



Applying the Care Delivery Value Chain: HIV/AIDS Care in Resource Poor Settings

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APPLYING THE CARE DELIVERY VALUE CHAIN: HIV/AIDS CARE IN RESOURCE POOR SETTINGS

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The care delivery value chain (CDVC) is a framework that allows a systemic analysis of value creation across the myriad of activities that occur during the care of a patient for a specific medical condition.¹ A medical condition is an inter-related set of patient medical circumstances best addressed in an integrated way. A medical condition includes common co-occurrences for which care should be tightly coordinated to provide the best value results.

The CDVC looks at care as an overall system, not as a series of discrete interventions. It describes the discrete activities that are required to deliver care and illustrates their sequence and organization. As clinical care requires many interdependent activities, value is measured as a product of the entire care cycle. The CDVC is a tool that allows one to outline and analyze the process of care delivery for a medical condition in order to use this information to configure this process to maximize value for patients. Individual activities within the care delivery cycle contribute value but do so in relation to other activities in the cycle. Thus the value of any discrete activity can only be understood by considering its relation to other activities within the care delivery value chain. The CDVC also highlights activities such as patient access, external factors, patient information, and patient engagement that are crucial in resource poor settings.

In this paper, we describe the care delivery value chain for HIV/AIDS care in resource poor settings. Much is known about HIV/AIDS care, and the purpose of this note is not to be exhaustive but to see care in an overall systemic perspective. The care cycle for HIV begins before infection with the virus and lasts until death. By delineating the activities involved in this care cycle and describing how they interrelate, we can evaluate how the sequence of activities should be aligned with value for patients. We

can also address such issues as how to improve coordination across activities, how appropriate human resources should be deployed across the care cycle, how facilities should best be designed to enhance value, and how information should be shared among activities.

BACKGROUND

HIV was first identified in 1981. By 2006, 39 million people were living with HIV/AIDS and more than 27 million had been killed by the disease.² Of those living with HIV/AIDS in 2006, 25 million were living in resource poor settings in sub-Saharan Africa where the adult prevalence rate was 7.2 percent. While sub-Saharan Africa was home to 10% of the world's population, it was home to 64% of the world's HIV/AIDS patients.³

The human immunodeficiency virus (HIV) is transmitted through infected bodily fluids or during birth. Worldwide, the most common mode of transmission is heterosexual intercourse.⁴ After entering the host, the virus preferentially attacks CD4 lymphocytes that constitute an essential part of the immune system. In early stages of the infection, as the virus is destroying CD4 lymphocytes, few symptoms may be evident after an initial flu-like illness. However, as the number of CD4 lymphocytes drop, the patient's immune system begins to weaken leaving him/her subject to various other infectious diseases including tuberculosis (TB) and opportunistic infections such as pneumocystis pneumonia (PCP).

The rate of progression from clinical latency to symptomatic disease depends on several factors including the health and nutritional status of the patient. In advanced stages of the disease, the virus can cause severe wasting, damage to vital organs, and eventually death.

The degree of CD4 suppression is a fairly reliable marker for disease progression and is often correlated with specific other infections that the HIV patient is susceptible to experience. Many decisions in the care of HIV infected patients utilize measurement of CD4 count to determine appropriate therapies. CD4 testing has been shown to be cost-effective in the care of HIV patients in resource-poor settings.⁵ It is also possible to measure the amount of viral burden in a patient, through viral load testing. This test although expensive, allows better evaluation of therapy than CD4 testing alone, as it is a more sensitive way to determine when a treatment regimen is failing.⁶ Viral load testing is widely used in developed countries and is being advocated as an adjuvant to CD4 testing in resource poor settings.⁷ However, it remains unavailable in the majority of these areas. When CD4 count measurement is not available, a clinical staging system

formulated by the World Health Organization and based on easily measured clinical signs, can be used to guide treatment decisions.⁸

Initiation of combination anti-retroviral therapy (ART) that interferes with the replication of the virus at many points of its lifecycle has revolutionized treatment of HIV/AIDS and has led to substantial declines in mortality and morbidity in resource-poor settings^{9 10}. ART in combination with prophylactic therapy for opportunistic infections has changed HIV/AIDS into a treatable, chronic disease in regions where these treatments are available^{11 12}.

