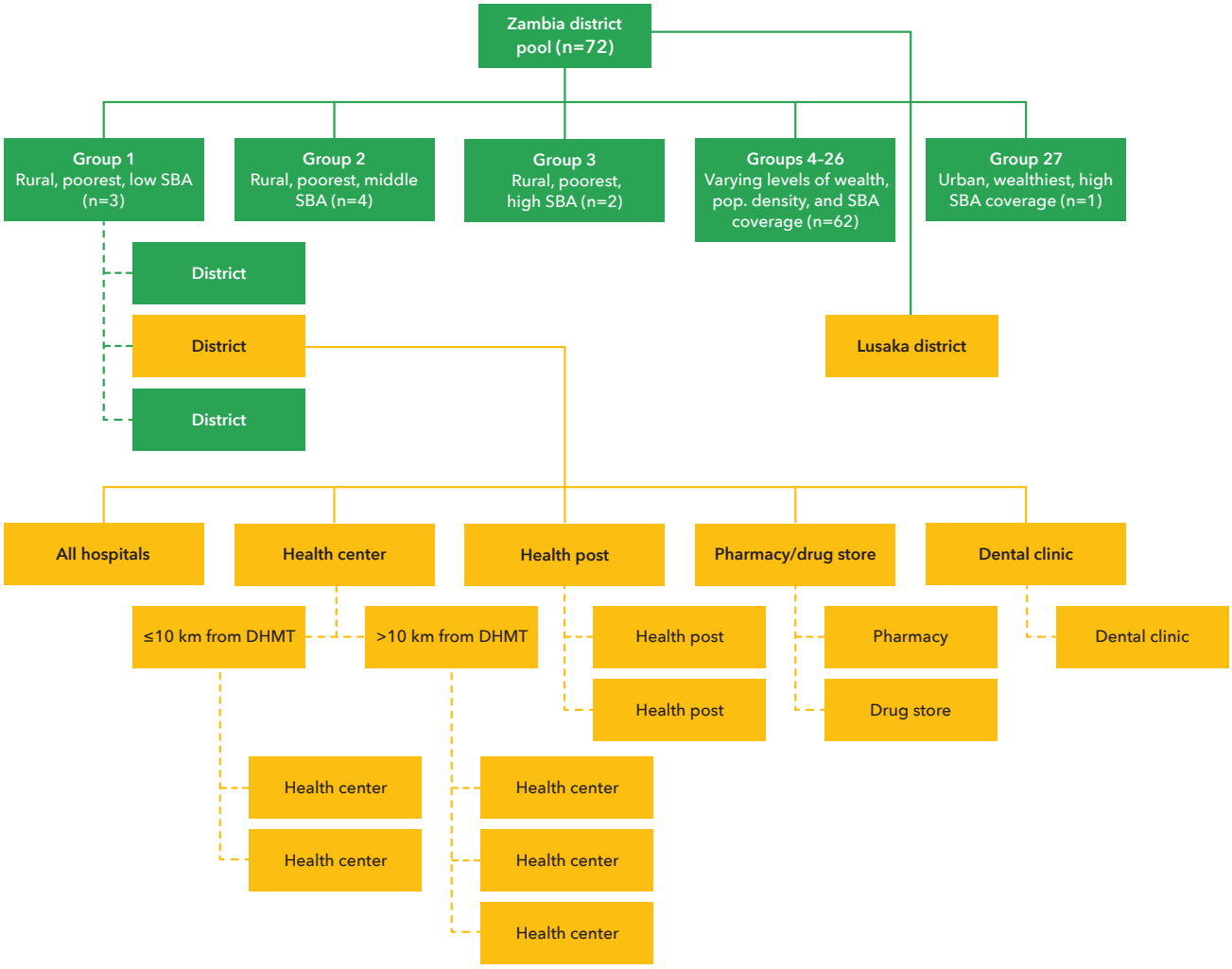
A total of 22 districts were selected through the district sampling frame, and 252 facilities from those districts were selected through the facility sampling frame:

- All known hospitals within the selected district.
- Two health centers within 10 kilometers of the selected district's District Health Management Team (DHMT) and three health centers located beyond 10 kilometers of the DHMT were randomly selected.
- Within a predetermined quota for districts, health posts supervised by selected rural health centers were sampled until the district quota was met.
- Based on a list of pharmacies, drug stores, and dental clinics requested from each selected district's DHMT, two pharmacies or drug stores and one dental clinic were selected using a convenience sample.

Figure 1 depicts this two-step sampling process used in Zambia.

ART module and clinical chart extraction. Of the facilities offering ART services that were selected for ABCE Facility Survey implementation, 46 facilities also received 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.

FIGURE 1 Sampling strategy for the ABCE project in Zambia



Note: Boxes that are green reflect groups considered for the district sampling frame. Districts that are yellow represent those selected through this district sampling process; Lusaka was automatically included. Solid lines indicate inclusion from the previous sampling step, while dashed lines indicate that a random selection of districts or facilities took place. For pharmacies, drug stores, and dental clinics, a convenience sampling approach, rather than random sampling, was used until quotas for these platforms were filled.

Table 2 provides more information on the specific indicators included in the ART Module.

For a subsample of these facilities with ART services, information from up to 250 clinical records for ART patients were 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 3 details the types of data extracted from clinical charts.

TABLE 2 Indicators included in the ART Module of the ABCE Facility Survey in Zambia

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

TABLE 3 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

Patient Exit Interview Survey

Based on a subset of sampled facilities, a maximum of 30 patients or attendants of patients were interviewed per facility. 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 by 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).

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

- Perceived quality of health services received.
- 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 4 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 15 years or older or, if younger than 15 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.

Data collection for the ABCE project in Zambia

Data collection occurred between September 2011 and April 2012. Prior to survey implementation, UNZA and IHME hosted a one-week training workshop for 30 research associates, where they received extensive training on the electronic data collection software (DatStat), the survey instruments, the Zambian 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, UNZA, and the ABCE field team. Following data collection, the data were methodically cleaned and re-verified and securely stored in databases hosted at IHME and UNZA.

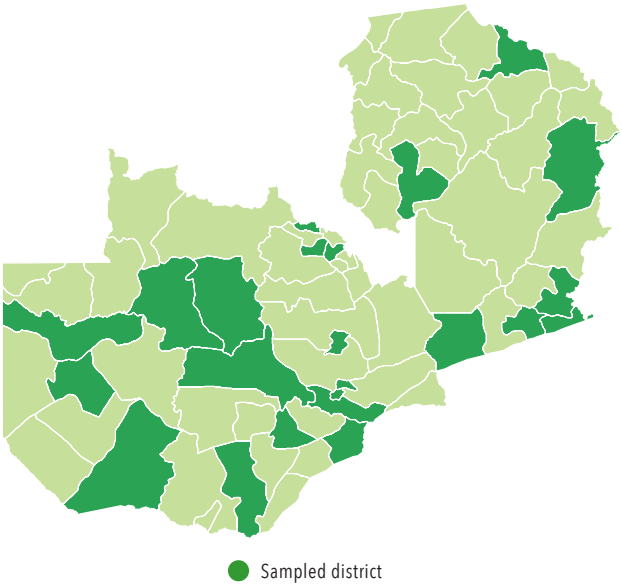
Figure 2 displays the districts sampled for the ABCE project in Zambia. Table 5 provides information on original and final samples for health facilities. The final sample of hospitals included 10 level 2 and 3 hospitals, 13 level 1 hospitals, and 10 private hospitals. For instances where facilities reported a different platform classification than what was recorded in the 2010 MOH facility list, we deferred to the facility report. Unless noted otherwise, we report on public and NGO-owned facilities within each platform together. This decision was informed by expert consultation with the ABCE team in Zambia.

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

TABLE 4 Types of questions included in the Patient Exit Interview Survey in Zambia

SURVEY CATEGORY	TYPES OF KEY QUESTIONS AND RESPONSE OPTIONS
Direct observation of patient	Sex of patient and/or patient's attendant
Direct interview with patient	Scaled-response demographic questions (e.g., levels 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

FIGURE 2 Districts sampled for the ABCE project in Zambia



DISTRICT	FACILITIES	FINAL SAMPLE (%)
Chadiza	6	3%
Chama	4	2%
Chililabombwe	6	3%
Chipata	8	4%
Kabwe	1	1%
Kafue	9	4%
Kalomo	8	4%
Kalulushi	8	4%
Kasempa	7	4%
Katete	7	4%
Kitwe	21	11%
Lukulu	7	4%
Lusaka	30	16%
Mbala	7	4%
Mongu	7	4%
Monze	8	4%
Mufumbwe	5	3%
Mumbwa	12	6%
Nyimba	4	2%
Samfya	7	4%
Sesheke	9	5%
Siavonga	7	4%
Total facilities	**188**	**100%**

TABLE 5 Facility sample, by platform, for the ABCE project in Zambia

FACILITY TYPE	ORIGINAL SAMPLE	FINAL SAMPLE	RESPONSE RATE
Hospitals	40	33	83%
Health centers	137	121	88%
Health posts	21	17	81%
Pharmacies/drug stores	32	13	41%
Dental clinics	22	4	18%
Total facilities	**252**	**188**	**75%**

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 costs 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 Zambia consider how to expand health system coverage and functions within constrained budgets.

Using the ABCE Zambia facility sample (Table 5), we analyzed five key drivers of health service provision at facilities:

- Facility-based resources (e.g., personnel, infrastructure and equipment, and pharmaceuticals), which are often referred to as inputs.
- Patient volumes and services provided at facilities (e.g., outpatient visits, inpatient bed-days), which are also known as outputs.
- Patient-reported experiences and their reported medical expenses, 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 Zambia, highlighting areas of high performance and areas for improvement.

Facility capacity and characteristics

Service availability

Across and within platforms in Zambia (Figures 3 and 4), several notable findings emerged for facility-based health service provision. All hospital types were the main providers of surgical services, internal medicine, and specialty care. Private hospitals more closely resembled the service profile of level 2 and level 3 hospitals than that of level 1 hospitals, with a greater proportion of private hospitals offering highly specialized services, such as pediatric surgery and gynecology, than Zambia's highest levels of public hospitals. However, fewer private hospitals provide more general services, such as nutrition, that align with some of the country's largest disease burdens (Murray et al. 2012). HIV/AIDS services were largely available among hospitals and urban health centers, but a lower proportion of smaller facilities, such as rural health centers and health posts, provide HIV/AIDS care. Over 60% of public and NGO-owned hospitals offered emergency services, whereas only 32% of rural health centers and 75% of private hospitals reported having an emergency unit or emergency team.

Differences in service availability across platforms were not unexpected, as the Zambian health system is deliberately structured to have varying levels of care, from hospitals to health posts (MOH 2005a). However, substantial variation was found *within* facility types, reflecting potential gaps in achieving or maintaining facility capacity requirements outlined in Zambia's strategic health plans (MOH 2005a). For example, according to the plans, the proportion of facilities providing nutritional care and support was expected to reach 60% by 2010 (MOH 2005a). Based on the ABCE sample, however, 49% of urban health centers, 38% of rural health centers, and 13% of health posts provided nutrition services in 2011–2012; across all platforms, 42% of facilities offered nutrition services. These findings illustrate many of the areas wherein basic service-provision gaps appear to exist, particularly among primary care facilities. In the next sections, we delve into the factors that likely affect the availability of these services across platforms.

FIGURE 3 Availability of services in hospitals, 2011–2012

	LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	PRIVATE HOSPITAL
Pharmacy	100	100	100
Laboratory	100	100	100
HIV/AIDS care	100	100	88
Surgery, general	90	92	88
Dentistry, general	100	69	88
Gynecology	79	77	100
Nursing	90	77	88
Pediatric	80	85	88
Family planning	70	92	88
Obstetric	90	85	75
Radiology, diagnostic	80	77	88
Immunization program	60	100	75
Internal medicine	80	69	75
Diagnostic/medical imaging	90	69	63
Morgue	80	100	38
Tuberculosis and other respiratory diseases	80	62	75
Health education services	90	69	50
Physical therapy and rehabilitation	80	69	50
Nutrition	90	69	38
Emergency medicine	50	69	75
Hematology	78	38	75
Surgery, pediatric	56	46	88
Orthopedic	70	31	88
Infectious disease/tropical medicine	90	54	38
Surgery, orthopedic	67	33	75
Public health services	70	77	25
Community outreach services	50	77	38
Anesthesiology	70	54	38
Intensive care, general	50	31	63
Ophthalmology	80	46	13
Intensive care, neonatal	60	15	63
Radiology, therapeutic	40	42	50
Dentistry, periodontal	60	17	50
Psychiatric	80	46	0
Intensive care, pediatric	60	15	50
Home-based services	40	69	13
Pathology	70	8	38
Dermatology	44	17	50
Perinatology	60	25	25
Blood donor center	70	15	25
Endoscopy	33	8	63
Palliative care	30	46	25
Neurology	40	8	50
Otolaryngology	40	15	38
Gastroenterology	38	15	38
Cardiology	30	8	50
Rehabilitation center	50	23	13
Surgery, ophthalmologic	56	17	13
Family medicine	22	38	25
Endocrinology and metabolism	40	17	25
Respiratory therapy	50	31	0
Long-term care center	40	23	13
Nephrology	30	8	38
Pulmonology	30	8	25
Urology	30	17	13
Occupational therapy	30	15	13
Surgery, neurological	33	0	25
Intensive care, cardiac	20	8	25
Stroke unit	30	8	13
Geriatric care/elder care	22	15	13
Oncology	50	0	0
Optometry	20	15	13
Chemotherapy	20	15	13
Surgery, colorectal	20	8	13
Smoking-tobacco cessation center	20	8	0
Speech/language pathology	10	0	13
Surgery, cardiovascular	10	0	13
Cardiac catheterization laboratory	0	8	13
Hospice	0	8	0

LOWEST AVAILABILITY — HIGHEST AVAILABILITY

Note: All values represent the percentage of facilities, by platform, that reported offering a given service.

FIGURE 4 Availability of services in health centers and health posts, 2011–2012

	URBAN HEALTH CENTER	RURAL HEALTH CENTER	PRIVATE HEALTH CENTER	HEALTH POST
Family planning	86	92	89	82
Immunization program	92	88	67	82
Community outreach services	89	85	33	71
HIV/AIDS care	86	64	67	47
Health education services	68	68	67	59
Pharmacy	78	66	67	41
Nursing	78	49	67	35
Home-based services	58	51	44	35
Pediatric	53	31	56	18
Obstetric	51	48	33	24
Tuberculosis and other respiratory diseases	68	36	22	18
Laboratory	62	34	33	6
Emergency medicine	38	32	22	41
Nutrition	49	38	13	13
Infectious disease/tropical medicine	36	19	22	25
Internal medicine	40	26	22	13
Public health services	36	36	11	18
Dentistry, general	27	16	22	0

LOWEST AVAILABILITY — HIGHEST AVAILABILITY

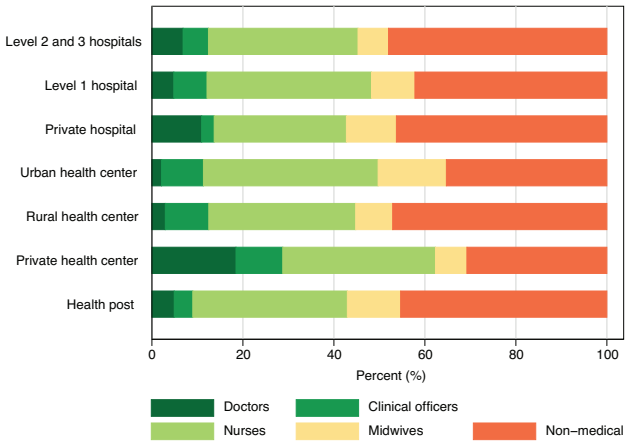
Note: All values represent the percentage of facilities, by platform, that reported offering a given service.

Human resources for health

Zambia 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 2011a). A facility's staff size and composition can directly affect the types of services it can effectively provide. As illustrated by Figure 5, there are some similarities and differences in staff composition across platforms. Notably, non-medical staff accounted for the largest proportion of personnel across nearly all facility types, ranging from an average of 31% in private health centers to 48% in level 2 and 3 hospitals. On the other end of the spectrum, doctors and clinical officers composed less than 14% of facility personnel, on average, across platforms, with the highest proportion at private health centers (29%) and the lowest at health posts (9%). The average facility composition of nurses was the most similar across platforms (between 29% and 38%).

