New infections and status of HIV/AIDS management in ten hospitals of Southern Ethiopia during 10 consecutive years until 2016

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Abstract

Background: Human immunodeficiency virus (HIV) belongs to a group of biological virus termed retrovirus. It has a unique and unusual life cycle. As part of this life cycle it copies its RNA genome into DNA, using an enzyme called reverse transcriptase. This life cycle is exception to the central dogma of molecular biology, in which information flows from DNA to RNA to protein. During a retroviral infection, information instead flows from RNA to DNA. HIV is a single-stranded RNA virus with a positive sense and a bipartite genome. The key objectives of this study were to determine/prove whether the risk of HIV/AIDS epidemic is declining, rising, or controlled at a constant level of prevalence or not, and to work out death rates due to HIV/AIDS.

Methods: Ten different hospitals each of which was the regular medical care service provider for HIV infected persons were selected to be the sites of sample collection from their databases in Southern Ethiopia. The statistical methods pre-planned to be employed in analyzing & interpreting the data collected were:- the statistics of histogram, the graph of multiple curves, and the expression of percentage.

Result: The unpooled average number of new HIV positive people registered per year is declining year after year and the corresponding number of deaths due to HIV/AIDS is also decreasing. On the other hand, the pooled number of HIV positive people alive is increasing year after year.The average number of deaths in each of the consecutive years is declining.

Conclusion: The pooled number of HIV positive people alive in human communities is rising up year after year. The average number of death rates due to HIV/AIDS in relation to the average number of pooled HIV positive people alive had been far less than 5% , being in the range of 0.47% to 3.13%. This achievement in medical care management is nearly equivalent to stopping death caused by HIV/AIDS!!

Key Words: epidemic, HIV positive, RNA, positive sense, bipartite genome, Southern Ethiopia

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I. Introduction

Human Immunodeficiency Virus (**HIV**) belongs to a group of biological virus termed retrovirus. A **retrovirus** has a unique and unusual lifecycle. As part of this life cycle, it copies its RNA genome into DNA, using an enzyme called **reverse transcriptase**. This is an exception to the **central dogma of molecular biology,** in which information flows from DNA to RNA to protein. During a retroviral infection, information instead flows from RNA to DNA.

