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An Evaluation of the Costs and Health Benefits Associated with an Overseas Voluntary HIV Screening Program for Refugees Undergoing Resettlement to the United States

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ABSTRACT

AN EVALUATION OF THE COSTS AND HEALTH BENEFITS ASSOCIATED WITH AN OVERSEAS VOLUNTARY HIV SCREENING PROGRAM FOR REFUGEES UNDERGOING RESETTLEMENT TO THE UNITED STATES

By

MICHELLE CANADY

JULY 24, 2015

Since 2010, HIV screening is no longer required as part of the overseas medical examination for U.S.-bound refugees. Estimated HIV prevalence for U.S.-bound refugees range from 0% to 9%, with an average of 2.2%. Based on this data, many refugees may be at high risk for HIV and HIV-associated infections and sequelae when compared to the 0.4% to 0.9% prevalence range in the U.S. population. The Centers for Disease Control and Prevention (CDC) believes that some refugees are also not being screened during health assessments after arrival in the U.S. These missed opportunities are creating a concerning public health gap in HIV diagnosis and early linkage to care. Given the uncertainty and potentially high prevalence in refugees bound for the U.S., it is important to consider the need and impact of overseas HIV screening interventions.

This capstone is an economic analysis of costs associated with an overseas voluntary HIV screening and treatment program for refugees undergoing resettlement to the U.S. There is a gap in the literature with regard to the costs to screen refugees for HIV either overseas or in the United States. This study seeks to close that gap by answering the following question:

- Will HIV screening for refugees overseas be less expensive for the U.S. government than domestic screening and will early screening have positive public health outcomes?

The results of this study suggest that HIV screening for refugees overseas will be less expensive for the U.S. government than domestic screening and early screening will have a positive effect on public health outcomes for refugees and receiving communities. Initiating the proposed intervention should provide cost-savings to the U.S. government each year. Increasing the rates of overseas screening should increase the number of refugees screened and linked to care at least 3 months earlier. Early screening and linkage to care is in line with both the U.S. National HIV Strategy and the United Nations High Commissioner for Refugees (UNHCR) recommendations, resulting in positive health benefits to U.S.-bound refugees and the receiving communities. For U.S.-bound refugees with HIV, health benefits of implementing the proposed overseas intervention would include increased life expectancy and quality of life; delayed onset of AIDS and opportunistic infections; and reduced transmission of HIV.

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VOLUNTARY HIV SCREENING PROGRAM FOR REFUGEES UNDERGOING RESETTLEMENT TO THE
UNITED STATES**

by

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B.S., MOUNT MERCY UNIVERSITY

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of Georgia State University in Partial Fulfillment
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MASTER OF PUBLIC HEALTH

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APPROVAL PAGE

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UNITED STATES

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INTRODUCTION

Refugees are people that have been forced to seek refuge outside of their country of nationality due to fears of persecution (DOS, 2014a). Each year, 50,000 to 70,000 refugees resettle to the U.S. (CDC, 2015a). Refugee populations are exceptionally vulnerable to disease outbreaks and profound health disparities (CDC, 2009; Pattie, Janakiram, Topp, and McCarthy, 2007; Szajma and Ward, 2015). They frequently fall through health jurisdictional gaps, lacking health-care services from their countries of origin and finding themselves outside the priorities of their host countries (Dr. Weinberg, personal communication, January 12, 2015).

Refugee populations are at risk for TB, HIV, numerous vaccine-preventable diseases, neglected tropical diseases, parasitic infections, obesity, diabetes, mental health issues, nutritional deficiencies, and chronic hepatitis B infection (Edberg, 2010; Eckstein, 2011; Walker et al., 2013; CDC, 2012a). The risks vary by refugee population and camps. For example the prevalence of pathogenic parasitic diseases ranges from 8% to 86% in refugees resettled to the U.S. (CDC, 2013a). The reason for the large range may be due to differences in living conditions, geographic location, age, previous exposures, and diet (CDC, 2013a).

Refugees in camps often face health issues that are magnified by crowded living conditions and limited access to health care (CDC, 2013b). These conditions can facilitate outbreaks of infectious disease among the vulnerable populations in the camps (CDC, 2013b). Since 2008, more than 50 outbreaks of communicable diseases, including measles, mumps, varicella, hepatitis E, polio and cholera have occurred; many were preventable outbreaks of vaccine-preventable diseases and diseases attributable to inadequate safe water and sanitation (Weinberg, Personal Communication, August 25, 2014).

The human immunodeficiency virus (HIV) remains an important public health challenge around the world, affecting the health of many populations including refugees. Globally, over 35 million people are living with HIV (CDC, 2013c). A great amount of progress has been made in the fight against HIV, but new infections occur each year affecting the lives of many individuals. In 2013, 2.1 million people were diagnosed with new infections illustrating the pervasive nature of the epidemic (CDC, 2013c). Estimated HIV prevalence rates for U.S-bound refugees range from 0% to 9%, with an average of 2.2%

(Dr. Klosovsky, personal communication, January, 25, 2015). Based on this data, many refugees may be at high risk for HIV and HIV associated infections and sequelae when compared to the 0.4% to 0.9% prevalence range in the U.S. population (UN AIDS, 2014).

Since 2010, HIV screening is no longer required as part of the overseas medical examination for U.S.-bound refugees. CDC believes that some refugees are also not being screened during health assessments after arrival in the U.S. (Dr. Weinberg, personal communication, January 12, 2015). These missed opportunities are creating a concerning public health gap in HIV diagnosis and early linkage to care. Given the uncertainty and potentially high prevalence in refugees bound for the U.S., it is important to consider the need and impact of overseas HIV screening interventions.

This study is an economic analysis of costs associated with an overseas voluntary HIV screening and treatment program for refugees undergoing resettlement to the U.S. There is a gap in the literature with regard to the costs to screen refugees for HIV either overseas or in the U.S. This study seeks to close that gap by answering the following question:

- Will HIV screening for refugees overseas be less expensive for the U.S. government than domestic screening and will early screening have positive public health outcomes?

LITERATURE REVIEW

Biology of Human Immunodeficiency Virus (HIV)

“The human immunodeficiency virus (HIV) is a retrovirus that infects cells of the immune system, destroying or impairing their function (WHO, 2014a).” Transmission of HIV can occur through unprotected sexual intercourse (anal or vaginal), transfusion of contaminated blood, sharing of contaminated needles, and between a mother and her infant during pregnancy, childbirth and breastfeeding (WHO, 2014a). As the infection progresses, the immune system becomes weaker, and the person becomes more susceptible to opportunistic infections (WHO, 2014a). CD4 positive (CD4+) T cells are destroyed as HIV attacks the immune system, leaving HIV-infected people susceptible to other diseases, infections, and complications (NIAID, 2012a). CD4 count is often used to measure the level of impaired immune function. Most healthy people have CD4 counts of around 800 to 1,200 (NIAID, 2012a). Often HIV-infected persons do not develop any serious symptoms for several years, but as the CD4 count declines serious symptoms and other opportunistic infections can occur (NIAID, 2012a).

Progression of HIV

There is a well-documented progression for HIV (AIDS.gov, 2013). Progression through the stages of HIV differ based on multiple factors including genetic makeup, age, health before infection, sub-type of infection, co-infection with other viruses, timeliness of diagnosis and linkage to care, adherence to treatment regimens, and health practices (AIDS.gov, 2013). The stages of HIV infection are:

- 1) **Acute Infection** – flu like symptoms occur within two to four weeks after infection, called “acute retroviral syndrome” (ARS) or “primary HIV infection.” During this stage there is a very high risk for transmission to sexual or drug using partners (AIDS.gov, 2013).
- 2) **Clinical Latency** – symptoms are not produced while the infection is living or developing, sometimes called “asymptomatic HIV infection” or “chronic HIV infection.” Transmission is still possible during this stage of the disease (AIDS.gov, 2013).
- 3) **Acquired Immunodeficiency Syndrome (AIDS)** – most advanced stage of HIV, when an HIV-infected person’s CD4 count drops below 200 or they have developed one or more opportunistic infections (AIDS.gov, 2013).

Opportunistic infections (OIs) are common in HIV-infected individuals, because they take advantage of the weakened immune system (AIDS.gov, 2010). They can be local, systemic, or spread across the body (AIDS.gov, 2010). Susceptibility is often associated with the CD4 count level (AIDS.gov,

2010). HIV treatment often increases the CD4 count helping to protect against OIs (AIDS.gov, 2010). CDC has compiled a list of more than 20 OIs that define AIDS including: candidiasis of bronchi, trachea, esophagus, or lungs; invasive cervical cancer; coccidioidomycosis; cryptococcosis; cytomegalovirus disease; histoplasmosis; isosporiasis; kaposi's sarcoma; mycobacterium avium complex; tuberculosis; pneumocystis carinii pneumonia; progressive multifocal leukoencephalopathy; salmonella septicemia; and toxoplasmosis of the brain (AIDS.gov, 2010).

Diagnosing HIV

HIV screening is an effective method to identify new HIV infections and to link patients to care and treatment (WHO, 2014a). Early diagnosis reduces high-risk behaviors in HIV positive patients resulting in reduced transmission. (WHO, 2014b). Screening includes a comprehensive approach that includes administering HIV diagnostic tests, delivering the test results, conducting pre- and post-screen counseling to encourage behavior change, and linkage to care if needed (WHO, 2013). Diagnostic testing refers to the administration of the blood tests and the laboratory process to identify the presence or absence of HIV infection (NIH, 2013).

HIV screening programs have been successful in diagnosing new cases of HIV infections over the course of the epidemic. One clear example is the success in using screening to diagnose HIV in pregnant women and using prevention methods to reduce transmission from mother-to-infant. Implementation of recommendations for universal prenatal HIV screening, treatment and prevention strategies have resulted in a 95% decrease in perinatal AIDS cases in the U.S. since 1992 (Mofenson et al., 2006). In addition, screening programs led to a decline in the risk for perinatal transmission from an HIV-infected mother to less than 2% (Mofenson et al., 2006).

Diagnostic Tests

Diagnostic tests for HIV include rapid antibody assay tests and confirmatory tests through enzyme-linked immunosorbent assay (ELISA) and the Western blot (Understanding Health, 2015). Blood testing can detect HIV through the presence or absence of antibodies in the blood (WHO, 2014b). During the first three to six weeks of infection, the antibodies are being produced in the body and are not yet detectable by the tests that are currently available (WHO, 2014a; NIAID, 2009). Transmission can occur at all stages of infection, but the greatest risk is during this early period (WHO, 2014a).

HIV Screening Guidelines

Different global and domestic organizations have developed recommendations and guidelines with regards to HIV screening. Among these organizations, the most applicable to this study are the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC). These organizations have revised their recommendations over the years as new testing methods and information on risk, transmission, and treatment for HIV became available.

World Health Organization

WHO first issued guidance on HIV screening, referred to as HIV testing and counseling (HTC), soon after HIV tests were first developed in 1985. WHO currently recommends that HIV screening should be voluntary and not mandated or coerced and the patient should have the right to decline screening (WHO, 2012). WHO issued subsequent guidance that included the five components that should be used in administering HIV screening (WHO, 2012). The five components are consent, confidentiality, counseling, correct test results, and connection/linkage to prevention, care, and treatment (WHO, 2012).

United States

CDC's HIV screening recommendations have been revised many times since the first guidelines were issued in 1985. The history of these guidelines and revisions are described below.

- **1985:** The U.S. Public Health Service, now a part of the CDC recommended screening of donated blood or plasma, shortly after HIV was identified as the cause of AIDS and an HIV antibody test was approved. With limited knowledge of the disease in the beginning of the epidemic, the goal of HIV screening was to protect the blood supply (Branson et al., 2006).
- **1987:** As the impacts of positive HIV serology became evident, CDC issued guidelines for HIV prevention, including counseling and testing as a priority strategy for persons at high risk and recommended routine screening of those seeking STD treatment (Branson et al., 2006).
- **1993:** After the approval of the first rapid test for HIV in 1992, CDC recommended extending voluntary counseling and screening to include hospitalized patients, emergency departments, and outpatients in acute-care hospital settings (Branson et al., 2006).
- **1994:** CDC recommended counseling for people with high-risk behaviors include client-specific prevention goals and strategies (Branson et al., 2006).
- **1995:** With demonstrated evidence of treatments that substantially reduce perinatal transmission of HIV from mother-to-infant, CDC recommended routine counseling of all pregnant women to encourage voluntary HIV screening (Branson et al., 2006).
- **2001:** CDC revised recommendations to include HIV screening in routine prenatal care,

simplify screening procedures, and encourage flexibility of the consent process. CDC also extended HIV screening recommendations in health-care settings to include more types of providers to increase access and flexibility of HIV counseling and screening. The guidelines include routinely offering screening to all patients in high HIV-prevalence settings and targeted risk-based screening in low prevalence settings (Branson et al., 2006).

- **2006:** CDC revised guidelines to include routine “opt-out” screening for all patients age 13 to 64 in all health care settings, including all pregnant women and annual screening for those at high-risk (Branson et al., 2006).

Treating HIV

While a cure does not yet exist for HIV or AIDS, treatment can slow the progression of HIV (AIDS.gov, 2013). Treatment reduces the HIV viral load in the body, preserves CD4 levels, and dramatically slows the destruction of the immune system (NIAID, 2012b). Current U.S. recommendations are to begin treatment upon diagnosis of HIV, regardless of CD4 count, to reduce the risk of disease progression (NIH, 2014). HIV screening and treatment can have many positive impacts on the lives of infected individuals and communities. Earlier diagnosis and linkage to care and treatment can lead to increased life expectancy and quality of life; delayed onset of AIDS and opportunistic infections; and reduced transmission of HIV.

With treatment, an HIV-infected person can live an almost normal lifespan and often never progress to AIDS (AIDS.gov, 2013). Vermund (2006) concludes that “the typical HIV-infected person now receiving potent combination ART lives at least 13–14 years longer than if he or she were to forego this therapy or if it were otherwise unavailable.” Unfortunately early diagnosis does not always happen and some people are diagnosed with HIV and AIDS at the same time (AIDS.gov, 2013). On average, the clinical latency stage lasts about 10 years for people not on treatment, but can progress more quickly (AIDS.gov, 2013). Often people who progress to AIDS without treatment only survive about 3 years and only about 1 year with an opportunistic infection (AIDS.gov, 2013).

Research shows that HIV treatment can also reduce the spread of HIV to others (AIDS.gov, 2013). The United States Preventive Services Task Force (USPSTF) found that knowing positive HIV status reduces transmission through reduced high risk behaviors (USPSTF, 2013). In 2011, the HIV Prevention Trials Network (HPTN) randomized clinical trial found that early HIV treatment reduced the risk

of sexual transmission of HIV, in heterosexual couples, to an uninfected partner by 96% (CDC, 2013c). The USPSTF found that approximately 60 infected people would need to be treated to prevent 1 death from HIV infection after 3 years (USPSTF, 2013). Given these significant benefits of early treatment, screening and early linkage to care is critical. To this end, the national HIV/AIDS strategy has a goal to increase the proportion of HIV-infected individuals linked to care within three months of diagnosis (Branson et al., 2006).

Prevalence of HIV

Globally

AIDS and HIV infections have had a cataclysmic impact on the global community, with some countries being far more impacted than others. Over the course of the epidemic, 35 million people have died and 70 million have been infected with HIV (WHO, 2014a). Worldwide, HIV prevalence is estimated at 0.8% in adults aged 15 to 49 years old (WHO, 2014a). However, the burden of HIV varies greatly across regions and countries (WHO, 2014a). For example, the most significantly affected area in the world is sub-Saharan Africa with nearly 1 in every 20 adults living with HIV (WHO, 2014a).