Zambia's *National Health Strategic Plan (NHSP), 2011–2015* specifies few absolute personnel targets by facility type (MOH 2010a), but it emphasizes the country's investment in adequately staffing rural facilities. Based on the

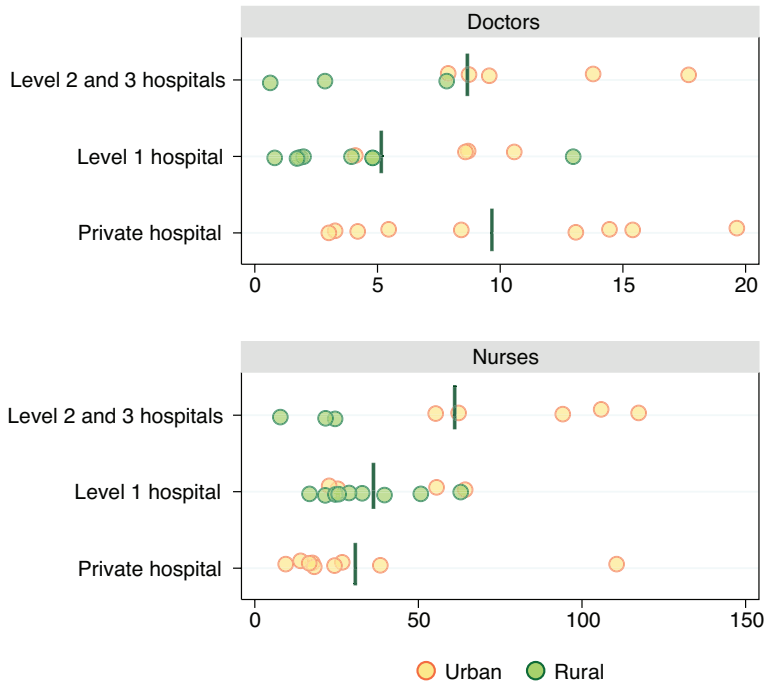
FIGURE 5 Composition of facility personnel, by platform, 2010



ABCE sample, we found facilities located in rural areas, across platforms, generally had far fewer medical personnel than their urban counterparts. Figure 6 depicts the distribution of doctors and nurses by type of hospital, and Figure 7 shows facility-level staffing numbers for doctors and clinical officers, nurses, and midwives by type of health center. For hospitals, these staffing disparities were most pronounced among level 2 and 3 hospitals, with nearly all urban level 2 and 3 hospitals exceeding the number of doctors and nurses found at their rural equivalents. Echoing the composition findings shown in Figure 5, nearly all private hospitals employed fewer nurses than public and NGO-owned hospitals but did not differ in terms of staffing doctors (especially in urban areas).

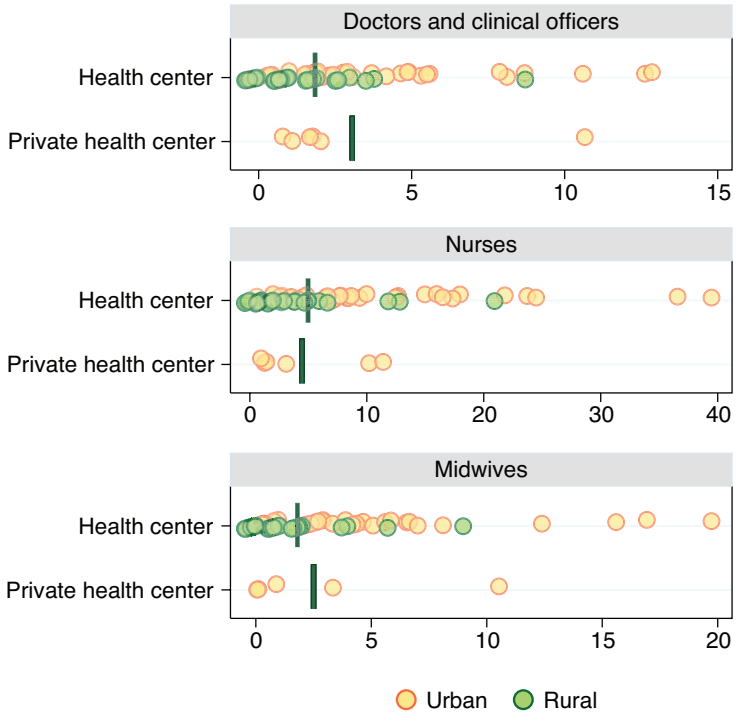
The staffing differences between urban and rural facilities in Zambia were only accentuated among health centers. Most rural facilities had fewer than two doctors or clinical officers on staff in 2010, and 45% employed neither. Urban health centers, by comparison, averaged three doctors and clinical officers, and only 21% lacked both. Rural health centers averaged two nurses per center, with 15% lacking any nursing support. Urban health centers averaged nine nurses per center, 30% more than rural health centers. Midwives were far more prevalent among urban health centers than rural ones; this finding, in combination with the low levels of antenatal care (ANC) and SBA in many rural districts, highlights the need for an increased focus on expanding ANC and SBA coverage (IHME 2014b).

FIGURE 6 Distribution of doctors and nurses, by hospital level, 2010



Note: Each circle represents a facility's number of doctors or nurses. The vertical line represents the average number of doctors or nurses across facilities within a given platform. Two hospitals were omitted from this figure due to their substantially larger staffs. Averages of personnel by hospital type depicted in this figure were computed without these two facilities.

FIGURE 7 Distribution of doctors and clinical officers, nurses, and midwives, by type of health center, 2010



Note: Each circle represents a facility's number of doctors and clinical officers, nurses, or midwives. The vertical line represents the average number of personnel across facilities within a given platform. One urban health center was omitted from this figure due to its substantially larger staff. Averages of personnel by health center type depicted in this figure were computed without this facility.

In an effort to "increase the number of employed and equitably distributed health workforce with appropriate skills mix" (MOH 2010a), Zambia's *NHSP, 2011–2015* uses the percentage of rural health centers with at least one midwife and one clinical officer as a key indicator. Based on the ABCE sample, we found that 43% of rural health centers had both of these skilled health personnel, 14% lacked a clinical officer but had at least one midwife, 16% had at least one clinical officer but no midwives, and 27% of facilities had neither in 2010. Of the facilities without a clinical officer or midwife on staff, 76% had at least one nurse.

Another staffing indicator was the percentage of health centers with two or more skilled health personnel, including doctors, nurses, midwives, and clinical officers. Based on the ABCE sample, we found that 62% of health centers met this target, which was substantially higher than the 2009 baseline (47%) (MOH 2010a). Except for one urban health center, all health centers with fewer than two skilled health personnel were located in rural areas. Four rural health centers reported having no skilled health personnel in 2010.

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.

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 ranging from laboratory to imaging equipment. Figure 8 illustrates the range of physical capital, excluding medical equipment, available across platforms.

Power supply. Access to a functional electrical supply was largely determined by a platform's location. Nearly all urban facilities, irrespective of their level of care, featured functional electrical connections to the energy grid. However, 38% of rural health centers and 47% of health posts lacked functional electricity.

FIGURE 8 Availability of physical capital, by platform, 2011–2012

	LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	PRIVATE HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER	PRIVATE HEALTH CENTER	HEALTH POST
Electricity	100	100	100	97	62	100	53
Piped water	100	77	70	79	27	100	29
Flush toilet	100	100	100	89	26	100	12
Disinfectant	88	67	100	94	77	100	63
TRANSPORTATION							
Any 4-wheeled vehicle	100	100	100	24	9	33	0
4-wheeled emergency vehicle	40	46	100	21	5	22	0
Any 2-wheeled vehicle	44	62	14	45	77	56	29
COMMUNICATIONS							
Any phone (cell or landline)	100	85	75	45	27	78	24
Computer	89	92	100	79	31	67	12

LOWEST AVAILABILITY — HIGHEST AVAILABILITY

Note: All values represent the percentage of facilities, by platform, that had a given type of physical capital.

Zambia 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, 30% of facilities with functional electricity also had a generator. Solar power was the main source of electricity for about one-third of rural health centers (35%) and health posts (33%), but none of these facilities also had a generator.

Facility level of care and location seemed to be related to the average number of hours facilities reported having electricity each day. Level 1 hospitals averaged just under 24 hours of daily electricity, whereas level 2 hospitals, private hospitals, and urban health centers all averaged about 22 hours of electricity each day. Rural health centers and health posts reported an average of 12 hours of electricity each day, with 43% of these facilities averaging six or fewer hours of daily electricity. Inadequate access to consistent electric power has substantial implications for health service provision, especially for the effective storage of medications, vaccines, and blood samples.

Water and sanitation. Availability of piped water varied substantially across platforms in Zambia. While all private health centers and level 2 and 3 hospitals had functional piped water, fewer than 80% of level 1 hospitals, private hospitals, and urban health centers used an improved water source. Piped water was far less available among rural facilities, with the majority of rural health centers and health posts using boreholes or wells as their main water source. Twelve percent of health posts lacked water access on or near facility grounds. This finding is worrisome given that 37% of health posts did not have disinfectant available at the time of visit, suggesting that adequate sanitation practices may be difficult for these facilities to implement. Disinfectant was much more available in urban facilities, but only 67% of level 1 hospitals had disinfectant at the time of visit. Level 1 hospitals also had lower levels of piped water (77%), which is of particular concern because they provide services requiring heightened sanitation (e.g., general surgery, emergency medicine) and are generally the highest level of care available in rural areas.

Primary waste systems also followed a stark urban-rural divide. All hospitals and private health centers had formal sewer infrastructure (with flush toilets), and nearly 90% of urban health centers featured flush toilets. Covered pit latrines were commonly found at rural health centers (66%) and health posts (65%), but many of these facilities were serviced by uncovered pit latrines as well (27% of rural health centers and 24% of health posts). Overall, 96% of facilities featured some form of improved sanitation system, but of those facilities, a portion of them also had unimproved waste structures on the same premises. Based on these findings, a number of facilities and their surrounding communities may experience elevated public health risks due to inadequate sanitation and waste disposal.

Transportation and communication. Facility-based transportation and modes of communication substantially varied across platforms and urbanicity. While all hospitals had access to some type of four-wheeled vehicle, very few health centers, irrespective of location and ownership, had them. A greater proportion of health centers had two-wheeled vehicles (45% of urban health centers and 77% of rural health centers), but this type of transportation clearly has its limitations, particularly on poorly maintained roads or during the country's wet season. With private hospitals as the clear exception, fewer than 50% of all other platforms had four-wheeled emergency transportation. This finding is cause for concern among lower-level hospitals and health centers, as they generally are the main facilities from which emergency referrals originate. Fewer than 25% of lower-level platforms had 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 public facilities. Interestingly, the availability of a functional computer in facilities generally exceeded that of phones, especially in urban health centers (79% had a functional computer and 45% had any kind of phone). Given the broad access to electricity among urban health centers, it is possible that the greater availability of computers may assist with recordkeeping and surveillance. Rural health centers and health posts featured minimal communications capacity, exemplifying the sizeable infrastructure gaps found between urban and rural localities. Internet connectivity was not assessed, but the field team reported inconsistent internet access in many areas of Zambia.

Equipment. In Zambia, facility equipment guidelines are designated by health system level (MOH 2008), with each successive facility type requiring additional and more sophisticated equipment than the level below it. Explicit guidelines for private facilities were not found, so we applied the equipment standards for their public counterparts (health centers and level 1 hospitals). Figure 9 shows equipment availability by platform, in accordance with MOH guidelines.

Overall, there were gaps in the availability of medical equipment at each type of facility. For health posts, 53% of facilities lacked the ability to measure blood pressure. Regardless of location and ownership, health centers generally lacked most of the equipment specifically designated to their level of care. However, in general, private health centers outperformed their public counterparts, especially in their stocks of suction machines and bag valve masks. Equipment availability varied more across hospital types, with level 1 hospitals generally having a higher availability of designated equipment, particularly imaging equipment (X-ray machines and ultrasound) than level 2 and 3 hospitals. For the most part, a greater proportion of private hospitals carried the equipment required for level 1 hospitals than level 1 hospitals themselves, which may reflect the private sector's more frequent specialization of services. In the ABCE sample, relatively few level 2 and 3 hospitals carried the equipment required for their specific level of care, which could affect adequate provision and quality of care for the country's most complex medical cases.

In general, a number of health centers, which are focused on delivering primary care in Zambia, were not necessarily equipped to provide the most basic components of such care. Even in urban health centers, 13% of facilities did not have an exam table, 11% lacked the capacity to measure blood pressure, and 24% did not have a stethoscope. Further, a portion of facilities in the ABCE sample did not carry any of the required medical equipment for their level of care; this worrisome finding applied to 1% of rural health centers, 3% of urban health centers, and 29% of health posts. With the country's growing burden of non-communicable diseases (NCDs) and related risk factors (e.g., early death and disability due to high blood pressure rose 86% between 1990 and 2010 [Murray et al. 2012]), it is increasingly important for health facilities to have the full range of recommended medical equipment to optimally diagnose and assess patient needs.

At the same time, a subset of facilities did have all of the required medical equipment designated to their level of care. Five health posts, one urban health center, and one rural health center met their respective equipment standards. It is possible that much could be learned from these

FIGURE 9 Availability of required medical equipment, by platform, 2011–2012

		LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	PRIVATE HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER	PRIVATE HEALTH CENTER	HEALTH POST
Required for all facilities	Stethoscope	78	92	100	76	68	100	71
	Exam table	89	69	71	87	77	89	88
	Blood pressure apparatus	78	92	100	89	73	89	47
Required for health centers and above	Refrigerator for medicines	89	85	100	82	81	100	
	Suction machine	89	69	100	37	18	89	
	Microscope	78	85	100	37	22	22	
	Bag valve mask	78	46	86	29	15	56	
	Centrifuge	67	62	57	26	11	11	
	Sterilizer	56	54	43	29	7	44	
Required for level 1 hospitals and above	Wheelchair	100	92	100				
	X-ray machine	78	100	100				
	Operating table	89	92	86				
	Electric autoclave	89	77	100				
	Generator	100	69	86				
	Ultrasound	67	92	86				
	Anesthesia	67	85	86				
	Oxygen canister	44	62	100				
	Incubator	78	54	71				
	Refrigerator for lab specimens	78	62	57				
	Dental drill	0	0	0				
Required for level 2 and 3 hospitals	Vital signs monitor	56						
	Defibrillator	22						
	ECG machine	11						
	Dialysis	0						

LOWEST AVAILABILITY — HIGHEST AVAILABILITY

Note: Availability of a particular piece of equipment was determined by facility ownership on the day of the visit. For example, many medical staff use their personally owned stethoscopes. Thus, stethoscope availability is dependent on personnel working at a facility at any given time, rather than a facility's equipment stores. All values represent the percentage of facilities, by platform, that reported having a given piece of equipment, as recommended by the MOH (MOH 2008).

facilities, particularly in terms of their acquisition and maintenance of medical equipment stocks.

These deficiencies in medical equipment availability are not unique to the facilities in the ABCE sample, as the 2005–2006 Public Expenditure Tracking/Quantitative Service Delivery Survey (PET/QSDS) also identified "serious deficits… across facilities in utilities, communications, transport, and medical equipment" (MOH et al. 2007). The persistence of these equipment deficits is cause for concern and warrants immediate attention.

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 exams, tests, and medications. Thus, it is import-

ant to consider this intersection of facility resources to best understand facility capacity for care. In this report, we focus on a subset of specific services (immunization, malaria treatment, and family planning), as well as the case management of high blood pressure, an increasing health issue in Zambia. We focused on these interventions as they represent both examples of high-priority health areas for the Zambian health system, such as broadening access to and coverage of key childhood immunizations, and 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. Zambia has purposefully prioritized expanding its immunization services for nearly a decade, as demonstrated by its comprehensive multiyear plans (MOH 2005b; MOH 2011b). These plans detail increasing vaccine provision via health centers, particularly those in rural areas; the Reaching Every District (RED) strategy to ensure that all districts attain high levels of immunization coverage; minimizing facility stock-outs of vaccines; and the target of having 90% of all children under the age of 1 year fully immunized. "Full immunization," according to Zambia's immunization schedule, includes having received the BCG vaccine, measles vaccine, the oral polio vaccine (OPV), and the pentavalent vaccine (MOH 2005b). Drawing from information collected by the ABCE Facility Survey, we assessed facility immunization services related to these priorities.

Figure 10 illustrates overall vaccine availability across platforms. The proportion of facilities that reported carrying any kind of vaccine was quite high, with the lowest among level 1 hospitals and health posts (88% each). In accordance with the country's immunization program priorities, the large majority of health centers, irrespective of location, reported carrying vaccines at the time of visit. These findings reflect Zambia's efforts to increase the availability of immunization services throughout the country, particularly in rural areas (MOH 2005b), as well as the structure of immunization delivery in the country. In urban areas, health centers generally provide the majority of immunization services, as opposed to hospital-based delivery, as urban hospitals are typically located near health centers with a formal immunization program. In rural areas, the distribution of facilities is sparser, which makes all levels of care, from hospitals to health posts, important delivery centers for immunization services.

Of the facilities that reported having vaccines, nearly 100% of private-sector facilities stocked all four of the key childhood immunizations. A portion of private health centers did not have OPV on the day of the facility visit, resulting in 80% of facilities with a full immunization stock of the four childhood vaccines. After private hospitals, health posts and urban health centers had the highest proportion of facilities with a full vaccine stock (88% and 85%, respectively), while level 2 and 3 hospitals reported the lowest (57%). It is important to note that the lower availability of vaccines at urban level 2 and 3 hospitals often corresponded to the higher availability of full immunization stocks at nearby urban health centers (e.g., one level 2 hospitals reported not stocking any of the four key childhood vaccines, but was supported by at least three fully stocked urban health centers), reflecting the structuring of immunization services in urban areas. This was further emphasized by the divide in vaccine stocks across urban and rural hospitals, such that 100% of all public or NGO-owned hospitals in rural areas, irrespective of their level, carried the measles vaccine, whereas 50% of level 2 and 3 hospitals and 67% of level 1 hospitals in urban localities had the measles vaccine at the time of visit. Among rural health centers, 75% carried all four key childhood vaccines, with the greatest proportion of facilities not having the pentavalent vaccine in stock at the time of visit (19%).

Zambia uses biannual Child Health Weeks as a main immunization outreach mechanism, particularly in rural areas (MOH 2005b); thus, facility-based availability of all vaccines fluctuates in parallel with Child Health Week preparations and administration. Failing to stock all recommended vaccines during these campaigns could potentially have a more detrimental effect than lacking them at other times, especially as Child Health Weeks target both children within the recommended age range for immunization and those who need "catch-up" vaccines. However, to achieve its ambitious "fully immunized child" targets, Zambian health facilities may benefit from more continuous vaccine stocks throughout the year.

