Article

LINKING HIV CASES (ALL AGES), NEW HIV INFECTIONS AND DEATHS DUE TO AIDS

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Abstract: The study determined the relationships among HIV cases (all ages), deaths due to AIDS, and the new HIV infections. It reveals that the number of new HIV infections is influenced by the number of HIV cases (all ages). In the same manner, the number of deaths due to AIDS is influenced by the number of HIV cases (all ages). Finally, Number of deaths due to AIDS is influenced by new HIV infections. Regression model specifications were developed: New HIV Cases = 1447.116 + 0.043 HIV cases all ages + ε_i ; Deaths due to AIDS = 1388.210 + 0.021 HIV cases all ages + ε_i ; Mortality = 278.465 + 0.523 New Cases + ε_i .

The study utilized secondary data taken from the Global Health Observatory Data Repository of the World Health Organization. There were 123 countries included in the study with complete data on three aspects: HIV cases (all ages) for 2017, New HIV infections for 2017, and Deaths due to AIDS for 2017. The secondary data was statistically treated using Simple percentage, Pearson Correlation Coefficient and Bivariate Linear Regression analysis.

Data in 2017 reveals that eight countries have more than 1 million HIV cases, all ages (6.5%). This includes Kenya, Malawi, Mozambique, Nigeria, South Africa, Uganda, United Republic of Tanzania, Zambia and Zimbabwe. Majority of the countries had less than 200,000 HIV cases.

Findings also show that most of the countries under investigation have less than 10,000 new HIV infections (81.30%). Ten countries have more than 40,000 new HIV infections for 2017. This includes Brazil, Indonesia, Kenya, Mozambique, Nigeria, South Africa, Uganda, United Republic of Tanzania, Zambia and Zimbabwe.

In terms of deaths due to AIDS in 2017, three countries have more than 50,000 cases which includes Mozambique, Nigeria and South Africa.

A Scatter Plot was prepared which shows that all three variables i.e. HIV cases all ages, Deaths due to AIDS, and New HIV infections have very strong linear correlation with each other. HIV cases all ages and New HIV infections ($r=.961$) has very strong positive correlation; Deaths due to AIDS and New HIV Infections ($r=.958$) has very strong positive correlation; HIV cases all ages and Deaths due to AIDS has strong positive correlation. All these correlation coefficients are statistically significant at 0.01 levels.

Keywords: HIV cases, all ages; new HIV infections; Deaths due to AIDS; South Africa; Nigeria; Mozambique

INTRODUCTION

By the turn of the 21st century, the exotic disease that seemed to strike only gay men has turned into a world-wide scourge: the human immunodeficiency virus (HIV) now infects over 32 million individuals and has killed some 25 million. In the United States as of 2007, some 563,000 people had died of AIDS. Since the outbreak was first recognized, a great deal has been learned about HIV, how it causes AIDS, and how it is spread (Schneider, 2011). HIV is transmitted through blood and other body fluids. Drug abusers frequently share syringes and needles increases the risk of acquiring the virus. Safe sexual practices, including the correct use of condoms and engaging

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in monogamous relationships, reduce the risk for HIV and other sexually transmitted diseases (Potter & Perry, 2004).

A person infected with HIV undergoes four phases, the active phase, the asymptomatic phase, the AIDS-related complex (ARC), and AIDS. Symptoms in the active phase includes rash, cough, malaise, night sweats and lymphadenopathy. There are no symptoms in the asymptomatic phase but the test is positive for HIV antigens. On the third phase (ARC), symptoms include lymphadenopathy, diarrhea, oral candidiasis, weight loss, fatigue, skin rash, recurrent infections and fever. During the final phase (AIDS), rare infections such as Pneumocystis carinii pneumonia or rare cancers such as Kaposi's sarcoma or B-cell lymphomas are experienced by the person (Craven & Hirnle, 2003).

Socio-economic, environmental and behavioural factors, as well as international travel and migration, foster and increase the spread of communicable diseases, pose significant threats to human health and may sometimes threaten international health security (www.euro.who.int).

The World Health Organization works with Member States, international organizations and bilateral agencies to help countries strengthen their programmes for the control of infectious diseases. But access to services is inadequate in many parts of the Region. The Region's poorer countries face the double burden of inadequate health systems and persistent communicable diseases. In cooperation with governments, WHO develops norms and standards, guidance and public health tools to help countries implement effective disease prevention and control programmes and address their risk factors. Much progress has unquestionably been made to date, yet emerging communicable diseases continue to challenge public health.

The global trends and adverse health impacts of HIV, viral hepatitis, STIs and Tuberculosis remain among the major and public concerns of our time. These conditions account for substantial morbidity and mortality with devastating fiscal and emotional costs to individuals, families and societies.