United States

The AIDS epidemic has also impacted the health and lives of millions of people in the U.S. where more than 1.2 million people in 2011 were living with HIV (CDC, 2013c). Approximately 50,000 new infections occur each year in the U.S. (CDC, 2013c). These new infections are disproportionately affecting specific groups of Americans, including gay and bisexual men, African American men and women (CDC, 2013c), foreign-born individuals, and African foreign-born individuals (Prosser, Tang, & Hall, 2012). The medical burden of HIV is exacerbated by the fact that about 20% of people living with HIV do not know they are infected and may unknowingly pass the virus to others (NIAID, 2009b).

According to the CDC, a high-prevalence setting is a geographic location or community with an HIV prevalence of at least 1% (Branson et al., 2006). These settings include sexually transmitted disease (STD) clinics, correctional facilities, homeless shelters, tuberculosis clinics, clinics serving men who have sex with men, and adolescent health clinics with a high prevalence of STDs (Branson et al., 2006).

Branson et al., 2006 found that more frequent screening would benefit those patients who are known to

be at higher risk for HIV infection, actively engaged in risky behaviors, and live in a high-prevalence setting (Branson et al., 2006).

U.S.-Bound Refugees

There is very limited literature published on HIV prevalence or incidence in refugee populations. Further, the studies that exist tend not to be applicable across all refugees because they are limited to specific regions of the world, refugee camps, or refugee populations. The most comprehensive data for all U.S.-bound refugees is from 2009, so it may not be reflective of the current state of HIV in refugees resettling to the U.S. The findings of the studies and data reviewed are summarized below.

- **Congolese Refugees in 2013:** A recent CDC study found a 6% prevalence rate after screening 176 refugees (Ms. Russell, personal communication, November, 10, 2014)
- **Refugees Resettling to the U.S. in 2009:** An analysis, by the International Organization for Migration (IOM), of refugees screened prior to resettlement found an average prevalence of 4.1%, ranging from 0% to 9.0% by country (Dr. Klosovsky, personal communication, January 25, 2015)
- **Refugees Resettling to New Zealand:** Nisbet et al. (2007) found a 1.3% prevalence in refugees settling to New Zealand over an 11 year time frame
- **Refugee Arrivals to Minnesota from 2000 to 2007:** A study by Lowther et al. (2012) found a 0.9% prevalence rate
- **African Refugees Resettling to France:** Bouree et al. (1995) found a 6.3% prevalence rate based on data from a three year period

Given the uncertainty and potentially high prevalence in refugees bound for the U.S., it is important to consider the need and impact of HIV screening interventions for refugees resettling to the U.S.

Overview of Refugee Resettlement to the U.S.

Through the U.S. Refugee Admissions Program (USRAP), the U.S. offers resettlement to approximately 50,000 to 70,000 refugees annually (CDC, 2015a). This U.S. program is considered a critical component of federal government efforts to shield vulnerable refugee populations displaced by political events around the globe (DOS, 2013). “A refugee is defined as any person who is outside his or her country of nationality who is unable or unwilling to return to that country because of persecution or a well-founded fear of persecution based on the alien's race, religion, nationality, membership in a particular social group, or political opinion (UNHCR, 1951).”

In 1950, the United Nations General Assembly established the Office of the United Nations High Commissioner for Refugees (UNHCR) to coordinate international protection and support of refugees worldwide (UNHCR, 2015b). “According to UNHCR, there are 15.4 million refugees around the world,” of which almost half are in Asia and about 28% are in Africa. (DOS, 2014a; UNHCR, 2015). Living conditions vary widely for refugees around the world, ranging from established refugee camps to living in urban areas (UNHCR, 2015). In camps, refugees usually have access to some basic health care services provided by non-governmental organizations working with UNHCR; however, in urban areas, the refugees may not have access to any routine health care or other support services, such as food rations (Dr. Weinberg, personal communication, January 12, 2015).

Resettlement is considered one of three possible “durable solutions” for refugees (DOS, 2014a). The other durable solutions: repatriation to their country of origin and local integration into the host country, are considered more desirable than resettlement. Often repatriation is not a feasible option because the conflict from which they fled continues to be prevalent in their home country (DOS, 2014a). Many times local integration in the host country is difficult due to economic, social, and political challenges (DOS, 2014a). Many refugees would prefer to return to their home countries, but for many it is not possible (UNHCR, 2015b). Millions of refugees spend decades in refugee camps, unable to return home (USCRI, 2015). Resettlement in another country is often the only way refugees have a chance to rebuild their lives (USCRI, 2015).

Historically, U.S. policy has admitted refugees of special humanitarian concern. The first refugee legislation was the Displaced Persons Act of 1948, following World War II, authorizing the admission of 400,000 displaced Europeans (Refugee Council USA, 2015). Future laws followed allowing people, escaping from countries with Communist leadership, from Hungary, Poland, Yugoslavia, Korea, China, and Cuba to resettle to the U.S. (Refugee Council USA, 2015). Over the years, many private and religious organizations have assisted with refugee resettlement, a model that has continued into the current U.S. refugee resettlement program (Refugee Council USA, 2015). Congress passed the Refugee Act of 1980, which provides the legal basis for today’s USRAP (Refugee Council USA, 2015).

During its history, the USRAP has responded to changing circumstances. For example, the end of the Cold War shifted from bigger groups of refugees in select areas to resettlement of refugees from

many countries around the world (DOS, 2014b). “In 2013, the USRAP admitted refugees of over 69 nationalities who began their journeys in some 92 countries (DOS, 2013).”

The U.S. has the largest resettlement program of any country around the world. “Since 1975, Americans have welcomed over 3 million refugees from all over the world. Refugees have built new lives, homes and communities in towns and cities in all 50 states” (DOS, 2014a). In fiscal year 2014, an estimated 69,500 refugees arrived in the U.S. (DOS, 2014b). Every year, the President, in consultation with Congress, sets a ceiling for the number of refugees to be resettled and specifies the geographic areas from which they should come. For example, the FY 2015 Presidential request specifies a ceiling of 70,000, with approximately 46,000 from Asia and 17,000 from Africa (DOS, 2014b).

Refugees come to the U.S. in a legal “refugee” status, allowing them to work and receive special support and services, such as refugee medical assistance (DOS, 2014b). One year after arrival, they are eligible to adjust to lawful permanent resident status (green card holders) and, after 5 years, they can become U.S. citizens (DOS, 2014b). The program is considered a public-private partnership with the premise that refugees should become economically self-sufficient as quickly as possible (DOS, 2013). Social services are available to refugees for up to five years after arrival, including employment services such as English language and vocational training to assist refugees to obtain employment and enhance their long-term career opportunities (DOS, 2014b).

Resettlement is a complex, multi-agency process including the Department of State (DOS), the Department of Homeland Security (DHS), and the Department of Health and Human Services (HHS).

- **Department of State (DOS), Bureau of Population, Refugees, and Migration (PRM)**
 - Works with UNHCR to identify refugees that should be considered for resettlement, manages policies on admission, and directs the overseas processing of refugees (DOS, 2014b).
 - Funds physicians to conduct the required medical examinations overseas (CDC, 2014a).
 - Coordinates transportation, reception, and integration of refugees to the U.S. (DOS, 2014b).
- **Department of Homeland Security (DHS)**
 - Makes determinations on refugee status abroad, conducts security clearances for refugee processing, and adjusts citizenship status of refugees (DOS, 2014b).

- **Department of Health and Human Services (HHS)**
 - The Office of Refugee Resettlement (ORR) provides assistance to refugees after arrival in the U.S. through grants to state and local programs, in collaboration with voluntary organizations known as Resettlement Agencies, which help newly arrived refugees settle into local communities (DOS, 2014b).
 - CDC provides technical guidance for medical screening for refugees prior to and after arrival in the U.S. (CDC, 2014a).

Health of Refugees

Health Care for U.S.-Bound Refugees

“The Secretary of the HHS has statutory responsibility for preventing the introduction, transmission, and spread of communicable diseases into the U.S. (42 U.S. Code § 264). The authority for carrying out these functions has been delegated to CDC’s Division of Global Migration and Quarantine (DGMQ). DGMQ works to fulfill this responsibility through a variety of activities, including the establishment of standards for medical examination of persons destined for the U.S. (ExpectMore.Gov, 2008).” These activities include development, coordination, and oversight of disease screening programs for immigrants and refugees (CDC, 2013b).

DGMQ plays a critical regulatory and public health role in the USRAP. Currently CDC provides technical and regulatory oversight to medical screening and identifies high risk refugee populations for major public health causes of morbidity and mortality for U.S. state and local public health follow-up (Expectmore.gov, 2008). DGMQ has the technical expertise and connections, including Regional Field Programs in Nairobi and Bangkok, to work overseas with health partners in refugee camps, provide oversight for the required overseas medical exam, and coordinate with state and local health department refugee programs and clinics for better continuity of care and program alignment (Dr. Weinberg, personal communication, January 12, 2015).

In addition, DGMQ developed the Quality Assessment Program (QAP) to monitor the quality of the overseas examination and ensure the validity and thoroughness of the health assessment (CDC, 2015b). Through QAP, DGMQ provides technical guidance to the overseas panel physicians who perform the medical screening examination at over 760 sites (CDC, 2015b). DGMQ teams, with medical

and laboratory expertise, perform on-site visits and make recommendations to sites on how to improve any deficiencies identified during the visit (CDC, 2015b).

Medical Examinations for U.S.-bound and Newly Arrived Refugees

Before resettlement, refugees undergo a required medical examination overseas governed by the technical requirements developed by DGMQ (CDC, 2014a). DOS/PRM subcontracts with physicians from the International Organization for Migration (IOM) to conduct the required medical exam (CDC, 2015b). After arrival, a domestic health assessment is recommended, but not required (CDC, 2013d). Refugees are eligible for eight months of refugee medical assistance, which is provided by ORR and administered by state refugee programs (DOS, 2014b). Some refugees are also eligible for Medicaid (DOS, 2014b). Local and state governments provide additional funding to support these assessments and follow-up care (DOS, 2014b). The first domestic health assessment usually occurs within 30 to 90 days after arrival (CDC, 2013d).

The required overseas medical exam for refugees focuses on the detection and treatment of “inadmissible conditions” as defined by regulations in [Section 212\(a\)\(1\)\(A\) of the Immigration and Nationality Act \(INA\)](#) (CDC, 2014b). “Inadmissible conditions” include TB, syphilis, chancroid, gonorrhea, granuloma inguinale, lymphogranuloma venereum, and Hansen's Disease (leprosy) (CDC, 2014b). The examination includes a medical history, physical examination, and screening and diagnostic testing (CDC, 2014b).

Previous experience demonstrated that more flexibility, beyond a fixed list of diseases, is needed to allow for rapid response to emerging disease outbreaks (CDC, 2014b). To address this need, CDC revised the scope of the medical exam in 2005 for specific situations requiring additional medical screening, testing and treatment for the following disease categories:

- “Quarantinable diseases designated by any Presidential Executive Order.
 - Current diseases include: cholera, diphtheria, infectious tuberculosis, plague, smallpox, yellow fever, viral hemorrhagic fevers, severe acute respiratory syndrome (SARS), and influenza caused by novel or re-emergent influenza (pandemic flu).
- Events that are reportable as a public health emergency of international concern (PHEIC) to the World Health Organization (WHO) under the International Health Regulations (IHR) of 2005

- Currently polio, smallpox, SARS, influenza, and other public health emergencies of international concern) (CDC, 2014b).”

A risk-based approach, based on medical and epidemiological factors, is now used to define the additional medical screening, testing, and treatment required (CDC, 2014b). The medical and epidemiologic factors considered are the potential public health impact, dynamics of the emergence of the disease, risk of spread to the U.S., transmissibility and virulence of the disease, pathogenic factors threatening U.S. health security, and impacts based on the geographic location of the medical examinations (CDC, 2014b).

The medical exam is valid for six months unless the refugee has active or inactive tuberculosis infection, in which case the exam is only valid for three months (DOS, 2015). The shortened validity is to reduce the risk of active tuberculosis in higher risk persons (DOS, 2015). If the exam validity expires before the refugee is able to travel to the U.S., the medical exam must be repeated (DOS, 2015). Refugees who have an inadmissible condition must undergo treatment before resettlement (DOS, 2015). The treatment is provided by IOM and paid for by DOS/PRM (DOS, 2015).

Unfortunately the required medical examination for resettlement does not address many important public health issues (Walker, Stauffer, and Barnett, 2013). Refugees are vulnerable populations who are often neglected and underserved, and many have not had access to adequate health care and prevention services for years (Pottie et al., 2007; Szajma & Ward, 2015). They are exceptionally vulnerable to disease outbreaks and profound health disparities and frequently fall through the health jurisdictional gaps, lacking health-care services from their countries of origin and falling outside the priorities of their host countries (Dr. Weinberg, personal communication, January 12, 2015).

Refugee populations are at risk for TB, HIV, numerous vaccine-preventable diseases, neglected tropical diseases, parasitic infections, obesity, diabetes, mental health, nutritional deficiencies, and chronic hepatitis B infection (Edberg, 2010; Eckstein, 2011; Walker et al., 2013; CDC, 2012b). The risks vary by refugee population and camps, for example the prevalence of parasitic diseases that are pathogenic ranges from 8% to 86% in refugees resettled to the U.S. (CDC 2013a). The reason for the large range may be due to differences in living conditions, geographic location, age, previous exposures, and diet (CDC 2013a).

Refugee Health Assessments for Newly Arrived Refugees

CDC recommends that refugees undergo a medical health assessment as soon as possible after arrival to the U.S. (CDC, 2012a). CDC provides guidelines for state public health departments and medical providers to carry out the assessments (CDC, 2013d). Currently, CDC's HIV guidelines for screening refugees after arrival to the U.S. are consistent with CDC's general HIV screening recommendations (CDC, 2012c). CDC also recommends that information about HIV testing, results, diagnosis, and care should be provided in native languages and culturally sensitive methods (CDC, 2012c). CDC estimates approximately 95% of refugees are being screened for HIV, after arrival to the U.S., as a part of this health assessment (Ms. Lee, personal communication, October 12, 2014). Even with this high rate of acceptance, screening is happening at least three months later than it would if it were performed overseas. This delay extends the time it takes for diagnosis and initiation of care and treatment, in turn increasing the risk of transmission to others.

Refugee Health and HIV: A Critical Public Health Gap

Since January 4, 2010, HIV screening is no longer required for refugees during the overseas medical examination, because HIV is preventable and is not spread through casual contacts (CDC, 2012c). The change was made to address the public health knowledge gained about HIV and the way it spreads since it was added as an inadmissible condition in 1987 (CDC, 2014a). The removal of HIV as an inadmissible condition for immigration to the U.S. was consistent with global recommendations and policies that sought to remove HIV-status to restrict migration.

Even though HIV screening is no longer required as part of the medical examination, refugees can still be screened if they provide consent (CDC, 2014b). However, the guidance from CDC to physicians conducting the examination is to no longer screen for HIV, but that they can advise refugees on screening if it is clinically indicated (CDC, 2013b). CDC did not initially encourage routine HIV screening due to the potential stigma and discrimination that may have occurred soon after the removal of the mandatory screening (Dr. Weinberg, Personal Communication, January 15, 2015). Refugees can be considered inadmissible to the U.S. on the basis of "public charge" which means if they are likely to become dependent of the government for subsistence or long-term care. Even though public charge is not supposed to be considered for treatment of infectious diseases, there was concern that discrimination

could occur due to stigma (USCIS, 2014). Currently only around 2% of refugees overseas are screened for HIV prior to resettling to the U.S., so many refugees are not aware of their HIV status prior to resettling to the U.S. (Dr. Klosovsky, personal communication, January 25, 2015). Due to this low acceptance rate, the removal of the required screening has left a critical public health gap to be addressed.

