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Mobile HIV units in South Africa: A systematic review

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Mobile HIV units in South Africa: A Systematic Review

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Abstract

Objective: To examine existing literature on mobile HIV testing units to determine if they have the potential to increase access to testing, treatment, and HIV education to decrease rates of HIV in South Africa.

Participants: Ten research articles evaluating the HIV intervention method of mobile HIV units in South Africa, including outcome measures.

Analysis: Systematic search of 87 articles from 2000 to 2018 and review of the 10 articles that met inclusion criteria.

Results: Several studies (n=5) showed that mobile testing units are effective at attracting hard to reach populations, such as men and young adults. Studies (n=3) also suggested that mobile testing units were successful at attracting first time testers. Mobile testing units did increase access to testing but did not necessarily increase access to treatment post-diagnosis. Some articles (n=2) found that mobile testing services have not yet found an effective way to link care once patients leave the unit. One article (n=1) found that the implementation of mobile testing units is cost-effective for South Africa and countries that are similarly resourced to South Africa.

Conclusions: This search found proof that mobile units increase access to testing, especially among hard to reach populations, and would be cost-effective to implement in South Africa. This study also found that if current mobile units are modified, they have the potential to increase access to education about HIV and increase access to treatment post-diagnosis. This search did not provide ample evidence that mobile testing units can decrease prevalence rates of HIV in South Africa.

Key Words: mobile HIV testing units, South Africa, mobile HCT

Chapter One: Introduction

The human immunodeficiency virus (HIV) epidemic in South Africa is a significant problem negatively affecting the health of the nation. South Africa is documented as having the largest HIV epidemic in the world, with 19% of all people living with HIV located in South Africa, even though South Africa only accounts for .7% of the world's population (UNAIDS, 2018, Mayosi, B.M., & Benatar, S.R., 2014). Additionally, 15% of all new HIV infections and 11% of all AIDS related deaths are in South Africa (UNAIDS, 2018). Of South Africa's total population of 56 million people, there is a total of 7.1 million people living with HIV, and 110,000 deaths due to HIV (WHO, 2017a).

The main problems that need to be addressed in relation to the HIV epidemic are access to testing, access to treatment, specifically antiretroviral treatment (ART), and education about HIV transmission, primarily sexual behaviors (AVERT, 2018, Mayosi, B.M., & Benatar, S.R., 2014, Johnson, L., 2015). One of the biggest obstacles to HIV prevention and treatment efforts is a lack of knowledge about, or denial of risk of, HIV status (Mayosi, B.M. et al., 2012). Reluctance to test is often largely due to both discrimination and social marginalization associated with a positive HIV diagnosis (Mayosi, B.M. et al., 2012). Lack of access to testing services has also been attributed to long wait times, low patient satisfaction scores, and patient distance from clinic facilities (Meehan, S.A. et al., 2017). Though newly expanded governmental guidelines have been successful in increasing access to ART to over 2,552 facilities throughout South Africa, about half of individuals in need are still not being treated (Mayosi, B.M. et al., 2012). This expansion of treatment from 2006 to 2011 decreased rates of AIDS related mortality, proving that access to ART plays an important role in improving the

health of South Africa (Mayosi, B.M. et al., 2012). A main obstacle to sustain effective prevention programs in South Africa is high-risk sexual behavior, indicating that there is still a substantial lack of education about best sexual practices which needs to be addressed (Benatar, S.R., 2004).

There is a distinct lack of literature that systematically reviews articles that have been published about mobile HIV units in South Africa. This might be because the implementation of mobile HIV testing units is relatively new, as demonstrated by the fact that the literature found on it is from within the last ten years. Since mobile HIV units are still relatively new, it is important to determine whether they are effective. This study will focus on the effect that the HIV/AIDS epidemic has on South Africa, specifically, the implementation of mobile HIV testing and counseling centers, and systematically review the existing literature to examine whether this intervention method has the potential to aid in the epidemic in South Africa.

It is hypothesized that mobile HIV testing and counseling units have the potential to decrease rates of HIV in South Africa. The following questions will be addressed:

Can mobile units increase access to HIV testing and treatment?

Can mobile units increase access to education about HIV transmission?

Can mobile units decrease rates of HIV in South Africa?

Is the implementation of mobile units cost-effective?

Chapter Two: Literature Review

South Africa

South Africa is a country located in Sub-Saharan Africa at the southernmost part of the African continent. South Africa is a country where political resistance has heavily influenced its history. In 1994, the country held its first democratic elections after decades of resistance to apartheid, the system of racial segregation and discrimination in South Africa (Coovadia, H. et al., 2009). Despite the fact that modern South Africa is economically considered to be a middle-income country, it has health outcomes that are much worse than those in lower income countries (Coovadia, H. et al., 2009).

South Africa's health particularly struggles in maternal and child health, noncommunicable diseases, violence and injury, and HIV/AIDS and tuberculosis (TB) (Coovadia, H. et al., 2009). The maternal mortality ratio, in 2015, was 138 deaths per 100,000 live births, and the infant mortality rate in 2015 was 35.5 per 1000 live births (WHO, 2017b). Maternal deaths that occur in South Africa are often directly related to HIV, and the leading cause of death for women of reproductive age is a combination of HIV and TB (Mayosi, B.M., & Benatar, S.R., 2014). However, these death rates have begun to decline since antiretroviral treatment (ART) was introduced in 2003 (Mayosi, B.M., & Benatar, S.R., 2014).

South Africa has one of the highest income disparities in the world, where the top 10% of citizens earn 58% of the total annual income, and the bottom 70% of citizens earn only 17% of the total annual income (Mayosi, B.M., & Benatar, S.R., 2014). These blatant disparities are also

deeply tied to diseases of poverty, notably HIV/AIDS and TB (Mayosi, B.M. & Benatar, S.R., 2014).

South Africa's health system, which consumed about 8.8% of the country's GDP in 2012, is comprised of both a public (run by the government) and private sector (WHO, 2015). High levels of unemployment and poverty make it so that the large burden of providing healthcare remains with the government in the public sector (Brand South Africa, 2012). The private sector typically spends about 4.4% of GDP on health and provides care to only 16% of the population, while the public sector typically spends around 4.1% of GDP on health and provides care to 84% of the population (Groenewald, Y., 2017). Since the public sector provides the vast majority of care, it is significantly over stretched and underfunded, and is consequently known for having facilities that are physically deteriorating, and that are poorly managed and under-resourced (Brand South Africa, 2012). There is also a significant shortage of doctors in the public sector, because 73% of general practitioners choose to go to the private sector (Brand South Africa, 2012). There are only about 1,200 to 1,300 medical school graduates each year in South Africa, which is significantly inadequate for a country with a population of 56 million (WHO, 2015). This means that there is only one practicing doctor for every 4,219 individuals in South Africa (Brand South Africa, 2012).