On the other hand, people with latent Tuberculosis (TB) are increasingly becoming infected with HIV and many more are developing active TB because HIV is weakening their immune system. People who are co-infected with both HIV and latent TB have an up to 50 times greater risk of developing active TB and becoming infectious compared to people not infected with HIV (www.avert.org).

In 2011, the largest number of new TB cases occurred in Asia, accounting for 60% of new cases globally. About 80% of reported TB cases occurred in 22 cases. Some countries are experiencing major decline in cases while cases are dropping very slowly in others. Brazil and China, for example, are among the 22 countries that showed a sustained decline in TB cases over the past 20 years. In the last decade, the TB prevalence in Cambodia fell by almost 45% (www.who.int).

Although cases of HIV/AIDS must be reported, as with other infectious diseases, caregivers cannot disclose a person's HIV status without consent. The legal and ethical right to confidentiality regarding HIV/AIDS raises an ethical issue related to protection of others when the infected individual continues behaviors that may expose others to the infection. In some circumstances, physicians are allowed limited disclosure without consent, such as to the patient's spouse. In such situations the imperative of confidentiality must be weighed against the duty to warn others in order to protect them from potential harm. At the present time there are no clear directives in this area for health care providers (Burkhardt & Nathaniel, 2002).

The greatest hope for controlling AIDS, especially in the developing world where the new drugs are unaffordable, is to develop a vaccine. Prevention through immunization has been the most effective approach for the viral scourges of the past, including smallpox, measles and polio. Early hopes for the rapid availability of a vaccine against AIDS have faded, however. In fact, after several promising vaccine candidates failed in clinical trials, the National Institute of Health held a meeting of vaccine researchers in March 2008, to reassess whether a vaccine will ever be possible and what new approaches could be tried. It should perhaps not be surprising that a virus so well adapted to disabling the immune system should be so effective at eluding attempts to employ that same immune system against it. Part of the difficulty in developing an effective vaccine is that the virus itself is constantly changing its appearance, making it unrecognizable to the immune mechanisms that are mobilized against it by a vaccine. This quality is common to RNA viruses. Another difficulty is that there is no good animal model for studying HIV/AIDS (Schneider, 2011).

Theoretical Background

This study is anchored on the Theory of Uncertainty in Illness by Merle Mishel. This theory has four major assumptions (Tomey & Alligood, 2002):

1. Uncertainty is a cognitive state, representing the inadequacy of an existing cognitive schema to support the interpretation of illness-related events.
2. Uncertainty is an inherently neutral experience, neither desirable nor aversive until it is appraised as such.
3. Adaptation represents the continuity of an individual's usual biopsychosocial behavior and is the desired out-

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come of coping efforts to either reduce uncertainty appraised as danger or maintain uncertainty appraised as opportunity.
4. The relationships between illness events, uncertainty, appraisal, coping, and adaptation are linear and unidirectional, moving from situations promoting uncertainty towards adaptation.

RELATED STUDIES

In the study of Likatavičius, Klavs, Devaux, Alix & Nardone (2008), they discovered that in 2006, 7693 newly diagnosed HIV infections among MSM were reported (56.7 per million men aged 15–64 years). In 23 countries with data for 2000–6, the number of new HIV diagnoses increased by 86% from 3003 to 5571. In 20 countries reporting individual HIV cases between 2000 and 2006, the median age at HIV diagnosis remained unchanged (36 years), whereas the proportion of MSM presenting with an AIDS-defining illness at the time of HIV diagnosis declined from 25% in 2000 to 10% in 2006 ($\chi^2 = 85.7$, $p<0.001$). In 30 countries reporting AIDS, incidence among MSM decreased by 40% from 2422 in 2000 to 1445 in 2006 and the number of deaths decreased by 57% from 876 to 373. Reported HIV prevalence ranged between 8% and 68% among MSM with sexually transmitted infections, between 10% and 18% among those recruited in community settings, but remained <10% in central Europe and Ireland. Whereas the decreasing rates of AIDS diagnoses and AIDS deaths reflect relatively good access to therapy, the increasing numbers of new HIV diagnoses and relatively high prevalence of HIV among MSM suggest the need for Europe-wide HIV prevention among MSM.