Focusing on the availability of individual vaccines also reveals differences across and within platforms. Public and NGO-owned hospitals reported lower availability of BCG immunization, which is a vaccine that is supposed to be administered at birth or first contact with the health system

FIGURE 10 Availability of vaccines, by platform, 2011–2012

	LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	PRIVATE HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER	PRIVATE HEALTH CENTER	HEALTH POST
Carry any vaccines	100	88	100	97	96	100	88
VACCINE AVAILABILITY							
BCG	86	75	100	94	92	100	88
Measles	71	88	100	94	94	100	88
OPV	86	75	100	97	88	80	88
Pentavalent	57	75	100	88	81	100	88
All vaccines	57	75	100	85	75	80	88

LOWEST AVAILABILITY — HIGHEST AVAILABILITY

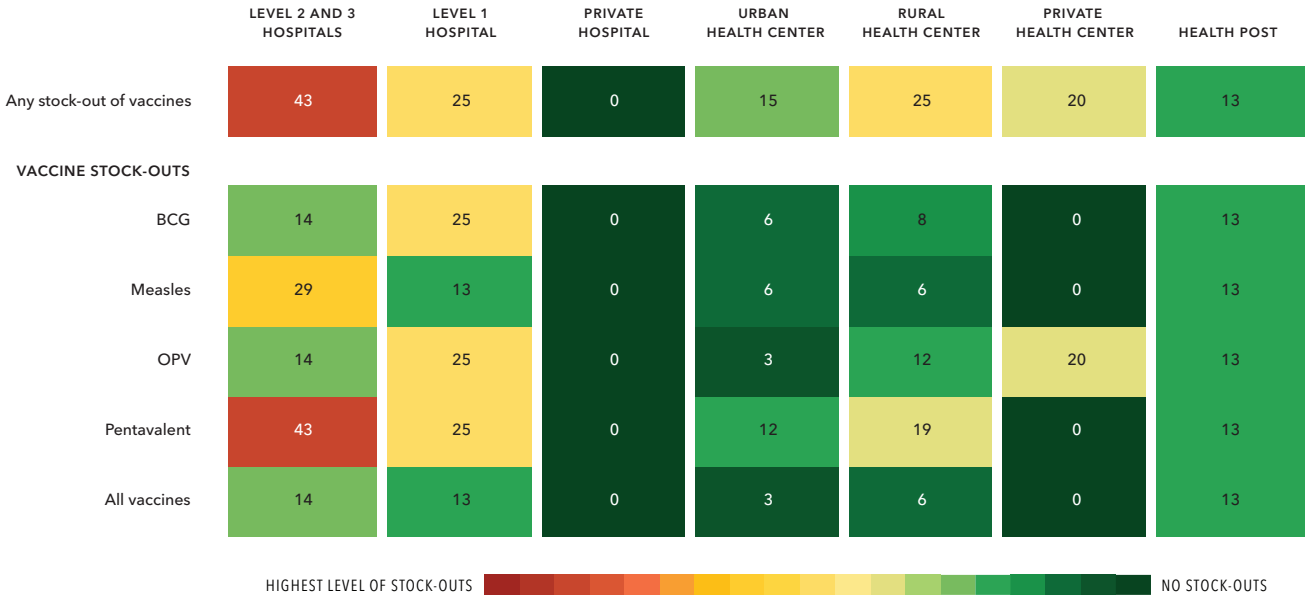
Note: Individual and combined vaccine availability was calculated based on the subsample of facilities that reported carrying any vaccines. Pentavalent vaccine availability includes facilities that had either the pentavalent vaccine in stock or all three components of the vaccine (diphtheria-pertussis-tetanus [DPT], Hib, and hepatitis B) in stock. All values represent the percentage of facilities, by platform, that reported carrying a given vaccine.

(MOH 2005b), whereas private facilities and health centers had very high availability of BCG at the time of visit. Zambia has experienced a number of localized measles outbreaks over the last few years, so the high availability of the measles vaccine at health centers is both likely a response to these outbreaks and a broader indicator of rising rates of measles immunization nationwide (i.e., no district documented measles immunization coverage below 86% in 2010, with a national average of 98% coverage [IHME 2014b]). However, it is interesting to note that 29% of level 2 and 3 hospitals did not carry the measles vaccine at the time of facility visit.

Zambia received its polio-free certification in 2005, but eight districts that border Angola and the Democratic Republic of Congo are considered at high risk for polio importation from these countries (WHO 2011). Two of these districts were included in the ABCE sample, and nearly all sampled facilities within these high-risk districts stocked OPV at the time of visit. Two facilities had stocked out of OPV in Lukulu district and one facility had stocked out of OPV in Sesheke district. The two facilities in Lukulu had also stocked out of all four recommended vaccines as well. With its nationwide introduction of the pentavalent vaccines in 2005, Zambia began phasing out of the individual immunization components (DPT, Hib, and hepatitis B) in favor of the pentavalent form (MOH 2005b). Among the facilities that carried vaccines, only four stocked individual pentavalent components without having the full pentavalent vaccine. This finding suggests that Zambia's phase-out of single-dose DPT and accompanying vaccine components may be working well.

Reducing vaccine stock-outs at facilities is a major priority in Zambia; in fact, the country set a target of 100% of districts with no stock-outs by 2007 (MOH 2005b). Based on the ABCE sample, we found that, among facilities that reported carrying vaccines, at least a few facilities within most platforms experienced some kind of immunization stock-out at the time of visit (Figure 11); however, private hospitals did not experience any stock-outs. Health posts and urban health centers reported the next lowest levels of any vaccine stock-out (13% and 15%, respectively), while 43% of level 2 and 3 hospitals experienced some kind of stock-out at the time of visit. With the exception of private health centers, the pentavalent vaccine was the most commonly stocked-out vaccine across platforms, which may be related to its recent introduction (MOH 2011). Among the 22 districts sampled for the ABCE project in Zambia, four districts (18% of the total sample) did not have any facilities with a vaccine stock-out at the time of visit. These districts

FIGURE 11 Vaccine stock-outs, by platform, 2011–2012



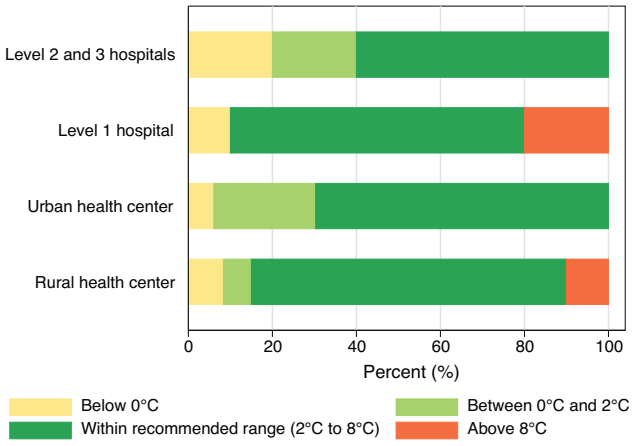
Note: Only facilities that reported carrying a given vaccine were included in the computation of the given vaccine stock-out. A vaccine was considered stocked out if a facility reported carrying the vaccine but did not have it stocked at the time of facility visit. All values represent the percentage of facilities, by platform, that stocked out of a given vaccine.

were Chadiza, Chama, Kasempa, and Nyimba. Notably, most of these four districts documented immunization coverage rates, across vaccines, that exceeded the national average in 2010 (IHME 2014b).

Beyond vaccine supply, several factors can affect a facility's capacity to provide immunization services, which include having 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, Zambia has prioritized increasing cold-chain capacity in its most recent immunization plan, for both existing vaccines and to qualify for the allocation of new immunizations (MOH 2011b). As part of the ABCE Facility Survey, we measured the storage temperature of all facilities that provided routine immunization storage and found that 28% of these facilities had refrigerators operating outside of the recommended storage range (2°C to 8°C) (WHO 2006). As shown in Figure 12, a greater proportion of facilities had storage temperatures below the recommended range, except for level 1 hospitals, wherein 20% of facilities experienced storage temperatures exceeding 8°C and 10% were below 0°C. Urban health centers had the lowest levels of improper storage readings, with only 6% of facilities recording storage temperatures below 0°C. At least 20% of urban health centers and level 2 and 3 hospitals recorded storage temperatures between 0°C to 2°C, a range in which vaccines are at high risk for becoming frozen (WHO 2008).

Availability of malaria treatment. Although Zambia has made notable progress in reducing its malaria burden (RBM 2011), the disease was still the country's second-leading cause of death in 2010 (Murray et al. 2012). Artemisinin-based combination therapies (ACTs) have been Zambia's first-line drug for uncomplicated malaria

FIGURE 12 Vaccine storage temperature range, by platform, 2011–2012

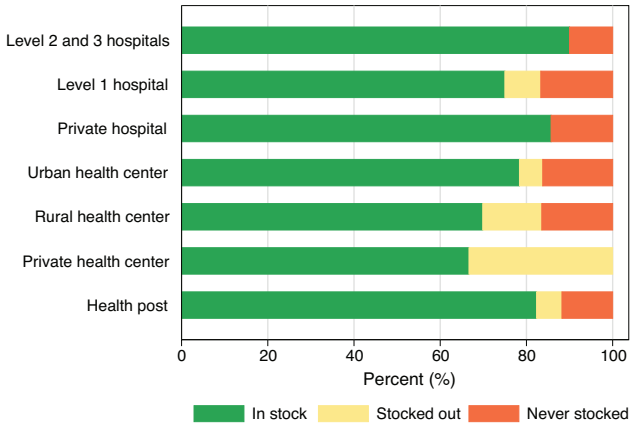


Note: Only facilities that reported carrying vaccines were included in this analysis.

since 2005 (MOH 2006), but studies indicate that facilities, especially those in rural areas, often experience ACT stock-outs. Figure 13 illustrates the range in ACT availability across platforms at the time of facility visit. We found that the vast majority of facilities stocked ACTs when they were visited, ranging from 67% of private health centers to 90% of level 2 and 3 hospitals. A lower proportion of rural health centers had ACTs (70%) than their urban equivalents (78%), which could be cause for concern given that rural areas in Zambia generally experience higher levels of malaria transmission than urban centers (Masaninga et al. 2013).

Across platforms, 10% of facilities had stocked out of ACTs at the time of visit, with the highest levels of stock-outs observed among private health centers (33%) and rural health centers (14%). Zambia's rainy season extends from November to April, during and immediately after which malaria transmission is most intense (Masaninga et al. 2013). The ABCE Facility Survey administration overlapped with some of these months of elevated malaria risk, which suggests that facility ACT stock-outs could be related to high demand for malaria treatment or indicative of supply chain issues. With the exception of private health centers, 10% to 17% of facilities across all platforms reported never carrying ACTs. This finding did not vary substantially across level of care, facility ownership, or urbanicity (i.e., urban and rural health centers reported similar rates of never stocking ACTs). Although some districts experience low levels of malaria transmission, and Zambia aims to have five malaria-free districts by 2015 (MOH 2011c), the fact that any facilities report never stocking the country's first-line drug against a major infectious disease warrants further examination.

FIGURE 13 Availability of ACTs, by platform, 2011–2012



Availability of family planning options. Zambia's most recent national strategic health plan outlined the importance of increasing access to modern contraceptives and family planning options throughout the country (MOH 2010a). With the ABCE Facility Survey, we assessed the availability of individual contraceptives as well as options for multiple methods (Figure 14). Condoms were most widely available across platforms, which is not surprising given that condoms are not exclusively used for family planning purposes (i.e., namely HIV/AIDS prevention, as well as protection against other sexually transmitted diseases). Injectables and oral contraceptives were the next most commonly available options, especially among lower levels of care (health centers and health posts). With the exception of private hospitals, which generally had the lowest availability of most contraceptive options, at least 70% of all facilities across platforms offered condoms and at least one type of female family planning method. Notably, 96% of rural health centers had these two forms of modern contraceptives; this is an improvement from the 2005–2006 PET/QSDS that found a substantial gap in self-reported capacity for and facility-based availability of family planning options among rural health centers (MOH et al. 2007). Substantially fewer facilities stocked condoms, at least one type of female family planning method, and emergency contraceptives. Private hospitals had the highest availability of emergency contraceptives (71%), but due to the relatively low availability of female family planning options, only 50% of private hospitals offered these three contraceptives, equaling the proportion of urban health centers that offered them.

Hypertension case management. As high blood pressure affects more Zambians (e.g., a 2010 survey found that nearly 35% of adults in Lusaka district were hypertensive [Goma et al. 2011]), a facility's ability to properly test for and treat hypertension is increasingly critical. Figure 15 depicts the availability of both blood pressure cuffs and any type of antihypertensive medication at the time of facility visit. The vast majority of facilities had at least a blood pressure cuff or medication to treat high blood pressure; however, an urban-rural gap was revealed for the case management of hypertension, as 9% of rural health centers and 18% of health posts lacked both diagnostics and medication. Notably, a substantial number of private facilities did have the proper diagnostic equipment but lacked antihypertensive medications, whereas many more public facilities stocked antihypertensive medication but did not have a blood pressure cuff at the time of visit. Level 1 hospitals and private hospitals featured the greatest capacity for hypertension case management, with 92% and 83% of facilities,

FIGURE 14 Availability of modern contraceptives, by platform, 2011–2012

	LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	PRIVATE HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER	PRIVATE HEALTH CENTER	HEALTH POST
INDIVIDUAL OPTIONS							
Condoms	80	100	71	95	96	100	100
Injectables	70	85	57	89	97	67	76
Oral contraceptive	50	69	57	92	85	89	82
Implants	50	62	57	58	34	11	12
Intrauterine device (IUD)	40	46	43	34	11	0	18
Emergency contraceptive	40	46	71	54	39	33	18
MULTIPLE OPTIONS							
Condom and one female contraceptive	70	85	50	89	96	89	88
Condom, at least one female contraceptive, and emergency contraceptive	40	46	50	50	35	33	18

LOWEST AVAILABILITY — HIGHEST AVAILABILITY

Note: Under the availability of multiple contraceptive options, having at least one female contraceptive was measured by a facility's availability of at least one of the following at the time of visit: oral contraceptive, injectables, implants, or an intrauterine device (IUD). All values represent the percentage of facilities, by platform, that had a given contraceptive.

respectively, having both diagnostics and treatment for high blood pressure at the time of visit. Among the rising rates of various non-communicable diseases and associated risk factors facing Zambia, hypertension may be considered one of the easier – and less expensive – to properly diagnose and treat. If case management gaps exist for hypertension, it is possible that even fewer facilities are fully equipped to handle more complex conditions, such as ischemic heart disease, diabetes, and stroke.

Facility outputs

Measuring a facility's patient volume and types of services delivered, which are known as outputs, is critical to understanding how facility resources align with demands for care. Figure 16 illustrates trends in average outpatient volume across platforms and over time. Overall, most platforms experienced very gradual increases in or stagnation of outpatient visits between 2006 and 2010; the clear exceptions were health posts and level 2 and 3 hospitals, which recorded annual increases of 10% and 11%, respectively, in average outpatient volumes from 2006 to 2010. By 2010, urban health centers documented the second-highest level of average outpatient visits, after Zambia's largest hospitals. Notably, rural health centers and health posts had similar average outpatient volumes in 2010; this finding may reflect the purposeful placement of health posts among hard-to-reach, rural communities and the success of their community outreach services (as shown in Figure 4).

Figure 17 depicts trends in average inpatient volumes across platforms that had inpatient capacity. Public and NGO-owned hospitals showed gradual growth in inpatient visits over time and generally experienced an average inpatient

FIGURE 15 Capacity to test for and treat hypertension, by platform, 2011–2012

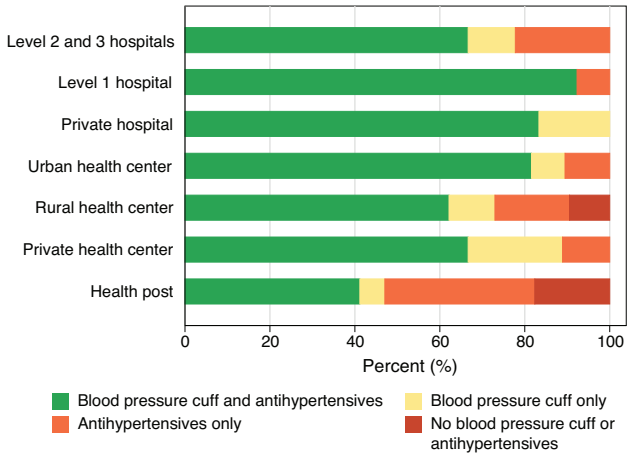
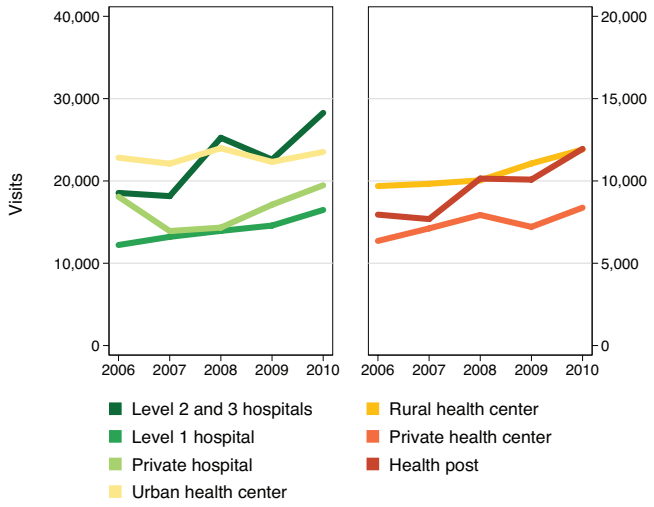


FIGURE 16 Average number of outpatient visits, by platform, 2006–2010



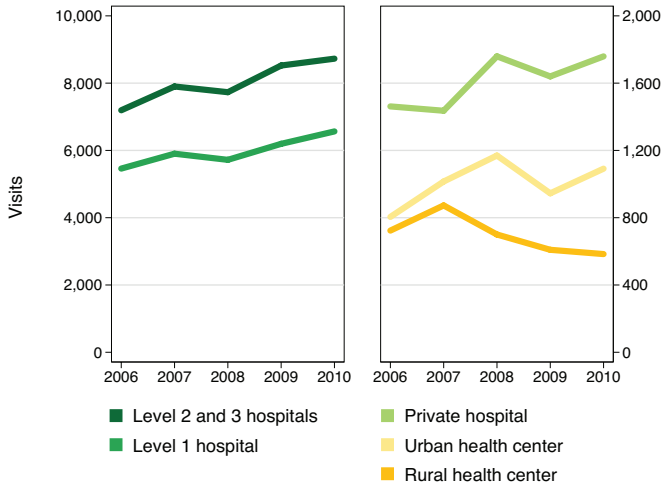
load over three times larger than those found in private hospitals. Trends in average inpatient visits diverged across urban and rural health centers, with the former increasing overall and the latter declining over time.

