Volume 2, Issue 8, August 2024 ISSN (E): 2938-3765

DETECTING FUTURE TRENDS OF HIV PREVALENCE AMONG INDIVIDUALS AGED 15-49 YEARS IN GUINEA USING HOLT'S LINEAR METHOD

Dr. Smartson. P. NYONI 1,
Thabani NYONI 2
1ZICHIRe Project, University of Zimbabwe, Harare, Zimbabwe
2Independent Researcher & Health Economist, Harare, Zimbabwe

Abstract
This study uses annual time series data of HIV prevalence among individuals aged 15-49 years for Guinea from 1990 to 2020 to predict future trends of HIV prevalence over the period 2021 to 2030. The study utilizes Holt's linear exponential smoothing model. The optimal values of smoothing constants α and β are 0.9 and 0.1 respectively based on minimum MSE. The results of the study indicate that annual HIV prevalence among individuals aged 15-49 years will slightly decline over the out of sample period. Therefore, it is vital to address major drivers of HIV transmission among this age group, improve ART retention & ART adherence among people living with HIV and monitoring the emergence of drug resistant HIV strains.

Keywords: - Exponential smoothing, Forecasting, HIV prevalence.

Introduction

According to the World Health Organization (WHO), more than 75 million people are living with HIV and above 40 million HIV/AIDS related deaths have been reported worldwide. By the end of 2022 approximately 39 million people were living with HIV and two thirds of those infected lived in the WHO-African region (WHO, 2023). The burden of HIV infection is highest in sub-Saharan Africa (SSA), where 66.7% of all infected individuals live. According to UNAIDS, in 2021, more than half (54%) of all people living with HIV worldwide were women and girls (UNAIDS, 2021; UNWomen, 2018). As per the WHO 2025 target, 95% of all people living with HIV (PLHIV) must know their HIV status, 95% of PLHIV should be on antiretroviral therapy and 95% of people on antiretroviral therapy must have suppressed viral load. The rapid scale up of antiretroviral therapy across Sub Saharan Africa has significantly contributed to the reduction of HIV related morbidity and mortality. However, HIV still remains problematic in Western and Central Africa (WCA) (UNAIDS, 2010). In Guinea, approximately 120,000 people are living with HIV and the reported HIV seroprevalence within the adult population (15–49 years) is low (1.5%), and around 35% of people living with HIV are on antiretroviral therapy (UNAIDS, 2018; UNAIDS, 2017). The aim of this study is to model and forecast HIV prevalence among individuals aged 15-49 years for Guinea using double exponential smoothing technique. The study findings are envisaged to

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

facilitate planning and allocation of available resources towards targeted HIV programs in order to effectively control the HIV epidemic in the country.

Literature Review

Author(s)	Objective (s)	Methodology	Main finding (s)
Albus et al. (2023)	To describe patient characteristics and outcomes of critically ill HIV-positive patients hospitalized in Conakry, Guinea between August 2017 and April 2018 at discharge and 6 months post-discharge.	retrospective observational cohort study	Outcomes for critically ill HIV-positive patients in our cohort were poor. We estimate that 1in-3 patients remained alive and in care 6 months after their hospital admission.
Rodríguez-Reinado et al. (2023)	To determine the perceptions of HIV and the meanings given to it among the population of Equatorial Guinea in order to assess to what extent they represent a barrier to the prevention strategies implemented hitherto.	A total of 30 semi-structured interviews and nine focal groups were carried out.	The interviewees' testimonies revealed a combination of differing perceptions and meanings around HIV. In some cases, HIV was perceived as "a non-existent illness", and in others as "a disease of others", or as "a disease of bad luck". Other majority perceptions of HIV classed it as "a deadly disease" or "a sexual illness".
Breton et al. (2022)	To evaluate the feasibility of a strategy combining early infant diagnosis (EID) and reinforced antiretroviral prophylaxis in high-risk infants as identified by interviews with mothers at Ignace Deen Hospital, Conakry, Guinea.	Prospective study	Reinforced antiretroviral prophylaxis and EID at birth are widely feasible. However, mothers' self-disclosure of HIV status and antiretroviral intake do not allow adequate evaluation of MTCT risk, which argues for maternal pVL measurement near delivery
Rasmussen et al. (2020)	To assess changes in HIV prevalence, risk factors for HIV, provision of PMTCT antiretroviral treatment (ART), and the association between HIV infection, birth outcomes and maternal characteristics at the Simão Mendes National Hospital, Guinea-Bissau's largest maternity ward	cross-sectional data collected from June 2008 to May 2013	A total of 85% of HIV- infected women received ART as part of PMTCT, yet overall treatment coverage during labour and delivery declined significantly for both mothers and infants. Twenty-two percent of infants did not receive treatment, and 67% of HIV-2-infected mothers and 77% of their infants received ineffective non-nucleoside reverse transcriptase inhibitors for PMTCT. Maternal HIV was associated with low birth weight but not stillbirth. Inadequate continuity of care and ART coverage present challenges to optimal PMTCT in Guinea-Bissau