A study by Hargreaves titled Socio-economic status and risk of HIV infection in an urban population in Kenya revealed that higher socio-economic status (SES) was associated with a more mobile lifestyle, later sexual debut and marriage among both sexes, and with circumcision among men aged 25-49 and condom use among women aged 25-49. Higher levels of alcohol consumption were associated with an increased risk of HIV infection and were more common amongst those of higher SES. HSV-2 infection was strongly associated with an increased risk of HIV infection and was more common among those of lower SES. HIV was associated with a lower SES among females aged 15-24 whereas in males aged 15-24 and females aged 25-49 there was some indication that it was associated with higher SES. Among males aged 25-49 there was no association between HIV infection and SES. It concluded that the risk of infection was high among groups of all SES. Risk profiles suggested men and women of lower SES maybe at greater risk of newly acquired HIV infection. New infections may now be occurring fastest among young women of the lowest SES (http://www.ncbi.nlm.nih.gov/pubmed/12225512).

In another study titled Socio-economic factors and tuberculosis: a district-based ecological analysis in Hong Kong, the study revealed that there was no significant association between Standardized notification ratios and socio-economic indices on education, occupation, unemployment and income. Socio-economic factors other than simple poverty are affecting the district-specific tuberculosis rates in Hong Kong (http://www.ncbi.nlm.nih.gov/pubmed/15305477).

OBJECTIVES

The study determined the relationship between HIV cases (all ages) and deaths due to AIDS as well as the relationship between HIV cases (all ages) and the new cases of HIV.

METHODS

The study utilized secondary data taken from the Global Health Observatory Data Repository of the World Health Organization. There were a total of 123 countries with complete data on three aspects: HIV cases (all ages) for 2017, New HIV infections for 2017, and Deaths due to AIDS for 2017.

The secondary data was statistically treated using Simple percentage, Pearson r and regression.

RESULTS AND DISCUSSION

Table 1 presents the HIV cases (all ages) among 123 countries. Data reveals that eight countries have more than 1 million cases (6.5%). This includes Kenya, Malawi, Mozambique, Nigeria, South Africa, Uganda, United Republic of Tanzania, Zambia and Zimbabwe. Majority of the countries had less than 200,000 cases.

Number of cases	Frequency	Percentage
More than 1 million cases	8	6.50
800,000 to 1 million cases	2	1.63
600,000 to 799,999 cases	2	1.63
400,000 to 599,999 cases	2	1.63
200,000 to 399,999 cases	12	9.76
Less than 200,000 cases	97	78.86
Total	123	100

Table 1. HIV Cases (all ages), 2017

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According to Schneider (2011), the reasons for the recent emergence of HIV disease as a significant problem include the disruption of traditional lifestyles by the movement of rural Africans to urban areas, trends magnified by population growth, waves of civil war, and revolution. The apparent worldwide explosion of AIDS then occurred because of changing patterns of sexual behavior and the use of addictive drugs in developed and developing countries, together with the ease of international air travel.

In table 2, findings show that most of the countries under investigation have less than 10,000 cases (81.30%). Ten countries have more than 40,000 new HIV infections. This includes Brazil, Indonesia, Kenya, Mozambique, Nigeria, South Africa, Uganda, United Republic of Tanzania, Zambia and Zimbabwe.

On the other hand, table 3 reveals the Deaths due to AIDS. Three countries have more than 50,000 cases which includes Mozambique, Nigeria and South Africa.

Number of cases	Frequency	Percentage
More than 50,000 cases	5	21.74
40,001 to 50,000 cases	5	21.74
30,001 to 40,000 cases	1	0.81
21,001 to 30,000 cases	3	2.44
10,000 to 20,000 cases	9	7.32
Less than 10,000 cases	100	81.30
Total	123	100

Table 2. New HIV Infections, 2017

Number of cases	Frequency	Percentage
More than 50,000 cases	3	2.44
40,000 to 50,000 cases	0	0
30,001 to 40,000 cases	1	0.81
21,000 to 30,000 cases	6	4.88
10,000 to 20,000 cases	8	6.50
Less than 10,000 cases	105	85.36
Total	123	100

Table 3. Deaths due to HIV/AIDS, 2017

As far as HIV cases (all ages), new cases of HIV and Deaths due to AIDS are concerned, South Africa, Nigeria, Mozambique, United Republic of Tanzania and Kenya has highest values. These countries have very high incidence of HIV cases whereas The former Yugoslav Republic of Macedonia, Qatar, Slovenia, Mongolia etc. has the lowest values (refer to Country Wise Extreme Values).

