

The Impact of HIV/AIDS in Georgia, USA

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Abstract: Georgia is known as the “Peach State” and is located in the Southern Region of the United States. Of the southern states, Georgia has the highest rate of HIV/AIDS cases, 24.9 per 100,000 people. There the rate for males is more than double the amount for females. My research will show the impact HIV has had on Georgia in the last five years. I will show some comparisons from 2013 to 2017 and predict an estimate number of HIV cases from 2018 to 2024. I will be looking at solutions that were made to determine whether or not those solutions were effective. I will create better and effective solutions based on the numbers for the next five years and show how the rate of HIV in Georgia can decrease.

1 Introduction to HIV/AIDS

The study and speculation about Human Immunodeficiency Virus (HIV) has been going on for decades. Through considerable research, scientists have put the pieces together that trace the Human Immunodeficiency Virus back to monkeys in Africa: the red-capped mangabeys and mustached guenons, which were hunted by chimpanzees. “Different viruses were passed from these monkeys to the chimpanzees that ate them” [5]. People in Western Africa would contract HIV (also known as Simian Immunodeficiency Virus, or SIV) from contact with blood from infected animals, or from eating chimpanzee meat.

After diseases of the heart and lungs, HIV/AIDS is the leading cause of death. HIV stands for Human Immunodeficiency Virus, and is also known as the virus that causes AIDS, the Acquired ImmunoDeficiency Syndrome. Unlike other colds, diseases, and viruses, the body cannot get rid of HIV totally. Even if a person catches it at an early stage, no treatment will get rid of HIV. Once a person contracts HIV, they will have it their entire life. HIV can be carried in blood or blood transfusions, semen, fluids from the vagina, and breast milk. Immunodeficiency means the immune system does not work properly for the body. Consequently, HIV is the type of disease that attacks the immune system, typically attacking the CD4-cells or T-cells. CD4-cells help the immune system fight off infections, illnesses, and pathogens. When HIV is not treated, the number of CD4-cells in a person’s body gets lower. Over time, HIV destroys the T-cells that fight infections in the body. As a result, infections or cancers take advantage of the weak immune system, letting the person

know they are in the last stage of HIV infection, AIDS. Currently there is no cure for HIV/AIDS. However, with the proper care, this disease can be controlled.

People diagnosed with HIV may take up to 10 pills a day. There are many factors that determine how many pills a person must take, such as the severity of the case, how far the disease has spread, their T-cell count, and other chronic health conditions. Medicines include Integrase strand transfer inhibitors (INSTIs), Nucleoside reverse transcriptase inhibitors (NRTIs), Non-Nucleoside reverse transcriptase inhibitors (NNRTIs), Cytochrome P4503A Inhibitors (CYP3A), and Protease inhibitors (PIs). “Before the advent of highly active antiretroviral therapy (HAART), patients with HIV infection developed physical manifestations related to the viral infection and AIDS. Patients infected with HIV treated with HAART frequently develop body physical changes that have an important psychosocial burden” [1].

Contracting HIV affects the person mentally, physically and emotionally. Symptoms of HIV may appear within 5 months or even 5 years. Patients will develop changes such as “lean body mass with preservation, herpes simplex, oral candidiasis, hairy leukoplakia, molluscum contagiosum, and rare tumors such as Kaposi’s sarcoma” [1]. Lipodystrophy syndrome has been around for a long time. This disease will start to become recognizable when someone is treated with HAART. “This set of changes includes the loss of fat in peripheral areas (face, buttocks, arms and legs) and the gain of fat in central portions of the body (abdomen and neck)” [7]. Some patients may also have mental symptoms during the time of their sickness. “Differential diagnosis of major depression in HIV-infected patients is complicated because several symptoms including fatigue, sleep disturbance, and weight loss, are frequent symptoms of HIV disease” [6]. HIV has early and late stages. In the early stages signs of HIV may or may not show. A person may feel achy, sick, and feverish. These symptoms are flu-like, which may be the body’s first reaction to the disease. The late stage is when a person develops AIDS.

Someone can contract or transmit HIV in various ways. The most common way that HIV will spread is by “having anal or vaginal sex with someone who has HIV without using a condom” or “sharing needles or syringes, rinse water, or other equipment used to prepare drugs for injection with someone who has HIV” [3]. Rare ways of contracting HIV can be from mother to child (during pregnancy or breastfeeding) or being stuck with a contaminated needle or object. A person cannot get HIV by hugging, shaking hands, mosquitoes, ticks, or by breathing in air. HIV is only contracted or transmitted by certain body fluids that carry HIV including “blood, semen, pre-seminal fluid, rectal and vaginal fluids, and/or breast milk” [3]. The most dangerous way of contracting or transmitting HIV is anal sex. During anal sex, either partner is at risk of contracting HIV. However, the person receiving anal sex is at a higher risk. “The bottom’s risk is very high because the lining of the rectum is thin and may allow HIV to enter the body during anal sex” [3]. A less risky way of getting HIV is through vaginal sex. As with anal sex, either partner is capable of contracting HIV. “When women have vaginal sex with someone who is HIV-positive, the virus can enter her body through the mucous membranes that line the vagina and cervix” [3].