HIV is a **single-stranded RNA virus and has a positive sense (+ sense) with reverse transcriptase.** From the structural point of view of its genome, HIV has a **bipartite genome**. There are two types of HIV viruses that infect humans, HIV-1 and HIV-2, with HIV-1 being responsible for most cases of HIV infection. HIV-1 can infect multiple types of immune cells, but its primary targets are white blood cells that carry a receptor called CD4 (glycoprotein in chemical composition) on their surface. HIV infects a white blood cell, that carries the CD4 receptor, involving the steps termed **Attachment**, **Entry**, **Reverse transcription**, **Integration into host DNA**, **Replication and gene expression**, **Assembly of new HIV-1 viruses**, and **Processing**.
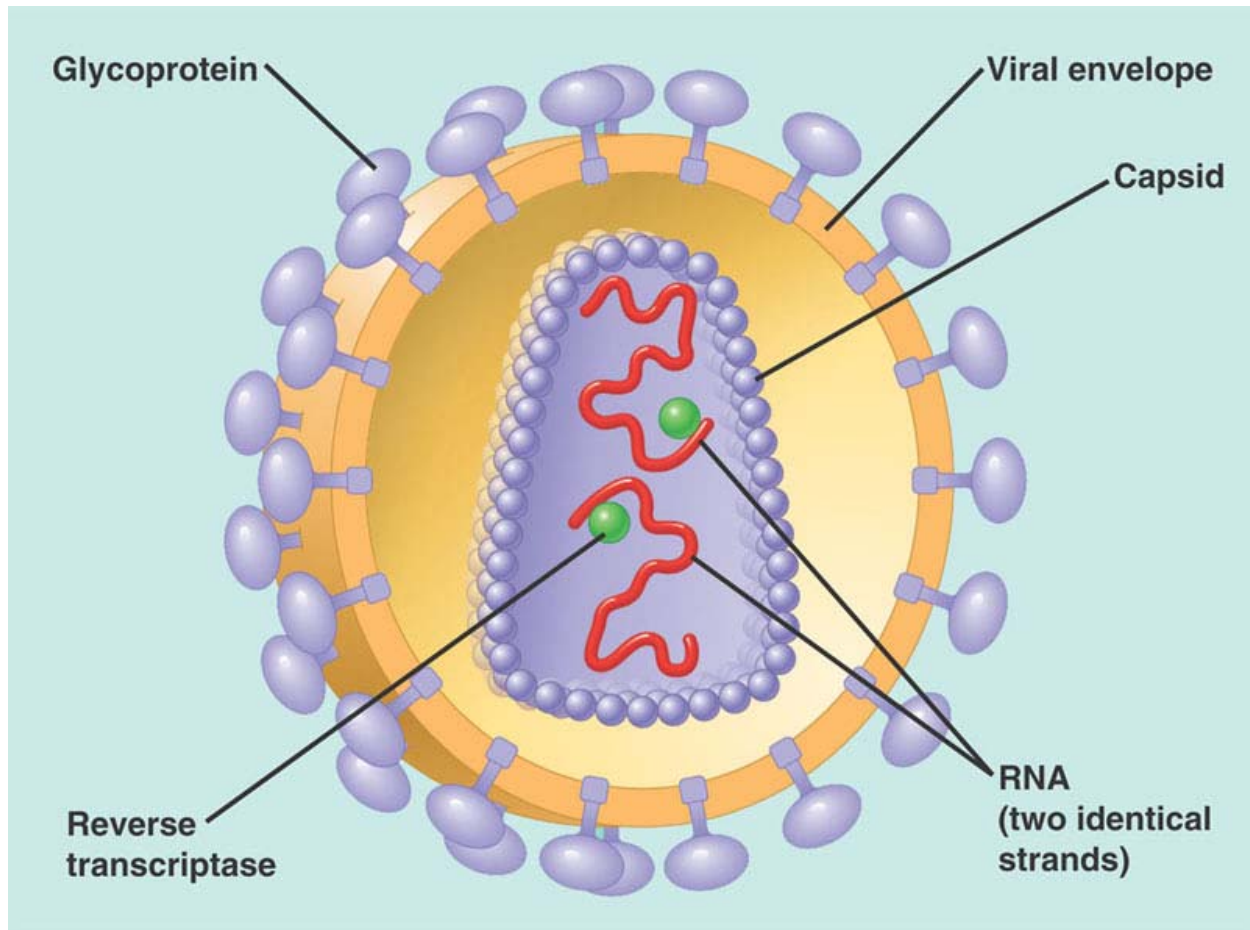
Figure 1: The anatomy of Human Immunodeficiency Virus (HIV).

Intestinal parasitic infections are one of the significant threats against the safe survival of HIV infected persons [1]. Intestinal parasites deteriorate the quality of life of HIV infected patients [2, 3]. Opportunistic intestinal parasites in HIV positive patients must be considered seriously because they cause horrifying diarrhea that leads to death particularly in developing countries where poor nutrition together with poor hygiene and several tropical diseases can make the situation worse [4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16]. In regions of tropics, parasitosis is spectacularly increasing the pathogenic effect of HIV infection [17, 118, 19, 20, 21, 22, 23, 24, 25, 26].

The key objectives of this study are:

►to determine/prove whether the risk of HIV/AIDS epidemic is declining, rising, or controlled at a constant level of prevalence or not, based on the concrete registered numbers (in ten different hospitals) of new infections of HIV, and

►to work out death rates due to HIV/AIDS each year in the course of 10 consecutive years until the end of 2015.

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II. Materials and methods

Ten different hospitals each of which was the regular medical care service provider for HIV infected persons were selected to be the sites of sample collection from their databases in Southern Ethiopia. The statistical methods pre-planned to be employed in analyzing & interpreting the data collected were:

▪the statistics of histogram,

▪the graph of multiple curves, and

▪the expression of percentage.

The collection of data from the databases of hospitals had been performed from 1 Oct. 2015 to 30 Jun. 2016.

**Specific area (site) of Study and Sample Size**

The specific sites of study included: Alaba Primary Hospital, Hawassa Aser Private Primary Hospital, Yirgacheffee Primary Hospital, Wachemo University (Nigist Eleni) Teaching & Referral Hospital, Bule Hora Teaching Hospital, Wolyeta Sodo University Teaching & Referral Hospital, Arbaminch University Teaching Hospital, Dilla University Teaching &Referral Hospital, Yirgalem General Hospital, and Hawassa University Teaching & Referral Hospital.

Sample Size: The sample size consisted of all new positive persons for HIV that were registered in each year for 10 consecutive years and the total number of deaths due to HIV/AIDS in each of the ten hospitals per year for the 10 consecutive years.