In a global survey conducted by the Future Health Index measuring healthcare system efficiency, South Africa ranked last (Groenewald, Y., 2017). This survey looked at South Africa along with countries such as the US, Chile, Argentine, Brazil, and China, and defined healthcare system efficiency as the ability to provide maximum results at the lowest cost (Groenewald, Y.,

2017). The group average for the countries that were surveyed was 10.5, while South Africa scored a low 4.4 (Groenewald, Y., 2017).

HIV/AIDS

HIV, also known as the human immunodeficiency virus, is a virus that can lead to AIDS, or acquired immunodeficiency syndrome, if not treated effectively and timely. HIV attacks the body's CD4 cells, which help the immune system fight off infections (CDC, 2018). If left untreated, HIV can reduce the number of CD4 cells in the body significantly, making an infected individual much more susceptible to other infections (CDC, 2018). The only way to know for sure whether or not you are infected with HIV is to get tested (CDC, 2018). Getting tested to know your status is crucially important to prevention and treatment efforts (Johnson, L., 2015). Knowing your status is the first step to starting treatment before the HIV progresses too far, and also can help prevent you from transmitting the virus to other individuals. (Johnson, L., 2015, CDC, 2018).

HIV is transmitted through certain bodily fluids, and only a person who already has HIV can transmit the virus to someone else (CDC, 2018). These bodily fluids include blood, semen, pre-seminal fluid, rectal fluid, vaginal fluid, as well as breast milk. HIV is most commonly transmitted through unprotected sexual behaviors and the use of needles or syringes (CDC, 2018). Contrary to popular belief, HIV is not transmitted by air, water, saliva, sweat, tears, closed-mouth kissing, insects, pets, sharing toilets, sharing food, or sharing drinks (CDC, 2018). Additionally, HIV can be spread from mother to child and this risk is especially high if the mother living with HIV is not being properly treated. (CDC, 2018).

Although there is no cure that currently exists, with proper medical treatment HIV can be controlled (CDC, 2017, WHO, 2017c). The medicine used to treat HIV is known as ART, or antiretroviral treatment. ART can drastically prolong the lives of individuals living with HIV, as well as reduce the risk of transmitting the virus to others, so long as the medicine is taken every day as instructed (CDC, 2018, WHO, 2017c). In the mid-1990s, before ART existed, individuals living with HIV quickly progressed to AIDS in just a few years, but now someone living with HIV, and treated with ART, can live about as long as someone who does not have HIV. (CDC, 2018).

HIV Epidemic in South Africa

Though HIV/AIDS is a problem everywhere, more than half of HIV positive individuals (about 52%) live in Sub-Saharan Africa (Wood, E.M. et al., 2018). As mentioned in the introduction, South Africa is documented as having the largest HIV epidemic in the world, with nearly one fifth of all people living with HIV in South Africa (UNAIDS, 2018). In 2012, the estimated prevalence of HIV was about 12.2%, a significant increase from 2008's prevalence of 10.6% (Zuma et al., 2016). The age group with the highest prevalence was those aged 25 to 49 years, with a rate of 25.2% (Zuma et al., 2016). Additionally, females had a significantly higher prevalence of HIV than men, and females between the ages of 15 to 24 had an incidence rate four times as high as males of the same age (Zuma, et al., 2016). Also, when looking at incidence rates by locality type, individuals living in urban informal settlements (which are newer and relatively undeveloped areas) had a higher HIV incidence rate than those living in urban formal settlements (which are older and relatively more developed areas). (Potts, D., 2008, Zuma et al., 2016).

The first ever reported case of HIV in South Africa was in 1981 (Udjo, E.O., 2006). According to Eric Udjo, over the past 30 years, fertility and mortality have decreased so that South Africa has the lowest fertility rates in mainland sub-Saharan Africa (Udjo, E.O., 2006). South Africa's average life expectancy at birth is 64 years, and South Africa's fertility rate is 2.4 births per woman (WHO, 2017a).

Since South Africa's fertility and mortality rates have shifted, in large part due to the HIV/AIDS epidemic, the relative size of the younger population decreased, while the relative size of the older population increased (Udjo, E. O., 2006). From 1970 to 2004, the relative size of the young population went from 41% to 34% of the total population, while the relative size of the elderly went from 5% to 7% of the total population. These shifts in population demographics come with strong government policy implications concerning "intergenerational demand" for health services. (Udjo, E. O., 2006).

As previously mentioned, there is no cure for HIV, but the disease can be controlled by utilizing ART, which is a lifelong treatment that includes a combination of three or more antiretroviral (ARV) drugs (WHO, 2017c). ARVs hinder the spread of the virus within the body, while simultaneously allowing an HIV infected individual's immune system to recover its ability to fight off infections (WHO, 2017c). South Africa has the largest ART program in the world, with an estimated coverage of 56% or 3,929,000 individuals receiving ART (AVERT, 2018, WHO, 2017a).

Causes of the Epidemic

According to my research, there are two major causes of the epidemic: lack of access to testing and treatment, and lack of education.

Lack of access

Lack of access as it relates to HIV can be defined as a lack of access to treatment, mainly ART, as well as a lack of access to testing services. There are many problems in regards to access to care for individuals living with HIV. South Africa has an under-resourced but overly-demanded public sector, which is unable to meet the needs of the patients, and an overly expensive private sector. (Brand South Africa, 2012, Pao, M., 2006). The majority of individuals that were tested for HIV in 2012 used public health facilities (70%), while the minority used private facilities (30%) (Meehan, S.A. et al., 2017). Hundreds of NGOs (nongovernmental organizations), that are all funded by different donors, provide treatment to individuals living with HIV. Though this is admirable, it should not be the case for a country that has the financial resources necessary to treat everyone in need (Pao, M., 2006, Coovadia, H. et al., 2009).

Another challenge in regards to access is a lack of human resources in South Africa's health care system (Pao, M., 2016, Wood, M.E. et al., 2018). There is an insufficient number of nurses and doctors, as well as other public health workers, to keep up with the demand for health services. This high demand and low supply creates barriers to access, such as long wait times, as well as overly stressed and exhausted healthcare workers, which cause many patients to feel "alienated" from the system (Pao, M., 2016, Wood, M.E. et al., 2018, Benatar, S.R., 2004). About 16% of healthcare workers themselves are HIV positive (Benatar, S.R., 2004).

Lack of access also extends to a lack of access to testing services. About 23% of individuals living with HIV are undiagnosed (Meehan, S.A. et al., 2017). It is imperative that HIV infected individuals know their status, preferably early on, so that they can be treated immediately and educated on best practices so as not to transmit the disease to others (Johnson, L., 2015). In Sub-Saharan Africa, less than 40% of HIV positive individuals know their status, or are aware of their partner's status (Matovu, J.K., 2011). Additionally, men are statistically more likely to go undiagnosed than women, meaning they should be considered a target population for HIV testing outreach programs (Meehan, S.A. et al., 2017).