Several states have provided CDC with examples that illustrate the negative impact of refugees arriving without knowledge of their HIV status and being linked with appropriate care and treatment. For example, in North Carolina a Congolese refugee died four months after arriving to the U.S. due to HIV-related causes, just 10 days after receiving his HIV diagnosis (Dr. Shetty, personal communication, November 5, 2014). In Colorado, almost 90 days after arrival to the U.S., a single nursing mother of five tested positive for HIV (Dr. Shetty, personal communication, November 5, 2014). Fortunately the child tested negative for HIV and nursing was stopped to eliminate the risk of the baby being infected (Dr. Shetty, personal communication, November 5, 2014). Illinois also had experience with two refugee women that did not learn of their HIV positive status until after giving birth (Dr. Shetty, personal communication, November 5, 2014). In these examples, HIV screening overseas may have allowed the refugees to have earlier awareness of their status, access to care and treatment, and continuity of care after arrival to the U.S., thus reducing the likelihood for poor health outcomes and transmission to their loved ones.

Opportunities exist for screening refugees for HIV before and after arrival to the U.S. CDC is considering implementing a public health intervention to increase access to voluntary counseling and testing in refugees prior to arrival in the U.S., during the required medical examination (Mr. Dalal, personal communication, November 29, 2014). CDC believes enough time has passed that this will no longer be a concern if physicians were encouraged to increase acceptance of HIV screening in refugees prior to arrival in the U.S. (Dr. Weinberg, personal communication, January 15, 2015). The proposed intervention would be aimed at addressing the critical gap in screening for HIV in refugees prior to coming to the U.S.

Pertinent differences in foreign-born, African-born, and refugee populations in HIV disease transmission, progression, and treatment adherence

Limited research is available comparing foreign-born, African-born, refugees, and U.S.-born populations about HIV disease related factors. The literature that is available reviews differences in HIV transmission, disease progression, adherence to treatment protocols, and health outcomes among foreign-born, African-born, refugees compared to U.S.-born populations. The findings applicable to this study are described below.

- **Routes of Transmission:** The literature suggests that rates of heterosexual transmission of HIV are higher in foreign-born and refugee populations than in U.S.-born populations.
 - 39.4% among foreign-born versus 27.2% for U.S. born individuals (Prosser et al., 2012)
 - New infections are four times higher among African-born residents than the general U.S. population (Blanas et al., 2013).
 - 81% of refugees reported heterosexual transmission as the primary risk factor for HIV as opposed to 60% in the U.S.-born population (Beckwith et al., 2008).
- **Disease Progression:** Blanas et al. (2013) found that Africans with HIV in the U.S. are often diagnosed at a later stage of infection with lower CD4 counts and higher rates of AIDS versus U.S.-born and most other foreign-born groups. They are also more likely to develop AIDS within 12 months of diagnosis as compared to U.S.-born Blacks (45% versus 37%).
- **Initiation of Treatment:** A study by Blanas et al. (2013) found that African-born populations may be more likely to initiate care within three months of diagnosis (76%) versus U.S.-born populations (72%).
- **Mortality and Survival Rates:** Even though African foreign-born are often diagnosed at later stages of disease, they appear to be more likely to have lower mortality and longer survival rates.
 - African-born populations appear to have lower mortality rates associated with HIV than U.S.-born populations, 7.1 per 1,000 per year versus 19.5 per 1,000 per year respectively (Blanas et al., 2013).
 - An earlier analysis by Blanas et al., 2013 found slightly higher survival rates among foreign-born versus U.S.-born blacks one year (87% versus 85%) and three years (82% versus 75%) after AIDS diagnosis.
 - A possible hypotheses for these differences are the combination of the persistence of the healthy immigrant effect with a high level of initiation and retention in care (Blanas et al., 2013). The healthy immigrant effect is a widely accepted phenomenon where immigrants in the U.S. have better health when compared to U.S.-born populations, even though they come from countries with higher morbidity and mortality rates and is not affected by socio-economic factors (e.g., education or income) (Kennedy et al., 2006).

Costs of HIV Screening in the United States

There are very few economics or cost studies of U.S. routine opt-out HIV screening in health care settings (e.g., emergency departments, primary care settings, urgent care centers, and STD clinics). The studies are structured so that they capture different components and therefore the cost results vary widely depending on settings and strategies for implementing screening. Because the studies are structured so differently, their component results (e.g., costs of screening or counseling) are not comparable. Table 1 provides a summary of some of the findings in the literature.

Table 1: Review of selected U.S. HIV screening cost studies

Publication	Costs	Year Dollars	Explanation
Phillips et al. (2000)	Incremental cost-per-HIV-case \$4,200 Targeted screening cost-per-HIV-case \$5,300	1999	Study examines two approaches to HIV screening, a targeted risk-based approach and a screen all approach. Using a survey of the literature for input costs, the authors develop a cost effectiveness ratio using a quality adjusted life year (QALY) measure as the outcome. The study finds that routine screening of all patients costs less and finds more cases of HIV than targeted screening. However, the author's note that targeted screening could be less expensive/more effective in some populations.
Mehta et al. (2008)	Personnel/labor costs-per-HIV-case identified Range \$1,980 to \$9,724	2004	Study examines the sociodemographics and behavioral risks of voluntary HIV screening in five sites within the same medical center. The study also publishes the personnel costs to administer HIV screens, though does not include the costs of the test itself. The primary driver behind the wide range in costs was the number of screens-per-employee during an eight hour shift. Where there were the fewest patients screened (emergency department), there were the highest personnel costs-per-HIV case detected.
Walensky et al. (2005)	Average per positive screen result \$4,850 Connect each HIV case with care \$5,550	2002	Study assesses identification of HIV cases in urgent care centers in Massachusetts. The authors obtained program expenditures or budgets, but from where and how is never explained in the publication. There are cost results printed in the article, but an explanation regarding the methods of calculation is not provided. With the lack of methods for estimating costs in mind, it is unclear whether the \$4,850 for the test result should be added to the \$5,550 to connect HIV cases with care, or whether the less expensive value was for patients diagnosed with HIV who were not connected with care.

One of the most pertinent studies for our purposes of determining HIV screening costs was Pinkerton et al. (2010). The authors analyzed HIV screen costs in 45 U.S. hospitals and found that the mean cost per test for rapid HIV screening in the U.S. is \$48.07 for a negative test and \$64.17 for a preliminary positive test (in 2006 dollars), with counseling accounting for 38.4% of the total cost. Costs were variable across hospitals and ranged from half to twice the estimates (Pinkerton et al., 2010). "The

total cost of performing a rapid HIV test included the personnel costs associated with performing counseling and screening-related procedures, the cost of the rapid-test kit, and the cost of miscellaneous disposable materials. The cost of the rapid-test kits was obtained from the study surveys. The cost of miscellaneous disposable items, such as latex gloves, sterile wipes and gauze pads, adhesive bandages, phlebotomy equipment (needles, holders, blood tubes), absorbent workspace covers, biohazard waste-disposal bags, and laboratory supplies (pipettes, tubes) was estimated based on expert opinion at \$1.50 per test (Pinkerton et al., 2010).”

Study Purpose

Since 2010, HIV screening is no longer required as part of the overseas medical examination for U.S.-bound refugees. CDC believes that some refugees are also not being screened during health assessments after arrival in the U.S. (Dr. Weinberg, personal communication, January 12, 2015). These missed opportunities are creating a concerning public health gap in HIV diagnosis and early linkage to care. Given the uncertainty and potentially high prevalence rates, ranging from 0 to 9%, in refugees bound for the U.S., it is important to consider the need and impact of overseas HIV screening interventions.

To address this public health gap, CDC is considering implementing an intervention to increase the acceptance of opt-in voluntary HIV screening overseas for refugees, ages 13 to 64, prior to resettlement to the U.S. Through this proposed strategy, the refugees would also be offered culturally and linguistically-appropriate health education, counseling, and linkage to care and treatment. Implementing this proposed strategy would ensure that USRAP applicants would have the opportunity to learn their HIV status through an informed consent process that is completely voluntary. Those applicants that screen positive could be started on treatment earlier, and then be linked in with appropriate medical care and other needed services more quickly and efficiently after resettlement.

A review of the published literature found that no research compares the factors of interest in this study for a population of refugees. There are no comparisons of the costs and benefits of overseas versus domestic screening of refugees. This study is an economic analysis of costs associated with an overseas voluntary HIV screening and treatment program for refugees undergoing resettlement to the

U.S. This study seeks to close the gap in the literature, regarding the costs to screen refugees for HIV overseas or in the U.S., by answering the following question:

- Will HIV screening for refugees overseas be less expensive for the U.S. government than domestic screening and will early screening have positive public health outcomes?

This study will provide unique information that can be used by the Division of Global Migration and Quarantine at CDC to support increased budget requests to provide HIV screening for refugees while they are still overseas. Like any other government organization, funding requests must be supported by evidence of both effectiveness and thrift.

METHODS

In order to structure the project, I set up a series of meetings with subject matter experts (SME) at the Centers for Disease Control and Prevention (CDC) in the Division of Global Migration and Quarantine (DGMQ). Through these conversations I was able to outline the details of the proposed intervention and the current state of HIV screening and treatment activities for refugees bound for the U.S. Further, the SMEs provided guidance with regard to analytic options as applied to the epidemiology of HIV and the options to conduct the economic analysis. Multiple meetings were conducted with SMEs to finalize the assumptions and specifics of the proposed intervention to be used for this project's analysis.

The list of SMEs consulted on the project are:

- Dr. Michelle Weinberg, Medical Officer, expert in refugee healthcare and development and implementation of public health programs in refugee populations
- Dr. Brian Maskery, Economist, expert in economic health studies on refugees and immigrant populations
- Dr. Margaret Coleman, Economist, expert in economic health studies on refugees and immigrant populations
- Dr. Bill Stauffer, Medical Officer, expert in refugee healthcare in the U.S.
- Dr. Alex Klosovsky, Medical Officer, expert in refugee health programs carried out by the International Organization for Migration (IOM)
- Mr. Warren Dalal, Public Health Advisor, expert in development and implementation of public health programs in refugee populations
- Ms. Deb Lee, Epidemiologist, expert in domestic refugee health programs
- Dr. Sharmila Shetty, Medical Officer, expert in domestic refugee health programs

Describe the Proposed Intervention

Based on discussions with CDC SMEs, it was determined that the proposed intervention would be to provide opt-in HIV screening overseas among the USRAP applicant population. Through this proposed strategy, the refugees would also be offered culturally and linguistically-appropriate health education, counseling, referrals to care and treatment, and voluntary screening for HIV. The proposed intervention is analyzed in this paper at two patient acceptance rates to estimate potential cost savings and health benefits. The 30% acceptance rate is referred to as "Option 1" and the 70% acceptance rate is referred to as "Option 2".

Objectives

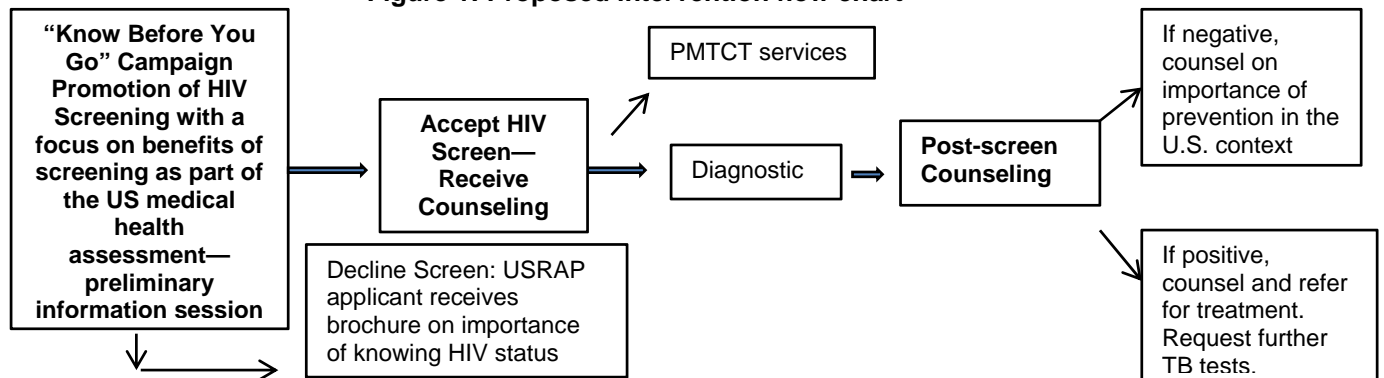
- 1) Increase the acceptance rate for voluntary opt-in HIV-screening overseas among the USRAP applicant populations
- 2) Improve the continuum of care for those that are HIV-positive and ensure that follow-up in the U.S. is made possible with accurate diagnostic information on HIV status

Program Components

The proposed intervention will introduce three main strategies to promote the knowledge of HIV status of USRAP applicants:

1. Branding the concept of promotion of HIV screening as part of the overseas medical examination process and an emphasis on mobilizing USRAP applicants to accept HIV screening
 - a. Mobilization will focus on the importance of knowing HIV status prior to resettlement to the U.S. to reduce barriers to access appropriate medical services
 - b. Health education materials will be developed, that are culturally appropriate and translated into native languages, to inform the refugees resettling to the U.S. of the advantages of being screened overseas as well as additional TB tests that would be required as part of the health exam process if the results are positive
2. Training staff to implement the new approaches to screening for HIV as part of the IOM medical examination for USRAP applicants
3. Offer voluntary HIV screening for all USRAP applicants aged 13 to 64

Figure 1: Proposed intervention flow chart



Program Assumptions

In planning new interventions, assumptions are needed to analyze the potential impacts of implementing the intervention. The following assumptions were used in the development of the proposed intervention.

- Additional IOM capacity will be needed to implement this type of voluntary “opt-in” approach with an enhanced focus on counseling/education to increase acceptance rates and to complete care/treatment referrals
- Training will be needed for new and current staff to implement the intervention
- USRAP applicants will be offered HIV screening adhering to the below principles:
 - Informed Consent
 - Confidentiality
 - Appropriate and high quality pre- and post-screen counseling
 - Provision of correct screen results with proper quality assurance of the laboratories
 - Connection/linkage to prevention, care and treatment
- Screening will be completed using a rapid HIV test and confirmation testing will be completed using ELISA/Western Blot
- Based on their front line experience with the uptake of medical protocols overseas, IOM suggested the 2 acceptance rates of 30% (Option 1) and 70% (Option 2) for use in this study
 - Acceptance rates could be as low as 30%, because refugees may be resistant to HIV screening due to concerns that a positive result may jeopardize resettlement and in some countries being HIV positive carries tremendous social stigma
- Costs associated with care/treatment referrals will be driven by the implementing partner (e.g., PEPFAR or host country programs)
 - The referral and treatment system is already established and being utilized for HIV care/treatment referrals
 - Costs associated with care/treatment referrals and medication supplies are expected to be covered by existing programs to which refugees will be referred by IOM
- Countries have IOM laboratories already in place

Anticipated Health Outcomes

Implementing this proposed strategy would ensure that USRAP applicants would have the opportunity to learn their HIV status through an informed consent process that is completely voluntary. Those applicants that screen positive could be started on treatment earlier, and then be linked in with appropriate medical care and other needed services more quickly and efficiently after resettlement.

Collect Data

The next step was to collect data in order to estimate HIV prevalence and the overseas and domestic costs associated with HIV screening. Literature, internal CDC data, and information provided by IOM were reviewed to identify the data available to estimate prevalence for this study. A literature review

resulted in some cost estimates for screening in the U.S., but as explained earlier in the section titled, “Costs in the U.S.” the studies were not comparable. Further, the study with the most complete costs (Phillips et al., 2000) used inputs for screening that were taken from other studies and adjusted to 1999 dollars. So not only would these screening dollar values need to be adjusted again for this study to 2015 dollars, but they were also old and inflation adjustments become increasingly inaccurate with time. Therefore, as explained in more detail below, the cost estimates in this study are based on prices in the 2015 Physicians’ Fee and Coding Guide (“the Guide,” 2015). IOM provided real-time actual data for the costs to screen refugees overseas to that we could compare overseas and domestic costs for the same processes.