Extreme Values				
			Name of Country	**Value**
HIV All Ages	Highest	1	South Africa	7200000.0
		2	Nigeria	3100000.0
		3	Mozambique	2100100.0
		4	Kenya	1500000.0
		5	United Republic of Tanzania	1500000.0
	Lowest	1	Comoros	200.0
		2	The former Yugoslav Republic of Macedonia	500.0
		3	Qatar	500.0
		4	Montenegro	500.0
		5	Bahrain	500.0
Mortality	Highest	1	Nigeria	150000.0
		2	South Africa	110000.0
		3	Mozambique	70000.0
		4	Indonesia	39000.0
		5	United Republic of Tanzania	32000.0

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Mortality	Lowest	1	The former Yugoslav Republic of Macedonia	100.0
		2	Slovenia	100.0
		3	Slovakia	100.0
		4	Singapore	100.0
		5	Serbia	100.0[a]
New Cases	Highest	1	South Africa	270000.0
		2	Nigeria	210000.0
		3	Mozambique	130000.0
		4	United Republic of Tanzania	65000.0
		5	Kenya	53000.0
	Lowest	1	The former Yugoslav Republic of Macedonia	100.0
		2	Slovenia	100.0
		3	Qatar	100.0
		4	Montenegro	100.0
		5	Mongolia	100.0[a]
a. Only a partial list of cases with the value 100.0 are shown in the table of lower extremes.				

Table 4. Country Wise Extreme Values (Highest and Lowest)

CORRELATION ANALYSIS

To know the correlation between HIV All Ages, New HIV infections, and Deaths due to AIDS, Pearson Correlation Coefficient technique is applied. Before calculating correlation coefficient Scatter plot was prepared. Following is Scatter plot of HIV All Ages, Mortality and New Cases of HIV.

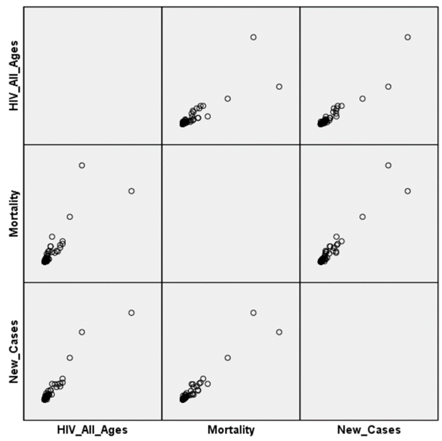

Figure 1. Scatter Plot between HIV All Ages, Mortality and New Cases of HIV

It can been seen from the above Scatter plot, all the variables i.e. HIV All Ages, New cases of HIV infections, and Deaths due to AIDS, may have strong positive linear correlation with each other. To know the actual correlation coefficient, Pearson correlation technique is used. Following are the results of correlation coefficient between the variables.

Correlations				
		HIV All Ages	**Mortality**	**New Cases**
HIV All Ages	Pearson Correlation	1	**.861****	**.961****
	Sig. (2-tailed)		.000	.000
	N	123	123	123
Mortality	Pearson Correlation	.861**	1	**.958****
	Sig. (2-tailed)	.000		.000
	N	123	123	123
New Cases	Pearson Correlation	.961**	.958**	1
	Sig. (2-tailed)	.000	.000	
	N	123	123	123
**. Correlation is significant at the 0.01 level (2-tailed).				

Table 4. Pearson Correlation Coefficient

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It can be seen from above table that all the three variables i.e. HIV All Ages, Mortality and New Cases of HIV has strong positive linear correlation with each other. HIV All Ages and New Cases of HIV (r=.961) has very strong positive correlation with each other followed by Mortality and New Cases of HIV (r=.958); whereas HIV All Ages and Mortality has strong positive linear correlation with each other (r=.861). All these correlation coefficients are statistically significant at 0.01 levels.

REGRESSION ANALYSIS

To know the contribution of HIV All Ages in to New Cases of HIV; bivariate liner regression is used. Following is the model specification;

$$\text{New Cases} = \alpha + \beta \text{ HIV All Ages} + \varepsilon_i$$

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.961[a]	.924	.923	9451.0479

a. Predictors: (Constant), HIV_All_Ages

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	131519507436.235	1	131519507436.235	1472.415	.000[b]
	Residual	10807998965.391	121	89322305.499		
	Total	142327506401.626	122			

a. Dependent Variable: New_Cases
b. Predictors: (Constant), HIV_All_Ages

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1447.116	894.145		1.618	.108
	HIV_All_Ages	.043	.001	.961	38.372	.000

a. Dependent Variable: New_Cases

$$\text{New Cases} = \alpha + \beta \text{ HIV All Ages} + \varepsilon_i$$
$$\text{New Cases} = 1447.116 + 0.043 \text{ HIV All Ages} + \varepsilon_i$$

Interpretations:

(1)Value of Adjusted R Square (.923) i.e. explanatory power of model suggests that; about 92.3% variations in New Cases are independently explains by variations in HIV All Ageas. It seems around 7.7% variations in New Cases are explains by some other factory which are not included in the model.