Methodology

This study utilizes an exponential smoothing technique to model and forecast future trends of HIV prevalence among individuals aged 15-49 years in Guinea. In exponential smoothing forecasts are generated from the smoothed original series with the most recent historical values having more influence than those in the more distant past as more recent values are allocated more weights than those in the distant past. This study uses the Holt's linear method (Double exponential smoothing) because it is an appropriate technique for modeling linear data.

Holt's linear method is specified as follows:

Model equation

$A_t=\mu_t + \rho_t \mathbf{t} + \varepsilon_t$……..…..[1]

Smoothing equation

$S_t= \alpha A_t + (1-\alpha)\ (S_{t-1} + b_{t-1})$……..……[2]

$0<\propto<1$

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

Trend estimation equation

$b_t = \beta (S_t - S_{t-1}) + (1-\beta) b_{t-1}$ .....[3]

$0 < \beta < 1$

Forecasting equation

$f_{t+h} = S_t + h b_t$ .....[4]

A_t is the actual value of HIV prevalence at time t

ε_t is the time varying **error term**

μ_t is the time varying mean (**level**) term

ρ_t is the time varying **slope term**

t is the trend component of the time series

S_t is the exponentially smoothed value of HIV prevalence at time t

α is the exponential smoothing constant for the data

β is the smoothing constant for trend

f_{t+h} is the h step ahead forecast

b_t is the trend estimate (slope of the trend) at time t

b_{t-1} is the trend estimate at time t-1

Data Issues

This study is based on annual HIV prevalence among individuals aged 15-49 years in Guinea for the period 1990 – 2020. The out-of-sample forecast covers the period 2021 – 2030. All the data employed in this research paper was gathered from the World Bank online database.

Findings of the study

Exponential smoothing Model Summary

Table 1: ES model summary

Variable	A
Included Observations	31
Smoothing constants	
Alpha (α) for data	0.900
Beta (β) for trend	0.100
Forecast performance measures	
Mean Absolute Error (MAE)	0.073867
Sum Square Error (SSE)	0.501226
Mean Square Error (MSE)	0.016169
Mean Percentage Error (MPE)	-2.066273
Mean Absolute Percentage Error (MAPE)	8.399906