Develop Study Model

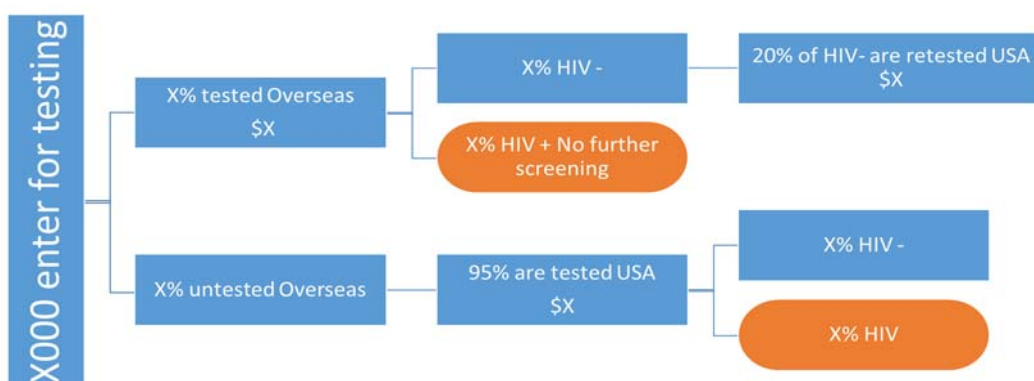
A review of the published literature finds that no research compares the factors of interest in this study for a population of refugees. There are no comparisons of the costs and benefits of overseas versus domestic screening of refugees. All of the recently published models and studies would have to be extensively modified to fit the refugee population and compare domestic and other country costs. For example, a review of recent published research finds multiple studies that have used different methods for assessing costs and cost-effectiveness of HIV screening and treatment including the Progression and Transmission of HIV/AIDS Model (PATH), the Markov Model, and the Cost-Effectiveness of Preventing AIDS Complication Model (CEPAC).

The PATH model was developed by CDC to “estimate lifetime measures and costs for HIV-infected individuals under different linkage to care models” (Gopalappa et al., 2012). The Markov model tracks a cohort of individuals some of whom are already infected with HIV (Sanders et al., 2005). The CEPAC model is a “widely published computer simulation of HIV disease and treatment.... [that] simulates an HIV screening program and determines when each simulated HIV-infected patient will become detected through screening or presentation of care with an AIDS-defining opportunistic infection (OI)” (Paltiel et al., 2005). All of these models were created based on U.S. population parameters, so modifications would have been required to adjust for any pertinent differences in HIV transmission, disease progression, and other factors between refugee populations and U.S. populations. The adjustment of these complex disease transmission models was beyond the scope of this project.

Therefore, a program-cost model was developed for this project to analyze both HIV prevalence and screening costs for Uganda, Ethiopia, and Kenya as compared with the domestic costs to perform the same HIV screening. The outcome of interest is the comparison of the costs to provide HIV screening overseas with costs for the same process in the U.S. based on different percentages of accepting overseas and domestic HIV screening. Figure 2 provides a schematic of the model that is repeated for each of the three countries: Uganda, Ethiopia, and Kenya. The model uses the average risk parameters and costs. At the start of the model, either 30% or 70% of refugees accept screening overseas, and the country-specific costs of screening are applied.

- Those who accept screening overseas (30% or 70%): different percentages of refugees are diagnosed as HIV free or HIV positive based on the country-specific prevalence rates. Those who are HIV positive drop out of the model at this point and are assumed to start treatment, ideally while still overseas. Those who are HIV negative arrive in the U.S. where 20% are re-screened at the domestic cost. Those found HIV positive in the U.S. go on to domestic treatment.
- For those who do not accept screening overseas (30% or 70%): some percentage have undiagnosed HIV but are never re-screened when they enter the U.S. 95% of the (30% or 70%) persons who do not accept overseas screening are assumed to be screened in the U.S. at domestic costs.

Figure 2: Model flow chart



Estimate Prevalence

The prevalence data collected was reviewed and analyzed for completeness and limitations were identified so that the data could be reliably used in the model. Due to the changes in the USRAP lifting requirements for HIV screening, HIV data in U.S.-bound refugee populations is largely not available after 2009. For example, HIV screening rates in the USRAP are currently very low at an estimated 2% by IOM,

so it appears that this information may be unreliable. The limited data available in the literature are based on small-sample CDC studies. All of the studies include very small numbers of refugees being screened. Further the studies are limited to specific regions of the world, refugee camps, and/or refugee populations. For example, a 2013 CDC study of Congolese refugees found a 6% prevalence based on screening of 176 refugees. The prevalence data from these sources are insufficient to apply to the current refugee population in the USRAP.

IOM provided 2009 USRAP HIV prevalence data by country as a potential data source for the study. This data is the actual results from the last year of mandatory screening of refugees bound for the U.S. or UNAIDS prevalence rates that were used as a proxy for countries where actual data was unavailable. UNAIDS data was provided for 2 countries, Burundi, and Rwanda. Based on the review and analysis of the available prevalence data sources, recommendations were discussed with the CDC SMEs. Based on these discussions, it seemed that the most reliable data was the 2009 IOM data. Therefore, a determination was made to use this dataset for estimating prevalence for this study. The 2009 IOM prevalence or UNAIDS proxy for each country was used in the model to determine the estimated number of HIV positive individuals that would be diagnosed during screening.

Based on these 2009 data, U.S.-bound refugees from Sub-Saharan Africa prevalence ranged from 1.3% (Burundi) to 9.0% (Uganda) (Dr. Klosovsky, personal communication, January 25, 2015). These values are all higher, and in some cases much higher, than the worldwide average of 0.8 % and the range of 0.4 to 0.9 % in the U.S. CDC recommends routine screening in all healthcare settings for the general populations (ages 13 to 64) and annual screening for high-risk populations. According to CDC, high-risk populations are geographic locations or communities with an HIV prevalence of at least 1%. According to the CDC definition all of the sub-Saharan African refugee populations would be considered high risk and routine and annual screening would be recommended.

IOM also provided estimates of the expected numbers of refugees that would be bound for the U.S. in 2015 by country (Table 2). The data, in Table 2, is the prevalence and anticipated number of refugees resettling to the U.S. in FY 2015 for the analysis for this study. The estimated numbers of HIV-positive refugees were multiplied by each acceptance rate to determine the estimated number of HIV positive refugees identified for Option 1 (30% acceptance) and Option 2 (70% acceptance).

Table 2: Estimated prevalence and positive cases for FY 2015 refugee arrivals

Country	2009 Prevalence ¹	2015 Estimated U.S. Arrivals ²	Estimated HIV Positive Refugees ³	Option 1 30% Acceptance Rate HIV+ Refugees ⁴	Option 2 70% Acceptance Rate HIV+ Refugees ⁵
UGANDA	9.00%	4,000	360	108	252
TANZANIA	4.01%	1,500	60	18	42
RWANDA*	2.90%	2,500	73	22	51
SOUTH AFRICA	2.42%	2,500	61	18	42
ETHIOPIA	1.93%	5,000	97	29	68
KENYA	1.38%	6,000	83	25	58
BURUNDI*	1.30%	2,000	26	8	18
Countries Analyzed Summary⁶	4.10%	15,000	616	185	431
Sub-Saharan Africa Summary⁷	3.28%	23,500	770	231	539
USRAP Estimate Low Range⁸	2.24%	50,000	1,120	336	784
USRAP Estimate High Range⁹	2.24%	70,000	1,565	470	1,098

* UNAIDS HIV prevalence proxy

1 2009 prevalence rates provided by IOM, based on 2009 actual data for the USRAP or UNAIDS proxy data

2 FY 2015 estimated U.S. arrivals provided by IOM

3 Estimated HIV positive refugees calculated by multiplying the prevalence rate with the FY 2015 estimated arrivals

4 Option 1 calculated by multiplying the estimated HIV positive refugees by the acceptance rate of 30%

5 Option 2 calculated by multiplying the estimated HIV positive refugees by the acceptance rate of 70%

6 Summary results for 3 pilot countries: Uganda, Ethiopia, and Kenya

7 Sub-Saharan Africa reflects the estimates for all refugees bound for the U.S. from sub-Saharan Africa

8 Low range for the USRAP is estimated at 50,000 refugees bound for the U.S.

9 High range for the USRAP is estimated at 70,000 refugees bound for the U.S.

Identify Domestic Costs

After arriving in the U.S., refugees are currently accepting HIV testing at a rate of 95%. This acceptance rate was used to estimate the domestic program costs for only screening refugees after they arrive in the U.S. The acceptance rate was determined based on CDC SMEs estimation of the rate of refugees currently screened after arrival to the U.S. The literature search did not produce reliable and/or recent costs for HIV screening in the U.S.

For costs, in an online search, we were able to identify the Current Procedural Terminology codes (CPT codes) that are universally used by all medical organizations (practices, clinics, and hospitals) to bill for HIV screening. CPT codes are the universal language of medical billing used in the U.S. by any medical organization that submits patient bills to any private insurance or public insurance such as Medicare, or Medicaid. First, we looked online (Google) to find billing protocols for HIV screening. The codes we found that are in routine use are shown in Table 3.

Table 3: CPT codes in routine use for HIV screening medical billing

CPT Code	Description	Used in Model (Yes or No)	Average Costs
86701	Test HIV 1*	Yes	\$92

86702	Test HIV 2	No	\$134
86703	Test HIV 1 and 2	No	\$136
86689	HIV Confirmatory Test	Yes	\$141
87390	HIV 1 age, eia	No	\$96
99401	15 minutes behavioral counseling to prevent STD*	Yes	\$93
99402	30 minutes behavioral counseling to prevent STD*	Yes	\$155
36415	Blood Draw*	Yes	\$24

* Denotes codes and costs used in the model

We then went to the 2015 Physician's Fee and Coding Guide to determine the costs associated with the different CPT codes that had been recommended for billing in different medical organizations guidance. The Physician's Fee and Coding Guides are published annually after a nationally representative survey of allowable billing charges in medical organizations. The results are arranged by CPT code and provide a low and high allowable billing for private insurance as well as the Medicare allowable billing charges for the same codes. Medicaid is not included because it is a state-based program. After reviewing the ranges of allowable billing charges for different CPT codes that represented components of the HIV screening process, it was decided to use the codes that had lower billing ranges. These ranges were averaged to ensure that domestic costs were not overstated when compared with overseas costs. The codes and costs used in the model to represent a typical domestic cost for HIV screening are shown in Table 3. A formula was created to determine the U.S. cost-per-person for HIV screening using the following steps:

- 1) The 86701 range for HIV testing seems to most closely match the values that appear in the literature, so 100% of the average is used on the assumption that everyone who accepts testing (30% or 70%) would get an initial test
- 2) 86689 seems to be the code of choice for confirmatory testing, we assign an average HIV positive prevalence, based on the average for sub-Saharan Africa, of 3.2% ($\$141 \times 3.2\%$)
- 3) We average the averages of 99401 and 99402 and assign 75% of that average to the total cost (based on an assumption that approximately 75% of persons tested receive some sort of risk assessment or counseling)
- 4) Add 100% of the blood draw 36415, assuming everyone who accepts testing would have a blood draw

Using this formula and the average prevalence of 3.2% for sub-Saharan Africa, $\$92 + (\$141 \times 3.2\%) + (((\$93 + \$155) / 2) \times .75) + \24 , the average domestic cost-per-person for HIV screening was \$214. The formula was used to calculate the U.S. domestic cost-per-person for each refugee

population group analyzed (e.g., Uganda) based on the corresponding prevalence.

Identify Proposed Intervention Costs

The model uses country-specific budget and labor information provided by IOM to identify the costs in Uganda, Ethiopia, and Kenya for screening and diagnosing a new HIV infection. Cost data provided by IOM for the three pilot countries is based on caseload and the screening acceptance rates of 30% (Option 1) and 70% (Option 2). The costs are derived based on the additional support required to implement the proposed opt-in HIV screening intervention.

The intervention has fixed costs that include staff (e.g., nurses and lab technicians), office administrative staff, and training for staff. The fixed costs do not change based on the number of refugees that accept HIV screening. Variable costs include laboratory consumables and patient support. The patient support includes education materials, nutritional support, home visits, and pre-departure evaluation. For Option 2 (70% acceptance rate) a 50% lab staffing adjustment is included to cover the additional lab tests that will need to be performed.

These costs are calculated per refugee screened to determine the additional variable costs at each screening acceptance level. In addition, overhead costs were included and calculated by IOM at a rate of 5%. We did not explicitly include overhead in the domestic totals because it is implied in the allowable billing charges. Costs were calculated based on screening acceptance rates of 30% and 70% for each country (Table 4).

Table 4: Costs per country to implement the proposed HIV screening intervention

Budget Line	Kenya	Ethiopia	Uganda	Total
Caseload Population (# U.S.-bound refugees)	6,000	5,000	4,000	15,000
Fixed Costs ¹	\$ 78,000	\$ 46,800	\$ 35,880	\$ 190,680
Operational Costs ² , Option 1 ³	\$ 24,713	\$ 14,159	\$ 10,000	\$ 65,040
Operational Costs ² , Option 2 ⁴	\$ 56,331	\$ 42,037	\$ 90,992	\$ 179,359
Overhead, Option 1	\$ 5,136	\$ 3,548	\$ 4,102	\$ 12,786
Overhead, Option 2	\$ 6,717	\$ 4,942	\$ 6,844	\$ 18,502
Total, Option 1	\$ 107,849	\$ 74,506	\$ 86,150	\$ 268,506
Total, Option 2	\$ 141,047	\$ 103,778	\$ 143,716	\$ 388,541

¹ Fixed costs include staff (e.g., nurses and lab technicians), office administrative staff, and training for staff.

² Operational costs include laboratory consumables and patient support

³ Option 1 is an acceptance rate of 30%

⁴ Option 2 is an acceptance rate of 70%

Assess Potential Health Benefits of the Proposed Intervention

The literature review documented that earlier HIV diagnosis and linkage to care and treatment can result in increased life expectancy and quality of life; delayed onset of AIDS and opportunistic

infections; and reduced transmission of HIV. The comparison of the proposed intervention against the current program identifies the number of new infections diagnosed and linked to treatment earlier. We used the number of new cases to assess the extent of that public health impact. Results related to this assessment are mostly qualitative, but when possible estimates of the health impacts were quantified.

According to the literature, early linkage to treatment has been shown to extend the lives of HIV positive individuals by an estimated additional 13 to 14 years (Walensky et. al, 2006). The proposed intervention would allow HIV positive refugees that opted for the test prior to arriving in the US to be linked to care and treatment at least three months earlier than the current domestic only screening program. We calculated the number of new infections that would be identified and linked to care at least three months earlier overseas and compared the changes in timing of diagnosis. We then used the number of new infections diagnosed from the modeling to determine the potential additional life-years that could be saved for each refugee population (three country total, sub-Saharan Africa, and USRAP) at each acceptance rate (Option 1: 30% and Option 2: 70%) for the proposed overseas HIV screening intervention.

The literature also suggests that approximately 60 individuals starting treatment at a CD4 count of 500 could prevent 1 death from HIV infection after 3 years. We divided the number of refugees in each population and acceptance rate that would start treatment earlier, likely at a higher CD4 count, by 60 to provide a sense of the number of deaths from HIV infection that might be prevented after three years. Since we cannot estimate CD4 counts for the new refugee infections diagnoses, this is a very crude estimate that only illustrates potential benefits of the proposed overseas intervention.