Effective ART suppresses the amount of circulating virus, as well as viral replication, often to undetectable levels. However, HIV survives in reservoirs of CD4 lymphocytes. If antiretroviral medication levels fall, the virus can quickly start to replicate. Active viral replication in the setting of sub-therapeutic medication levels leads to the development of viral mutations that cause resistance to ART. This is a major cause of treatment failure and the need to move to second-line care regimens.

Ensuring close adherence to medication regimens by patients is therefore an important factor in delivering effective HIV care. Close adherence has been shown to lead to sustained suppression of viral loads¹³ and improved clinical outcomes.¹⁴ It is difficult but possible to achieve adequate adherence rates in resource-poor settings. A recent meta-analysis of studies from 12 sub-Saharan African countries showed adherence levels comparable to those achieved in North America.¹⁵ In smaller studies, high adherence rates to ART have been achieved with the use of directly observed therapy¹⁶ and home visits¹⁷.

Management of HIV/AIDS differs by gender due to pregnancy and female specific illnesses such as cervical cancer. Women with HIV are more susceptible to gynecological infections and have more gynecologic complaints than their non-HIV infected counterparts. They are also more likely to suffer from cervical cancer¹⁸. Since peri-natal transmission is responsible for 90% of new HIV infections in children and can be significantly reduced by ART therapy and other measures, identification of HIV infected pregnant women and provision of ART to halt mother-to-child transmission are critical tasks. The care of women requires added activities to address these gynecological-specific and pregnancy-associated aspects of care.

PRIMARY ACTIVITIES

Care delivery for any medical condition consists of a myriad of different types of activities that are often linked. The way one activity is performed frequently affects the results of other activities. The best allocation of effort and spending can only be understood by looking at the entire value chain.

We reviewed the literature and interviewed expert practitioners to map care delivery for HIV/AIDS in resource-poor settings. The care delivery value chain for HIV/AIDS can be divided into seven categories of primary activities: prevention, testing/screening, staging, delaying progression, initiating antiretroviral therapy, continuous disease management, and management of clinical deterioration.

Prevention Prevention seeks to halt transmission of HIV from infected to non-infected individuals. The most effective strategies include promotion of condom use, provision of easily accessible counseling and testing services, and the use of anti-HIV drugs to prevent maternal-to-child transmission of HIV¹⁹. However, effective use of condoms is often limited by gender power dynamics.²⁰ In selected populations, treating sexually transmitted infections and decreasing high-risk behaviors such as needle sharing and can also be highly effective.²¹

Testing/Screening HIV testing is critical to both HIV prevention and treatment.²² Testing identifies symptomatic and asymptomatic individuals with HIV and provides an entry point to care. Testing also provides an opportunity to counsel those who are not infected on ways to reduce their risk. As part of pre-natal services, testing identifies HIV infected pregnant women allowing treatment of mothers if indicated, and prevention of maternal-to-child transmission of HIV.

The HIV testing process consists of pre-test counseling, drawing blood for the testing, performing the test, and informing the patient of the test result with post-test counseling. All initially positive HIV tests are confirmed by a second test. Rapid tests for HIV are now widely available in the developing world and are endorsed by the WHO²³. These tests require little laboratory equipment, utilize whole blood from finger prick samples, have results available in less than thirty minutes, and are available for about US\$1 per test.

Staging If the confirmatory test is positive, the diagnosis of HIV infection is made. The stage of infection is then determined and this will guide treatment decisions. The patient receives a detailed clinical assessment that includes a physical examination with measurement of weight, determination of current medical conditions including pregnancy, and current medication use. Laboratory measurements are performed

including measurement of CD4 count (where possible), hemoglobin measurement, pregnancy testing of women if appropriate, and screening for tuberculosis, malaria, STI's and any opportunistic infections²⁴. Once this evaluation is completed, a decision is made about the patient's clinical stage and whether antiretroviral treatment should be initiated or can be safely postponed.

All patients with HIV should be screened for active and latent tuberculosis. Patients with active tuberculosis should be treated promptly for the disease. Patients with latent tuberculosis should receive prophylaxis to reduce development of active tuberculosis²⁵

An assessment is also made of the patient's social and economic circumstances to determine barriers to effective treatment. These barriers often include lack of transportation, food security, a safe living environment, or social supports. Once staging has been determined, activities are undertaken either to delay progression or to initiate antiretroviral therapy (ART).