The screening and diagnostic test used to generate the data bases of the hospitals studied.

The screening and diagnostic test for HIV was based on a serial **National Algorithm of Ethiopia** that consisted of 3 inseparable tests (Test 1, Test 2, Test 3).
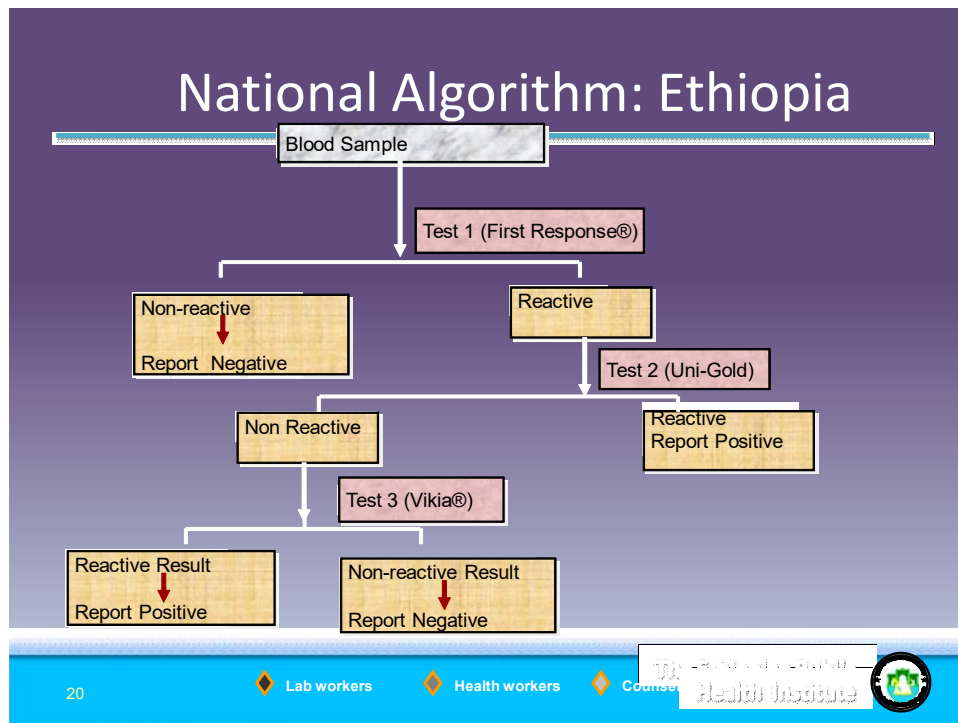
In the context of HIV-Test Algorithm, the term **Reactive** means **Positive** for HIV whereas

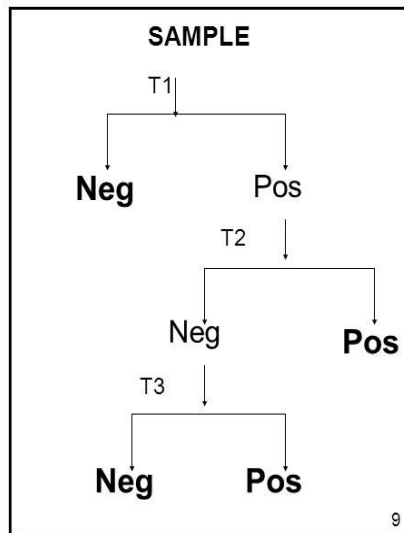**Non-reactive** means **Negative** for HIV.

The **Old Algorithm of Ethiopia** implemented for screening and diagnostic test of HIV, before the **New National Algorithm of Ethiopia** was the following one displayed in the box.

HIV Serial Rapid Test Algorithm

- **T1: Screening test**
  - If (+) go to T2

- **T2: Confirmatory test**
  - If (-) go to T3

- **T3: Tie breaker**

SAMPLE

T1

Neg   Pos

T2

Neg   **Pos**

T3

Neg   **Pos**

9

The difference between the **Old** and **New Algorithms of Ethiopia** is:- that in the **New Algorithm of Ethiopia** which replaced the old one and is currently in use in every hospital throughout Ethiopia, the First Response (i.e., Test 1) can identify HIV-1 and HIV-2 whereas the **Old Algorithm** could not depict that.