Lack of education

Lack of education in regards to HIV means a lack of an individual's knowledge about how HIV is spread as well as methods to prevent transmission. According to a study that was done, including questions about correctly identifying ways to prevent transmission of HIV as well as rejecting myths and misconceptions about HIV, less than one third (26.8%) of individuals interviewed had accurate knowledge of sexual transmission and prevention of HIV. (Zuma, K. et al., 2016). This means that over 70% of those interviewed had been operating under false knowledge about HIV. This lack of education makes individuals much more susceptible to contracting as well as transmitting the virus.

In order to decrease sexually transmitted cases of HIV, prevention programs need to incorporate messages about continual condom use, the dangers of multiple sexual partners, as well as educate the public about safe sex practices, since sexual transmission is the main HIV transmission method in South Africa (Zuma, K. et al., 2016). Past studies proved that offering comprehensive sex education in South African school systems led to decreased rates of sexually

transmitted infections (AVERT, 2018). This suggests that providing the public with HIV education has the potential to decrease transmission, especially among the target youth population.

Intervention

Testing and counseling centers

HIV Counseling and Testing (HCT), also referred to as Voluntary Counseling and Testing (VCT) is crucial in providing HIV positive individuals with the healthcare services and treatment that they need to move forward. HCT has important benefits as an initial point of care for individuals living with HIV. HCT has also been proven to increase openness and reduce stigma associated with HIV, which has been a barrier to access for many individuals (Matovu, J.K., 2011).

More specifically, mobile HCT, or mobile HIV testing units, have the potential to improve the lack of access issues that South Africa is facing. Mobile HIV testing units bring the services to the people, making them more accessible. Mobile HIV testing units can increase access to and use of HCT in hard to reach areas and among hard to reach populations, especially among first time testers (Motovu, J.K., 2011). Additionally, compared to public facility clinics, mobile units have shorter wait times and higher patient satisfaction scores (Meehan, S.A. et al., 2017). These are both essential elements in making sure that individuals utilize HIV testing services to know their status.

Chapter Three: Methodology

This systematic review was aimed to address the hypothesis that mobile HIV testing and counseling units have the potential to decrease rates of HIV in South Africa by increasing access to testing, treatment, and HIV education. The research questions that this search was aimed to address include:

Can mobile HIV testing units increase access to HIV treatment and education?

Can these mobile units decrease rates of HIV in South Africa?

Is the implementation of these units cost effective?

To be included in this review, articles had to pass the following criteria: articles had to be written in the English language, based on work in South Africa, published between 2000 and 2018, and had to be directly related to mobile HIV testing units, including the outcomes of those interventions.

For the review, an internet-based search of four comprehensive databases was conducted in order to identify relevant peer-reviewed literature about mobile HIV testing units in South Africa. The initial search yielded 87 results which included the databases PubMed (n= 21), CINAHL (n= 43), SCOPUS (n= 20) and psycINFO (n= 3) and used the search terms "mobile HIV testing units," "mobile HIV testing and counseling units," "mobile HCT," and "South Africa". A secondary review of these results exposed duplicated articles (n=22) between the databases, so the sample was reduced to 65 different articles. Next, the articles were reviewed again to see if they would pass the inclusion criteria. A total of 33 articles did not pass this review, (n= 11) because they did not study South Africa, and (n= 22) because they did not study

mobile HIV testing units. The remaining articles (n=22) were then read through to determine whether they would fully pass the inclusion criteria. A total of 12 articles did not pass this final review, (n=12) because they did not focus on South Africa. This literature search process yielded (n = 10) total articles to be studied.

This search process utilized can be viewed in Figure 1, and the final results with inclusion criteria can be viewed in Table 1.