Among sampled facilities that provided ART services, we found that average ART visits increased rapidly across platforms between 2006 and 2010 (Figure 18). This finding corresponds with Zambia's expansion of ART services, especially after support of antiretrovirals (ARVs) and corresponding treatment programs from the US President's Emergency Plan for AIDS Relief (PEPFAR) started in 2004 (PEPFAR 2014). For example, average ART visits nearly quadrupled among urban health centers from 2006 to 2010, rising to an average of 19,572 ART visits in 2010. Notably, average ART volumes were more similar among urban health centers and level 2 and 3 hospitals, whereas rural health centers and level 1 hospitals recorded more comparable ART visits. A greater proportion of level 2 and 3 hospitals are located in urban areas, so this division across public and NGO-owned platforms may be related to the disproportionate HIV/AIDS burden experienced by Zambia's more densely populated localities (NAC 2010).

Inpatient visits generally entail more service demands than outpatient visits, including ongoing occupancy of facility resources such as beds. In Figure 19, bed occupancy rates are displayed across platforms for 2010. A facility's occupancy rate was calculated by dividing the number of reported inpatient bed-days for 2010 by the number of beds within a facility, multiplied by 365 (days). Overall, occupancy rates were relatively low across platforms and facilities in 2010, with only 12 facilities recording rates higher than 50%. This finding implies that the availability of facility beds was not a major constraint to providing inpatient services. Health centers showed a clear divide in occupancy rates by facility location, with 76% of rural health centers falling below the platform average of 20%.

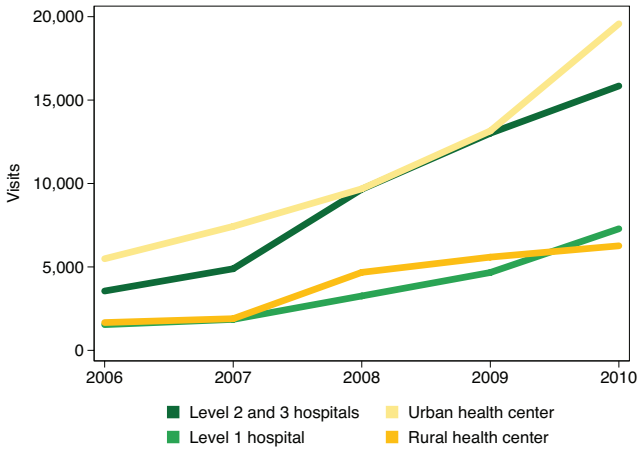
It is important to note that the ABCE Facility Survey did not capture information on the length of inpatient stays,

FIGURE 17 Average number of inpatient visits, by platform, 2006–2010



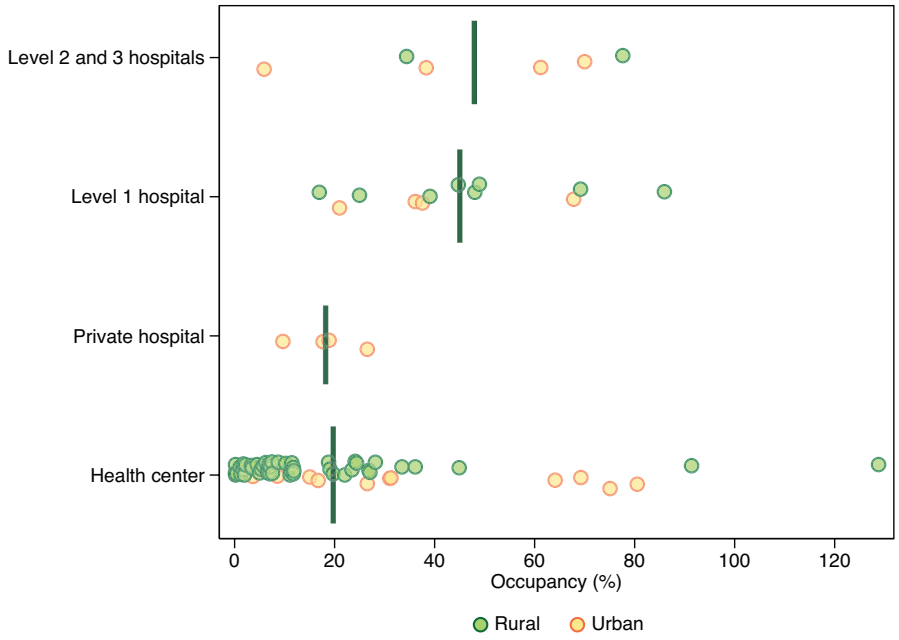
Note: Only one private health center reported having inpatient services in the ABCE sample. In 2010, this facility had 499 inpatient visits.

FIGURE 18 Average number of ART visits, by platform, 2006–2010



Note: No private hospitals in the ABCE sample reported providing ART services. Only one private health center reported providing ART in the ABCE sample. In 2010, this facility had 11,223 ART visits.

FIGURE 19 Facility occupancy rates across platforms, 2010



Note: Each circle represents a facility's occupancy rate in 2010. The vertical line represents the average occupancy rate across facilities within a given platform. We do not present on occupancy rates at private health centers because only one private health center reported having inpatient services. The facility's occupancy rate for 2010 was 13%.

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 hinges 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 6 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 these patients were women and were younger than 30 years old. Most patients, or attendants if they were younger than 15 years old, had a post-primary education. However, patient composition was slightly different across urban and rural primary care facilities, with a lower proportion of interviewed patients at rural health centers and health posts having attained a post-primary education (35% and 40%, respectively) compared to patients presenting at urban health centers (66%). Patients seeking care at private facilities generally had much higher rates of post-primary education (93% for private hospitals and 95% for private health centers) than patients who went to public and NGO-owned facilities (e.g., 70% for level 2 and 3 hospitals and 57% for level 1 hospitals).

Out-of-pocket expenditures

With the exception of level 3 hospitals, at which user fees can account for up to 10% of facility revenues, patients who seek care from public facilities in Zambia are supposed to pay minimal medical expenses; in fact, the Zambian government abolished user fees for primary health services and medical care in rural areas in 2006 (Masiye et al. 2010). Patient reports from the facilities in the ABCE sample align with this policy change, such that medical care provided at most public and NGO-owned facilities, excluding level 2 and 3 hospitals, resulted in few, if any, out-of-pocket expenditures (Figure 20). We found that the majority of patients (89%)

TABLE 6 Characteristics of patients interviewed after seeking non-HIV care at facilities, 2011–2012

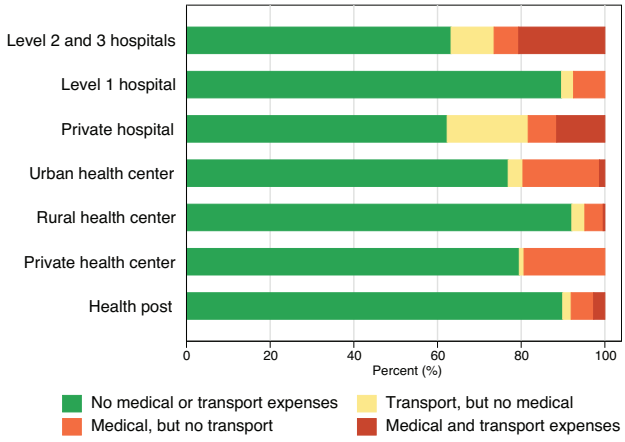
CHARACTERISTIC	LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	PRIVATE HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER	PRIVATE HEALTH CENTER	HEALTH POST	ALL FACILITIES
Percent female	62%	57%	65%	75%	69%	67%	69%	69%
Educational attainment								
None or pre-primary	2%	4%	1%	7%	14%	0%	17%	9%
Primary	29%	39%	6%	27%	52%	5%	43%	37%
Post-primary	70%	57%	93%	66%	35%	95%	40%	53%
Patient age (years)								
≤ 5	5%	9%	19%	24%	23%	30%	40%	23%
6–17	9%	13%	10%	14%	14%	7%	16%	13%
18–29	39%	38%	30%	30%	31%	32%	19%	31%
30–39	24%	16%	19%	17%	15%	20%	12%	16%
40–49	11%	10%	12%	6%	8%	9%	6%	8%
≥ 50	12%	13%	10%	8%	9%	2%	8%	9%
Self-reported overall health								
Poor	10%	7%	13%	12%	14%	10%	11%	12%
Fair	25%	30%	25%	35%	22%	48%	15%	27%
Good	29%	37%	37%	30%	34%	13%	32%	32%
Very good	22%	21%	16%	17%	19%	20%	33%	19%
Excellent	14%	5%	10%	5%	11%	9%	8%	9%
Total patient sample	**68**	**174**	**191**	**623**	**1,026**	**88**	**149**	**2,319**

Note: Educational attainment refers to the patient's level of education or the attendant's educational attainment if the interviewed patient was younger than 15 years old.

reported no medical expenses across facilities, with fewer than 6% of patients paying medical expenses at level 1 hospitals, rural health centers, and health posts. Notably, a comparable percentage of patients had some kind of medical expense at urban health centers and private health centers.

Among patients presenting to level 2 and 3 hospitals and private hospitals, many experienced an additional financial burden in transportation expenses. At these facilities, over 30% of patients reported incurring a transport-related expense prior to receiving care. This finding may be explained by patients traveling far distances to access specialty care at these facilities. Fewer than 6% of patients who sought care at level 1 hospitals, health centers, and health posts reported transportation expenses associated with their visit. Over 20% of patients attending level 2 and 3 hospitals reported incurring both medical expenses and transportation expenses, followed by 12% of patients who sought care at private hospitals.

FIGURE 20 Patient medical and transportation expenses, by platform, 2011–2012



The vast majority of patients who were not seeking HIV services experienced minimal, if any, expenses associated with their visits; for those patients that did pay, there was variation in the expenses they incurred. Figure 21 depicts the proportion of patients who experienced different levels of medical expenses at each sampled facility and across facility types and ownership. The majority of medical expenses paid at public and NGO-owned facilities were less than 5 kwacha ($1), whereas most patients who had medical expenses at private facilities spent more than 50 kwacha ($9) for care. More than 70% of patients reported having user fees at a rural health center in Southern province, with 3% paying less than 5 kwacha ($1) for services and 70% spending between 5 and 49 kwacha ($1 to $9) for care. Patients also reported paying medical expenses at two other rural health centers in Southern province. Because publicly owned health centers in rural areas should not be charging user fees, per Zambian national policy since 2006 (Masiye et al. 2010), determining why patients at some rural health centers experienced these medical expenses may warrant further attention.

Travel and wait times

The amount of time patients spend traveling to facilities and then waiting for services can substantially affect health care-seeking behaviors. Among interviewed patients, we found that average travel time to facilities and wait times at facilities varied substantially by platform and facility location

FIGURE 21 Levels of medical expenses experienced by patients not seeking HIV services, by platform, 2011–2012

Note: Each bar represents a facility and the proportion of patients who paid different levels of medical expenses.

(Figure 22). It is important to note that patients only reported on the time spent traveling to facilities, not the time needed for a round-trip visit. In general, patients at public and NGO-owned facilities experienced longer travel times than those seeking care at their private counterparts. This is likely to be related to the locations of these private facilities, which were predominately in urban areas. Urban health centers, for example, had a much more similar travel time profile to that of private hospitals. Nearly half of patients presenting at public and NGO-owned hospitals traveled at least one hour to receive care, and more than 20% took two or more hours to reach these hospitals. This finding may be explained by two factors: (1) the closest hospital for many patients, especially those in rural areas, is often far away; and (2) 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 relatively nearby facilities. Fewer than 50% of patients who sought care at health posts spent less than 30 minutes traveling. On average, patients seeking care at urban facilities traveled 47 minutes, whereas their rural counterparts spent an average of 70 minutes traveling for care.

In terms of wait time, a large portion of patients had to wait at least one hour before receiving care at public and NGO-owned facilities, whereas the majority of patients at private facilities experienced wait times less than one hour (Figure 23). This divide was most evident among level 2 and 3 hospitals and private hospitals, with 53% of patients waiting at least two hours before receiving care at the former, and fewer than 10% of patients at private hospitals experiencing similarly long wait times. Interestingly, 46% of patients waited fewer than 30 minutes at health posts, whereas just over 24% of patients at rural health centers and 41% at urban health centers reported comparably short wait times. Average wait times did not differ much by facility location, with patients reporting an average wait time of 90 minutes at urban facilities and 94 minutes at rural facilities.

Overall, patients spent more time waiting for health services than traveling to receive them (Table 7). At level 2 and 3 hospitals, for example, 66% of patients reported spending more time waiting at the hospital for care than traveling to the facility; conversely, only 25% of patients indicated traveling for a longer amount of time to reach a level 2 or 3 hospital than the time they spent waiting for care. More patients at urban health centers reported waiting longer for care (55%) than those who traveled for a longer amount of time (37%); this difference was even greater among patients at private health centers, with 64% of patients waiting longer than the time it took to travel to the facility and 26% reporting the opposite. Similar results were documented in a World Bank report (Picazo and Zhao 2009), wherein 60% of patients reported being within a 30 minute walk from a health facility, but average wait times were more than twice as long (65 minutes). Longer wait times were attributed to staffing shortages at the time; however, our findings from the ABCE project in Zambia are less conclusive.

Patient satisfaction with care. Overall, interviewed patients reported relatively high levels of satisfaction with the care, but average ratings differed by platform (Figure 24). More than 70% of patients who received care from private hospitals and level 2 and 3 hospitals gave an overall rating of 8 or higher, out of a possible 10, far exceeding the

FIGURE 22 Patient travel times to facilities, by platform, 2011–2012

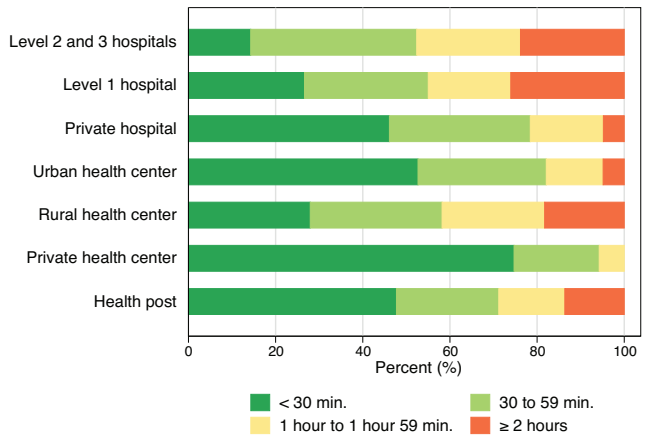


FIGURE 23 Patient wait times at facilities, by platform, 2011–2012

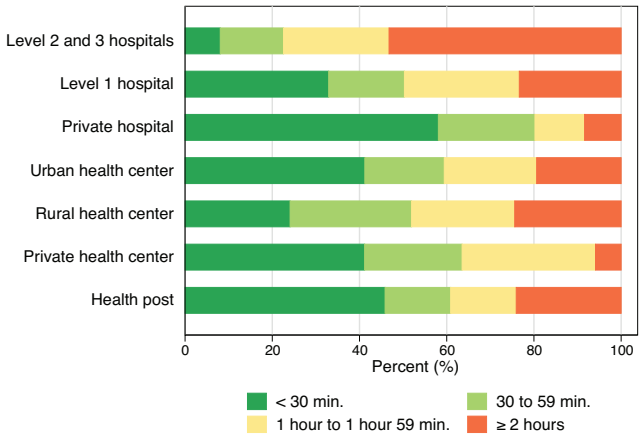


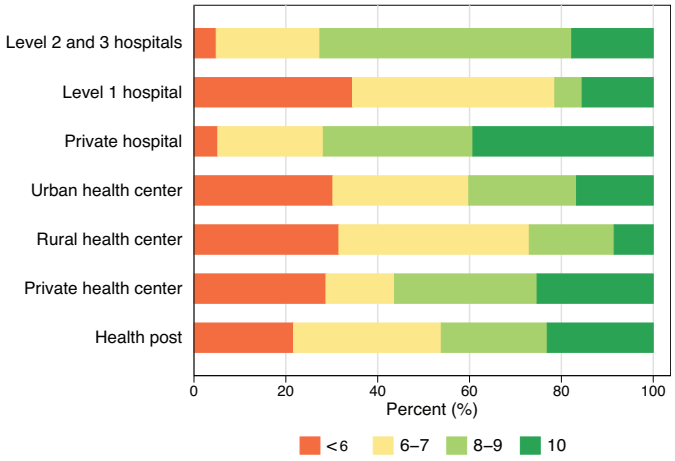
TABLE 7 Patient reports of time spent traveling to facilities and waiting for care, by platform, 2011–2012

PATIENT REPORTS	LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	PRIVATE HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER	PRIVATE HEALTH CENTER	HEALTH POST
Longer travel time	25%	49%	50%	37%	34%	26%	40%
Longer wait time	66%	45%	30%	55%	48%	64%	47%
Equal travel and wait time	9%	6%	20%	8%	18%	10%	13%

proportion of patients who gave the same ratings at other facilities. This finding is particularly noteworthy for level 2 and 3 hospitals, given that patients presenting at these facilities also reported some of the longest wait times for care. Level 1 hospitals and health centers (both rural and urban) had at least 30% of patients rating their experience below a score of 6 out of 10.