Definitions: An **algorithm** is defined as a combination and sequence of different specific tests used in a given strategy. A **strategy** is also defined as a testing approach used to meet a specific need, such as for blood safety, surveillance, and diagnosis. For a given strategy, multiple algorithms may be used depending on the needs of test settings.

Screening: There were times when large scale screening test campaigns of people for HIV infection in tents on road-sides had been executed, being sponsored by Ethiopian Government. Blind screening tests are also performed on many patients of hospitals for HIV infection. In Ethiopia at present, in order to establish a legal marriage contract between a male & female in Church, Mosque, Municipality, Court, or in rural locations of the country under the control of relative elders, it is obligatory for both the male & female to present a recent **Certificate** that verifies he/she is HIV-negative, from an authorized Health Center.

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Treatment: The government of Ethiopia is highly committed to increasing access to antiretroviral therapy, i.e., HIV treatment. In January 2005, Ethiopian government launched a program to provide access to HIV treatment free of charge and made a commitment to roll out the program across the country in 2005 and 2006, with the long-term objective of ensuring universal access to HIV treatment. Clinical guidelines on the use of antiretroviral drugs have been developed in accordance with international standards. The current model for delivering anti-HIV/AIDS treatment is physician-led and hospital-based. The health centres provide regular medical care services for HIV/AIDS patients so as to maintain them alive. Services for treatment adherence against HIV/AIDS are provided at the community level. Anti-HIV/AIDS drugs for treatments are distributed by licensed pharmacists. Whether an HIV-positive person is taking HIV treatment (i.e., with the group of drugs called ART drugs) or not, it is necessary for him/her to take additional group of drugs to prevent infections (prophylaxis). For example, he/she may need to take cotrimoxazole (Septrin) to prevent pneumonia until his/her CD4 cell count rises above 200 cells per ml of blood while on HIV treatment. Screening HIV patients for tuberculosis is one the tests to give treatment promptly if positive. Every HIV positive client is regularly checked by his/her medical care service provider hospital for opportunistic infections, change in body weight, and CD4 cell count/viral load every half to six months depending on the health status of the patient so as to provide the required treatment promptly. For instance, when the absolute CD4 cell count drops below 200 cells per ml of blood, preventative antibiotics may be prescribed for potentially life-threatening infections. The goal of HIV treatment is to lower the viral load below the detectable level (i.e., below 40-75 copies/ml of blood) and the clinical stage of HIV infection called AIDS cannot manifest itself in the client. According to the guidelines of WHO it would be wise to start HIV treatment by the time when CD4 cells count is less than 500 cells/ml of blood for HIV positive persons. If the body weight loss of HIV patient is serious because of malnutrition due to the economic inadequacy of the patient to take adequate diet, the healthcare provider hospital gives him/her ready-made & sealed bags of food that have the maximum nutritive value, free of charge, to increase the body weight of the concerned client. Injecting isolated pure CD4+ live T helper cells into needy HIV positive individuals is also applied.