Figure 1. Literature Search Process

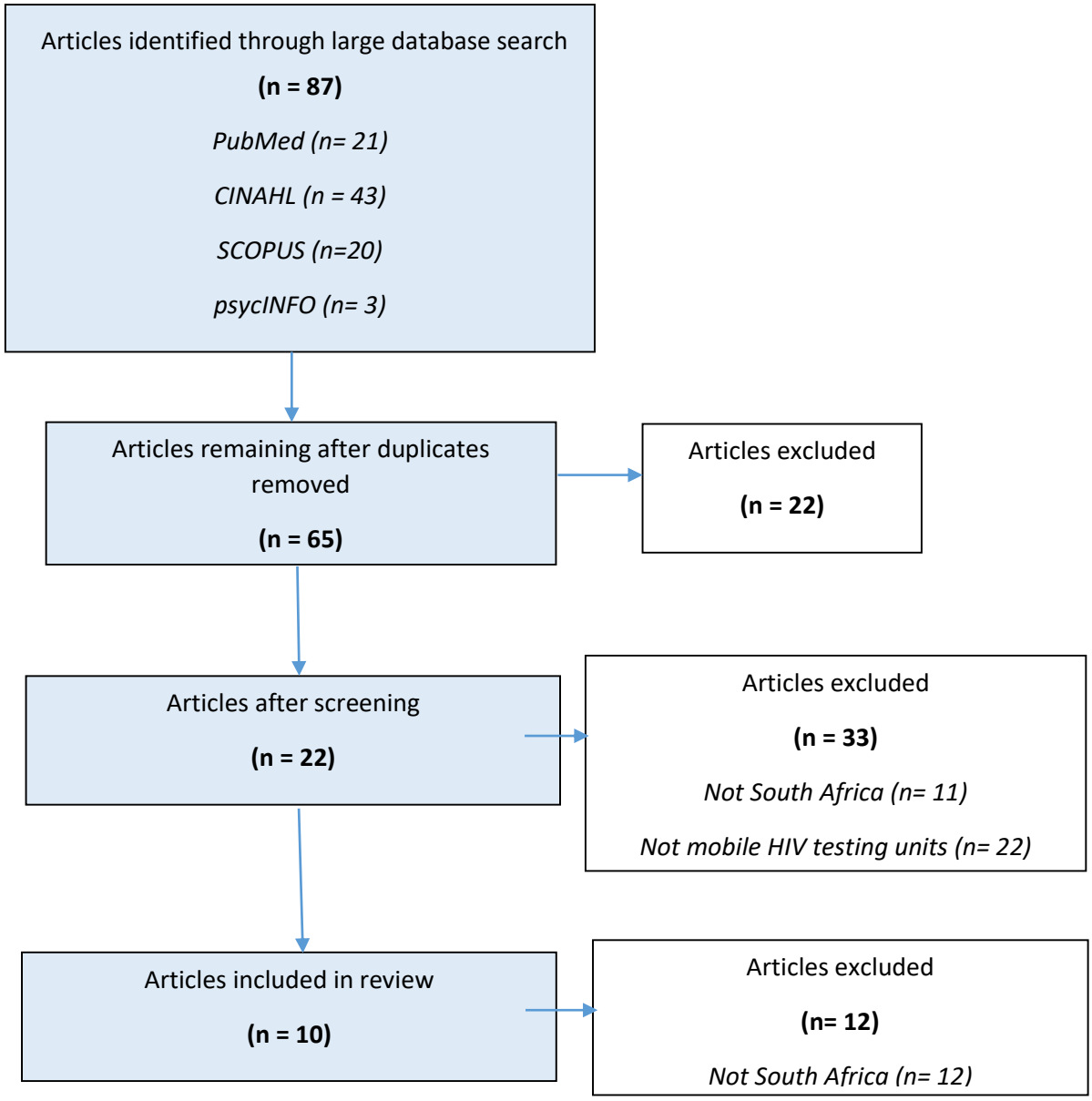

Table 1. Systematic Review Results

PUBMED:						
	Author, Year	**English language**	**South Africa**	**2000-2018**	**Mobile HIV Testing Units**	**Outcomes**
	Schaik, N.V. et al., 2010	yes	yes	2010	yes	yes
	Larson, B.A. et al., 2012	yes	yes	2012	yes	yes
	Maheswaran, H., et al., 2012	yes	yes	2012	yes	yes
	Bassett I.V., et al., 2013	yes	yes	2013	yes	yes
	Govindasamy, D., et al., 2013	yes	yes	2013	yes	yes
	Bassett, I.V. et al., 2014	yes	yes	2014	yes	yes
	Mabuto, T., et al., 2014	yes	yes	2014	yes	yes
	Meehan, S. et al., 2014	yes	yes	2014	yes	yes
	Bassett, I.V. et al., 2015	yes	yes	2015	yes	yes
CINAHL:						
	Rooyen, H. V, et al., 2012	yes	yes	2012	yes	yes

Chapter Four: Results

As a result of the literature search process, 10 full-length articles satisfied all of the eligibility criteria. Table 2 summarizes the articles studied, including authors, publication year, population studied, intervention modality, methods, statistical analyses, and outcomes. The studies are arranged alphabetically by the last name of the first author.

The most common analyses employed were the Chi-Square test, which was used in 5 studies, and the Wilcoxon Rank Sum, which was used in 3 studies. Other analyses used in these studies include Kruskal-Wallis, Logistic Regression, CEPAC-I, ICER, the Poisson Approach, STATA, Fisher Exact Test, and the Clopper Pearson Method.

In terms of outcomes in the 10 articles reviewed, more than half (n= 6) found that mobile testing units reached a higher proportion of male testers, as well as a higher proportion of young adult testers, which are both considered hard to reach populations (Basset, I.V. et al., 2015, Meehan, S., et al., 2014, Mabuto, T., et al., 2014, Bassett, I.V. et al., 2013, Schaik, N.V. et al., 2010, Rooyen, H.V., et al., 2012). Several articles (n= 3) found that mobile testers were also more likely to be first time testers (Mabuto, T. et al., 2014, Maheswaran, H. et al., 2012, Rooyen, H.V. et al., 2012). Additionally, a couple of articles (n= 2) found that those that tested HIV positive at mobile units were more likely to be at an earlier stage of the disease than at nonmobile clinics (Basset, I.V. et al., 2015, Schaik, N.V. et al., 2010).

Table 2. A Summary of Mobile HIV Testing Units in South Africa, 2000 to 2018 (N=10)

Authors, Year	Population	Intervention Modality	Methods	Statistical Analyses	Outcomes
Schaik, N.V. et al., 2010	Clients older than 15 years old that visited the TuTu Tester mobile HIV testing unit, a primary health care clinic, or a district level hospital in Cape Town	Mobile HIV testing unit, primary health care clinic, and district level hospital	-Compared data from 3 HIV testing services in Cape Town -Mobile HIV testing was provided by Tutu Tester, facility-based data were collected from the HCT registers at a primary health care clinic and a district level hospital -Data on age, sex, HIV status and CD4 counts were collected between August and December 2008.	-Statistical analysis used STATA -Proportions were calculated according to services -Chi-Square tests were used to investigate differences in proportions. -Logistic regression model used to calculate HIV risk in the different services, adjusted for age and sex	-Mobile service tested a significantly higher proportion of men (51.5%) compared with stationary services (40.2% and 39.6% respectively). -Lab CD4 results were available for 44.2% of the HIV-positive individuals at the mobile service, 65.3% at the primary health care clinic, and 42.6% at the hospital -Over 75% of HIV-infected individuals at the mobile service had a CD4 count >350 cells/µl, compared with 48.1% at the clinic and 32.0% at the hospital
Larson, B. et al., 2012	-All adult patients diagnosed with HIV by Access VCT between May and November 2010.	Mobile HCT program	-Study used data generated by a pilot project implemented by Right to Care, a South African non-profit organization -During pilot project, all those diagnosed with HIV were called by an ACCESS VCT counselor eight weeks after their HIV test	-Analyzed data using STATA -Relative risks of successful follow up were estimated using the modified Poisson approach, with testing group, gender, tested previously for	-508 adult patients were diagnosed with HIV in the mobile program during pilot period -Median age was 33 years -59.6% were women -39.9% reported having tested previously for HIV. -No differences in successful contact between the testing groups or by age/previous HIV testing experience

Authors, Year	Population	Intervention Modality	Methods	Statistical Analyses	Outcomes
			-Patients were asked if they had completed their referral visit to a clinic. -Each patient was called up to three times, on different days and times of day. -A retrospective review of program records was completed in late February 2011 -Data collected included date of HCT, age, sex, previous HIV test(s), whether or not a CD4 test was offered and accepted, CD4 count result (if accessible), and self-reported completion of referral visit, based on follow up phone call.	HIV, and age as covariates.	-Women were more likely to be contacted than men -For the 197 patients offered the CD4 test who were successfully followed up by phone, 117 (59.4%) reported completing their referral visit within 8 weeks of HIV testing -These findings suggest that integration of POC CD4 testing into mobile HCT programs can increase the proportion of patients who accept the referral provided and make at least one visit to an HIV clinic
Maheswaran, H. et al., 2012	Community members in Hlabisa subdistrict, KwaZulu-Natal	Home-based and Mobile HIV testing services	-Home and mobile testing service started February 2009 -Area was divided along traditional boundaries into smaller units using a geographical information	-HIV prevalence rates and 95% confidence interval were calculated across baseline characteristics -Data evaluated for significant	-Greater proportion of participants proceeded to HIV testing with mobile (96.6%) than home testing (91.8%) -Overall numbers of clients tested each day were higher in the home testing service (15.1 vs. 13.7) -Women were a greater