Based on the literature review provided in section “Pertinent differences in foreign-born, African-born, and refugee populations in HIV disease transmission, progression, and treatment adherence,” it appears that there are marked differences between African-born and U.S.-born in the stage at which HIV is diagnosed and uptake of treatment post-diagnosis. African-born populations are diagnosed at later, more critical stages but they are also more likely to follow treatment recommendations to try and maintain their health. Therefore, if African-born refugees could be diagnosed earlier, CDC SMEs surmise that the benefits to early diagnosis through screening might be even greater than we have estimated in the study.

Determine Results

Cost Analysis

First, a comparison was completed to determine the cost differences between the proposed overseas screening intervention and the current domestic program. The average costs-per-screen were calculated for personnel, testing/processing, and training for each intervention. The results were used to determine and compare the major cost drivers for each intervention.

Using the model and prevalence for each refugee population, we calculated costs-per-screen, new infection, and total program costs for each intervention. The refugee populations include the three countries (Uganda, Kenya, and Ethiopia), the average of the three countries, sub-Saharan Africa, and the entire U.S. Refugee Admissions Program (USRAP). The interventions included were the proposed overseas HIV screening intervention, at acceptance levels of 30% (Option 1) and 70% (Option 2), and the current domestic HIV screening intervention. The costs were then compared to determine potential cost-savings for the proposed intervention versus the current program.

A sensitivity analysis for the costs was conducted for Kenya and Uganda to determine the lowest acceptance level of testing that would be cost saving. Kenya and Uganda were chosen because they had the highest and lowest prevalence and estimated number of refugee arrivals. The model was used to calculate and analyze the costs for implementing the HIV screening program at acceptance levels of 5, 10, 15, 20, and 25 percent. The associated savings or additional costs were analyzed to determine the threshold of acceptance level to produce cost savings to the U.S. government.

Health Benefits Assessment

Based on a review of the literature, health benefits of early diagnosis and treatment of HIV were used to assess and state the potential health benefits of the proposed overseas HIV screening intervention. The estimated number of new infections identified was compared across the timeline of possible diagnosis of the interventions. We also calculated life-years saved and deaths averted over three years for each refugee population (total of three countries, sub-Saharan Africa, and USRAP) at each acceptance rate (Option 1: 30% and Option 2: 70%) for the proposed intervention.

RESULTS

Cost Analysis

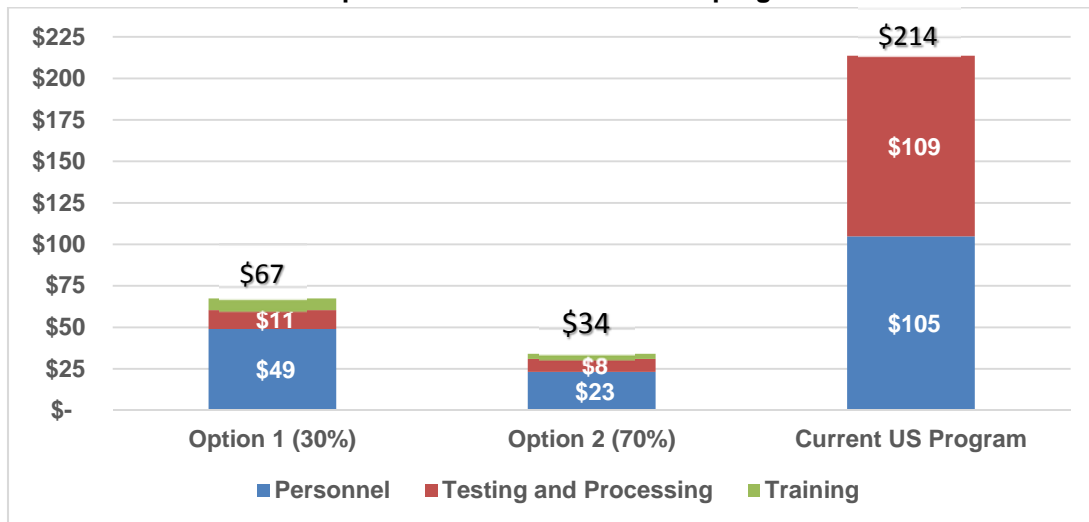
Differences in Costs of Proposed Intervention and Current Program

The major cost differences between the proposed overseas screening intervention and the current program are driven by personnel and testing supplies (Figure 3). Personnel includes costs for staff (e.g., nurses and lab technicians), office administration, patient support, and a lab staffing adjustment for Option 2 (70% acceptance). Testing/processing includes operational costs for laboratory consumables. Training includes the additional training to implement the proposed intervention overseas. Each category was then adjusted to include the 5% IOM overhead costs.

- ***Overseas, the average costs per screen consist of personnel, testing/processing, and training.***
 - **Option 1 (30% acceptance rate) total average costs per screen are \$67, including:**
 - \$49 for personnel (73%),
 - \$11 for testing/processing (17%), and
 - \$7 for training (10%).
 - **Option 2 (70% acceptance rate) total average costs are \$34, including:**
 - \$28 for personnel (68%),
 - \$8 for testing/processing (23%), and
 - \$3 for training (9%).
- ***Domestically, the average costs per screen consist of personnel and testing/processing.***
 - **The current program average costs per screen are \$214, including:**
 - \$105 for personnel (49%) and
 - \$109 for testing/processing (51%).

For all interventions the majority of the costs for screening are for personnel and testing/processing, but these cost categories are much more expensive in the U.S. In the U.S., the overall costs-per-screen are 2 to 5 times higher; personnel costs-per-screen are about 1 to 4 times higher; testing/processing costs-per-screen have the most drastic differences at 9 to 13 times higher.

Figure 3: Cost differences per screen by category and intervention acceptance level in comparison with the current U.S. program



Cost Analysis by Country

For all three countries analyzed (Uganda, Ethiopia, and Kenya), the costs for the current domestic only HIV screening program are higher than the proposed overseas intervention at both acceptance levels (30% and 70%). Cost-savings for the proposed intervention appear to be substantial when compared to the current intervention.

Uganda

Figure 4 and 5 depict the model flow for each option for the proposed intervention in Uganda, Option 1 (30% acceptance rate) and Option 2 (70% acceptance rate). Table 5 shows the cost calculations using the model, with inputs of 4,000 refugee arrivals and 9% prevalence, for Option 1, Option 2, and the Current HIV screening programs.

Figure 4: Uganda cost analysis model – Option 1 (30% Acceptance)

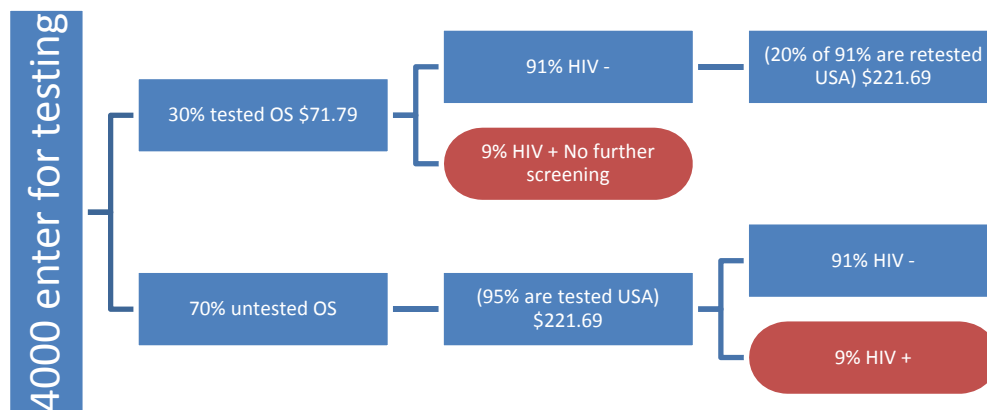


Figure 5: Uganda cost analysis model – Option 2 (70% Acceptance)

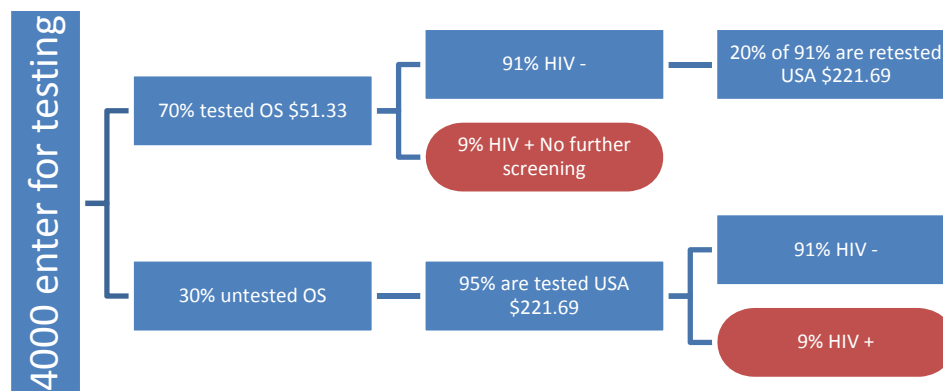


Table 5: Cost calculations for Uganda refugee HIV screening program options

Option 1 - 30% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
30 yes	1200	\$71.79		\$86,150	218	\$221.69	\$134,567
70 no	2800		\$221.69	\$589,695			\$589,695
Total	4000						\$724,263
Option 2 - 70% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
70 yes	2800	\$51.33		\$143,716	510	\$221.69	\$256,689
30 no	1200		\$221.69	\$252,727			\$252,727
Total	4000						\$509,415
Current Domestic Program	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
95% yes	3800		\$221.69	\$842,422			\$842,422

Table 6 compares the costs of the proposed overseas screening intervention and the current domestic screening. Using the model with inputs of 4,000 refugee arrivals and 9% prevalence, potential total program cost-savings for the proposed overseas intervention when compared to the current domestic intervention are:

- **Total Program Cost-Savings for Overseas Options compared to Domestic Screening**
 - **Option 1 = \$118,159 cost savings (14% reduction)**
 - Domestic costs at \$842,422 **minus** Option 1 costs at \$724,263
 - **Option 2 = \$333,007 (40% reduction)**
 - Domestic costs at \$842,422 **minus** Option 2 costs at \$509,415

Table 6: Cost comparison of proposed interventions versus the current program in Uganda

Costs	Option 1 (30%)	Option 2 (70%)	Current Program	Cost Savings versus Current Program			
				Option 1		Option 2	
				\$	%	\$	%
Cost Per Screen	\$72	\$51	\$222	\$150	68%	\$170	77%
Cost Per New Infection	\$798	\$570	\$2,463	\$1,666	68%	\$1,893	77%
Total Program Costs	\$724,263	\$509,415	\$ 842,422	\$118,159	14%	\$333,007	40%

Ethiopia

Figure 6 and 7 depict the model flow for each option for the proposed intervention in Ethiopia, Option 1 (30% acceptance) and Option 2 (70% acceptance). Table 7 shows the cost calculations using the model, with inputs of 5,000 refugee arrivals and 1.93% prevalence, for Option 1, Option 2, and the Current HIV screening programs.

Figure 6: Ethiopia cost analysis model – Option 1 (30% Acceptance)

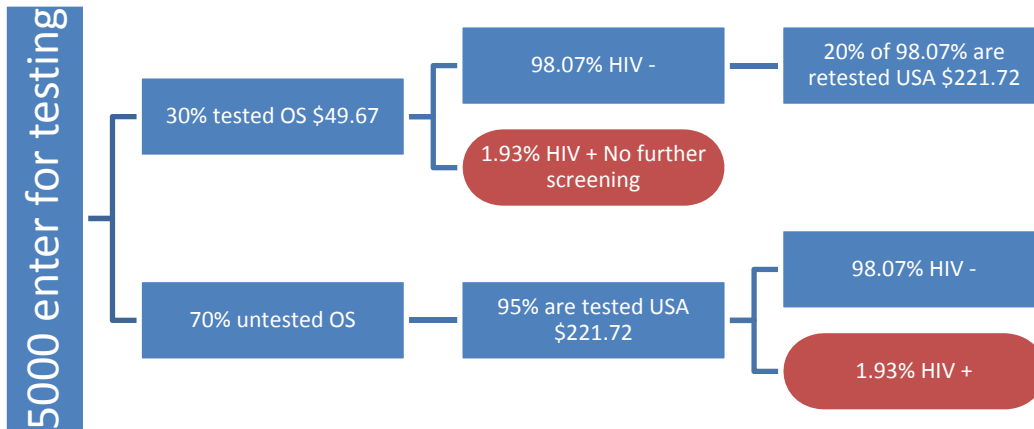


Figure 7: Ethiopia cost analysis model – Option 2 (70% Acceptance)

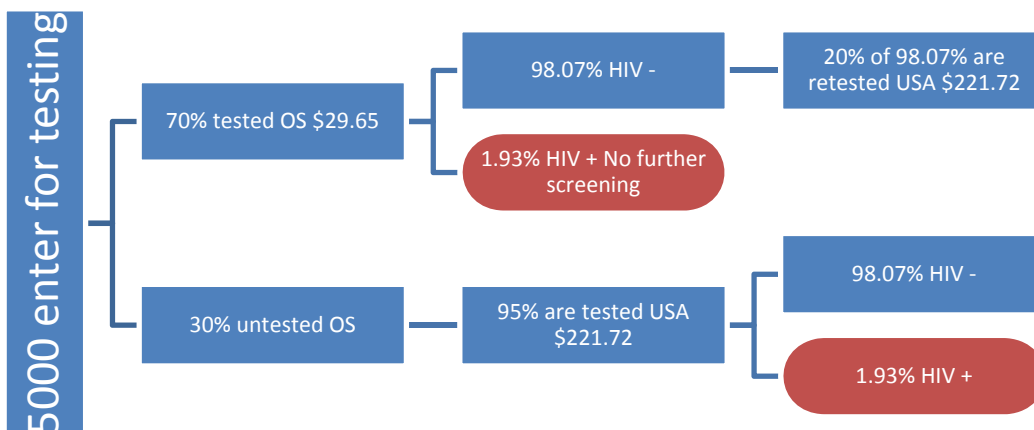


Table 7: Cost calculations for Ethiopia refugee HIV screening program options

Option 1 - 30% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
30 yes	1500	\$49.67		\$74,506	294	\$211.72	\$136,797
70 no	3500		\$211.72	\$703,973			\$703,973
Total	5000						\$840,770
Option 2 - 70% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
70 yes	3500	\$29.65		\$103,778	686	\$211.72	\$249,123
30 no	1500		\$211.72	\$301,703			\$301,703
Total	5000						\$550,826
Current Domestic Program	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
95% yes	4750		\$211.72	\$1,005,676			\$1,005,676

Table 8 compares the costs of the proposed overseas screening intervention and the current domestic screening. Using the model with inputs of 5,000 refugee arrivals and 1.93% prevalence, potential total program cost-savings for the proposed overseas intervention when compared to the current domestic intervention are:

- **Total Program Cost-Savings for Overseas Options compared to Domestic Screening**
 - **Option 1 = \$164,906 cost savings (16% reduction)**
 - Domestic costs at \$1,005,676 *minus* Option 1 costs at \$840,770
 - **Option 2 = \$454,850 (45% reduction)**
 - Domestic costs at \$1,005,676 *minus* Option 2 costs at \$550,826

Table 8: Costs comparison of proposed interventions versus the current program in Ethiopia

Costs	Option 1 (30%)	Option 2 (70%)	Current Program	Cost Savings versus Current Program			
				Option 1		Option 2	
				\$	%	\$	%
Cost Per Screen	\$50	\$30	\$212	\$162	77%	\$182	86%
Cost Per New Infection	\$2,574	\$1,536	\$10,970	\$8,396	77%	\$9,434	86%
Total Program Costs	\$840,770	\$550,826	\$1,005,676	\$164,906	16%	\$454,850	45%

Kenya

Figure 8 and 9 depict the model flow for each option for the proposed intervention in Kenya, Option 1 (30% acceptance) and Option 2 (70% acceptance). Table 9 shows the cost calculations using the model, with inputs of 6,000 refugee arrivals and 1.38% prevalence, for Option 1, Option 2, and the Current HIV screening programs.