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

Residual Analysis for the Applied Model

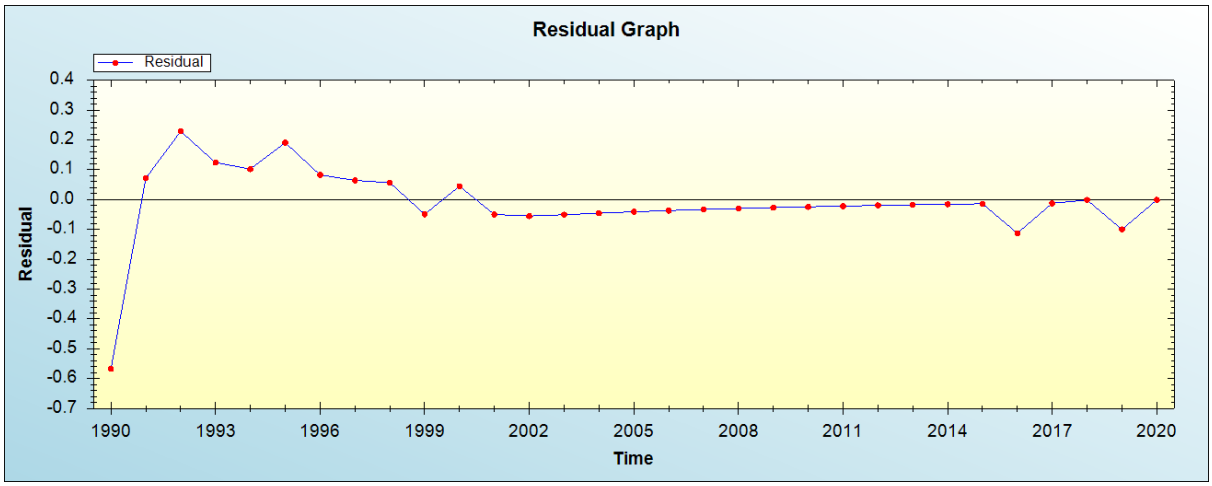

Figure 1: Residual analysis

In-sample Forecast for A

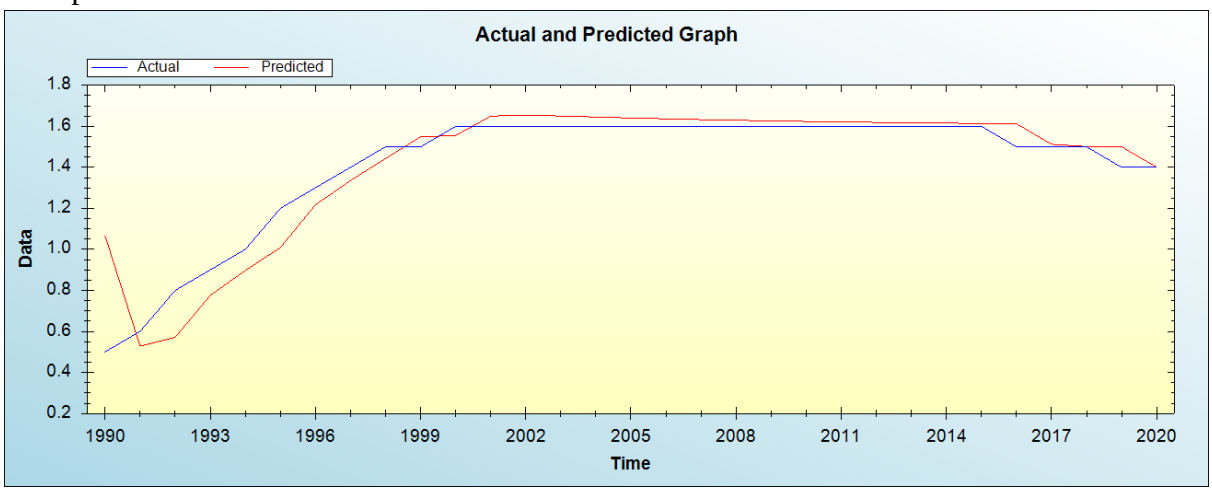

Figure 2: In-sample forecast for the A series

Actual and Smoothed graph for A series

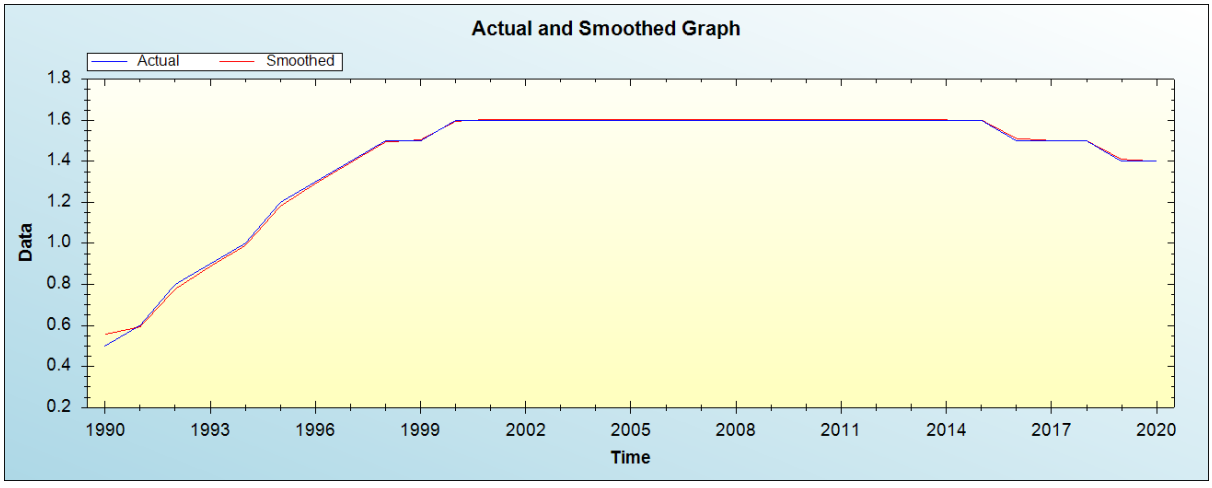

Figure 3: Actual and smoothed graph for A series

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

Out-of-Sample Forecast for A: Actual and Forecasted Graph

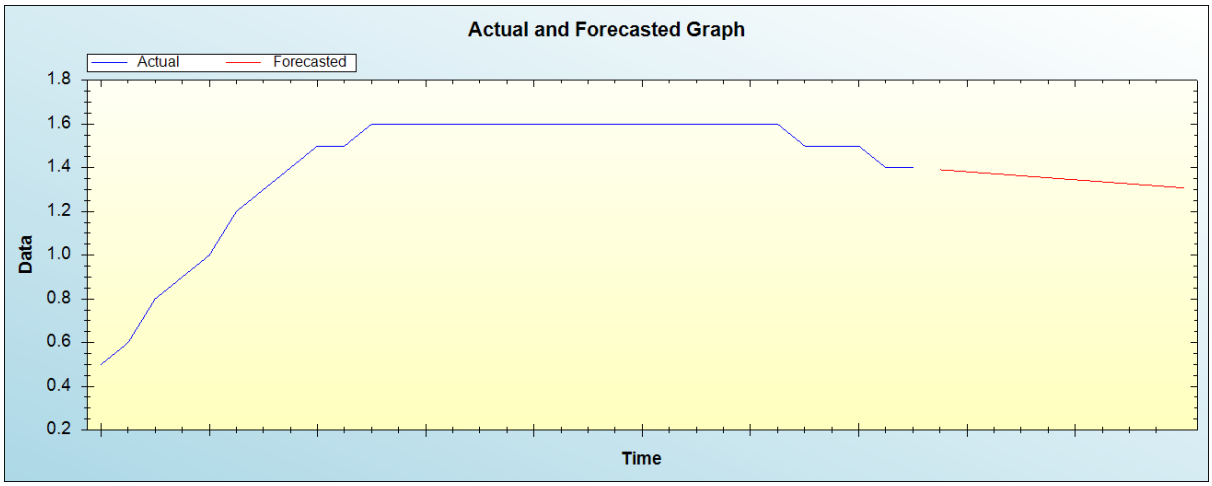

Figure 4: Out-of-sample forecast for A: actual and forecasted graph

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Year	Forecasted HIV prevalence
2021	1.3909
2022	1.3816
2023	1.3724
2024	1.3632
2025	1.3540
2026	1.3448
2027	1.3355
2028	1.3263
2029	1.3171
2030	1.3079

The main results of the study are shown in table 1. It is clear that the model is stable as confirmed by evaluation criterion as well as the residual plot of the model shown in figure 1. It is projected that annual HIV prevalence among individuals aged 15-49 years will slightly decline over the out of sample period.

Policy implication and conclusion

Our study findings indicate that annual HIV prevalence among individuals aged 15-49 years will slightly drop in the out of sample period. Therefore, the government should address major drivers of HIV transmission among this age group. In addition, priority should be given to ART retention, improving ART adherence among people living with HIV and monitoring the emergence of drug-resistant HIV strains.