Authors, Year	Population	Intervention Modality	Methods	Statistical Analyses	Outcomes
			system -Units of approximately equal population size/density were visited by either the home or mobile testing unit for a period of 2–20 days. -Surveys recorded participant's demographic details, area where service was offered, subsequent uptake and outcome of HCT, and past use of HIV testing services.	differences between the 2 services. -Fisher exact test was used to test for significant differences.	proportion of clients tested in both services -Men were a higher proportion of testers at mobile sites (40.8%) than home services (30.1%) -Mobile service tested a greater proportion of clients who were single (65.9% vs. 49.9%) and who had never previously had a HIV test (62.0% vs. 55.3%) -No significant differences in HIV prevalence by gender, age, marital, or employment status.
Rooyen, H.V. et al., 2012	-Individuals 16 years of age and older who were in the vicinity of the mobile unit and agreed to participate	Mobile HCT	-Pilot studies were conducted between April and September 2005 in Soweto, SA and KwaZulu-Natal, SA -A mobile caravan with laboratory and counselling spaces was set up at visible, convenient community venues (markets, churches, community and shopping centers, and transportation hubs)	-Compared age distribution with a Wilcoxon rank sum test -Chi-Square tests used for categorical variables -Binomial confidence intervals calculated with Clopper Pearson Method for HIV	-Men were more likely than women to be first time testers at both sites -At both sites young testers (less than 20 years old) were more likely to be first time testers compared to older testers -At both sites, patient satisfaction with Mobile HCT was extremely high (all the rural participants feeling 100% comfortable and satisfied with service) -Urban clients were 100% comfortable and completely satisfied

Authors, Year	Population	Intervention Modality	Methods	Statistical Analyses	Outcomes
			-Rapid (same day) HIV testing was conducted using a parallel rapid testing algorithm -After post-test counselling, participants were invited to complete a client exit survey, if they were emotionally capable	prevalence estimates	(97%) with the mobile HCT service. -In exit interview, most participants mentioned convenience and accessibility of mobile services in both settings
Basset, I.V. et al., 2013	-Adults (15 and older) presenting for HIV testing at Ithembalabantu's mobile HIV testing unit and IPHC (clinic)	Mobile HIV testing unit and IPHC clinic	-Compared testers between July 2011 and November 2011 in the mobile unit and the clinic with respect to demographic data, presenting CD4 count, and linkage to HIV care	-Used Chi-Square tests for categorical data and Wilcoxon rank-sum tests for continuous variables. -Compared the proportion of mobile and clinic testers who linked to care using Chi-Squared tests.	-Mobile testers had lower HIV prevalence than clinic testers (10% versus 36%), -Mobile testers were younger than clinic testers (23 versus 27 years) -Mobile testers were more likely than clinic testers to live >5 km or >30 minutes from the clinic (64% versus 40%) -Of those who tested HIV positive, 10% of mobile testers linked to care, versus 72% of clinic testers -Clients tested at the mobile unit were more likely to be male than clinic testers (46% versus 43%)

Authors, Year	Population	Intervention Modality	Methods	Statistical Analyses	Outcomes
Govindasamy, D. et al., 2013	Newly diagnosed individuals older than 18 at a mobile testing unit within the South African Cape Metropolitan region, with either HIV, TB symptoms, diabetes, and/or hypertension	Mobile screening unit	-An observational cohort study was conducted between January and November 2011 -Used a mixed study design -The first component used a retrospective analysis of clinical records to identify new diagnoses -Generate a list of clients newly-diagnosed with HIV and TB symptoms, diabetes and/or hypertension at the mobile unit between March 2010 and September 2011.	-Analyses were conducted using STATA	-In HIV-infected cohort: -The majority of clients were female (63.9%) -Mean age was 34.1 years -Mean CD4 count was 481 cells/µl -At follow-up, the majority of clients were in a relationship (73.8%) and 53.8% were unemployed -Participants reported the following as the main reasons for failing to link to HIV care: lost referral letter (18.8%), insufficient time during the day to attend a clinic (15.6%) or relocated (12.5%)
Bassett, I.V. et al., 2014	Mobile HIV testing unit deployed in Cape Town, South Africa	Medical-facility based testing and mobile HIV testing units	-The Cost-Effectiveness of Preventing AIDS Complications International (CEPAC-I) model, evaluated the clinical and economic value of adding a mobile HIV testing unit -Included point-of-care CD4 count testing to current medical facility-based HIV testing in Cape Town	-Cost Effectiveness of Preventing AIDS Complications International (CEPAC-I) computer simulation model evaluated two HIV screening strategies in Cape Town -Determined cost-effectiveness	-Adding a mobile unit intervention increased life expectancy by .5 months to 250.4 months in the overall population and by 8.5 months to 140.7 months for HIV-infected individuals. -Adding a mobile unit intervention to current medical facility-based testing increased the discounted average per-person lifetime costs from $3,970 to $4,070 -Incremental cost-effectiveness ratio of

Authors, Year	Population	Intervention Modality	Methods	Statistical Analyses	Outcomes
			-Reported all outcomes used to inform resource allocation decisions on a present-value basis using a 3% discount rate -The Screening Model determined whether/when HIV-infected individuals are diagnosed and link to care -The Disease Model assessed each simulated patient's clinical progression and treatment	using the mobile unit's incremental cost-effectiveness ratio (ICER) in comparison to South Africa's annual per capita GDP	$2,400/year of life saved (YLS) for the mobile unit intervention compared to medical facility-based testing. -For 18,870 people projected to be evaluated by the mobile unit over 2 years, the total undiscounted HIV-related costs over the 2 years increased $900,000 (from $1.5 million to $2.4 million), -Proportion of HIV-infected people alive in care increased from 53% to 59% and the proportion with suppressed viral loads increased from 35% to 39%. This increase would result in many lives saved -This ICER ($2,400/YLS) is significantly less than the annual per capita GDP of South Africa, so mobile units are considered very cost-effective -Mobile unit remained very cost-effective even if targeted to the lowest prevalence of undiagnosed HIV area in South Africa (Western Cape), as long as linkage to care probabilities were greater than 30%.
Mabuto, T. et al., 2014	Clients were at least 15 years old and had a	Clinic-based, rural mobile, urban mobile, and stand-	-Conducted a cross-sectional study using programmatic	-Used the Pearson's Chi-square or Kruskal-Wallis	-Proportion of men that tested was slightly higher in the urban mobile HCT units (52%) compared to