Figure 8: Kenya cost analysis model – Option 1 (30% Acceptance)

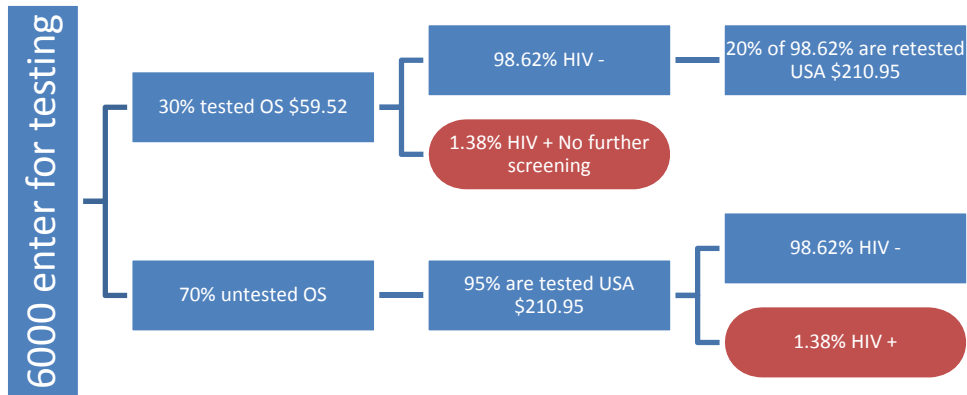


Figure 9: Kenya cost analysis model – Option 2 (70% Acceptance)

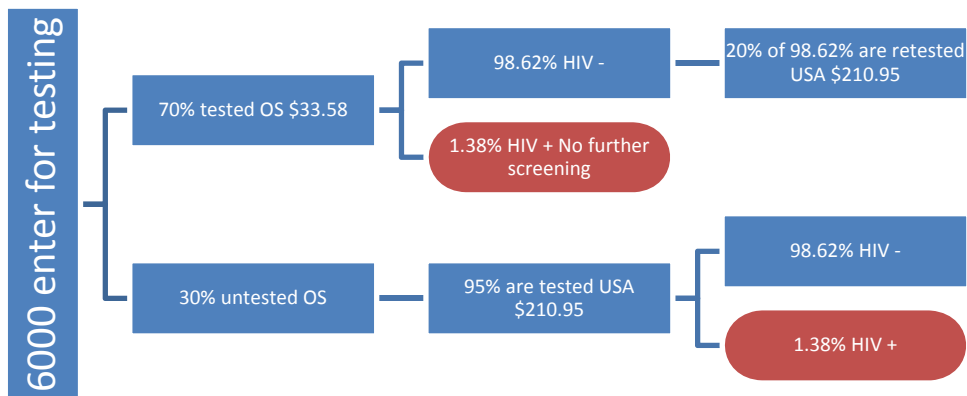


Table 9: Cost calculations for Kenya refugee HIV screening program options

Option 1 - 30% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
30 yes	1800	\$59.92		\$107,849	355	\$210.95	\$182,741
70 no	4200		\$210.95	\$841,674			\$841,674
Total Costs	6000						\$1,024,415
Option 2 - 70% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
70 yes	4200	\$33.58		\$141,047	828	\$210.95	\$315,797
30 no	1800		\$210.95	\$360,717			\$360,717
Total Costs	6000						\$676,514
Current Domestic Program	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
95% yes	5700		\$210.95	\$1,202,391			\$1,202,391

Table 10 compares the costs of the proposed overseas screening intervention and the current domestic screening. Using the model with inputs of 6,000 refugee arrivals and 1.38% prevalence,

potential total program cost-savings for the proposed overseas intervention when compared to the current domestic intervention are:

- **Total Program Cost-Savings for Overseas Options compared to Domestic Screening**
 - **Option 1 = \$177,976 cost savings (15% reduction)**
 - Domestic costs at \$1,202,391 *minus* Option 1 costs at 1,024,415
 - **Option 2 = \$525,877 (44% reduction)**
 - Domestic costs at \$1,202,391 *minus* Option 2 costs at \$676,514

Table 10: Costs comparison of proposed interventions versus the current program in Kenya

Costs	Option 1 (30%)	Option 2 (70%)	Current Program	Cost Savings versus Current Program			
				Option 1		Option 2	
				\$	%	\$	%
Cost Per Screen	\$60	\$34	\$211	\$151	72%	\$177	84%
Cost Per New Infection	\$4,342	\$2,434	\$15,286	\$10,944	72%	\$12,852	84%
Total Program Costs	\$1,024,415	\$676,514	\$1,202,391	\$177,976	15%	\$525,877	44%

Country Summary and Projections for Sub-Saharan Africa and the USRAP

The model was used with the following inputs (Table 11) to summarize the three country results and estimate costs for sub-Saharan Africa, and the U.S. Refugee Admissions Program (USRAP).

Table 11: Refugee admissions and average HIV prevalence in refugee populations

Refugee Population	Number/ Prevalence
Three Country Summary (Uganda, Ethiopia, and Kenya)	
Average Prevalence Estimate	4.10%
Estimated Refugee Admissions	15,000
Sub-Saharan Africa	
Average Prevalence Estimate	3.28%
Estimated Refugee Admissions	23,500
US Refugee Admissions Program (USRAP)	
Average Prevalence Estimate	2.24%
Low Range Estimated Refugee Admissions	50,000
High Range Estimated Refugee Admissions	70,000

Based on the model inputs outlined above, there would be significant annual total program cost-savings for the proposed overseas intervention when compared to the current domestic intervention. Table 12 outlines the estimated annual total program cost-savings for each refugee population (e.g., refugees bound for the U.S. from sub-Saharan Africa) for the 2 options (30% and 70% acceptance) of the proposed intervention compared with the current domestic intervention.

Table 12: Estimated total program cost-savings for the proposed intervention compared to the domestic intervention by refugee population

Cost Savings	Sub-Saharan Africa ¹	US Refugee Admissions Program	
		Low Range ²	High Range ³
Per screen⁴			
Option 1 (in dollars) ⁶	\$146	\$151	\$165
Option 1 (in percentage reduction) ⁶	68%	72%	78%
Option 2 (in dollars) ⁷	\$177	\$179	\$185
Option 2 (in percentage reduction) ⁷	82%	85%	88%
Per new infection⁵			
Option 1 (in dollars) ⁶	\$4,440	\$6,726	\$7,368
Option 1 (in percentage reduction) ⁶	68%	72%	78%
Option 2 (in dollars) ⁷	\$5,405	\$7,999	\$8,278
Option 2 (in percentage reduction) ⁷	82%	85%	88%
Total program			
Option 1 (in dollars) ⁶	\$657,163	\$1,478,119	\$2,371,633
Option 1 (in percentage reduction) ⁶	14%	15%	17%
Option 2 (in dollars) ⁷	\$1,977,756	\$5,741,826	\$6,309,634
Option 2 (in percentage reduction) ⁷	41%	57%	45%

¹ Sub-Saharan Africa reflects the estimates for all refugees bound for the U.S. from sub-Saharan Africa

² Low range for the USRAP estimated at 50,000 refugees bound for the U.S.

³ High range for the USRAP estimated at 70,000 refugees bound for the U.S.

⁴ Cost per screen for Option 1 and 2 reflects overseas cost per screen, domestic screening cost per screen is the same as the current program

⁵ Cost per new infection for Option 1 and 2 reflects overseas cost per screen, domestic screening cost per screen is the same as the current program

⁶ Option 1 is the proposed overseas screening intervention at the 30% acceptance rate

⁷ Option 2 is the proposed overseas screening intervention at the 70% acceptance rate

The following figures summarize the costs-per-screen (figure 10), per new infection (figure 11), total program costs (figure 12). All of these summaries illustrate the significant cost-savings that could be realized by implementing the proposed HIV screening overseas, even at a low acceptance level of 30%.

Figure 10: Summary of costs per screen by refugee population

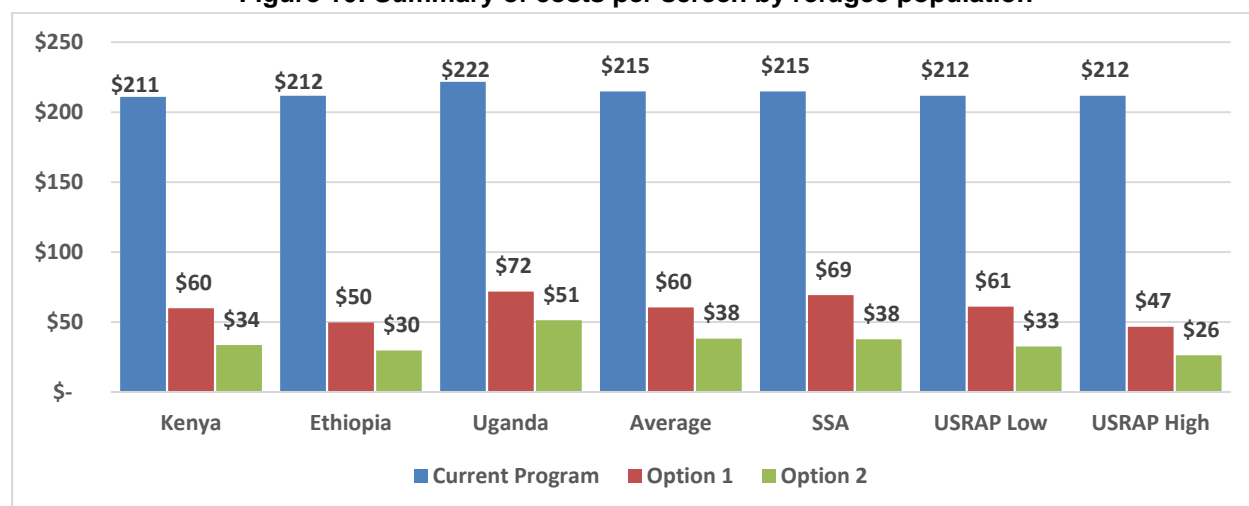


Figure 11: Summary of costs per new infection by refugee population

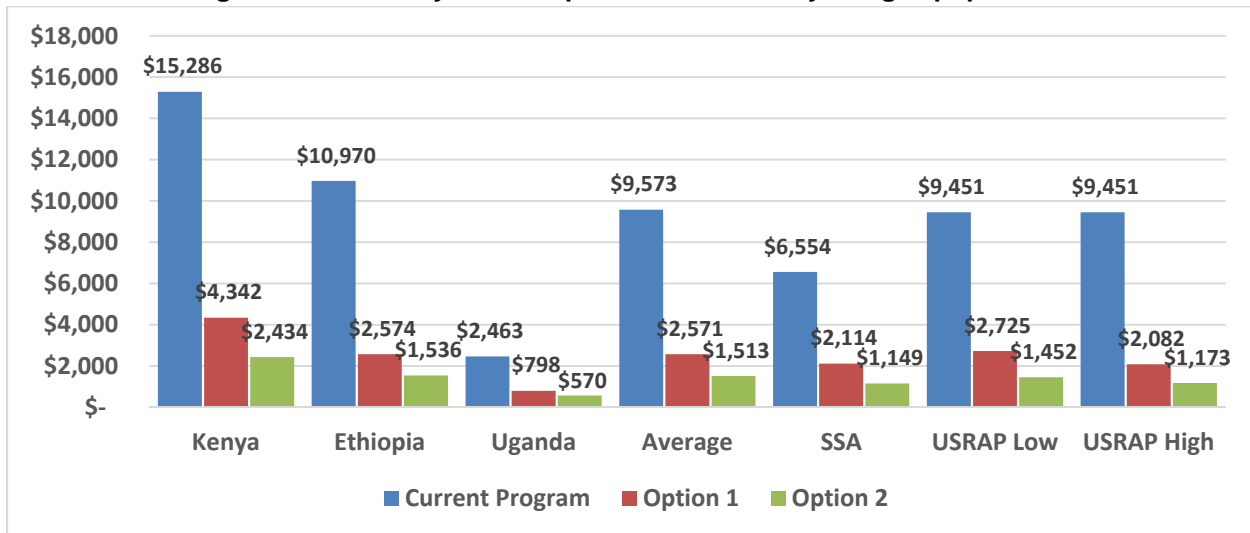
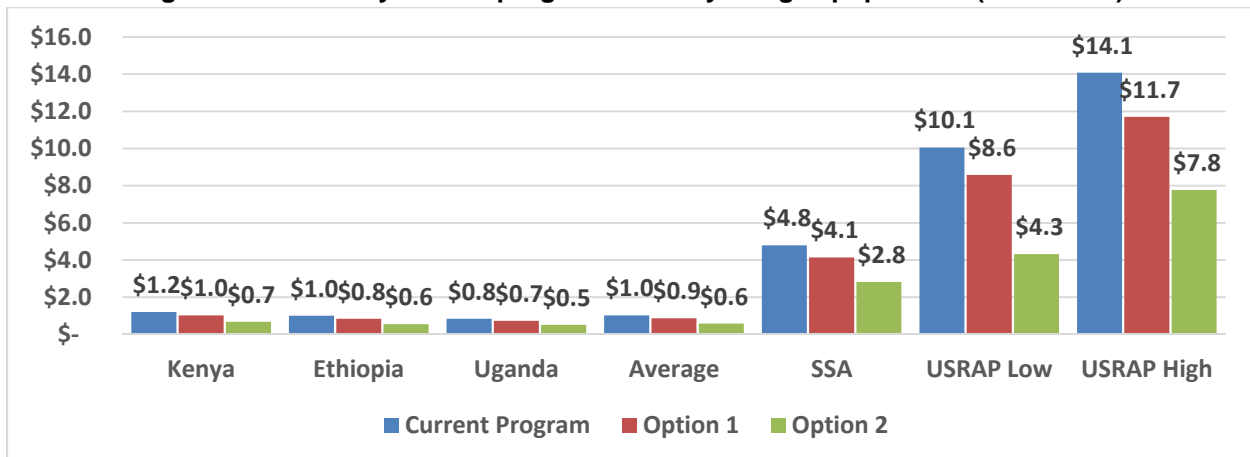


Figure 12: Summary of total program costs by refugee population (in millions)



Sensitivity Analysis for Kenya and Uganda

Table 13 (Kenya) and Table 15 (Uganda) represent the costs for acceptance levels of 5, 10, 15, 20, and 25 percent using the same prevalence and estimated refugee admission numbers for FY 2015. Table 14 (Kenya) and Table 16 (Uganda) depict the additional costs or cost savings to the U.S. government at each of these acceptance levels. Kenya and Uganda were used for this analysis because they had the lowest and highest prevalence rates. Based on this analysis, implementing the proposed intervention with acceptance levels below 10% in Kenya or Uganda may cost the U.S. government more than the current U.S. domestic screening program. Currently CDC and IOM believe acceptance rates will be 30% or higher, but the government would need to determine whether the health benefits outweigh the

additional costs if the acceptance levels are below 10%. That said, it is widely accepted in the literature that screening and early initiation into treatment is cost-effective and provides significant health benefits.