(2)Value of F-Statistics (F=1472.415, $p < 0.01$) i.e. model specification test suggests that; model is correctly specified i.e. bivariate liner regression as F-Statistics is significant at 0.01 level. This also indicates that HIV All Ages is one of the important variables to explain variations in New Cases.

(3)Estimated coefficient of β (.043) i.e. slop coefficient suggests that; one unit change in HIV All Ages will change New Cases by 0.043 unit. Estimated coefficient of β is statistically significant at 0.01 level (t=38.37, $p < 0.01$).

To know the contribution of HIV All Ages in to Mortality; bivariate liner regression is used. Following is the model specification;

$$\text{Mortality} = \alpha + \beta \text{ HIV All Ages} + \varepsilon_i$$

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.861[a]	.742	.740	9503.8579

a. Predictors: (Constant), HIV_All_Ages

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	31442402304.492	1	31442402304.492	348.109	.000[b]
	Residual	10929121058.110	121	90323314.530		
	Total	42371523362.602	122			

a. Dependent Variable: Mortality
b. Predictors: (Constant), HIV_All_Ages

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Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1388.210	899.141		1.544	.125
	HIV_All_Ages	.021	.001	.861	18.658	.000
a. Dependent Variable: Mortality						

$$\text{Mortality} = \alpha + \beta \text{ HIV All Ages} + \varepsilon_i$$
$$\text{Mortality} = 1388.210 + 0.021 \text{ HIV All Ages} + \varepsilon_i$$

Interpretations:

(1) Value of Adjusted R Square (.740) i.e. explanatory power of model suggests that; about 74.0% variations in New Cases are independently explains by variations in HIV All Ageas. It seems around 26% variations in Mortality are explains by some other factory which are not included in the model.

(2) Value of F-Statistics ($F=348.109$, $p < 0.01$) i.e. model specification test suggests that; model is correctly specified i.e. bivariate liner regression as F-Statistics is significant at 0.01 level. This also indicates that HIV All Ages is one of the important variables to explain variations in Mortality.

(3) Estimated coefficient of β (.021) i.e. slop coefficient suggests that; one unit change in HIV All Ages will change Mortality by 0.021 unit. Estimated coefficient of β is statistically significant at 0.01 level ($t=18.65$, $p < 0.01$).

To know the contribution of New Cases in to Mortality; bivariate liner regression is used. Following is the model specification;

$$\text{Mortality} = \alpha + \beta \text{ New Cases} + \varepsilon_i$$

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.958[a]	.919	.918	5340.8720
a. Predictors: (Constant), New_Cases				

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	38920008778.258	1	38920008778.258	1364.422	.000[b]
	Residual	3451514584.344	121	28524913.920		
	Total	42371523362.602	122			
a. Dependent Variable: Mortality						
b. Predictors: (Constant), New_Cases						

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	278.465	509.888		.546	.586
	New_Cases	.523	.014	.958	36.938	.000
a. Dependent Variable: Mortality						

$$\text{Mortality} = \alpha + \beta \text{ New Cases} + \varepsilon_i$$
$$\text{Mortality} = 278.465 + 0.523 \text{ New Cases} + \varepsilon_i$$

Interpretations:

(1)Value of Adjusted R Square (.918) i.e. explanatory power of model suggests that; about 91.8% variations in Mortality are independently explains by variations in New Cases. It seems around 26% variations in Mortality are explains by some other factory which are not included in the model.

(2) Value of F-Statistics ($F=1364.422$, $p < 0.01$) i.e. model specification test suggests that; model is correctly specified i.e. bivariate liner regression as F-Statistics is significant at 0.01 level. This also indicates that

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New Cases is one of the important variables to explain variations in Mortality.

(3) Estimated coefficient of β (.523) i.e. slop coefficient suggests that; one unit change in New Cases will change Mortality by 0.523 unit. Estimated coefficient of β is statistically significant at 0.01 level ($t=36.93$, $p < 0.01$).

CONCLUSION

In conclusion, this study presents relationships among HIV cases (all ages), deaths due to AIDS, and the new HIV infections. It reveals that the number of new HIV infections is influenced by the number of HIV cases (all ages). In the same manner, the number of deaths due to AIDS is influenced by the number of HIV cases (all ages). Finally, Number of deaths due to AIDS is influenced by new HIV infections. Regression model specifications were developed: New HIV Cases = 1447.116 + 0.043 HIV cases all ages + εi ; Deaths due to AIDS = 1388.210 + 0.021 HIV cases all ages + εi ; Mortality = 278.465 + 0.523 New Cases + εi .

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