Authors, Year	Population	Intervention Modality	Methods	Statistical Analyses	Outcomes
	recorded HIV-test result.	alone HCT services	data among clients receiving HCT through three delivery models between January 1, 2009 and June 30, 2012. -Data included socio-demographics, HIV testing history, HIV test results, responses to a four-symptom TB screen (cough, fever, weight-loss, night sweats) and the testing modality	tests to compare client characteristics by testing model. -Logistic regression was performed to analyze associations between a new HIV diagnosis and HCT model, perceived HIV risk, sex, and TB symptoms	the clinic based (46%) and stand-alone (50%) -Proportion with prior HIV testing varied between 63% for the mobile units to 72% for the stand-alone fixed unit -Proportion with perceived HIV risk ranged from 50% for clients of the mobile units to 73% among those accessing the fixed stand-alone testing -Rural mobile HCT reached the greatest proportion of first-time HIV testers (61%) and the greatest proportion of clients who did not perceive themselves to be at risk for HIV (64%) -Urban (63.7%) and rural (51.8%) mobile units had a higher proportion of first-time testers who did not perceive themselves to be at risk of HIV compared to fixed clinic based (47.3%) and stand-alone units (25.1%)
Meehan, S. et al., 2014	-Adult clients (18 or older) who self-initiated for an HIV test at either a mobile or clinic service	Mobile HCT and clinic HCT	-A matched design was used with one mobile HCT service matched with one or more clinics within each of the eight areas around Cape Town.	-Summary statistics were calculated for each service type within a matched pair - Differences of outcomes from pairs were used to	-Proportion of males accessing mobile HCT exceeded that of clinic HCT -Mean age of participants attending mobile HCT was older than clinic participants -Participants who accessed mobile HCT

Authors, Year	Population	Intervention Modality	Methods	Statistical Analyses	Outcomes
			-Data collected between February and April 2011 using a survey. -Survey collected data on demographic and socioeconomic variables, and reasons for accessing certain health providers.	calculate effect sizes and 95% confidence intervals.	were more likely to report that they were just passing, deemed an "opportunistic" visit
Bassett, I.V. et al., 2015	-Adults (older than 15) who self-presented for testing at the mobile HIV testing units and at iThembalabantu HIV clinic, between July and November 2011	Mobile community-based testing and clinic-based testing	-Testers offered HIV pre-test counseling and responded to an oral survey, which included health and demographic information -Participants underwent rapid HIV testing -Results were available to tester within 25 minutes -Patients diagnosed with HIV were offered phlebotomy for CD4 count testing and were asked to retrieve their CD4 count results at iThembalabantu Clinic two weeks later -Mobile testing sites have a ''high'' newly diagnosed rate if the rate at that	-Compared demographics, HIV prevalence, and distance traveled for mobile unit and clinic testers using Chi Squared test (categorical data) and Wilcoxon rank-sum test (continuous variables)	TESTERS -Greater proportion of mobile testers (47%) were male compared to IPHC testers (43%) -Mobile testers were significantly younger than IPHC testers (mean age 28 vs. 32 years) -HIV infection rate was lower among mobile testers (10 %) compared to IPHC testers (35 %) -Among those infected with HIV, mobile testers were less likely to have a CD4 count done than those tested at IPHC (45% vs. 86 %), and to return to IPHC for the results (23% vs. 77 %) MOBILES SITES -Taxi stands at major transport junctions and commercial sites had highest HIV prevalence (17–26 %). -College residences had the lowest HIV prevalence (0–4 %)

Authors, Year	Population	Intervention Modality	Methods	Statistical Analyses	Outcomes
			site was greater than the overall newly diagnosed rate across all sites. -Mapped the geospatial distribution of the mobile sites, including tester demographics and HIV infection rates		DISTANCE -64% of mobile testers lived closer to their nearest clinic than to the mobile site where they were tested. -Statistically significant difference in median distance between HIV-infected and HIV-negative patients' home and their chosen testing site (2.7 km vs. 2.3 km)

Chapter Five: Discussion of Results

The goal of this study was to look at studies published between 2000 and 2018 and analyze whether mobile HIV testing units could improve access to HIV testing and treatment, improve access to HIV education, whether these units are cost effective, and ultimately decrease emerging rates of HIV in South Africa.

Access to treatment/testing

The first question this systematic review addressed was: "do mobile HIV testing units have the potential to increase access to HIV testing and treatment?" From the 10 articles studied, (n= 5) agreed that mobile testing units are effective in attracting statistically hard to reach populations, such as men and young adults (Basset, I.V. et al., 2015, Bassett, I.V. et al., 2013, Maheswaran, H. et al., 2012, Schaik, N.V. et al., 2010, Rooyen, H.V. et al., 2012).Young adults have a high HIV prevalence, and HIV prevalence increases substantially with age (Basset, I.V. et al., 2015). Encouraging young adults to get tested while they're still young has the potential to influence safer practices as well as earlier diagnoses/intervention before the disease progresses too far. According to the articles reviewed, men are less likely than women to get tested for HIV in clinics, but this could be due to a multitude of factors, including (but not limited to) the stigma surrounding a positive HIV diagnosis, the accessibility of clinics/the ability to get to a clinic, and lack of time to schedule getting to a clinic (Basset, I.V. et al., 2015, Bassett, I.V. et al., 2013, Maheswaran, H. et al., 2012, Schaik, N.V. et al., 2010, Rooyen, H.V. et al., 2012). Mobile HIV testing units were successful in attracting men by offering services in areas that men typically frequent, such as train stations, taxi and other transportation hubs (Meehan, S. et al., 2014). These mobile services are seen by the patients as "opportunistic," as many of these clients would not have sought out HCT otherwise (Meehan, S. et al., 2014). An opportunistic service refers to a

service that clients would not actively seek out but utilize when it is convenient for them – such as if that service is located near or on their way to their job or school (Meehan, S. et al., 2014).

From the 10 articles studied, (n = 3) found that mobile testers were more likely to be first time testers (Mabuto, T. et al., 2014, Maheswaran, H. et al., 2012, Rooyen, H.V. et al., 2012). This is significant because, when looked at with the finding that mobile testers typically lived under 5 kilometers from the mobile clinic, it shows that distance is a major barrier to clinic-based testing (Bassett, I.V. et al., 2013). Therefore, mobile HIV testing units can increase access to testing services.

However, though mobile HIV testing units increase access to testing, particularly for hard to reach populations, that does not necessarily mean that they increase access to treatment post-diagnosis. A couple of articles (n= 2) pointed out that mobile services still have not found effective ways to link patients to care after they leave their unit (Larson, B.A. et al., 2012, Govindasamy, D. et al., 2013). A high proportion of mobile testers don't complete CD4 counts or enroll in HIV treatment programs (Larson, B.A. et al., 2012). This is not because testers are not willing – when offered a rapid CD4 test in mobile setting, 90% of patients chose to take the test (Larson, B.A. et al., 2012). Since linkage to care after a diagnosis is a struggle that mobile testing units face, it was suggested that these mobile units partner or link with community health workers, similar to case managers, to support patients in their entry to care and through the treatment process (Govindasamy, D. et al., 2013).