Table 13: Cost calculations for acceptance levels below 30% for Kenya

5% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
30 yes	300	\$290.33		\$87,100	147.93	\$210.95	\$118,305
70 no	5700		\$210.95	\$1,142,272			\$1,142,272
Total Costs	6000						\$1,260,577
10% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
70 yes	600	\$152.08		\$91,250	295.86	\$210.95	\$153,660
30 no	5400		\$210.95	\$1,082,152			\$1,082,152
Total Costs	6000						\$1,235,812
15% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
70 yes	900	\$106.00		\$95,399	443.79	\$210.95	\$189,015
30 no	5100		\$210.95	\$1,022,032			\$1,022,032
Total Costs	6000						\$1,211,047
20% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
70 yes	1200	\$82.96		\$99,549	591.72	\$210.95	\$224,370
30 no	4800		\$210.95	\$961,913			\$961,913
Total Costs	6000						\$1,186,283
25% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
70 yes	1500	\$69.13		\$103,699	739.65	\$210.95	\$259,725
30 no	4500		\$210.95	\$901,793			\$901,793
Total Costs	6000						\$1,161,518
Current Domestic Program	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
95% yes	5700		\$210.95	\$1,202,391			\$1,202,391

Table 14: Costs or cost-savings at acceptance levels below 30% for Kenya and new infections identified by time frame

Acceptance Rate New Program	Difference from Current Program	% Change	New Infections Identified		
			0 months ¹	3 months ²	> 3 months ³
5%	-\$39,462	-3%	4	75	4
10%	\$4,025	0%	8	71	4
15%	\$47,513	4%	12	67	4
20%	\$91,001	8%	17	63	3
25%	\$134,488	11%	21	59	3

¹ Reflects number of new cases identified overseas at start of program

² Reflects number of new cases identified domestically 3 months later than at the time of overseas screening than with the overseas intervention

³ Reflects number of new cases identified longer than 3 months than at the time of overseas screening

Table 15: Cost calculations for acceptance levels below 30% for Uganda

5% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
5 yes	200	\$250.86		\$50,172	39	\$210.95	\$58,494
95 no	3800		\$210.95	\$761,514			\$761,514
Total Costs	4000						\$820,008
10% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
10 yes	400	\$143.42		\$57,368	79	\$210.95	\$74,011
90 no	3600		\$210.95	\$721,435			\$721,435
Total Costs	4000						\$795,445
15% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
15 yes	600	\$107.61		\$64,563	118	\$210.95	\$89,528
85 no	3400		\$210.95	\$681,355			\$681,355
Total Costs	4000						\$770,883
20% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
20 yes	800	\$89.70		\$71,759	158	\$210.95	\$105,045
80 no	3200		\$210.95	\$641,275			\$641,275
Total Costs	4000						\$746,320
25% Acceptance	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
25 yes	1000	\$78.95		\$78,955	197	\$210.95	\$120,562
75 no	3000		\$210.95	\$601,196			\$601,196
Total Costs	4000						\$721,757
Current Domestic Program	People At Start	Overseas Screening Costs	USA Screening Costs	Initial Screening Costs	Rescreens in USA	USA Screening Costs	TOTAL COSTS
95% yes	3800		\$210.95	\$801,594			\$801,594

Table 16: Additional costs or cost savings for acceptance levels below 30% for Uganda and new infections identified by time frame

Acceptance Rate New Program	Difference From Current Program	% Change	New Infections Identified		
			0 months ¹	3 months ²	> 3 months ³
5%	-\$18,414	-2%	18	325	17
10%	\$6,149	1%	36	308	16
15%	\$30,711	4%	54	291	15
20%	\$55,274	7%	72	274	14
25%	\$79,837	10%	90	257	14

1 Reflects number of new cases identified overseas at start of program

2 Reflects number of new cases identified domestically 3 months later than at the time of overseas screening than with the overseas intervention

3 Reflects number of new cases identified longer than 3 months than at the time of overseas screening

Assessment of the Potential Health Benefits for the Proposed Intervention

The proposed overseas HIV screening intervention, at acceptance levels of 30% (Option 1) and 70% (Option 2), could lead to earlier HIV diagnosis and linkage to care and treatment for more U.S.-bound refugees. This earlier linkage to care will likely result in increased life expectancy (extended by up to 13 years) and quality of life; delayed onset of AIDS and opportunistic infections; and reduced transmission of HIV. Potential life-years saved (Table 17) and deaths averted over 3 years (Table 18) could also be realized through the proposed overseas HIV screening intervention.

These benefits could be magnified by differences in risk factors for transmission, stage of diagnosis, and adherence to treatment in refugees compared to U.S.-born populations. According to the literature, early HIV treatment can reduce the risk of sexual transmission, in heterosexual couples, to an uninfected partner by 96%. Based on the literature reviewed, heterosexual transmission is a higher risk factor in African-born and refugee populations versus U.S.-born populations. Given this pertinent difference in risk factors for HIV transmission, early diagnosis and treatment of new HIV infections in refugee populations may have a greater effect on reducing transmission than on U.S.-born populations. Further, there may also be an effect of reducing the incidence of mother-child transmission of HIV.

Table 17: Estimated new infections identified earlier and life-years saved for the proposed intervention by refugee population

Refugee Population and Overseas Intervention Option	New Infections Identified			Number of New Infections Diagnosed Earlier	Potential Life Years Saved ⁴
	0 months ¹	3 months ²	> 3 months ³		
Three Country Total (Uganda, Ethiopia, and Kenya)					
Option 1	185	409	22	185	2,400
Option 2	431	175	9	431	5,601
Current Program	0	585	31	N/A	N/A
Sub-Saharan Africa					
Option 1	231	512	27	231	3,004
Option 2	539	219	12	539	7,008
Current Program	0	732	39	N/A	N/A
US Refugee Admissions Program (USRAP)					
Low Range					
Option 1	336	745	39	336	4,368
Option 2	784	319	17	784	10,192
Current Program	0	1,064	56	N/A	N/A
High Range					
Option 1	470	1,043	55	470	6,115
Option 2	1,098	447	24	1,098	14,269
Current Program	0	1,490	78	N/A	N/A

1 Reflects number of new cases identified overseas at start of program

2 Reflects number of new cases identified domestically 3 months later than at the time of overseas screening than with the overseas intervention

3 Reflects number of new cases identified longer than 3 months than at the time of overseas screening

4 Early linkage to treatment can extend the life of HIV positive individuals by up to 13 to 14 additional years

Table 18: Estimated deaths averted over 3 years by diagnosing 60 new infections by refugee population

Refugee Population and Overseas Intervention Option	Number of New Infections Diagnosed	Deaths Averted Over 3 Years
Three Country Total (Uganda, Ethiopia, and Kenya)		
Option 1	185	62
Option 2	431	144
Sub-Saharan Africa		
Option 1	231	77
Option 2	539	180
US Refugee Admissions Program (USRAP)		
<i>Low Range</i>		
Option 1	336	112
Option 2	784	261
<i>High Range</i>		
Option 1	470	261
Option 2	1,098	366

Limitations

Several limitations exist in completing this study. First, the prevalence data for refugees used for this study from 2009 is outdated and may not accurately reflect current prevalence in U.S.-bound refugee populations. Second, the HIV screening cost data for the U.S. is based on estimates for billing codes most often used by medical practices and not specific to refugee population screening costs. Some states, like New York, receive a flat-rate-per refugee for medical screening during the first nine months. This may not be as comparable as actual cost data from the government perspective for refugee-related HIV screening in the U.S. Third, cost and prevalence data for overseas screening was averaged based on the actual IOM data for the three pilot countries to estimate results for sub-Saharan Africa and the USRAP. Averages from the three countries may not be generalizable to the larger refugee populations. Fourth, the “opt-in” voluntary screening approach used in the proposed intervention may result in lower acceptance rates, so the results for Option 2 (70% acceptance rate) may be over-estimates. Fifth, the limited research available on the specific health benefits of HIV screening in refugees makes it difficult to correctly estimate the health impact of the proposed intervention on refugees bound for the U.S.

Despite the limitations of this study, it provides unique information that can be used by the DGMQ at CDC to support increased budget requests to provide HIV screening for refugees while they are still overseas. Like any other government organization, funding requests must be supported by evidence of both effectiveness and thrift. As our results show, early HIV screening is good medicine for refugees and saves government dollars.

CONCLUSIONS

This study estimates and compares the costs associated with an overseas voluntary HIV screening and treatment program for refugees undergoing resettlement to the U.S. and the current domestic screening program after arrival in the U.S. The results suggest that HIV screening for refugees overseas will be less expensive for the U.S. government than domestic screening and early screening will have positive effect on public health outcomes for refugees and receiving communities. Initiating the proposed intervention, at either acceptance level analyzed, should provide significant cost-savings to the U.S. government each year. At the prevalence rates estimated for each of the sub-populations of refugees they would all be considered high risk by the CDC and would justify routine and annual screening for HIV.

Increasing the rates of overseas screening should increase rates of earlier screening and linkage to care. Early screening and linkage to care is in line with both the U.S. National HIV Strategy and UNHCR recommendations, resulting in positive health benefits to U.S.-bound refugees and the receiving communities. For U.S.-bound refugees, health benefits of implementing the proposed overseas intervention would include increased life expectancy and quality of life; delayed onset of AIDS and opportunistic infections; and reduced transmission of HIV.

RECOMMENDATIONS

Based on the results of this study, several recommendations are suggested for CDC to consider in moving forward with implementation of the proposed intervention to improve acceptance of HIV screening overseas in refugees bound for the U.S. The recommendations are consistent with the results of other refugee health interventions that have been implemented in refugee populations resulting in significant cost-savings for the U.S. governments. A few significant examples are described below.

- **Revised TB Screening and Treatment Program for U.S.-bound Immigrants and Refugees:** CDC implemented revised CDC TB screening and treatment requirements using directly observed therapy for refugee and immigrants, resulting in more than 1,000 cases of TB diagnosed and treated overseas prior to arrival in the U.S. and \$15 to 25 million in cost-savings to the U.S. health care system each year (CDC, 2013e).
- **A Pilot Vaccination Program for U.S.-bound Refugees:** A vaccination program was implemented for 50,000 out of 70,000 U.S. bound refugees annually against 10 diseases with 9 vaccines for refugees resettling from 5 pilot countries (Ethiopia, Kenya, Malaysia, Nepal, and Thailand). A cost analysis of one measles importation in Kentucky found that the total event costs (medical and public health response) from one imported case of measles in a refugee was \$25,000 (Coleman et. al, 2012). The cost benefit analysis found that the cost of vaccinating 1,500 refugees overseas would yield a potential return on investment of 490% (Coleman et. al, 2012).
- **Mass Drug Administration Programs for Parasitic Infections and Malaria:** A drug program has been implemented to provide presumptive therapy for U.S. bound refugees, resulting in refugees being 90% less likely to have *Ascaris* or hookworm. This \$5.1 million presumptive treatment program for intestinal parasites from 1999 to 2010 averted an estimated 5,500 cases and saved up to \$92.1 million in U.S. health care costs (Swanson et. al, 2012; Unpublished CDC Data, 2015). A \$2.1 million presumptive treatment program for malaria in Africa from 1999 to 2010 averted an estimated 4,800 cases and saved approximately \$11.2 million in potential U.S. health care costs (Collinet-Adler et. al, 2007; Unpublished CDC Data, 2015).

In addition to results of implemented refugee health interventions, a cost benefit analysis was completed for overseas hepatitis B virus screening. The net benefit depends on the percentage of refugees that receive post-arrival screening and length of follow-up considered. After 10 years, if 50% of refugees were screened in the US in the 'Vaccinate only' policy, the 'Screen and vaccinate' policy would provide an estimated net benefit of \$450 million over the ten-year period for a cohort of 58,538 refugees compared to the 'Vaccinate only' policy (Jazwa et. al, 2015). This is due primarily to benefits of early diagnosis and treatment.

The results of this study are in line with other interventions that have been successful in identifying and treating more refugees overseas, prior to arrival in the U.S., and providing significant cost-savings to the U.S. government in the process. The recommendations presented below aim to help CDC gain the health and cost benefits from implementing the proposed HIV screening intervention overseas. The recommendations include educating critical partners, implementing a pilot program, expanding the current analysis to include treatment costs, standardizing reporting of refugee health data, and determining ways to obtain more recent refugee prevalence data for further analysis.

1) Disseminate study results to educate critical internal and external partners in refugee resettlement and public health on the cost and health benefits for the proposed overseas HIV screening intervention compared to the current domestic program.

- Internal partners include CDC leadership, the CDC Washington Office (CDC-W), and the Office of Financial Resources (OFR).
 - CDC leadership's understanding of the potential cost and health benefits of the proposed intervention may be critical in moving forward with implementing a pilot program and potential expansion to the entire USRAP.
 - CDC leadership could assist with finding funds to begin a pilot intervention and encouraging other Federal partner agencies to assist with these efforts.
 - CDC-W and OFR can assist with strategies to secure short- and long-term resources to pilot the proposed overseas HIV screening intervention.
- External partners include federal partners (e.g., PRM, ORR, and DHS) and non-federal partners (e.g., state refugee health coordinators, ASTHO, NACCHO, CSTE, and voluntary agencies for refugee resettlement).
 - Federal partners that work together in refugee resettlement efforts have different missions, but have a shared interest in addressing infectious diseases in refugees resettling to the U.S. Education of these partners will help encourage support in implementing the proposed intervention and potential opportunities to share resources to move this proposed intervention towards implementation.

- Non-federal partners will be essential for state and local public health and refugee resettlement support of increasing HIV screening efforts overseas.

2) Implement a pilot intervention, with evaluation plan, in the three countries analyzed, Uganda, Ethiopia, and Kenya, to determine feasibility and further evaluate costs and benefits of the proposed overseas HIV screening intervention.

- A pilot intervention would allow CDC to evaluate the costs and benefits of the proposed intervention based on real time and accurate information to:
 - Identify unanticipated implementation challenges and adjustments needed for further roll-out of the intervention to a wider refugee population (e.g., Sub-Saharan Africa or USRAP).
 - Identify strategies to work with local communities to plan and execute implementation to reduce or address possible unanticipated consequences related to HIV stigma.
 - Determine more accurate prevalence and acceptance rates and the resources required to better estimate the benefits (e.g., costs and health), feasibility, and resources needed to continue and/or expand the intervention.
 - Refine evaluation plans to ensure program success can be measured to determine the expected outcomes are being met.

3) Expand analysis to include treatment costs to identify the full cost-benefits of implementing the proposed intervention.

- Like HIV screening, HIV treatment costs are likely to be much less expensive overseas than in the U.S. The cost per year cited for HIV treatment is \$23,000, so the additional savings could be substantial. Including an analysis of the estimated savings for initiating treatment at least three months earlier overseas would provide a fuller picture of the potential cost-benefits for the proposed intervention.

4) Develop standardized state reporting of U.S. bound refugee health data.

- Currently refugee health data in the U.S. is collected at the state level, but a current system does not exist for standard reporting to CDC. Lack of standard reporting makes it difficult for CDC to make recommendations to improve refugee health programs and interventions, both overseas and domestically.

5) Determine ways to obtain more recent prevalence data for U.S.-bound refugee populations in the USRAP to better analyze the potential cost and health benefits of implementing the proposed intervention.

- More recent data would allow for a more accurate analysis to provide better estimates of the potential cost-savings and health benefits for implementing the proposed intervention in specific refugee populations and the entire USRAP.