Figure 25 provides a more in-depth examination of patient ratings of facility characteristics and visit experiences. Overall, private facilities had higher average ratings across all visit indicators, particularly private hospitals. Patients gave higher average ratings for staff interactions across platforms than the average scores associated with facility characteristics. This contrast was most evident among health posts, with patients reporting relatively low levels of satisfaction with wait time (an average of 3 out of 5) and spaciousness (an average of 2.8 out of 5). These findings echo results documented in a 2009 World Bank country report, wherein patient ratings of care were quite high (85% out of 100%), especially for staff interactions (Picazo and Zhao 2009).

FIGURE 24 Patient ratings of facilities, by platform, 2011–2012



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.

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 for estimating efficiency

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 (doctors, nurses, and other medical staff) and 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 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, but on average, we

FIGURE 25 Average patient ratings of facility visit indicators, by platform, 2011–2012

	LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	PRIVATE HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER	PRIVATE HEALTH CENTER	HEALTH POST
Overall rating	**8.2**	**6.2**	**8.5**	**7**	**6.5**	**7**	**7.3**
STAFF INTERACTIONS							
Provider respectfulness	4.4	3.8	4.4	4.1	4.1	4.4	4.1
Provider compassion	4.3	3.8	4.4	4	4	4.4	4.1
Provider reception	4.3	3.7	4.4	4	4	4.3	4.1
Provider honesty	4.2	4	4.4	4.1	4.1	4.2	4.2
FACILITY CHARACTERISTICS							
Privacy	4.1	4	4.5	4.1	4.2	4.1	4.1
Wait time	3.3	3	4	3.3	3.3	3.9	3
Cleanliness	3.8	3.2	4.6	3.4	3.5	4.2	3.5
Spaciousness	3.7	3.1	4.5	3.1	3.1	4	2.8

LOWEST RATINGS — HIGHEST RATINGS

Note: Average overall 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."

estimated that one inpatient bed-day was equivalent to 3.7 outpatient visits; one birth was equivalent to 10.6 outpatient visits; and one ART visit was equivalent to 1.6 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.

Efficiency

Both across and within platforms, we found a remarkable range in health service production and efficiency scores among Zambian 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 three visits in private hospitals to 16 visits at health posts. Interestingly, private health centers averaged much lower total facility outputs per medical staff per day (three) compared to health centers (six for urban health centers and 11 for rural health centers). Public and NGO-owned hospitals recorded between five and seven outpatient equivalent visits per medical staff per day (seven for level 2 and 3 hospitals and five for level 1 hospitals). Figure 26 shows that rural facilities, namely rural health centers and health posts, averaged higher service production per day than urban facilities.

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 and health posts. Urban health centers saw the largest volume of ART-specific visits, measured in outpatient equivalent visits, averaging 0.9 visits per medical staff per day; level 2 and 3 hospitals had the next highest volumes. For inpatient bed-days, as reported in outpatient equivalent visits, level 2 and 3 hospitals had the highest outputs per medical staff per day (three), with inpatient bed-days accounting for a large proportion of each of these facilities' total output volume. Notably, private hospitals and rural health centers had about the same average inpatient

bed-days per medical staff per day (two), but because rural health centers had much higher volumes of outpatient visits, on average, inpatient bed-days accounted for a smaller proportion of this platform's total patient volume.

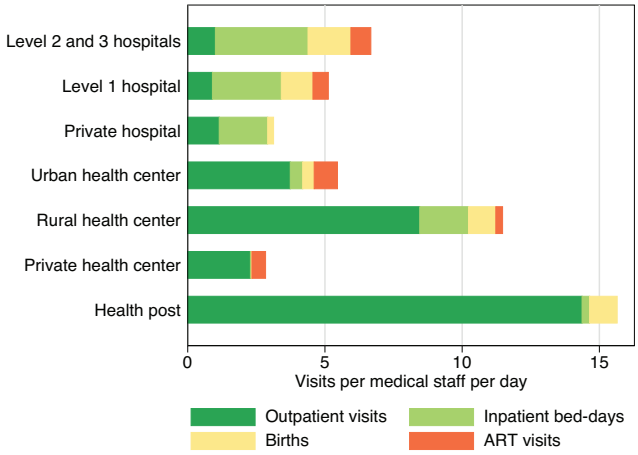
In estimating efficiency scores for all facilities, two main findings emerged. First, efficiency scores were generally quite low across all health facilities, with 70% of facilities scoring 50% or lower. Second, the range between the facilities with the highest and lowest efficiency scores was quite large within platforms, especially among public and NGO-owned facilities. This finding suggests that a substantial performance gap may exist between the average facility and facilities with the highest efficiency scores. Figure 27 depicts this range of facility efficiency scores across platforms.

A greater proportion of larger public facilities (varying levels of public hospitals) generally had higher efficiency scores than smaller facilities (health centers and health posts), but there was notable overlap at each end of the efficiency spectrum. Across public and NGO-owned facilities, at least one facility recorded an efficiency score of 78% or higher, and among each type of health center and health posts, multiple facilities posted efficiency scores of 100%. By comparison, numerous facilities, especially among health centers, had efficiency scores of close to 0%.

Facility location seemed to be related to efficiency scores in different ways across platforms. Among level 2 and 3 hospitals, for example, a greater proportion of urban facilities had higher efficiency scores than those located in rural areas; at the same time, a number of urban level 2 and 3 hospitals received efficiency scores below 3%. For level 1 hospitals, more rural facilities exceeded the efficiency average for the platform than urban ones. Urban health centers averaged an efficiency score of 40%, with a range of 3% to 100%, and rural health centers scored an average of 42%, ranging from 2% to 100%.

Table 8 compares facility characteristics of the "most efficient" facilities (those that ranked among the top 10% of efficiency scores in 2010) 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 had higher levels of efficiency), but they were not necessarily universal. For private hospitals, for example, the facility with the lowest efficiency score reported more than twice the number of inpatient bed-days than hospitals with the highest efficiency score. Among rural health centers and health posts, facilities with the highest efficiency scores generally had fewer total medical staff (summing the average number of doctors, nurses, and other medical staff together) than facilities with the lowest 10% of efficiency scores. The opposite was found for urban health centers and private health centers, with the highest-scoring facilities generally having many more medical personnel than facilities with the lowest 10% of efficiency scores. Patient composition also varied across different facility types, such that the private hospital with the highest efficiency score had far more outpatient visits than inpatient bed-days, whereas the average number of inpatient bed-days far exceeded outpatient visits at level 1 hospitals with the highest 10% of efficiency scores. In sum, the efficiency with which health facilities operate in Zambia is likely affected by several factors, including but certainly not limited to facility-based capital and patient volumes.

FIGURE 26 Range and composition of average output production across platforms, 2010

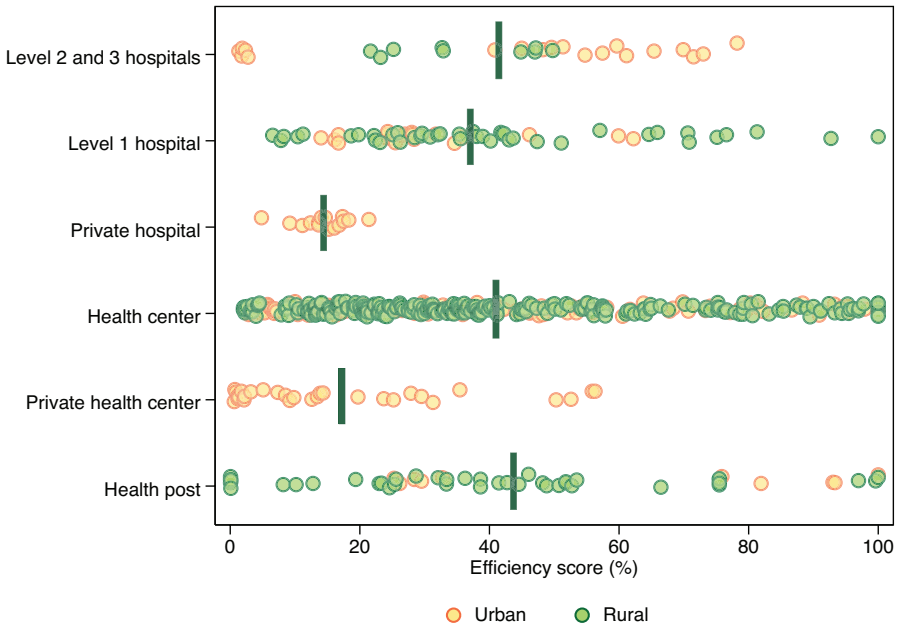


Note: All visits are reported in outpatient equivalent visits estimated at the facility level. Conversion to outpatient equivalent visits varied across facilities; on average, one inpatient bed-day was equivalent to 3.7 outpatient visits; one birth was equivalent to 10.6 outpatient visits; and one ART visit was equivalent to 1.6 outpatient visits.

As shown in Figure 27, a large portion of health facilities in Zambia 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 28 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

FIGURE 27 Range of efficiency scores, by platform, 2006–2010



Note: Each circle represents a facility's efficiency score for a given year between 2006 and 2010. 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, 2010

	LEVEL 2 AND 3 HOSPITALS		LEVEL 1 HOSPITAL		PRIVATE HOSPITAL		URBAN HEALTH CENTER		RURAL HEALTH CENTER		PRIVATE HEALTH CENTER		HEALTH POST	
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 (%)	**78**	**2**	**61**	**11**	**18**	**17**	**88**	**8**	**98**	**5**	**56**	**1**	**100**	**0**
Average annual outputs														
Outpatient visits	35,524	1,876	27,570	2,349	26,462	3,385	23,574	4,164	12,887	3,525	34,310	216	17,463	241
Inpatient bed-days	64,071	4,532	37,559	7,750	2,124	7,580	N/A	N/A	735	113	561	N/A	102	2
Births	2,635	N/A	963	511	356	N/A	1,371	38	221	15	10	N/A	79	N/A
ART visits	27,728	712	10,297	3,042	N/A	N/A	11,443	787	1,144	N/A	11,223	N/A	N/A	N/A
Total outputs	129,958	7,120	76,388	13,653	28,944	10,967	36,388	4,451	14,033	3,577	46,104	216	17,644	243
Average inputs														
Beds	458	210	137	85	60	88	N/A	N/A	23	5	12	N/A	4	3
Doctors	13	8	8	4	8	5	1	1	0	0	1	1	0	0
Nurses	62	55	38	63	38	9	9	7	2	2	10	1	1	2
Other medical staff	4	18	18	17	35	2	10	5	2	5	12	0	1	8
Non-medical staff	160	84	24	45	37	13	10	5	2	4	9	2	2	3
Total number facilities	**1**	**1**	**2**	**1**	**1**	**1**	**3**	**3**	**6**	**5**	**1**	**1**	**2**	**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.

on our analyses, private facilities had the largest potential for increasing service provision without expanding current resources. Overall, based on our estimation of efficiency, a large portion of Zambian health facilities, both urban and rural, could increase the volume of patients seen and services provided with the resources available to them.

Compared to the other sub-Saharan African countries currently included in the ABCE project, we found that, on average, Zambia performed at similar or higher levels of efficiency (Table 9). In Zambia, the average efficiency score across all facilities was 42% in 2010, which was higher than the average scores for Kenya (41%), Uganda (31%), and Ghana (27%). Further, Zambia featured the largest proportion of facilities operating at high levels of efficiency, with 14% of all facilities recording an efficiency score of 80% or higher in 2010. By comparison, 10% of Kenyan health facilities performed at a similar level, while only 5% of facilities in Ghana and Uganda had comparably high efficiency scores.

Under a scenario in which all facilities operated as efficiently as the most efficient facilities in the ABCE sample, we estimated that facilities in Zambia could add an average of 13 visits per medical staff per day, as measured in outpatient equivalent visits. We found similar results for Kenya, while Ghana and Uganda demonstrated even greater potential for service expansion.

These findings provide a data-driven understanding of facility capacity and how health facilities have used their resources in Zambia; 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.

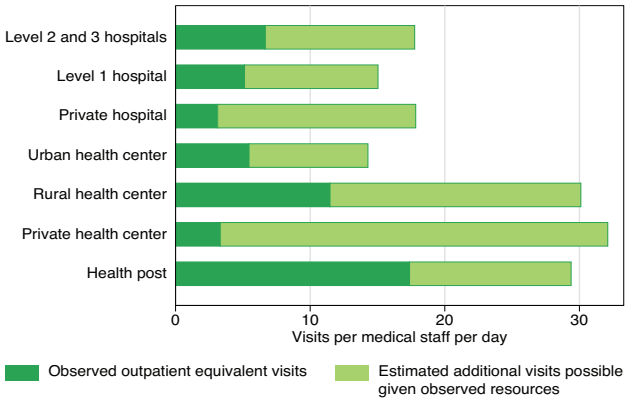
Costs of care

To estimate 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 data were adjusted for inflation and are presented in 2010 kwacha. While we collected all costing data prior to Zambia's rebasing of its currency in 2013, we converted all findings to align with the country's present currency structure by dividing cost estimates by 1,000. All US dollar estimates were based on the 2010 exchange rate of 5.34 kwacha per 1 USD.

In terms of annual total expenditures, trends in average facility spending varied by platform between 2006 and 2010 (Figure 29). Private hospitals and level 2 and 3 hospitals recorded slightly higher levels of average expenditures in 2010 than in 2006, which were largely driven by increased spending on personnel. Other platforms, especially level 1 hospitals and health posts, experienced minimal changes in average annual spending between 2006 and 2010. On average, urban health centers and level 2 and 3 hospitals spent more funds on administrative services and training than other platforms. Health posts averaged very low, if any, spending on administrative services or infrastructure.

Figure 30 shows the average composition of expenditure types across platforms for 2010. Spending on personnel accounted for more than half of facility expenditures across platforms. By contrast, private health centers averaged 52% of total expenditures on personnel and spent 32% of total expenditures on medical supplies,

FIGURE 28 Observed and estimated additional visits that could be produced given observed facility resources, 2010



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 10.6 outpatient visits; and one ART visit was equivalent to 1.6 outpatient visits. Using outpatient equivalent visits, we estimated the average additional visits facilities could have produced, given observed inputs, in 2010.

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

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

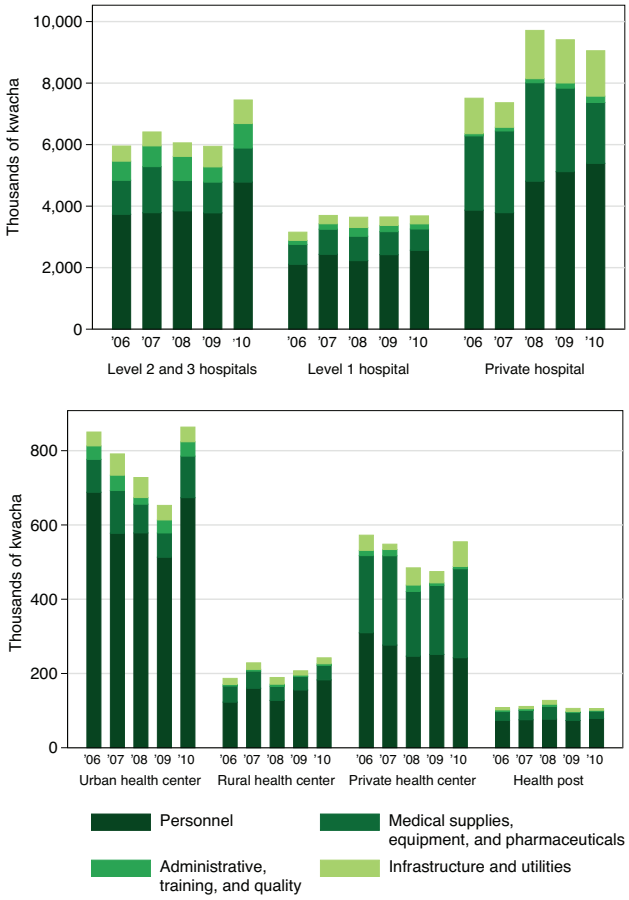
Note: All visits are reported in outpatient equivalent visits estimated at the facility level. Conversion to outpatient equivalent visits varied across facilities; on average, one inpatient bed-day was equivalent to 3.7 outpatient visits; one birth was equivalent to 10.6 outpatient visits; and one ART visit was equivalent to 1.6 outpatient visits.

equipment, and pharmaceuticals. All other platforms had similar levels of expenditures allocated to medical supplies and medications (between 14% and 23%), but varied more in terms of spending on infrastructure and administration. It is important to note that expenditures on pharmaceuticals did not include the costs of ARVs. An average of 13% of total expenditures at private hospitals were allocated to infrastructure and utilities, but 3% was spent on administrative services and training. Urban health centers more equally distributed funding across these two categories, with an average of about 5% for each in 2010. On average, expenditures on administration and training accounted for no more than 5% of total expenditures across platforms, with level 2 and 3 hospitals spending the most (15%) and health posts spending the least (2%).