Delaying Progression Patients whose clinical stage or CD4 count does not yet warrant initiation of antiretroviral therapy are monitored regularly and re-evaluated until antiretroviral therapy is deemed necessary. Patients are monitored every six months for progression by clinical assessment and CD4 count measurement. A patient may remain in this state for months before moving to the next set of activities. Appropriate care can delay the progression of the disease.

Tuberculosis remains a leading cause of morbidity and mortality among HIV patients.²⁶
²⁷ Co-infection with tuberculosis accelerates HIV replication. ²⁸ ²⁹ Treatment of active and latent tuberculosis as described above, delays progression and leads to substantial improvements in health for HIV patients.³⁰ ³¹

Malnutrition accelerates HIV progression,³² ³³ and provision of multivitamin and micronutrient supplements has been proven to delay the progression of HIV disease³⁴ ³⁵.

HIV positive persons are counseled to prevent the spread of HIV to their sexual contacts and children. Successful efforts are cognizant of and responsive to social barriers, such as women's power within their home environments³⁶.

Initiating Antiretroviral Therapy When a patient's CD4 count (or clinical stage) falls below a threshold value, he or she is started on anti-retroviral therapy. Current evidence supports prompt initiation of ART if the CD4 count is less than 200 cells/mm³ and safe postponement of ART if the CD4 count is greater than 350 cells/mm³. It is

unclear what is the best time to begin ART for patients with CD4 counts between 350 and 200 cells/mm³.³⁷ Baseline physical examination and laboratory testing including hemoglobin and pregnancy testing are performed before prescribing these medications. Currently used first line regimens include three medications and cost approximately US \$160-175 per patient per year.³⁸

Depending on the patient's clinical stage and CD4 count, prophylactic therapy with cotrimoxazole, an antibiotic against opportunistic and bacterial infections is started as well.³⁹ The patient is also counseled about possible side effects from the treatment such as rash and hepatitis. Nutritional supplementation and social support are provided as needed to address barriers to effective medical therapy.

The patient is educated about the need for strict adherence to the treatment regimen. Having community health workers closely involved in the patient's care has been effective in ensuring better adherence.^{40 41 42} A recent meta-analysis showed better viral suppression, likely resulting from improved adherence in patients living impoverished settings, when ART was provided without charge.⁴³

Continuous Disease Management Patients on anti-retroviral therapy are seen in clinic on a regular basis and are assessed for their adherence to medications, need for social assistance or nutritional support, clinical status, and risk of transmitting the virus. The patient's CD4 count is checked every 6 months.

Common side effects of therapy are monitored, and screening lab tests (if available, such as blood counts and liver tests) to identify side effects early are performed monthly (for the first three to six months) and then semiannually or as symptoms indicate.⁴⁴ Family members and close contacts are screened twice a year for HIV infection.

During the course of treatment, numerous adverse effects can be encountered which need to be managed. Common adverse effects include rash, anemia, hepatitis, neuropathy and kidney stones. Most of the adverse reactions to HIV treatment are not life threatening, but they may reduce a patient's adherence to the medication regimen, and therefore should be treated aggressively. Often times this involves therapies aimed at reducing symptoms, but may also involve changing antiretroviral agents.

Management of Clinical Deterioration At some point in the course of his or her illness, a patient's clinical status will deteriorate. Opportunistic infections and bacterial infections will require specific therapies. Failure of anti-retroviral therapy to halt

progression of disease requires switching to second line anti-retroviral regimens if available. Current second line agents cost approximately US\$600-700 per patient per year.⁴⁵ Successful treatment of infections and second line regimens often return a patient to the previous care stage until further events occur.

At some point, many patients will require end-of-life care to help manage uncomfortable symptoms, provide nursing care, and provide emotional support. These activities can take place in dedicated hospices or be delivered in the patient's home

OPTIMIZING THE HIV/AIDS CARE DELIVERY VALUE CHAIN

The care delivery value chain helps reveal insights into why successful HIV/AIDS programs are effective, and many of the current best practices of HIV/AIDS care in resource poor settings can be better appreciated by considering them in light of the overall system of care delivery. Although many of the suggested best practices below have not yet been studied in a rigorous fashion, they are informed by the experiences of practitioners in the field and the analysis of successful programs.