REFERENCES

- AIDS.gov. (2010). HIV/AIDS Basics. *Opportunistic Infections*. Retrieved April 5, 2015, from <http://aids.gov/hiv-aids-basics/staying-healthy-with-hiv-aids/potential-related-health-problems/opportunistic-infections/>.
- AIDS.gov. (2013). HIV/AIDS Basics. *Stages of HIV Infection*. Retrieved April 5, 2015, from <http://aids.gov/hiv-aids-basics/just-diagnosed-with-hiv-aids/hiv-in-your-body/stages-of-hiv/>.
- Beckwith, C.G., DeLong, A.K., Desjardins, S.F., Gillani, F., Bazerman, L., Mitty, J.A., Ross, H., Cu-Uvin, S. (2008). HIV infection in refugees: a case-control analysis of refugees in Rhode Island. *International Journal of Infectious Diseases*, 13(2):186-9Now 2. doi:10.1016/j.ijid.2008.06.004.
- Blanas, D.A., Nichols, K., Bekele, M., Lugg, A., Kerani, R., Horowitz, C. (2013). HIV/AIDS Among African-Born Residents in the U.S. *Journal of Immigration Minor Health*, 15(4): 718–724. doi:10.1007/s10903-012-9691-6.
- Bourée P., Lamour P., Bisaro F., Didier E. (1995). Study of an HIV positive, tropical origin population in a refugee center in France. *Bulletin de la Societe de Pathologie Exotique*, 88(1):24-28.
- Branson, B.M., Handsfield, H.H., Lampe, M.A., Janssen, R.S., Taylor, A.W., Lyss, S.B., Clark, J.E. (2006). Revised Recommendations for HIV Testing of Adults, Adolescents, and Pregnant Women in Health-Care Settings. *Morbidity and Mortality Weekly Report*, 55(RR14);1-17.
- Centers for Disease Control and Prevention. (2009). Department of Health and Human Services CDC FY 2011 Justification of Estimates for Appropriation Committees. Retrieved on June 17, 2015, from http://www.cdc.gov/fmo/topic/Budget%20Information/appropriations_budget_form_pdf/FY2011_CDC_CJ_Final.pdf.
- Centers for Disease Control and Prevention. (2012a). Immigrant and Refugee Health. *Summary Checklist for the Domestic Medical Examination for Newly Arriving Refugees*. Retrieved June 14, 2015, from <http://www.cdc.gov/immigrantrefugeehealth/guidelines/domestic/checklist.html>.
- Centers for Disease Control and Prevention. (2012b). Immigrant and Refugee Health. *Screening for HIV Infection During the Refugee Domestic Medical Examination*. Retrieved March 7, 2015, from <http://www.cdc.gov/immigrantrefugeehealth/guidelines/domestic/screening-hiv-infection-domestic.html>.
- Centers for Disease Control and Prevention. (2012c). Immigrant and Refugee Health. *Technical Instructions for Panel Physicians and Civil Surgeons*. Retrieved March 7, 2015, from <http://www.cdc.gov/immigrantrefugeehealth/exams/ti/hiv-guidance-panel-civil.html>.
- Centers for Disease Control and Prevention. (2013a). Immigrant and Refugee Health. *Domestic Intestinal Parasite Guidelines*. Retrieved July 8, 2015, from <http://www.cdc.gov/immigrantrefugeehealth/guidelines/domestic/intestinal-parasites-domestic.html>.
- Centers for Disease Control and Prevention. (2013b). Immigrant and Refugee Health. Retrieved March 5, 2015, from <http://www.cdc.gov/immigrantrefugeehealth/index.html>.
- Centers for Disease Control and Prevention. (2013b). Division of Global Migration and Quarantine. *Improving Health for Kenya's Refugees by Building Laboratory Capacity*, Retrieved July 8, 2015, from <http://www.cdc.gov/nceid/dgmq/feature-stories/dadaab.html>.
- Centers for Disease Control and Prevention. (2013c). HIV/AIDS. *Prevention Benefits of HIV Treatment*. Retrieved June 14, 2015, from <http://www.cdc.gov/hiv/prevention/research/tap/>.

Centers for Disease Control and Prevention. (2013d). Immigrant and Refugee Health. *Refugee Health Guidelines*. Retrieved June 14, 2015, from <http://www.cdc.gov/immigrantrefugeehealth/guidelines/refugee-guidelines.html>.

Centers for Disease Control and Prevention. (2013e). Justification of Estimates for Appropriations Committees. Retrieved July 18, 2015, from http://www.cdc.gov/fmo/topic/Budget%20Information/appropriations_budget_form_pdf/FY2013_CDC_CJ_Final.pdf.

Centers for Disease Control and Prevention. (2014a). Immigrant and Refugee Health. *Medical Examination of Immigrants and Refugees*. Retrieved June 14, 2015, from <http://www.cdc.gov/immigrantrefugeehealth/exams/medical-examination.html>.

Centers for Disease Control and Prevention. (2014b). Immigrant and Refugee Health. *Laws and Regulations*. Retrieved March 7, 2015, from <http://www.cdc.gov/immigrantrefugeehealth/laws-regulations.html>.

Centers for Disease Control and Prevention. (2015a). Panel Physician Portal. *Resources and Information*. Retrieved June 17, 2015, from <http://www.cdc.gov/panelphysicians/>.

Centers for Disease Control and Prevention. (2015b). *National Center for Emerging and Zoonotic Infectious Diseases (NCEZID)*. Retrieved on June 17, 2015, from <http://www.cdc.gov/ncezid/dw-index.html>.

Coleman, M.S., Garbat-Welch L., Burke H., Weinberg M., Humbaugh K., Tindall A., Cambron J. (2012) Direct costs of a single case of refugee-imported measles in Kentucky. *Vaccine*,30(2):317-21. doi: 10.1016/j.vaccine.2011.10.091.

Collinet-Adler S., Stauffer W., Williams D.N., Larsen K, Slattery W. (2007). Malaria imported into the United States: The financial impact of pre-departure empirical anti-malaria therapy in refugees. *American Journal of Tropical Medicine*, 77(3):458-63.

Department of State. (2013). Proposed Refugee Admissions for Fiscal Year 2013. *Report to Congress*. Retrieved May 15, 2015 from <http://www.state.gov/documents/organization/198157.pdf>.

Department of State. (2014a). Bureau of Population, Refugees, and Migration. *Refugee Admissions*. Retrieved June 13, 2015 from <http://www.state.gov/j/prm/ra/index.htm>.

Department of State. (2014b). Proposed Refugee Admissions for Fiscal Year 2015. *Report to Congress*. Retrieved May 15, 2015 from <http://www.state.gov/j/prm/releases/docsforcongress/231817.htm>.

Department of State. (2015). U.S. Department of State Foreign Affairs Manual Volume 9 Visas. Retrieved on June 17, 2015, from <http://www.state.gov/documents/organization/86936.pdf>.

Eckstein, B. (2011). Primary Care for Refugees. *American Family Physician*. 83(4), 429-436.

Edberg, M., Cleary, S. Vyas, A. (2011). A Trajectory Model for Understanding and Assessing Health Disparities in Immigrant/Refugee Communities. *Journal of Immigrant and Minority Health*, 13(3), 576-584.

ExpectMore.Gov. (2008). Detailed Information on the CDC: Division of Global Migration and Quarantine Assessment. Retrieved June 14, 2015, from <https://www.whitehouse.gov/sites/default/files/omb/assets/OMB/expectmore/detail/10009087.2008.html>.

Gopalappa, C., Farnham, P.G., Hutchinson, A.B., Sansom, S.L. (2012). Cost Effectiveness of the National HIV/AIDS Strategy Goal of Increasing Linkage to Care for HIV-Infected Persons. *Journal of Acquired Immune Deficiency Syndromes*, 61(1):99-105. DOI: 10.1097/QAI.0b013e31825bd862.

Jazwa, A., Coleman, M.S., Gazmararian, J., Wingate, L.T., Maskery, B., Mitchell, T., Weinberg, M. (2015). Cost-benefit comparison of two proposed overseas programs for reducing chronic Hepatitis B infection

among refugees: is screening essential? *Vaccine*. 10;33(11):1393-9. doi: 10.1016/j.vaccine.2015.01.010.

Kennedy, S, McDonald, J.T., Biddle, N. (2006). The healthy immigrant effect and immigrant selection: evidence from four countries. *SEDAP Research Paper*, No. 164.

Lowther, S.A., Johnson, G., Hendel-Paterson, B., Nelson, K., Mamo, B., Krohn, K., Pessoa-Brandão, L., O'Fallon, A., Stauffer, W. (2012). HIV/AIDS and Associated Conditions among HIV-Infected Refugees in Minnesota, 2000–2007. *International Journal of Environmental Research and Public Health*. 9 (4197-4209) doi:10.3390/ijerph9114197.

Mehta, S. D., Hall, J., Greenwald, J. L., Cranston, K., & Skolnik, P. R. (2008). Patient Risks, Outcomes, and Costs of Voluntary HIV Testing at Five Testing Sites Within a Medical Center. *Public Health Reports*, 123(5), 608–617.

Mofenson, L.; Taylor, A.; Rogers, M.; Campsmith, M.; Ruffo, M.; Clark, J.; Lampe, M.; Nakashima, A.; Sansom, S. (2006). Achievements in Public Health: Reduction in Perinatal Transmission of HIV Infection --- U.S., 1985—2005. *Morbidity and Mortality Weekly Report*, 55(21), 592-597.

National Institute of Allergy and Infectious Disease (NIAID). (2009). HIV/AIDS. *Diagnosis*. Retrieved April 10, 2015 from <http://www.niaid.nih.gov/topics/HIVAIDS/Understanding/Pages/diagnosis.aspx>.

National Institute of Allergy and Infectious Disease (NIAID). (2012a). HIV/AIDS. *How HIV Causes AIDS?*. Retrieved April 10, 2015 from <http://www.niaid.nih.gov/topics/hivaids/understanding/howhivcausesaids/Pages/cause.aspx>.

National Institute of Allergy and Infectious Disease (NIAID). (2012b). HIV/AIDS. *Treatment of HIV Infection*. Retrieved April 10, 2015 from <http://www.niaid.nih.gov/topics/hivaids/understanding/treatment/Pages/Default.aspx>.

National Institute of Allergy and Infectious Disease (NIAID). (2015). HIV/AIDS. *Health and Research Topics*. Retrieved April 10, 2015 from <http://www.niaid.nih.gov/topics/hivaids/Pages/Default.aspx>.

National Institutes of Health (2013). AIDSinfo. *Guidelines for the Use of Antiretroviral Agents in HIV-1-Infected Adults and Adolescents*. Retrieved April 14, 2015 from <http://aidsinfo.nih.gov/contentfiles/lvguidelines/adultandadolescentgl.pdf>.

Nisbet, S. M., Reeve, A. M., Ellis-Pegler, R. B., Woodhouse, A. F., Ingram, R. J., Roberts, S. A., McAllister, S. M. and Thomas, M. G. (2007), Good outcome in HIV-infected refugees after resettlement in New Zealand: population study. *Internal Medicine Journal*, 37: 290–294. doi: 10.1111/j.1445-5994.2007.01335.x.

Paltiel, A.D., Weinstein, M.C., Kimmel, A. D., Seage, G.R., Losina, E.L., Zhang, D.H., Kenneth. S.M., Freedberg, A., and Walensky, R.P. (2005). Expanded Screening for HIV in the U.S. — An Analysis of Cost-Effectiveness. *New England Journal of Medicine*, 352:586-595 doi:1056/NEJMsa042088.

Phillips, K.A., Fernyak, S.B. (2000). The cost-effectiveness of expanded HIV counselling and testing in primary care settings: a first look. *AIDS*, 14(14): 2159-2169.

Pinkerton, S.D., Bogart, L.M., Howerton, S.S., Becker, K.B., Asch, S.M. (2010). Cost of Rapid HIV Testing at 45 U.S. Hospitals. *AIDS Patient Care and STDs*, 24(7): 409-413. doi:10.1089/apc.2009.0348.

Pottie, K., Janakiram, P., Topp, P., & McCarthy, A. (2007). Prevalence of selected preventable and treatable diseases among government-assisted refugees: Implications for primary care providers. *Canadian Family Physician*, 53(11), 1928–1934.

Prosser, A. T., Tang, T., and Hall, H. I. (2012). HIV in persons born outside the U.S., 2007–2010, *Journal of the American Medical Association*, 308(6):601-607.

Sanders, G.D., Bayoumi A.M., Sundaram V., Bilir S.P., Neukermans C.P., Rydzak C.E., Douglass L.R., Lazzeroni L.C., Holodniy M., Owens D.K. (2005). Cost-effectiveness of screening for HIV in the era of highly active antiretroviral therapy. *New England Journal of Medicine*, 352(6):570-85.

Swanson S, Phares CR, Mamo B, et al. Albendazole therapy and enteric parasites in United States-bound refugees. *N Engl J Med* 2012;366:1498-507.

Szajna, A. and Ward, J. (2015), Access to Health Care by Refugees: A Dimensional Analysis. *Nursing Forum*, 50: 83–89. doi: 10.1111/nuf.12051

The Guide: 2015 Physicians' Fee and Coding Guide. Procedure Coding, Billing & Fee Information for Health Care Professionals. InGauge Healthcare Solutions; Atlanta, GA 30360; www.coderscentral.com:March, 2015.

The UN Refugee Agency (UNHCR). (2015b). Protection. Retrieved March 7, 2015, from <http://www.unhcr.org/pages/49c3646cc8.html>.

The UN Refugee Agency (UNHCR). (2015). Refugee Figures. Retrieved June 14, 2015, from <http://www.unhcr.org/pages/49c3646c1d.html>.

The UN Refugee Agency (UNHCR). (1951) The Refugee Convention, Retrieved May 3, 2013, from <http://www.unhcr.org/4ca34be29.pdf>.

Refugee Council USA. (2015). History of the U.S. Refugee Resettlement Program. Retrieved March 7, 2015, from <http://www.rcusa.org/?page=history>.

UN AIDS. (2014). Global Report. *Report on the Global AIDS Epidemic*. Retrieved April 8, 2015, from http://www.unaids.org/en/media/unaids/contentassets/documents/epidemiology/2013/gr2013/UNAIDS_Global_Report_2013_en.pdf.

Understanding Health. (2015). Understanding AIDS & HIV. *AIDS Test*. Retrieved June 17, 2015, from <http://www.understanding-aids-hiv.com/aids-test.php?keywords=aids+test>.

U.S. Committee for Refugees and Immigrants (USCRI). (2015). Resettling Refugees in America. Retrieved March 5, 2015, from <http://www.refugees.org/our-work/refugee-resettlement/>.

U.S. Committee for Refugees and Immigrants (USCRI). (2009). Public Charge. Retrieved July 18, 2015, from <http://www.uscis.gov/green-card/green-card-processes-and-procedures/public-charge>.

U.S. Preventive Services Task Force (USPSTF). (2013). Screening for HIV. *Current Recommendations*. Retrieved on April 5, 2015 from <http://www.uspreventiveservicestaskforce.org/uspstf/uspshivi.htm>.

Vermund, S.H. (2006). Millions of Life-Years Saved with Potent Antiretroviral Drugs in the United States: A Celebration, with Challenges *J Infect Dis.*, 194 (1): 1-5 doi:10.1086/505154.

Walensky, R.P., Paltiel, A.D., Losina, E., Mercincavage, L.M., Schackman, B.R., Sax, P.E., Weinstein, M.C., Freedberg, K.A., (2006). The Survival Benefits of AIDS Treatment in the United States. *Journal of Infectious Disease*, 194 (1): 11-19 doi:10.1086/505147.

Walker, P.F., Stauffer, W.M., Barnett, E.D. (2013). Arrival in the United States: Health Status & Screening of Refugees, Immigrants, & International Adoptees. Centers for Disease Control and Prevention. CDC Health Information for International Travel 2014. New York: Oxford University Press; 2014.

World Health Organization. (2012). HIV/AIDS. *HIV testing services*. Retrieved June 14, 2015, from <http://www.who.int/hiv/topics/vct/about/en/>.

World Health Organization. (2013). HIV/AIDS. *Executive Summary*. Retrieved June 13, 2015, from <http://www.who.int/hiv/pub/guidelines/arv2013/intro/executivesummary/en/>.

World Health Organization (WHOa). (2014a). Health Topics. *HIV/AIDS*. Retrieved April 8, 2015 from http://www.who.int/topics/hiv_aids/en/.

World Health Organization (WHOb). (2014b). Global Health Observatory. *HIV/AIDS*. Retrieved April 8, 2015 from <http://www.who.int/gho/hiv/en/>.

World Health Organization (WHOc). (2014c). Health Topics. *HIV/AIDS*. Retrieved January 15, 2015, from <http://www.who.int/mediacentre/factsheets/fs360/en/>.