Facility costs by visit type and services provided. As illustrated by Figure 31, across nearly all platforms, outpatient visits cost the least to provide and births were the most expensive. The exception was private health centers, at which the average cost of an ART visit in 2010, excluding costs of ARVs, was nearly three times less than that of an outpatient visit. Private hospitals spent the most per patient visit across all services they provided, whereas rural health centers provided the least expensive services across all visit types (health posts averaged less expensive production of outpatients and births, but did not offer ART services). Notably, level 1 hospitals were one of the least expensive producers of ART services, with cost levels closer to those found at health centers than other hospitals. In comparison with private hospitals and level 2 and 3 hospitals, each ART visit cost level 1 hospitals at least half of what other hospitals averaged per ART visit.

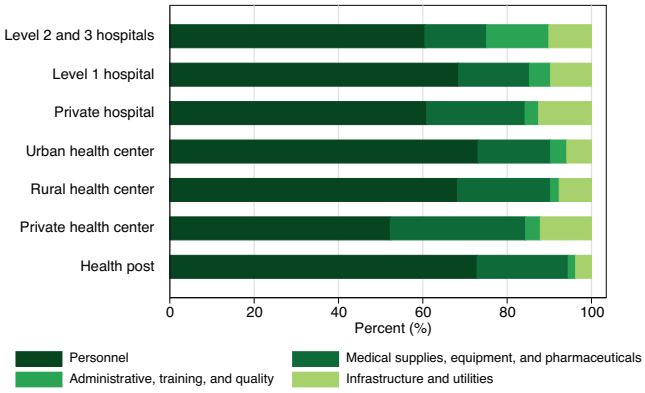
In comparison with Ghana, Kenya, and Uganda, the average facility cost per patient in Zambia was similar or lower for most services (Table 10). The exception was the average facility cost per ART visit, exclusive of ARV costs, such that each ART visit cost an average of 79 kwacha ($15) to produce across facilities in Zambia, exceeding per-visit costs in Uganda (49 kwacha [$9]) and Kenya (48 kwacha [$8]). Ghana had the highest average facility cost per ART

FIGURE 29 Average total expenditure and type of expenditure across platforms, 2006–2010



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

FIGURE 30 Average percentage of expenditure type across platforms, 2010



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

visit, excluding ARVs, at 87 kwacha ($16). The average facility cost per outpatient visit in Zambia (43 kwacha [$8]) was close to the lowest cost found across countries (for Uganda, at 40 kwacha per outpatient visit [$7]). In Zambia, the average facility cost of each inpatient bed-day was 104 kwacha ($20), whereas the next least expensive was 163 kwacha ($30) per inpatient bed-day in Ghana. Further, the facility cost of an average inpatient bed-day in Zambia was about half the cost to produce the same output in Kenya (216 kwacha, or $40, per inpatient bed-day).

Figure 32 compares the average percentage of total expenditure among facilities that provided ART services with those that did not in 2010. Of the facilities that did not provide ART services, more than 50% of all expenditures were allocated to outpatient care; the exception was private hospitals, at which 47% of total expenditures were spent on outpatient services. This finding likely reflects the large volume of outpatients served by these types of platforms. Among facilities that provided ART services, outpatient spending still accounted for the largest proportion of expenditures for health centers, but inpatient bed-days contributed to a greater portion of total spending. Expenditure composition was more diverse for hospitals. Among all public and NGO-owned hospitals, inpatient bed-days accounted for a much larger proportion of total expenditures than outpatient spending. Notably, ART visits, excluding costs of ARVs, generally contributed to a greater proportion of costs among primary care facilities than hospitals. About 10% of total facility costs were attributable to ART visits at public hospitals; for lower-level platforms, however, an average of 24% of urban health center spending was allocated to ART visits, 20% for rural health centers, and 36% for private health centers.

FIGURE 31 Average facility cost per visit, across output types and by platform, 2010

OUTPUT TYPE		LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	PRIVATE HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER	PRIVATE HEALTH CENTER	HEALTH POST
Outpatient visit	**(2010 kwacha)**	**103**	**38**	**171**	**51**	**21**	**148**	**19**
	(2010 USD)	$19	$7	$32	$10	$4	$28	$4
Inpatient bed-day	**(2010 kwacha)**	**243**	**100**	**471**	**120**	**59**	**193**	**84**
	(2010 USD)	$46	$19	$88	$22	$11	$36	$16
Birth	**(2010 kwacha)**	**560**	**860**	**3,289**	**287**	**122**	**272**	**95**
	(2010 USD)	$105	$161	$616	$54	$23	$51	$18
ART visit (excluding ARVs)	**(2010 kwacha)**	**140**	**57**		**98**	**35**		
	(2010 USD)	$26	$11		$18	$7		

HIGHEST COST — LOWEST COST

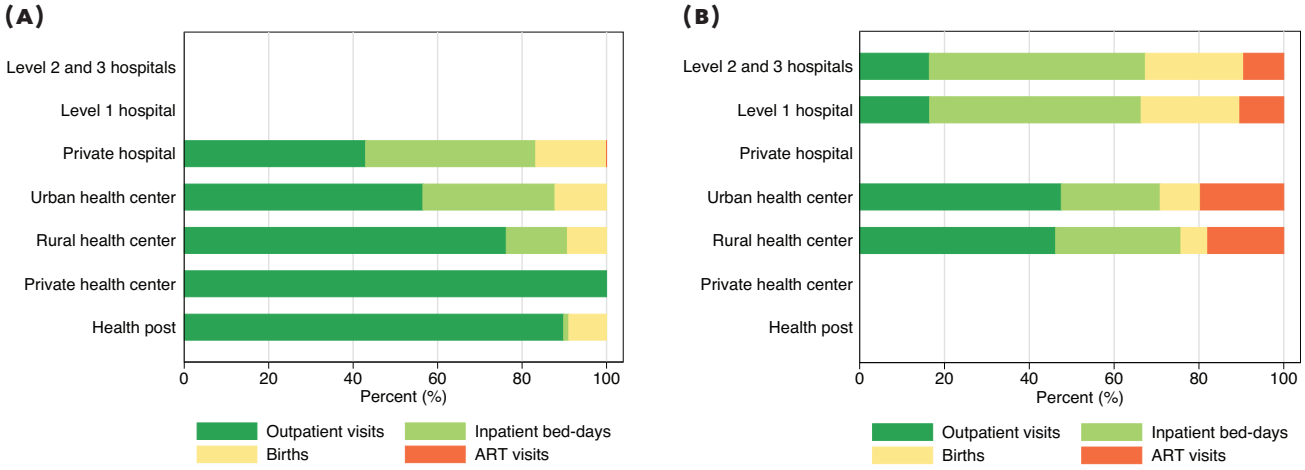
Note: The costs composing ART visits exclude costs of ARVs (but include other medications) provided to the patient. All cost estimates are in 2010 kwacha, with 5.34 kwacha equaling 1 USD. Based on the ABCE sample, no private hospitals reported providing ART services, and only one private health center had ART patients in 2010. The average cost per ART visit at this private health center, excluding costs of ARVs, was 56 kwacha ($10). Health posts in our sample did not provide ART services.

TABLE 10 Average facility cost per visit across output types, for a subset of ABCE countries, 2010

OUTPUT TYPE		ZAMBIA	GHANA	KENYA	UGANDA
Average cost per outpatient visit	**(in 2010 kwacha)** (in 2010 USD)	**43** $8	**63** $12	**49** $9	**40** $7
Average cost per inpatient bed-day	**(in 2010 kwacha)** (in 2010 USD)	**104** $20	**163** $30	**216** $40	**199** $37
Average cost per birth	**(in 2010 kwacha)** (in 2010 USD)	**352** $66	**716** $134	**478** $89	**325** $61
Average cost per ART visit (excluding ARVs)	**(in 2010 kwacha)** (in 2010 USD)	**79** $15	**87** $16	**48** $9	**49** $9

Note: The lowest average cost per output type is highlighted in green and the highest average cost per output type is highlighted in red. Costs for ART visits exclude costs of ARVs (but include other medications) provided to the patient. All cost estimates are in 2010 kwacha, with 5.34 kwacha equaling 1 USD.

FIGURE 32 Average percentage of total expenditures, by platform, for (A) facilities that did not provide ART services, and (B) facilities that provided ART services, 2010



Note: All public and NGO-owned hospitals in the ABCE facility sample provided ART services in 2010, whereas no private hospitals reported providing ART services. The cost of an ART visit excludes the cost of ARVs provided to the patient. There was only one private health center that provided ART services in the ABCE sample, so it was omitted from the figure.

Main findings
Facility-based ART services

Since 1995, HIV/AIDS has been the underlying cause of least 18% of the early death and disability experienced by Zambians (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 2013). At a time when international aid for HIV/AIDS programs is no longer escalating (IHME 2014a), 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 detailed 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 patient ART initiation characteristics between 2006 and 2011, as measured by clinical chart extractions.
- Facility effectiveness of monitoring patients.
- Reported experiences and costs of care by ART patients, capturing "demand-side" factors of health service provision.
- Estimated costs and efficiency of ART services across facility types.

Due to the small fraction of private facilities that provided ART services in the ABCE sample, we focus on assessing the ART program characteristics of public and NGO-owned facilities.

Facility capacity and characteristics

Table 11 provides an overview of the sampled facilities that provide ART services. The final sample included 46 facilities from 20 districts, and featured a mixture of facilities based on ownership, urbanicity, and platforms. These facilities saw an average of 3,103 ART patients in 2010, and had offered ART services for an average of five years at the time of survey.

In terms of services offered, PMTCT and HIV testing and counseling were nearly universal among facilities; however, two health centers indicated that they did not have PMTCT services. Child integrated nutrition programs were much more common among hospitals (57% reported having these programs) than health centers (40%), but that may be a product of hospitals generally serving HIV patients with more complications and illnesses. About one-third of facilities offered adult integrated nutrition programs. A greater proportion of hospitals offered male circumcision services (81%) compared to health centers (40%), which may be related to the availability of personnel with enough training to perform the procedure. ART staffing was more frequently led by nurses at health centers (96%) than hospitals (82%), which may reflect platform differences in staff composition. Across platforms, less than half of all facilities had received general HIV training in the last year.

Patient characteristics

Among the ART patients for whom chart information was extracted (Table 12), 59% were female and the vast majority had achieved at least a primary or secondary education. The median patient age was 38 years, and more than half of patients began ART in 2009 or 2010.

Patient drug regimens over time. Between 2007 and 2010, there was a transition away from d4T-based drug regimens and toward those with a tenofovir (TDF)-based regimen in both hospitals and health centers (Figure 33). This trend is explained by WHO and Zambia's national guidelines, which stipulated the phase-out of d4T-based regimens for adult patients initiating ART as of 2006 (MOH 2010b). Further, Zambia was one of the first countries in sub-Saharan Africa to adopt a TDF-based therapy as its first-line ARV (UNAIDS 2012), and has quickly scaled up its use among ART initiates. TDF regimens are generally associated with higher patient tolerance and are considered more convenient than AZT-based therapies due to its delivery as a single, daily combination pill. However, TDF tends to be more expensive than AZT, which is an important consideration given Zambia's growing patient population and stagnating international aid. It is important to note that we found substantial variation in TDF prescription practices

TABLE 11 Characteristics of public and NGO-owned facilities that provide ART, by platform, 2011–2012

INDICATOR	LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER	ALL PLATFORMS
Number of facilities	**9**	**13**	**18**	**6**	**46**
Location					
Rural	33%	69%	0%	100%	39%
Urban	67%	31%	100%	0%	61%
HIV services					
Male circumcision	63%	92%	44%	25%	61%
PMTCT	100%	100%	88%	100%	95%
HIV testing and counseling	100%	100%	100%	100%	100%
Adult integrated nutrition program	38%	31%	31%	25%	32%
Child integrated nutrition program	50%	62%	44%	25%	49%
Staff guidelines and facility capacity					
Nurse-led care	100%	69%	100%	83%	89%
General HIV training in the last year	33%	62%	56%	17%	48%
CD4 tests performed on-site	100%	100%	50%	67%	81%

Note: Integrated nutrition programs were defined as programs wherein (1) patients are referred from the facility-based nutrition program to the HIV program, and (2) the nutrition program performs HIV testing if HIV is suspected.

FIGURE 33 ART regimen at initiation, by platform, 2007–2010

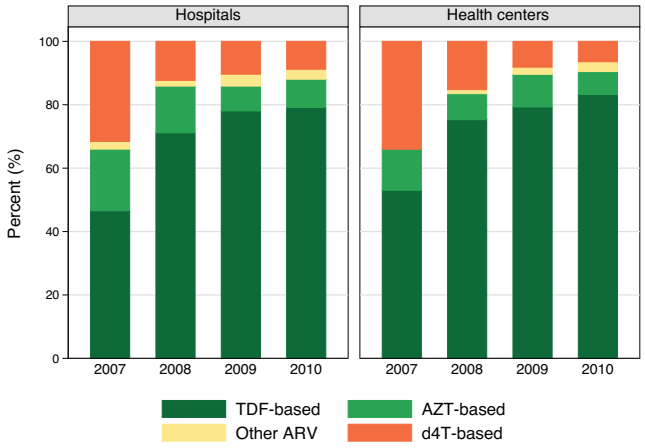


FIGURE 34 ART regimen at initiation, by facility, 2010

Note: Each bar represents a facility and the proportion of patients who initiated ART on a given regimen in 2010.

TABLE 12 Characteristics of ART patients at initiation, by platform, 2006–2011

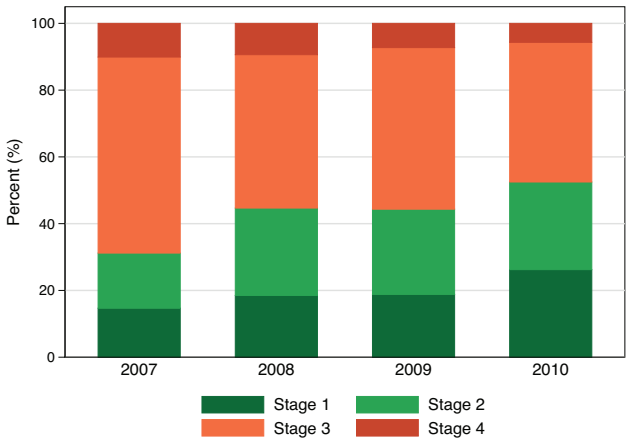
INDICATOR	LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER	ALL PLATFORMS
Number of charts	**1,803**	**2,501**	**3,254**	**970**	**8,528**
Percent female	57%	59%	61%	59%	59%
Median age (years)	39	38	38	39	38
Median initial CD4	178	169	169	176	171
Education level					
None	10%	13%	9%	23%	12%
Primary	43%	48%	43%	47%	45%
Secondary	40%	35%	43%	25%	38%
Post-secondary	6%	4%	5%	6%	5%
Year of ART initiation					
2006	5%	6%	2%	6%	4%
2007	15%	15%	13%	8%	14%
2008	19%	15%	19%	20%	18%
2009	20%	27%	27%	32%	26%
2010	29%	36%	36%	33%	34%
2011	12%	2%	3%	1%	5%

across facilities (Figure 34). In 2010, prescription rates of TDF at ART initiation ranged from 11% to 100%.

Clinical characteristics. Between 2007 and 2010, there was gradual shift toward earlier initiation based on changes in WHO staging guidelines. In 2007, 69% of patients initiating ART were classified as WHO stage 3 or 4, whereas 47% of patients initiated at the same stages in 2010 (Figure 35). Nonetheless, a substantial portion of Zambian patients still began ART fairly late in disease progression in 2010. Further, we observed substantial variation in WHO stage at ART initiation across platforms (Figure 36). These differences may correspond with the availability of community outreach services, especially in rural areas. 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 37. In 2007, 66% of patients began ART at a CD4 cell count less than 200 cells/mm^3, whereas 55% patients initiated ART at the same CD4 level in 2010. From 2007 to 2010, median CD4 cell count at initiation increased 31%, from 143 cells/mm^3 in 2007 to 187 cells/mm^3 in 2010. Nevertheless, this level of CD4 remained well below the initiation threshold of 350 cells/mm^3 set by Zambia's clinical guidelines in 2010 (MOH 2010b). This finding suggests that the majority of HIV-positive individuals are seeking care once they are symptomatic. Further, consistently between 2007 and 2010, about 10% of patients initiated ART with a CD4 cell count lower than 50 cells/mm^3. This lack of progress in identifying HIV-positive individuals well before CD4 cell counts drop to such low levels warrants further attention.

FIGURE 35 WHO stage at initiation, 2007–2010



Note: WHO staging classifies HIV disease progression on the basis on 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:

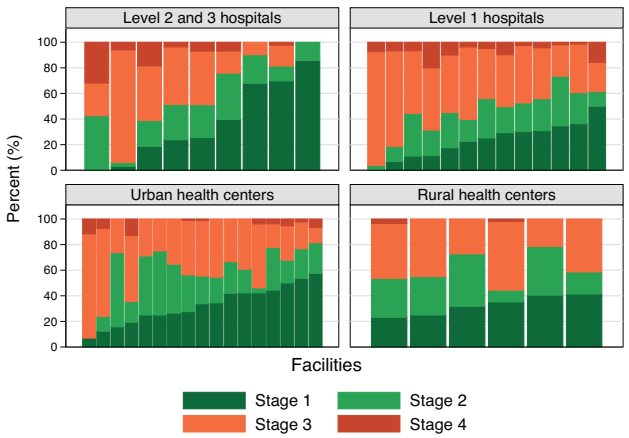
- Stage 1: patients are largely asymptomatic but usually experience persistently large or swollen lymph nodes.
- Stage 2: patients experience moderate levels of unexplained weight loss, recurrent respiratory infections, and often report a range of other moderate ailments (e.g., skin infections, oral 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).