To prevent a person from becoming HIV-positive, they must make a conscious effort to make the right decision. There are many prevention programs and tools for people to take great advantage of. Therefore, a person cannot say they were not aware of how to prevent such action. Not only are there programs, but a person can prevent themselves from

contracting the disease. People can practice strategies such as: “abstinence, limiting the number of sexual partners, never sharing needles, and using condoms the right way every time you have sex” [3]. Two major prevention drugs that people are using to their advantage are pre-exposure prophylaxis (PrEP) and post-exposure prophylaxis (PEP). The difference between (PrEP) and (PEP) is that (PrEP) “is the administration of antiretroviral drugs to an uninfected person before potential HIV exposure to reduce the risk of infection and continued during risk” [4]. This antiretroviral drug can be administered by a gel being applied to the vagina or rectum or in the form of a pill. This drug is very useful because it prevents a person from contracting HIV. “So, the moment the virus enters the body, HIV replication is inhibited, and HIV is not able to establish permanent infection” [4]. A person should consider taking PrEP if they are having sexual intercourse with someone with HIV, if they are not using contraceptives, and if they are sharing needles, or syringes. For complete protection, PrEP is taken for 7 consecutive days for receptive anal sex. However, for receptive vaginal sex and injection drug use, PrEP is taken for 21 consecutive days for full protection. “Studies have shown that PrEP reduces the risk of getting HIV from sex by about 99% when taken daily. Among people who inject drugs, PrEP reduces the risk of getting HIV by at least 74% when taken daily” [3]. For post-sexual exposure, PEP is given to HIV- infected blood or potentially infectious bodily fluid patients. So, this prevention tool is for patients who are HIV-positive or people who may think they have contracted HIV from another person. PEP also “is a comprehensive management which includes first aid, counseling, risk assessment, relevant laboratory investigations based on informed consent of the source and exposed person” [4]. A patient can take PEP if they have been exposed to someone who is HIV-positive up to 72 hours after exposure; then the patient will have to take the drug for about 30 consecutive days.

2 Data and Mathematical Model

The most prominent, modern example of how the government, policies, and public health are intertwined is HIV/AIDS. The HIV/AIDS rate in Georgia continues to increase year by year. The increasing rates in Georgia solely belong to a certain group – young, black males who have sex with other males. Between 2013 and 2017, males have held the lead for the number of cases and new cases every year. The rate continues to increase yearly, as shown in Table 1 and Figure 1.

year	living with HIV/AIDS
2012	50,436
2013	51,510
2014	53,230
2015	54,754
2016	56,789
2017	58,808
2018	60,346

Table 1

Annual totals of people in GA living with HIV/AIDS 2012-2018

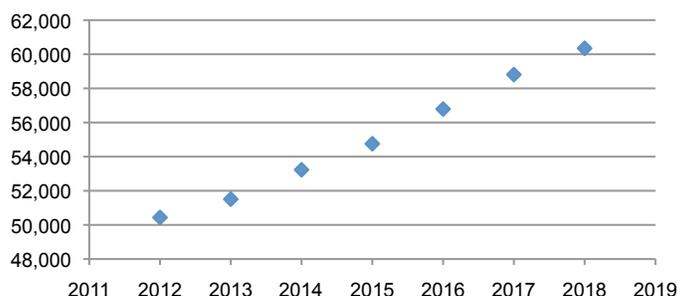


Figure 1. Annual data for people in Georgia, USA living with HIV/AIDS. [2]

We observe that the yearly increase is growing (ever so slightly), so we will make a model from the differential equation $y' = ky$, which has the exponential solution

$$y = Ce^{kt}.$$

In 2013, there were 51,510 cases (overall) of HIV/AIDS in Georgia. This number will be the initial point to determine the value of C in the exponential function. Then in 2014, a year later, the number of HIV/AIDS cases increased to 53,230 in Georgia. Therefore, the initial condition is identified: at $t = 0$, $y = 51,510$ and at the second point, $t = 1$, $y = 53,230$. We can now formulate the exponential function:

$$\begin{aligned} y &= Ce^{kt}, \quad t = 0, \quad y = 51,510 \\ \Rightarrow 51,510 &= Ce^{k(0)} = Ce^0 = C, \end{aligned}$$

and

$$\begin{aligned} y &= 51,510 e^{kt}, \quad t = 1, \quad y = 53,230 \\ \Rightarrow 53,230 &= 51,510 e^{k(1)} = 51,510 e^k \\ \Rightarrow \frac{53,230}{51,510} &= e^k \\ \Rightarrow \ln \left(\frac{53,230}{51,510} \right) &= \ln e^k \\ \Rightarrow \ln \left(\frac{53,230}{51,510} \right) &= \ln e^k = k \\ \Rightarrow k &= \ln \left(\frac{53,230}{51,510} \right) = 0.0328461836. \end{aligned}$$

Thus

$$y = 51,510e^{0.0328461836t}$$

Now we can graph predicted values, listed in Table 2 and shown in Figure 2 on the next page, and compare with the data we have.

year	living with HIV/AIDS	t	predicted living with HIV/AIDS
2012	50,436	-1	49,846
2013	51,510	0	51,510
2014	53,230	1	53,230
2015	54,754	2	55,007
2016	56,789	3	56,844
2017	58,808	4	58,742
2018	60,346	5	60,704
2019		6	62,731
2020		7	64,826
2021		8	66,990
2022		9	69,227
2023		10	71,539
2024		11	73,927

Table 2: Yellow lines show that 2013 and 2014 were used to compute C and k for exponential model.