Consistent with previous studies, these results suggest that bringing services to community members via mobile HIV testing units is important, as people will take advantage of the opportunity to get tested if the services are easily accessible (Johnson, L., 2015, Motovu, J.K., 2011, Basset, I.V. et al., 2015, Bassett, I.V. et al., 2013, Maheswaran, H. et al., 2012, Schaik, N.V.

et al., 2010, Rooyen, H.V. et al., 2012). These results also suggest that mobile testing units need to do more in order to support patients through their HIV diagnoses, to ensure that they have access to the treatment they need after they are diagnosed.

My recommendation moving forward would be to conduct a study in South Africa that examines ways to better link patients to ART after they are diagnosed at a mobile HIV testing unit, as this seemed to be one of the major flaws in mobile HIV testing units.

Access to education

The second question this systematic review addressed was: "do mobile HIV testing units have the potential to increase access to HIV education?" From the 10 articles reviewed, only 1 study (n= 1) addressed this point. Since the majority of mobile HIV testing patients were younger than 25 years old, and two-thirds were unmarried, it was suggested that mobile testing units should provide patients with additional sexual health information and best practices, in order to have mobile units double as an effective prevention strategy (Maheswaran, H. et al., 2012). Since people younger than 25 years old account for 41% of new HIV infections (Maheswaran, H. et al., 2012), it is imperative that they have access to the correct information about the disease, its transmission, as well as safe sex practices.

Consistent with previous studies, this result suggests that mobile HIV testing units should combine access to testing services with access to education about sexual health information, particularly to younger, single adults (AVERT, 2018, Maheswaran, H. et al., 2012). This will make mobile HIV units a form of primary as well as secondary prevention.

My recommendation for future studies would be to conduct studies that focus on the educational component of mobile HIV testing units, measuring the effects that providing information has on patients. Some potential outcome measures can include whether this new

information has the ability to change patient's behaviors, as well as whether patients retain the information they are given at the units.

Cost-effectiveness

The third question this systematic review addressed was: "are mobile HIV testing units cost-effective to implement?" From the 10 articles reviewed, only 1 study (n= 1) addressed this point. Though mobile HIV testing units were perceived to be very cost-effective by the international standards studied, this does not necessarily make them affordable (Basset, I.V. et al., 2014). Start-up costs for a mobile HIV unit can be upwards of $600,000, with additional hundreds of thousands of dollars per year spent on supplementary care costs (Basset, I.V. et al., 2014). However, since mobile HIV units are considered very cost-effective and were proven to increase life expectancy for HIV diagnosed individuals, they can be deemed affordable in geographic areas with high HIV prevalence and that have access to resources similar to Cape Town (Basset, I.V. et al., 2014).

Another important observation about mobile HIV testing units was that there are several different approaches to how they are set up and implemented, which means they are flexible to the financial and physical needs of the communities they serve (Basset, I.V. et al., 2014).

This result suggests that mobile HIV testing units are very cost-effective and worthwhile to implement for geographic areas that have high rates of HIV and that are similarly resourced to Cape Town, but cost-effectiveness does not reflect affordability. Consistent with previous literature, South Africa is a country that has the resources available to treat all of those in need (Pao, M., 2006, Coovadia, H. et al., 2009, Basset, I.V. et al., 2014)

My recommendation for future studies would be to examine the different levels of cost-effectiveness in regards to mobile HIV testing units, to examine how flexible the units can be in areas with less financial resources and different community needs than South Africa.

Summary

This study found that mobile HIV testing units are an important intervention method. The study found that mobile HIV units were successful at increasing access to testing services, especially for hard-to-reach and at-risk populations, such as men, young adults, and first-time testers. This study also found that mobile HIV units can potentially increase access to treatment post-diagnosis as well as access to HIV education. In order to do so, the current mobile units need to modified. Additionally, mobile units were found to be cost-effective in South Africa, though that may not necessarily be true for other, poorly resourced countries. The literature reviewed did not specifically address mobile HIV unit's ability to decrease rates of HIV, because none of the studies directly measured HIV prevalence before and after the mobile units were implemented.

There are a number of important limitations to this study. For one, this study was limited to the literature that already exists, and secondly, this research was conducted from the United States, not in South Africa. Both these limitations mean that there was no direct interaction with study participants.

For future researchers concerned with mobile HIV units and linkage to care, I recommend conducting a study that provides mobile units with the proper resources to at least initially be able to treat HIV-positive patients. For future researchers concerned with mobile HIV units and HIV education, I recommend conducting a study that measures individual's behavior before and after utilizing a mobile HIV unit, to examine whether providing HIV education at

mobile units is worthwhile. Additionally, I recommend developing standardized pre and post tests that directly measure HIV prevalence in the community where mobile HIV units are placed. This will help researchers determine whether or not mobile HIV units are effective at decreasing rates of HIV.

Appendix

Definition of terms:

ART – Antiretroviral Therapy

ARV – Antiretroviral drug

CD4 count - A lab test that measures the number of CD4 T lymphocytes in one's blood

HCT - HIV Counseling and Testing

HIV - Human Immunodeficiency Virus

TB - Tuberculosis

VCT - Voluntary Counseling and Testing

References

AVERT. (2018, March 26). HIV and AIDS in South Africa. Retrieved April 03, 2018, from https://www.avert.org/professionals/hiv-around-world/sub-saharan-africa/south-africa

Bassett, I. V., Govindasamy, D., Erlwanger, A. S., Hyle, E. P., Kranzer, K., Schaik, N. V., . . . Freedberg, K. A. (2014). Mobile HIV Screening in Cape Town, South Africa: Clinical Impact, Cost and Cost-Effectiveness. *PLoS ONE*, 9(1). doi:10.1371/journal.pone.0085197

Bassett, I. V., Regan, S., Mbonambi, H., Blossom, J., Bogan, S., Bearnot, B., . . . Losina, E. (2015). Finding HIV in Hard to Reach Populations: Mobile HIV Testing and Geospatial Mapping in Umlazi Township, Durban, South Africa. *AIDS and Behavior*, 19(10), 1888-1895. doi:10.1007/s10461-015-1012-3

Bassett, I. V., Regan, S., Luthuli, P., Mbonambi, H., Bearnot, B., Pendleton, A., . . . Mhlongo, B. (2013). Linkage to care following community-based mobile HIV testing compared with clinic-based testing in Umlazi Township, Durban, South Africa. *HIV Medicine*, 15(6), 367-372. doi:10.1111/hiv.12115