Availability of clinical information for monitoring patients

The ability to risk-stratify patients at the time of ART initiation based on CD4 cell counts, WHO stage, and body mass index (BMI) is critical for determining need 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, 15% of ART patients did not have CD4 cell counts recorded at initiation, 3% were not assigned a WHO stage, 3% lacked a weight measurement, and 22% did not have records of height in 2010. Measuring a patient's height is relatively easy and low-cost, yet this information was less frequently 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). 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.

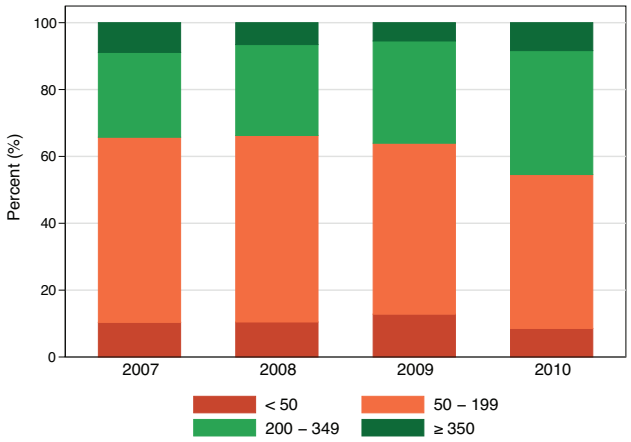
After ART initiation, established patients require ongoing monitoring to detect treatment failure. Patients can often be considered "established" after receiving treatment for one year. Among patients who initiated ART in 2010, a moderate proportion received follow-up measures of their CD4 cell counts during their second year of therapy (12 to 24 months after initiating). As shown in Table 13, 84% received any CD4 tests during their second year of treatment; this was a 75% increase from 2006, when fewer than half of

FIGURE 36 WHO stage at initiation, by facility, 2010



Note: Each bar represents a facility and the proportion of patients who initiated at a given WHO stage in 2010.

FIGURE 37 CD4 cell count at initiation, 2007–2010



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

ART patients received a CD4 test during their second year of therapy. By 2010, many more patients had received at least one weight measurement during their second year of therapy, rising from 65% in 2006 to 92% in 2010. 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. 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 90% 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 (78% among patients initiating in 2009) than patients who began treatment at WHO stage 1 (93%), 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 14% to 100%, but this finding may more accurately reflect recordkeeping practices than patient outcomes.

Patient perspectives

In addition to patients who did not seek HIV-specific care, we conducted the Patient Exit Interview Survey with 402 patients who reported seeking HIV services (Table 14). Their demographic profiles were generally similar to our sample of patients who did not receive HIV care; however, our HIV patient sample had more men (40% versus 31%) and an older age distribution than the non-HIV sample.

Out-of-pocket expenditures. As shown in Figure 38, the vast majority of HIV patients (82%) reported having no medical or transport expenses associated with their facility visit, with rural health centers having the highest proportion of patients without payments (95%). Over 30% of patients who sought HIV services at higher-level hospitals and urban health centers incurred transportation expenses. A very small portion of patients had medical expenses associated with their visits to urban and rural health centers (4%). Overall, patients seeking HIV care experienced minimal expenses, especially for medical care, which corresponds with Zambia's national policy of providing ART services at no cost in public facilities (UNAIDS 2012).

Travel and wait times. Of patients seeking HIV services, 19% reported traveling two or more hours to the facility where they received care (Figure 39). A greater proportion of patients spent at least two hours in transit to level 1 hospitals (39%) than any other platform, which is likely attributable to either the rural locations of most of these hospitals or their designation as the primary referral

TABLE 13 Facility availability of patient clinical information, by initiation year, 2006–2010

INDICATOR	2006	2007	2008	2009	2010
Recorded at initiation					
CD4 cell count	78%	76%	86%	86%	85%
WHO stage	98%	98%	98%	97%	97%
Weight	94%	95%	95%	98%	97%
Height	45%	58%	70%	74%	78%
BMI	45%	57%	68%	74%	78%
Recorded at any point during second year of therapy					
CD4 cell count	48%	57%	64%	63%	84%
Weight	65%	85%	90%	92%	92%

TABLE 14 Characteristics of patients who sought HIV services and were interviewed after receiving care at facilities, 2011–2012

CHARACTERISTIC	LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER	ALL FACILITIES
Percent female	56%	59%	71%	49%	60%
Educational attainment					
None or pre-primary	6%	7%	2%	15%	7%
Primary	40%	50%	27%	41%	38%
Post-primary	53%	43%	71%	45%	55%
Patient age (years)					
≤ 5	2%	0%	2%	1%	1%
6–17	6%	2%	6%	3%	4%
18–29	24%	27%	30%	43%	32%
30–39	27%	34%	36%	32%	33%
40–49	24%	27%	20%	16%	21%
≥ 50	16%	9%	5%	5%	8%
Self-reported overall health					
Poor	5%	6%	10%	15%	10%
Fair	10%	28%	33%	36%	29%
Good	35%	32%	30%	30%	31%
Very good	29%	23%	25%	9%	21%
Excellent	21%	10%	1%	11%	9%
Total patient sample	**62**	**96**	**139**	**105**	**402**

Note: Educational attainment refers to the patient's level of education or the attendant's educational attainment if the interviewed patient was younger than 15 years old.

hospital for rural health centers. Urban health centers recorded the highest percentage of HIV patients who traveled less than 30 minutes to receive care (45%).

Overall, HIV patients experienced relatively long wait times at facilities (Figure 40), with average wait times rising in parallel with health system level. At level 2 and 3 hospitals, 60% of HIV patients waited more than two hours before receiving care. In contrast, 22% of patients experienced wait times longer than two hours at rural health centers, with 12% of patients receiving care within 30 minutes. In comparison with patients who did not seek HIV care, more HIV patients waited longer at facilities and far fewer experienced wait times of less than 30 minutes. This finding was most pronounced at level 1 hospitals, with 23% of non-HIV patients waiting at least two hours and 43% of HIV patients reporting the same wait times. Conversely, over

FIGURE 38 HIV patient medical and transportation expenses, by platform, 2011–2012

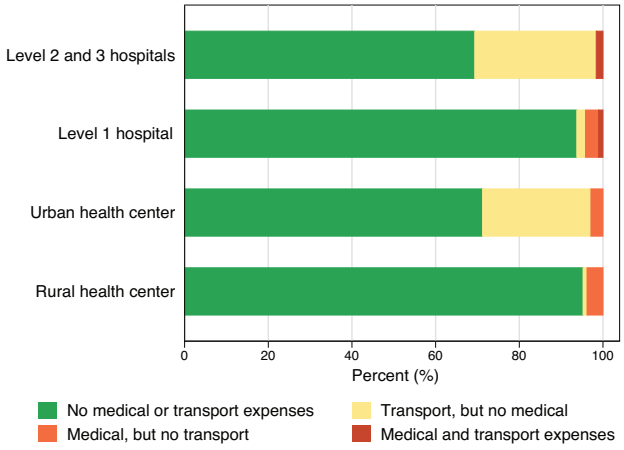


FIGURE 39 HIV patient travel times to facilities, by platform, 2011–2012

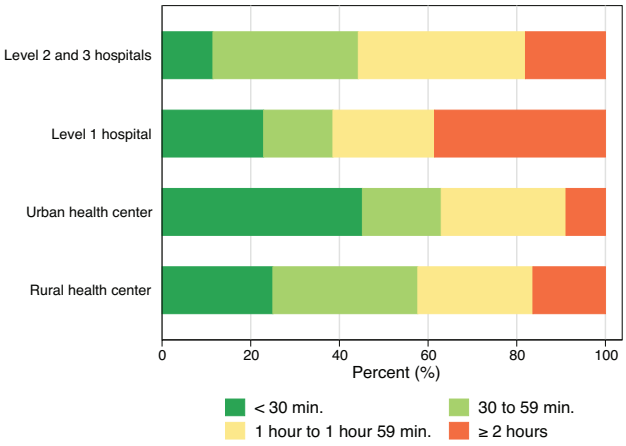
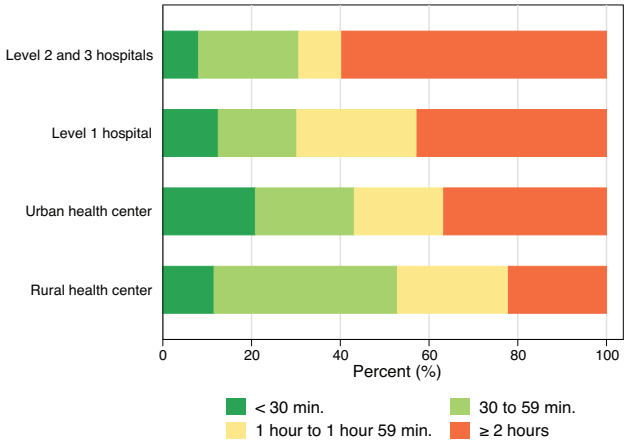


FIGURE 40 HIV patient wait times at facilities, by platform, 2011–2012



30% of non-HIV patients at level 1 hospitals received care within 30 minutes, whereas just over 13% of HIV patients experienced similar expediency.

Similar to patients who were not seeking HIV care, HIV patients generally spent more time waiting for services than traveling to facilities to receive care (Table 15). In general, we found that patients presenting for HIV services waited longer than non-HIV patients at the same facility types. This difference between the two patient types was most pronounced among level 1 hospitals (59% of HIV patients had longer wait times than travel times, compared to 45% of non-HIV patients). Among the facilities at which 100% of patients seeking HIV services had to wait least an hour before receiving care, a lower proportion of non-HIV patients reported waiting the same amount of time.

Patient satisfaction with care. Similar to the experiences reported by non-HIV patients, patients seeking HIV services indicated that they were generally satisfied with the facility-based care received (Figure 41). Notably, despite reporting longer wait times, nearly 50% of HIV patients at level 2 and 3 hospitals gave the highest rating possible (10 out of 10); among non-HIV patients, fewer than 20% provided a similarly high rating. A somewhat smaller proportion of patients seeking HIV services gave ratings below a 6 (22%) than those who were not seeking HIV care (28%).

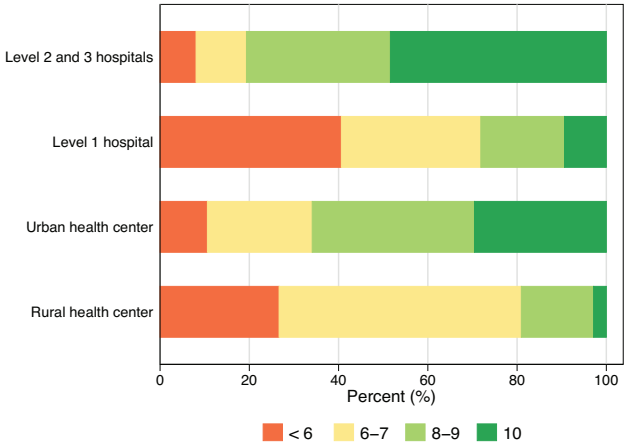
Figure 42 details HIV patient ratings of facility characteristics and visit experiences. Compared to non-HIV patients, patients seeking HIV care gave slightly higher average overall ratings for level 2 and 3 hospitals (8.8 versus 8.2) and urban health centers (8.1 versus 7.0). Patients, irrespective of the type of care they sought, reported similarly high ratings of staff interactions across platforms. While non-HIV patients expressed less satisfaction with facility

TABLE 15 HIV patient reports of time spent traveling to facilities and waiting for care, by platform, 2011–2012

PATIENT REPORTS	LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER
Longer travel time	28%	34%	27%	37%
Longer wait time	61%	59%	65%	56%
Equal travel and wait time	11%	6%	7%	7%

characteristics, particularly wait times, patients who sought HIV services graded these components even more harshly. For instance, HIV patients gave an average of 2.5 (out of 5) for wait times at level 1 hospitals, 17% lower than the average ratings recorded by non-HIV patients. These results are not unexpected, especially given that HIV patients generally did wait longer than their non-HIV peers at the same types of facilities.

FIGURE 41 HIV patient ratings of facilities, by platform, 2011–2012



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.

FIGURE 42 Average HIV patient ratings of facility visit indicators, by platform, 2011–2012

	LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER
Overall rating	**8.8**	**6.1**	**8.1**	**6.4**
STAFF INTERACTIONS				
Provider respectfulness	4.2	3.9	4.1	4.2
Provider compassion	4.3	3.9	4.0	4.1
Provider reception	4.3	3.7	4.2	4.1
Provider honesty	4.3	3.9	4.2	4.2
FACILITY CHARACTERISTICS				
Privacy	4.3	4.1	4.2	4.2
Wait time	2.7	2.5	3.3	3.0
Cleanliness	3.6	3.2	3.4	3.6
Spaciousness	3.5	2.8	3.5	3.3

LOWEST RATINGS HIGHEST RATINGS

Note: Average overall 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."

Efficiency and costs

Efficiency

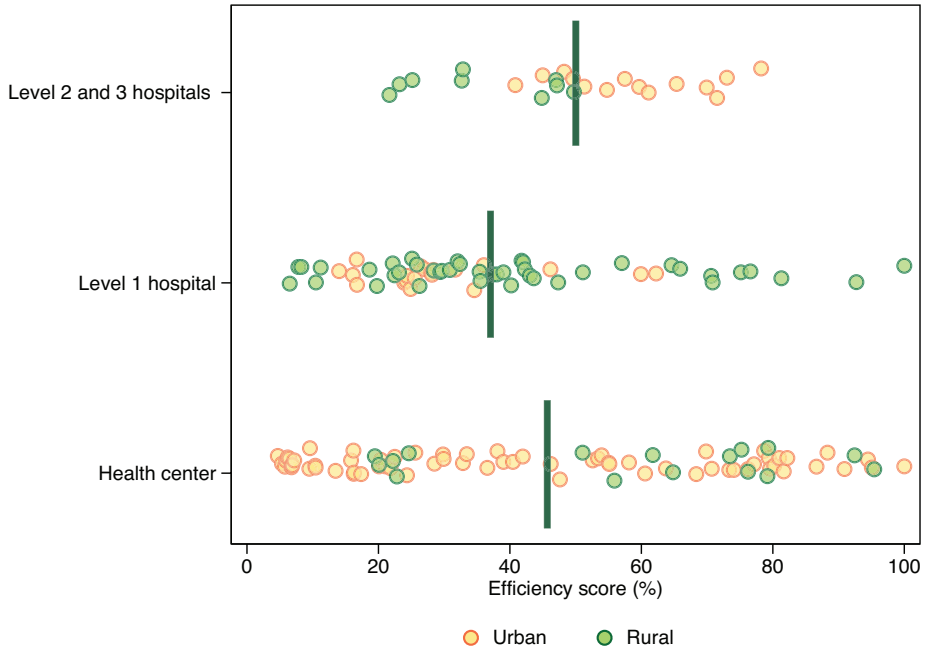
In this section, we focus only on the facilities that reported providing ART services. These facilities were included in the previous section on efficiency, but due to the continued scale-up of ART provision in Zambia and the perceived burden of ART programs on facility resources (UNAIDS 2012), it is of policy relevance to consider the efficiency levels for this subset of facilities (Figure 43).

The distribution of efficiency scores varied by platform, especially with respect to facility location (urban or rural). For level 2 and 3 hospitals, urban facilities generally recorded higher efficiency scores, whereas most, if not all, rural facilities fell below the platform's average efficiency score (50%). Among level 1 hospitals, however, rural facilities posted efficiency scores at both extremes, ranging from 7% to 100%. Urban and rural health centers scored along the full spectrum, illustrating the diversity of primary care facilities that provide ART services. 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 centers with ART services was 46%, whereas the average efficiency score for all health centers, irrespective of ART provision, was 41%.

Given their observed levels of facility-based resources, it would appear that many facilities have the capacity to produce much larger ART patient volumes than they currently do. Figure 44 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 (e.g., given their observed resources, level 1 hospitals could more than triple their average annual ART patient visits).