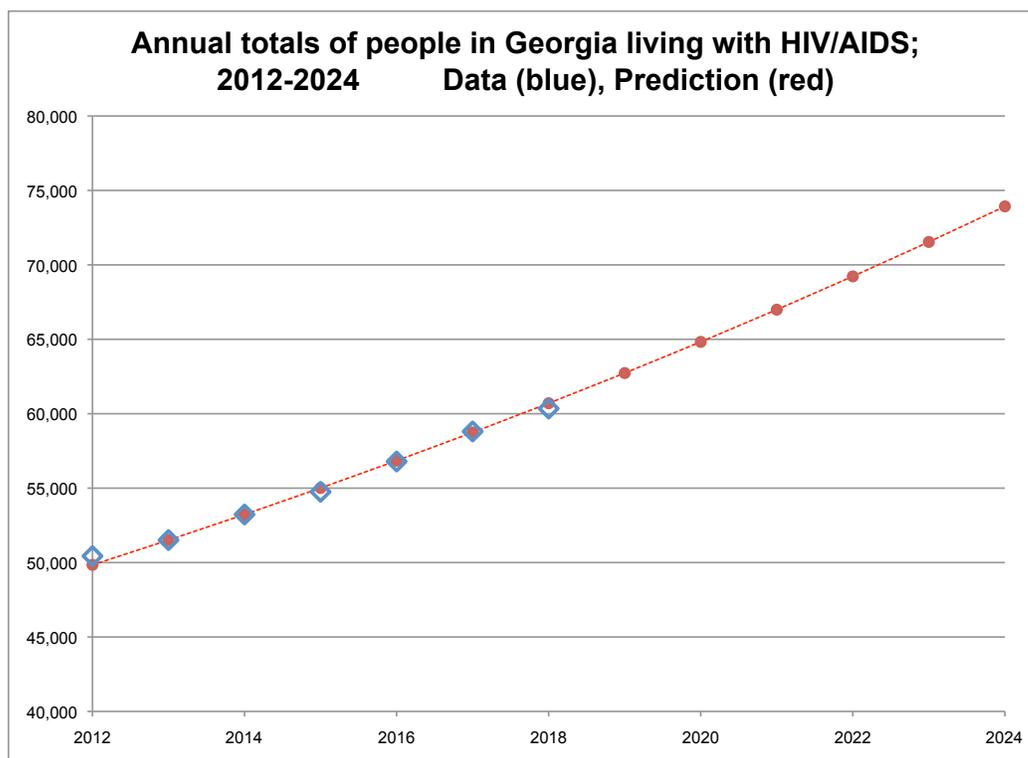


Figure 2: Anticipated annual totals (red) for people in Georgia, USA living with HIV/AIDS. Data values from Figure 1 added in blue.

As shown in Figure 2, the exponential model (red) closely approximates the data (blue diamonds) from 2012 to 2018, and indicates how over the next few years the HIV/AIDS rate may continue to increase. According to the graph, there are approximately 2,000 new cases of HIV/AIDS every year. Therefore, the solutions that have been put in place previously will not decrease the number of cases in the next five years. New solutions must be implemented to decrease those.

3 Suggested Interventions

A solution that could decrease the number of HIV/AIDS would be to have clinic workers go to different organizations, give speeches, and host workshops for the community. This will ensure that people know exactly what HIV/AIDS is, how a person can contract it, and the many ways one will remain HIV positive. This also gives a person the opportunity to ask questions about things that they didn't fully understand. The clinic workers could bring in people who have HIV and allow them to share their stories on how they contracted HIV.

An alternative solution that would help keep the number of HIV cases low is to implement a course curriculum for all high schools worldwide for 11th and 12th graders. The class should be year-round and a required course to graduate. In today's time, students at this age (or younger) are starting to become sexually active and getting tattoos and piercings. This solution could help those students who aren't being given this information at home. It will allow students at an early age to make sure they are taking care of their bodies for the right reason.

4 Conclusion

The wide spread of HIV/AIDS has been around for years and has impacted the lives of many people and their families, some of whom may have even died from this terrible disease. Families, communities, school systems, and churches must take the time out to educate themselves and others around them on how this disease can ultimately change their lives for the worst. This epidemic must be prevented so people can live healthy and prosperous lives.

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