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

References

1. UNAIDS Global report 2010 | UNAIDS Report on the global AIDS epidemic 2010 [Internet]. 2017 [cited 2017 Sep 15]. http://www.unaids.org/globalreport/Global_report.htm
2. UNAIDS data 2018. https://www.unaids.org/en/resources/documents/ 2018/unaids-data-2018.
3. UNAIDS (2017). 90–90–90—An ambitious treatment target to help end the AIDS epidemic. https://www.unaids.org/en/resources/documents/2017/90-90-90
4. World Health Organization (WHO). HIV and AIDS: Key Facts, 13th July 2023. https:// www. who. int/ news- room/ fact- sheets/ detail/ hiv- aids? gclid= CjwKC AjwlJ imBhA sEiwA 1hrp5 jhRtv 7x1gH w2LC5 uLjSc gR7VB J6CmU zphXB Ij13Z 8N- 9o5fC Uehkh oC4xM QAvD_ BwE.
5. UNWomen (2018). Facts and figures: HIV and AIDS, Prevalence and New Infec- tions [Internet]. New York, USA: UNWomen; 2018 p. 2. Available from: https:// www. unwom en. org/ en/ what- we- do/ hiv- and- aids/ facts- and- figur es. Accessed 2 Jan 2023.
6. UNAIDS (2021). Global HIV & AIDS statistics—Fact sheet [Internet]. Geneva, Switzerland: UNAIDS; 2021 p. 6. Available from: https:// www. unaids. org/ en/ resou rces/ fact- sheet. Accessed 2 Jan 2023.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5