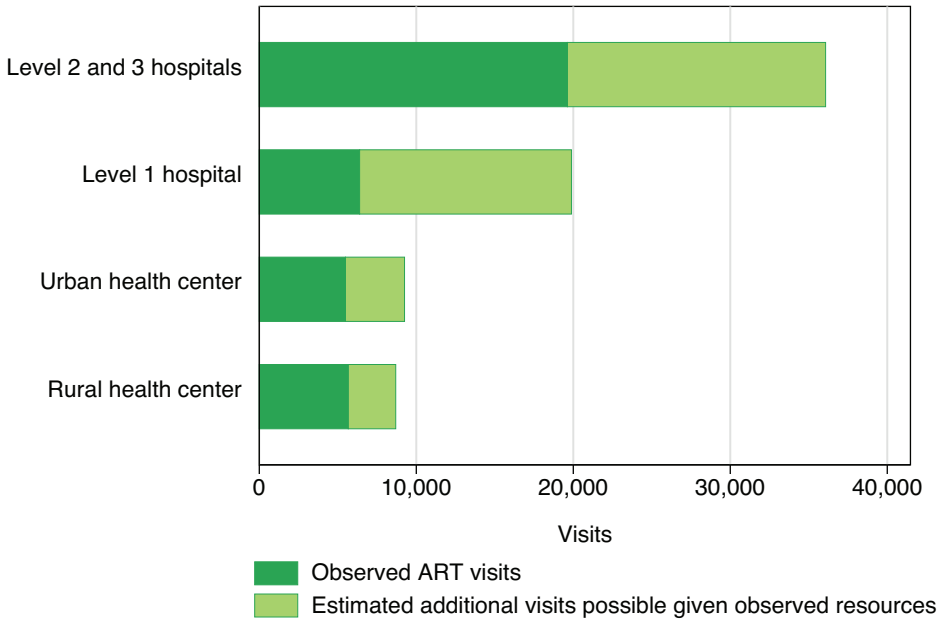
These findings may be a reflection of many factors that we have not analyzed, including a poor distribution of personnel and facility resources, lower demand for ART services than anticipated, or inadequate stocking of essential supplies, namely ARVs. Nonetheless, these results suggest that staffing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

FIGURE 43 Range of efficiency scores for facilities providing ART services, 2006–2010



Note: Each circle represents a facility's efficiency score for a given year between 2006 and 2010. The vertical line represents the average efficiency score across all facilities that provide ART services within a given platform.

FIGURE 44 Estimated potential annual ART visits given observed facility inputs, by platform, 2010



Similar to Zambia, we found that Kenya and Uganda also showed substantial potential for ART service provision given the facility resources observed through the ABCE project (Table 16). 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). This potential expansion of ART services, at minimal added cost to facilities, has substantial implications for the capacity of Zambia'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 Zambia's goal of providing universal access to HIV/AIDS treatment and prevention by 2015 (NAC 2010).

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

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

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 recommended number of annual visits for new and established ART patients from the national guidelines (MOH 2010b);

3 The ARV regimens of ART patients in 2010 extracted from clinical charts; and

4 The ceiling ARV prices published by the Clinton Health Access Initiative (CHAI) in 2010 (CHAI 2010).

Based on facility data collected through the ABCE Facility Survey and ART patient data extracted from clinical charts, we estimated the average cost per ART visit, excluding the cost of ARVs, for 2010. We then multiplied the average visit cost by the number of annual visits recommended by Zambia's national guidelines (11 for new patients and four for established patients) (MOH 2010b). In doing this, we were able to project what it would cost facilities in Zambia if ART patients adhered to clinical guidelines set forth by the MOH.

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 2010 to the mix of ARV regimens observed in the ABCE sample (CHAI 2010). 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 17 details projected ART costs by patient type (new and established) and across platforms. We found that average cost per visit, excluding ARVs, substantially varied across platforms, from 35 kwacha ($7) at rural health centers to 140 kwacha ($26) in level 2 and 3 hospitals.

In general, we estimated that ARVs would account for a large portion of projected annual costs, but the proportion varied by patient types and platforms. For example, to treat a new ART patient for one year, we estimated costs of ARVs accounted for 41% of projected ART costs at level 2 and 3 hospitals, whereas we estimated that ARVs would compose 73% of total projected ART costs in rural health centers. The

TABLE 17 Projected facility costs, by ART patient type and platform, for 2010

INDICATOR		LEVEL 2 AND 3 HOSPITALS	LEVEL 1 HOSPITAL	URBAN HEALTH CENTER	RURAL HEALTH CENTER
Average cost per visit (excluding ARVs)	**(in 2010 kwacha)**	**140**	**57**	**98**	**35**
	(in 2010 USD)	$26	$11	$18	$7
PROJECTED ANNUAL COSTS, BASED ON ZAMBIAN ART VISIT RECOMMENDATIONS*					
New ART patients					
Projected annual visit costs	**(in 2010 kwacha)**	**1,540**	**630**	**1,080**	**386**
	(in 2010 USD)	$288	$118	$202	$72
Projected annual total costs** (including ARVs)	**(in 2010 kwacha)**	**2,616**	**1,601**	**2,158**	**1,437**
	(in 2010 USD)	$490	$300	$404	$269
Established ART patients					
Projected annual visit costs	**(in 2010 kwacha)**	**560**	**229**	**393**	**140**
	(in 2010 USD)	$105	$43	$74	$26
Projected annual total costs** (including ARVs)	**(in 2010 kwacha)**	**1,421**	**1,117**	**1,401**	**989**
	(in 2010 USD)	$266	$209	$262	$185

* Based on Zambia's clinical guidelines for ART, we used 11 and four ART visits as the visit frequency for new and established patients, respectively (MOH 2010b). Established ART patients are patients who have been on ART for a minimum of one year.

** 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 2010 (CHAI 2010).

Note: We had insufficient data to estimate annual total costs of ART patients for private hospitals and private health centers. All cost estimates are in 2010 kwacha, with 5.34 kwacha equaling 1 USD.

proportion of total costs that are for ARVs is much higher for established patients, ranging from 61% at level 2 and 3 hospitals to 86% at rural health centers. 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 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 over 60%, largely due to the less frequent visit schedule for established patients. The projected annual cost per ART patient including ARVs declined far less, ranging from about 31% at rural health centers to 46% at level 2 and 3 hospitals. 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 Uganda (Table 18), we projected that average ART patient costs were higher in Zambia. Across platforms and facility ownership, the average cost per ART visit in Zambia, excluding the costs of ARVs, was slightly higher (79 kwacha [$15]) than the average ART visit in Kenya and Uganda (48 and 49 kwacha [$9 each], respectively).

In terms of annual projections, we estimated that the average annual facility cost per ART patient, excluding ARVs, ranged from 278 kwacha in Kenya ($52) to 458 kwacha in Zambia ($86); this finding was based on the average number of annual ART patient visits observed in Kenya and Uganda in 2010 (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 slightly decreased. While Zambian facilities still had the highest projected annual cost (1,418 kwacha per ART patient per year, or $266), its projected annual patient cost with ARVs was only about 30% higher than the costs projected for Kenya and Uganda (975 kwacha [$182] and 1,066 kwacha [$200], respectively). This finding is particularly notable given that Zambia has had consistently higher prescription rates of TDF-based regimens, one of the more expensive ARVs, at ART initiation than Kenya and Uganda.

Our results suggest that the projected costs of ARVs account for a slightly larger proportion of total ART costs at facilities in Kenya and Uganda (71% and 73%, respectively) than in Zambia (68%). Funding for ARV and non-ARV components of ART programs can originate from different sources, with the former often supported by international donors 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.

TABLE 18 Projected facility costs per ART patient, across a subset of ABCE countries, for 2010

INDICATOR		ZAMBIA	KENYA	UGANDA
Average cost per ART visit (excluding ARVs)	**(in 2010 kwacha)**	**79**	**48**	**49**
	(in 2010 USD)	$15	$9	$9
Average number of annual ART visits per patient		5.8*	5.8	5.8
Projected annual cost per patient (excluding ARVs)	**(in 2010 kwacha)**	**458**	**278**	**284**
	(in 2010 USD)	$86	$52	$53
Projected annual cost of ARVs	**(in 2010 kwacha)**	**960**	**697**	**782**
	(in 2010 USD)	$180	$130	$146
Projected annual cost per patient (including ARVs)	**(in 2010 kwacha)**	**1,418**	**975**	**1,066**
	(in 2010 USD)	$266	$182	$200

* We had insufficient data to estimate the average number of ART visits patients had in 2010 for Zambia. As a result, we used the average number of annual ART visits observed in 2010, 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 2010 (CHAI 2010). All cost projections are in 2010 kwacha, with 5.34 kwacha equaling 1 USD.

Conclusions and policy implications

To achieve its vision of a "nation of healthy and productive people" (MOH 2010a), Zambia has strived to enact policies and programs that promote greater access to health services, support the delivery of cost-effective interventions, and equitably provide high-quality care throughout the country. These goals are ambitious but attainable, yet their achievement hinges on the many drivers and dimensions of health service provision coming together to support optimal health system performance.

The health landscape in Zambia has been evolving, which is leading to a diverse set of health facility characteristics in terms of capacity, efficiency, costs, and HIV services. These findings underscore the importance of rigorously measuring health facility performance and costs of services across and within levels of care. Without detailed analyses, it would be nearly impossible to accurately capture the range of health services provided by facilities and the corresponding costs of their provision.

Facility capacity for service provision

In many ways, facility capacity serves as the backbone for health service delivery and overall health system performance. If a 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 family planning, immunization, and HIV/AIDS care, were generally high across facility types in Zambia. Such broad access reflects the prioritization – and execution – of expanding these services throughout the country.

At the same time, substantial gaps in reported service availability and the actual capacity to provide those services emerged. While nearly 90% of all facilities, across platforms, indicated that they carried vaccines, far fewer facilities stocked all four of the key childhood immunizations recommended by national guidelines and also kept them within the proper temperature range (53%). Further, a substantial number of facilities had stocked out of at least one of these four vaccines at the time of visit and nearly one-third of them had storage temperatures outside of the recommended range. In combination, most facilities experienced a notable divide between their reported availability of services and their true capacity for optimally delivering them.

These findings are not novel (MOH et al. 2007, Picazo and Zhao 2009), 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, especially as Zambia debates strategies to achieve universal health coverage.

The availability of basic infrastructure and medical equipment may underlie many of the health service capacity challenges experienced by Zambian health facilities. Beyond lacking consistent access to electricity and improved sanitation, a substantial proportion of rural health centers and health posts experienced gaps in the availability of required medical equipment. In 2010, more than half of the rural health posts lacked the ability to measure blood pressure, and nearly 20% provided care without an exam table.

Higher-level facilities also experienced serious equipment gaps, with more than 30% of level 1 hospitals lacking an exam table and nearly one-third of level 2 and 3 hospitals not having ultrasound capabilities. Compared to public and NGO-owned facilities, private facilities generally had a higher availability of required medical equipment, further emphasizing the growing need to address the gaps in infrastructure and physical capital observed outside of the private sector.

At the same time, Zambia increasingly grapples with the health burdens associated with NCDs (Murray et al. 2012), and the country remains largely unprepared to properly diagnose and treat chronic conditions. For example, only 65% of public and NGO-owned health centers and health posts – Zambia's main outlets for primary care – had both the means to measure high blood pressure and dispense appropriate treatment. Other NCDs and related risk factors require much more sophisticated equipment and medication options to optimally diagnose and treat (e.g., electrocardiography [ECG] machines provide diagnostic information for ischemic heart disease), and far fewer facilities had the capacity to properly manage these conditions (e.g., 11% of level 2 and 3 hospitals had an ECG machine).

Across facilities, non-medical personnel were generally the most prevalent type of staff, usually exceeding the number of doctors, clinical officers, and nurses employed by facilities. While we found some exceptions, urban facilities largely had higher levels of skilled medical personnel than their rural counterparts. Zambia has long viewed staffing its rural facilities as an important challenge to overcome (MOH 2011a), and our findings reinforce the continued need to address the country's geographic discrepancies in human resources for health.

Facility production of health services

With ART visits as the clear exception, average patient volumes remained fairly steady between 2006 and 2010 across platforms. Shortages in human resources and overcrowding of facilities are viewed as widespread in Zambia (MOH 2011a); aside from health posts and rural health centers, however, we found that most facilities averaged fewer than seven visits per medical staff per day in 2010. These seven visits were 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.

Based on the ABCE sample, the average health facility in Zambia had an efficiency score of 42%, which reflects the relationship between facility-based resources and the facility's total patient volume each year. With this information, we estimated that facilities could substantially increase the number of patients seen and services provided each year – by an average of 178% more outputs – based on their observed levels of medical personnel and resources in 2010. While these findings generally contrast with more prevalent views of health facility capacity in Zambia, 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, but 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 at least two hours before receiving care); the optimal provision of services (e.g., one urban health center with a very high efficiency score lacked ACTs at the time of visit); 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 Zambian 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 Uganda also demonstrated substantial potential for service expansion. In Zambia, the average facility efficiency score exceeded those estimated for the other three countries, suggesting that Zambia has already shown comparatively higher levels of service delivery than the other African countries currently included in the ABCE project. With 14% of all Zambian facilities operating with an efficiency score of 80% or higher in 2010, contrasting with the 5% of comparably efficient facilities identified in Ghana and Uganda, it is possible that other countries could learn from Zambia's system of highly efficient facilities.

Similarly, we projected that Zambia could markedly increase annual ART patient volumes, given observed facility resources, potentially expanding ART visits by an average of 117% if facilities operated at optimal efficiency levels. This suggests that further progress toward universal access to HIV/AIDS treatment and care, a goal set by Zambia's National HIV/AIDS/STD/TB Council (NAC) (NAC 2010), could be achieved with observed facility resources. Comparable results were found for Kenya and Uganda, 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. These findings are particularly relevant to ongoing policy debates in Zambia 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 updated WHO guidelines.

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 health center was nearly three times as high as an outpatient visit at an urban health center. Births were by far the most expensive output to produce across facilities, incurring a minimum of five times the cost of the average outpatient visit. 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 Uganda, the average facility cost per patient was generally similar or lower in Zambia, particularly for inpatient care. 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 facility-based health care expenses across these countries. Future studies should also 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 Zambia's priority of removing cost barriers to health services (MOH 2010a), the majority of interviewed patients reported not having medical expenses associated with their facility visit. This finding was particularly pronounced among patients seeking HIV care, which again aligns with the country's national policies. Of the patients who reported medical expenses, most presented at private facilities or level 3 hospitals; however, a portion of them experienced user fees at publicly owned rural health centers, a finding that suggests the incomplete implementation of user fee abolishment at rural facilities providing primary care services (Masiye et al. 2010). As Zambia considers strategies to achieve universal health coverage, it will be increasingly important for the country to identify where medical payment policies are effective and where they are not enforced.

Across services sought (HIV and non-HIV), patients largely experienced longer wait times at facilities than the time they spent traveling to receive care. Past studies point to staffing shortages as the main driver of extended wait times at Zambian facilities (Picazo and Zhao 2009), 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.

Overall satisfaction with care was high among Zambian patients, both for those seeking HIV services and those who were not. However, a larger proportion of all patient types gave lower ratings for level 1 hospitals. Patients rated interactions with facility staff and their providers quite highly, regularly viewing characteristics of facility staff with greater satisfaction than the characteristics of the health facility itself. Facility wait times received the lowest ratings across facility types, but interestingly, there was no clear relationship between patients' reports of overall satisfaction and the amount of time they spent waiting for care. High patient ratings of facility staff may be related to Zambia's efforts to improve the training and retention of medical staff (MOH 2011a). 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 versus 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 Zambia, the country's health system must find ways to optimize in terms of capacity, efficiency, and cost. In general, we found successes and ongoing challenges in HIV/AIDS care in Zambia. As an early adopter of TDF-based regimens, Zambia phased out d4T-based ART regimens more rapidly than other countries. This finding bodes well for the availability of internationally recommended ART regimens at the initiation of treatment. From 2007 to 2010, Zambia documented gradual progress in initiating ART patients at earlier stages of disease progression, both in terms of WHO staging and CD4 cell count. However, the majority of patients in 2010 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 Zambia to improve its monitoring of patient clinical data. The country demonstrated improvement in collecting patient data at initiation between 2006 and 2010, but too many ART patients still did not receive measures of

their CD4 cell count at initiation in 2010. Further, very few patients received viral load measurements after their first year of ART, which could make the prompt identification of treatment failure very challenging. In order to be more responsive to increasing ART patient volumes, greater investment in ART patient recordkeeping and data collection ought to be considered.

While facilities that provide ART services generally had higher efficiency scores than those that did not, we still found that a large proportion of facilities could potentially expand service provision given their observed levels of staffing and beds. This was particularly evident among level 1 hospitals, which generally saw ART patient volumes more similar to those found among rural health centers than higher-level public hospitals or even urban health centers. These findings suggest that rising demand 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 Zambia without significantly straining their facility-based resources.

Under a fully efficient scenario of ART service provision, we estimated that facilities in Zambia could provide more than 9,000 additional ART visits per year given the facility-based resources observed in 2010. These estimated potential gains could more than double the observed number of ART visits, with minimal additional costs to facilities in terms of personnel and beds. These findings were similar to predicted gains in ART patient volumes for Kenya and Uganda, although Zambia stood to expand services at a much greater magnitude. At the same time, 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 ART annual costs at facilities, ranging from 41% to 73% of total costs for new ART patients and up to 86% of total costs for established patients. Second, projected annual costs, both including and excluding the estimated costs of ARVs, declined substantially for facilities after ART patients became established, or 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 projected costs of ART services decreased with established patients, reductions in spending were more associated with visit costs while projected 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 non-drug 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 aid for HIV/AIDS treatment is stagnating or declining in Zambia (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 Zambia, excluding the costs of ARVs, was slightly higher than the equivalent visit in Kenya and Uganda. Projected annual costs per ART patient in Zambia, both with and without ARVs, exceeded those estimated for Kenya and Uganda; however, the projected cost of ARVs accounted for a lower proportion of total-year costs per patient in Zambia (68%) than Kenya and Uganda (71% and 73%, respectively). These findings indicate that the sustained financing of ARVs will remain a high priority in Zambia, as their costs drive a large portion of ART expenses. At the same time, Zambia may be slightly less affected by potential shifts in financing of 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 Zambia 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 Zambia, but also inform global efforts to address factors that hinder the delivery of or access to health services. More efforts like the ABCE project in Zambia are needed to continue many of the positive trends highlighted in this report and to overcome the challenges identified. Analyses that took into account a broader set of the country's facilities would undoubtedly provide an even clearer picture of levels and trends in facility 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 Zambia.

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