Benatar, S. R. (2004). Health Care Reform and the Crisis of HIV and AIDS in South Africa. *New England Journal of Medicine*, 351(1), 81-92. doi:10.1056/nejmhpr033471

Brand South Africa. (2012, July 2). Health care in South Africa. Retrieved April 03, 2018, from https://www.brandsouthafrica.com/south-africa-fast-facts/health-facts/health-care-in-south-africa

CDC. (2018, March 16). HIV/AIDS. Retrieved April 3, 2018, from https://www.cdc.gov/hiv/basics/transmission.html

Coovadia, H., Jewkes, R., Barron, P., Sanders, D., & Mcintyre, D. (2009). The health and health system of South Africa: Historical roots of current public health challenges. *The Lancet*, 374(9692), 817-834. doi:10.1016/s0140-6736(09)60951-x

Govindasamy, D., Kranzer, K., Schaik, N. V., Noubary, F., Wood, R., Walensky, R. P., . . . Bekker, L. (2013). Linkage to HIV, TB and Non-Communicable Disease Care from a Mobile Testing Unit in Cape Town, South Africa. *PLoS ONE*, 8(11). doi:10.1371/journal.pone.0080017

Groenewald, Y. (2017, June 09). South Africa last in healthcare efficiency study. Retrieved April 03, 2018, from https://www.fin24.com/Economy/south-africa-last-in-healthcare-efficiency-study-20170609

Johnson, L. (2015, September 15). HIV testing in South Africa: Successes and challenges. Retrieved April 03, 2018, from http://sacemaquarterly.com/hiv-prevention/hiv-testing-in-south-africa-successes-and-challenges.html

Larson, B. A., Schnippel, K., Ndibongo, B., Xulu, T., Brennan, A., Long, L., . . . Rosen, S. (2012). Rapid Point-of-Care CD4 Testing at Mobile HIV Testing Sites to Increase Linkage to Care. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 61(2). doi:10.1097/qai.0b013e31825eec60

Mabuto, T., Latka, M. H., Kuwane, B., Churchyard, G. J., Charalambous, S., & Hoffmann, C. J. (2014). Four Models of HIV Counseling and Testing: Utilization and Test Results in South Africa. *PLoS ONE*, 9(7). doi:10.1371/journal.pone.0102267

Maheswaran, H., Thulare, H., Stanistreet, D., Tanser, F., & Newell, M. (2012). Starting a Home and Mobile HIV Testing Service in a Rural Area of South Africa. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 59(3). doi:10.1097/qai.0b013e3182414ed7

Mahlathi, P., Dlamini, J. (2015). South Africa's health system. Retrieved April 03, 2018, from http://www.who.int/workforcealliance/031616south_africa_case_studiesweb.pdf

Matovu, J. K. (2011). HIV counselling and testing on the move. *The Lancet Infectious Diseases*, 11(7), 492-493. doi:10.1016/s1473-3099(11)70072-x

Mayosi, B. M., & Benatar, S. R. (2014). Health and Health Care in South Africa — 20 Years after Mandela. *New England Journal of Medicine*, 371(14), 1344-1353. doi:10.1056/nejmsr1405012

Mayosi, B. M., Lawn, J. E., Niekerk, A. V., Bradshaw, D., Karim, S. S., & Coovadia, H. M. (2012). Health in South Africa: Changes and challenges since 2009. *The Lancet*, 380(9858), 2029-2043. doi:10.1016/s0140-6736(12)61814-5

Meehan, S., Naidoo, P., Claassens, M. M., Lombard, C., & Beyers, N. (2014). Characteristics of clients who access mobile compared to clinic HIV counselling and testing services: A matched study from Cape Town, South Africa. *BMC Health Services Research*, 14(1). doi:10.1186/s12913-014-0658-2

Meehan, S., Rossouw, L., Sloot, R., Burger, R., & Beyers, N. (2017). Access to human immunodeficiency virus testing services in Cape Town, South Africa: A user perspective. *Public Health Action*, 7(4), 251-257. doi:10.5588/pha.17.0052

Pao, M. (2006, April 19). Q&A: Access to HIV/AIDS Care in South Africa. Retrieved April 3, 2018, from https://www.npr.org/templates/story/story.php?storyId=5349660

Potts, D. (2008). The urban informal sector in sub-Saharan Africa: From bad to good (and back again?). *Development Southern Africa*, 25(2), 151-167. doi:10.1080/03768350802090527

Rooyen, H. V., Mcgrath, N., Chirowodza, A., Joseph, P., Fiamma, A., Gray, G., . . . Coates, T. (2012). Mobile VCT: Reaching Men and Young People in Urban and Rural South African Pilot Studies (NIMH Project Accept, HPTN 043). *AIDS and Behavior*, 17(9), 2946-2953. doi:10.1007/s10461-012-0368-x

Schaik, N. V., Kranzer, K., Wood, R., & Bekker, L. (2010). Earlier HIV diagnosis - are mobile services the answer? *South African Medical Journal*, 100(10), 671. doi:10.7196/samj.4162

Udjo, E. O. (2006). Demographic Impact of HIV/AIDS on the Young and Elderly Populations in South Africa. *Journal of Intergenerational Relationships*, 4(2), 23-41. doi:10.1300/j194v04n02_03

UNAIDS. (2018, January 12). South Africa. Retrieved April 03, 2018, from http://www.unaids.org/en/regionscountries/countries/southafrica

WHO (2015). South Africa's health system. Retrieved April 3, 2018, from http://www.who.int/workforcealliance/031616south_africa_case_studiesweb.pdf

WHO. (2017a). South Africa HIV country profile: 2016. Retrieved April 03, 2018, from http://www.who.int/hiv/data/Country_profile_South_Africa.pdf?ua=1

WHO. (2017b, November 24). South Africa statistics summary (2002-present). Retrieved April 03, 2018, from http://apps.who.int/gho/data/node.country.country-ZAF

WHO. (2017c, November). HIV/AIDS. Retrieved April 09, 2018, from http://www.who.int/mediacentre/factsheets/fs360/en/

Wood, E. M., Zani, B., Esterhuizen, T. M., & Young, T. (2018). Nurse led home-based care for people with HIV/AIDS. *BMC Health Services Research*, 18(1). doi:10.1186/s12913-018-3002-4

Zuma, K., Shisana, O., Rehle, T. M., Simbayi, L. C., Jooste, S., Zungu, N., . . . Abdullah, F. (2016). New insights into HIV epidemic in South Africa: Key findings from the National HIV Prevalence, Incidence and Behaviour Survey, 2012. *African Journal of AIDS Research*, 15(1), 67-75. doi:10.2989/16085906.2016.1153491