Improving maternal and child primary health care services improve HIV/AIDS outcomes. Efforts to reduce mother-to-child transmission of HIV increase value by decreasing new infections in a vulnerable population. Locating maternal and child health services within the scope of HIV care delivery allows coordination between these services and HIV prevention and treatment services. Providing routine prenatal care helps identify HIV pregnant women who can benefit from treatment of their infection and from prophylaxis to reduce viral transmission to their infants. These services reduce the incidence of new infections among children and improve pregnancy outcomes.

Having birthing facilities available allows for HIV testing of mothers who present in labor and were not previously screened. Providing antiretroviral therapy during labor to HIV positive mothers is a key activity to preventing mother-to-child transmission of HIV. Having adequate peri-natal services available allows for preventing post-partum mother to child transmission through provision of infant formula and avoidance of breast-feeding.

Screening is most effective when integrated into a primary health care system. Freestanding voluntary counseling and testing (VCT) centers, separate from the clinical centers where care is provided to HIV patients can be problematic. Freestanding VCT centers allow for neither linkages nor coordination between screening and the rest of

the care cycle. Furthermore, separate VCT centers offer little value to patients, as they provide no clinical care.

Integrating screening centers within centers providing clinical services allows for a more seamless flow of information along the CDVC. In addition, this arrangement reduces many barriers to testing: patients no longer need to feel stigmatized by visiting a free standing site, and routine screening of patients presenting to primary care or prenatal clinics can be facilitated.

Diagnosis of and treatment of tuberculosis is integral to HIV/AIDS care. Patients with newly diagnosed HIV infection in resource poor settings suffer from many of the other endemic diseases that affect impoverished peoples such as tuberculosis and malaria. Tuberculosis remains a leading cause of death among AIDS patients in resource poor settings. Therefore robust screening for active and latent tuberculosis must be integrated into the HIV/AIDS care delivery value chain. Tuberculosis screening, including ability to perform chest radiographs, is an essential service for newly diagnosed HIV patients. HIV/AIDS treatment efforts must be linked to effective tuberculosis treatment programs tailored toward the challenges of managing HIV co-infected tuberculosis patients.

Improving adherence to anti-retroviral therapy improves outcomes and costs. Current antiretroviral therapies need high rates of patient adherence in order to be effective. Improving adherence delays emergence of drug resistance and improves survival. Since high adherence reduces emergence of viral resistance, which is major cause of treatment failures, the need to switch to high cost second line ART should be reduced in programs with high adherence rates. High adherence rates are clearly associated with improved patient outcomes.⁴⁶

Activities to improve adherence are high value activities because they improve patient outcomes. Ensuring adherence is a fundamental activity of an HIV/AIDS treatment program, and not solely a responsibility of the patient. Activities to improve adherence include reducing pill burden, actively managing side effects, and involving family and community members in medication management.⁴⁷ Programs that have used community health workers to administer directly observed ART have reported high adherence rates.⁴⁸

Management of social and economic barriers is critical to the treatment of HIV/AIDS. HIV/AIDS disproportionately affects marginalized and impoverished populations.

Patients in resource-poor settings often have limited access to transportation, clean water, safe housing, or reliable food supplies. They can lack adequate educational and economic opportunities. Women and children's rights and agency may be severely limited in some contexts. HIV care is complex and life-long, and these barriers need to be addressed in order for effective care to be delivered.

Research suggests that providing multivitamin supplements and ensuring adequate food security can delay progression of AIDS and improve outcomes in malnourished populations.⁴⁹ In addition, the provision of ART without charge has been shown to improve viral suppression in patients.⁵⁰ Despite these findings, many programs continue to charge user-fees despite little data to support their effectiveness.

These barriers to care must be understood as part of configuring the care delivery value chain, not outside of it. Activities to reduce these barriers maximize value across the care cycle by encouraging patients' entry into care and by helping to facilitate follow up and retention. To reduce these barriers, programs can waive user fees, and provide services such as transportation and food supplements to the most needy.

CONCLUSION

The prevention and treatment of HIV/AIDS in resource-poor settings presents enormous challenges. Many of the social and economic factors that make populations living in these settings vulnerable to HIV/AIDS such as poverty, malnutrition, and political instability conspire to create barriers to effective care delivery. HIV/AIDS is a complex disease entity with numerous associated interventions. Understanding how these interventions are related to each other and how local socioeconomic factors influence them is critical to effective program design. Programs that account for barriers to care and integrate their activities to maximize the value they deliver to patients have been successful despite these challenging settings.

In this paper, we have used the care delivery value chain to map the activities associated with HIV/AIDS care delivery in resource poor settings in order to illuminate effective linkage and coordination of these activities. The framework allows the synthesis of knowledge about the overall system of care delivery and provides a common language for improving it. Government agencies, philanthropic organizations, and non-governmental organizations can use this framework to improve HIV/AIDS care delivery.

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HIV/AIDS CARE FOR MEN IN RESOURCE POOR SETTINGS: CARE DELIVERY VALUE CHAIN

Knowledge Management						
Informing and Communicating	Lifestyle Counseling Self Management	Lifestyle Counseling Explanation of the diagnosis and the implications Explaining the course of HIV and prognosis	Lifestyle Counseling Explanation of the diagnosis and the implications	Explanation of Medication Instructions and Side-Effects	Medication Compliance	Managing Complications Explanation of the co-morbid diagnoses and the implications End-of Life Counseling
Measuring	HIV Testing Screen for TB and, if indicated, Simultaneously Screen for Sexually Transmitted Infections (Chlamydia, Gonorrhoea) Collect baseline demographics	HIV testing for others at risk HIV Staging Clinical examination, CD4+ count, and other labs Testing for common co-morbidities	CD4+ Count Monitoring (Continuous Staging) Continuous Assessment of Co-Morbidities Regular Clinical Examinations to Assess for Disease Progression Socioeconomic and Nutrition Assessment	CD4+ Count Monitoring (Continuous Staging) Monthly Primary Care Assessment HIV Testing for Others at Risk Laboratory Evaluation for Medication Initiation	HIV Staging and Medication Response Highly Frequency Primary Care Assessment Assessing/Managing Complications of Therapy HIV testing for others at risk (bi-annually) Laboratory Evaluation	HIV Staging and Medication Response Monthly Primary Care Assessment Laboratory Evaluation
Accessing	Meeting patients in high risk settings Primary Care Clinics Testing Centers	Primary Care Clinics Laboratories (on-site at primary clinic) Testing Centers	Primary Care Clinics Support Groups Laboratories (on-site at primary clinic) Pharmacy Food Centers Home Visits	Primary Care Clinics Support Groups Laboratories (on-site at primary clinic) Pharmacy Community Health Workers/Home Visits	Primary Care Clinics Support Groups Laboratories (on-site at primary clinic) Pharmacy Community Health Workers/Home Visits	Primary Care Clinics Support Groups Laboratories (on-site at primary clinic) Pharmacy Community Health Workers/Home Visits Hospitals & Hospice Facilities Food Centers
Primary Activities	Prevention and Screening	Diagnosing and Staging (if + in screening stage)	Pre Anti-Retroviral Medical and Psychosocial Management	Intervening / ARV-Initiation	Continuous Disease Management	Management of Complications and Clinical Deterioration
	<ul style="list-style-type: none"> Identifying high risk individuals Testing at-risk individuals Promoting appropriate risk reduction strategies Modifying behavioral risk factors Connecting patients with primary care system Creating a medical record 	<ul style="list-style-type: none"> Formal diagnosis and staging Determine method of transmission and others at potential risk Identify others at risk Determine TB, syphilis, and status of other sexually transmitted diseases Create management plan, including scheduling of follow-up visits 	<ul style="list-style-type: none"> Formulate a treatment plan Initiate therapies that can delay onset Limit co-morbidities that affect progression of disease Improve patient awareness of disease progression, prognosis, and transmission Connect patient to care team, including community health work 	<ul style="list-style-type: none"> Initiate comprehensive anti-retroviral therapy and assess medication readiness Prepare patient for disease progression and side-effects of associated treatment Manage secondary infections and associated illnesses 	<ul style="list-style-type: none"> Managing effects of associated illnesses Determine supporting nutritional modifications Preparing patient for end-of-life management Primary care and health maintenance 	<ul style="list-style-type: none"> Identifying clinical and laboratory deterioration Initiating second-line, third-line drug therapies Managing acute illness and opportunistic infection either through aggressive outpatient management or hospitalization Managing side effects of treatment Provide additional community/social support if needed