III. Results

Table 2: Average pooled number of HIVpositive persons under medical care in each of 10 Hospitals after subtracting the average number of deaths in each year during each of ten consecutive years, Southern Ethiopia.
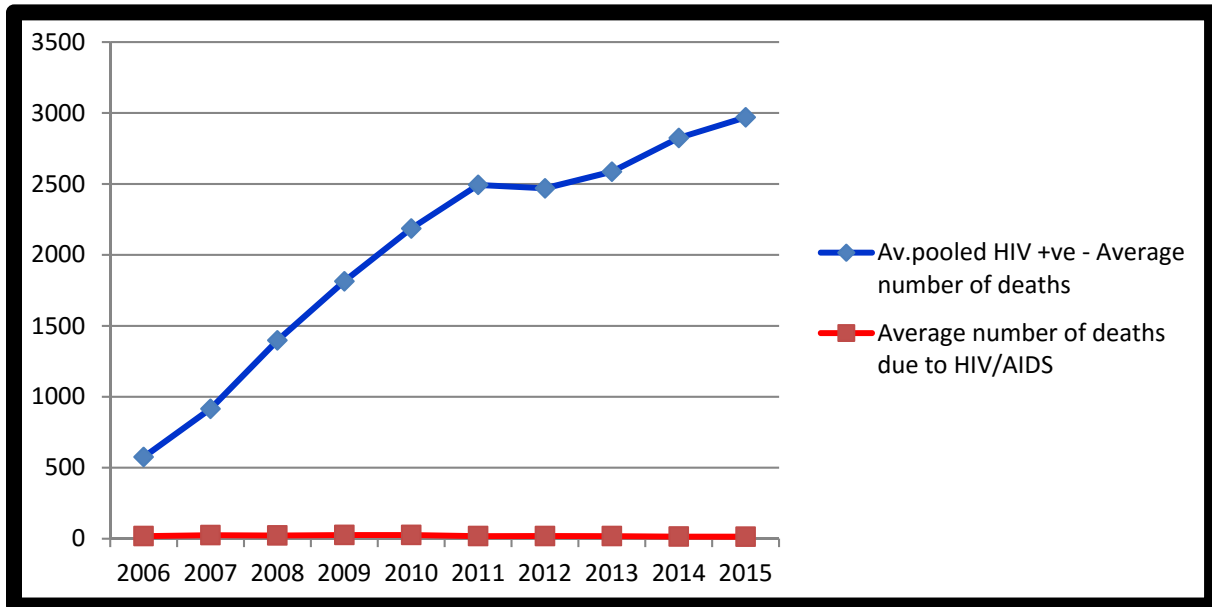
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Year	Pooled average number of HIV positive people alive after subtracting the average number of deaths for each of 10 consecutive years at each of ten hospitals	Average number of deaths due to HIV/AIDS per year during 10 consecutive years from 2006 to 2015 at each of ten hospitals
2006	575	18 (3.13%)$^{\neq}$
2007	915	25 (2.73%)
2008	1397	23 (1.65%)
2009	1814	26 (1.43%)
2010	2186	26 (1.19)
2011	2493	18 (0.72%)
2012	2469	19 (0.77)
2013	2586	18 (0.70%)
2014	2824	15 (0.53%)
2015	2969	14 (0.47%)

$^{\neq}$The percentile quantity in parenthesis adjacent to the value that meant "average number of deaths due to HIV/AIDS per year during 10 consecutive years from 2006 to 2015 at each of ten hospitals" represented the percentile death rate due to HIV/AIDS.

The ten hospitals of medical care service giving in favor of HIV positive persons and utilized as the first-hand information data sources of databases for this study project in Southern Ethiopia were:

►Bule Hora Teaching Hospital,

►Yirgacheffee Primary Hospital,

►Dilla Teaching & Referral Hospital,

►Yirgalem General Hospital,

►Hawassa Aser Private Primary Hospital,

►Hawassa University Teaching & Referral Hospital,

►Alaba Primary Hospital,

►Wachemo University (Nigist Eleni) Teaching & Referral Hospital,

►Wolyeta Sodo University Teaching & Referral Hospital, and

►Arbaminch University Teaching Hospital.

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Figure 3: The statistical graph of two curves, indicating:

1. the continuous increase in the average number of pooled HIV positive people after subtracting the average number of deaths (represented by **blue Curve**) in each of 10 consecutive years at each of ten different hospitals, and

2. an effective decline in the average number of deaths due to HIV/AIDS in each year during 10 consecutive years at each of ten hospitals.

The **red colored curve** in Figure 3 above that represented the average number of deaths in each year for 10 consecutive years was apparently a straight line and rested on the surface of a straight line, i.e., on X-axis, being in the **first quadrant** with the positive value of Y-axis.

The term "pooled" means the sum of all new persons positive for HIV in each of the preceding consecutive years. Example; if 81, 100, 103, 70, 64, and 102 were the numbers of new persons registered positive for HIV virus at a hospital called Y in 2006, 2007, 2008, 2009, 2010, and 2011 respectively, then the **pooled number** of HIV positive persons at hospital Y in:

(a) year **2009** = 81+100+103+70 = <u>354</u> ; (b) year **2011**= 81+100+103+70+64+102 = <u>520</u>
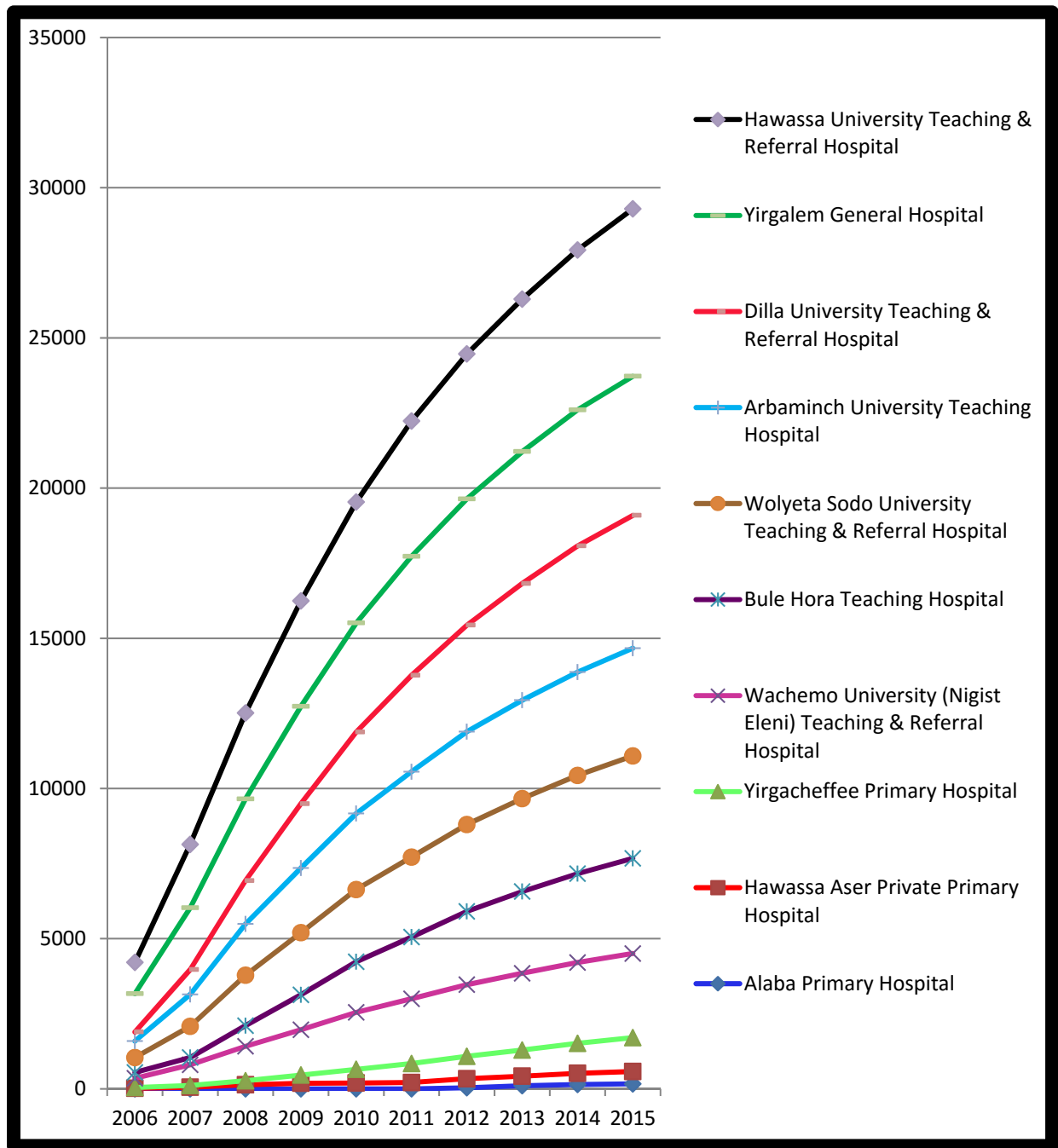
Table 3: Pooled number of HIV positive people alive after subtracting number of deaths during each of 10 consecutive years (i.e., 2006 to 2015) at each of the ten hospitals, Southern Ethiopia.

Year ➝	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015

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Alaba Primary Hospital							38	106	147	167
Hawassa Aser Private Primary Hospital	18	56	136	186	196	211	301	316	372	412
Yirgacheffee Primary Hospital	26	57	135	274	453	632	745	871	995	1127
Wachemo University (Nigist Eleni) Teaching & Referral Hospital	307	689	1145	1506	1899	2156	2384	2556	2692	2799
Bule Hora Teaching Hospital	195	243	689	1164	1683	2054	2439	2720	2958	3170
Wolyeta Sodo University Teaching & Referral Hospital	495	1038	1677	2068	2404	2662	2893	3095	3272	3409
Arbaminch University Teaching Hospital	550	1062	1707	2153	2531	2842	3091	3274	3437	3584
Dilla University Teaching & Referral Hospital	302	826	1442	2139	2713	3208	3545	3885	4200	4422
Yirgalem General Hospital	1274	2056	2718	3239	3628	3960	4201	4391	4528	4630
Hawassa University Teaching & Referral Hospital	1044	2112	2862	3515	4028	4505	4827	5077	5323	5575
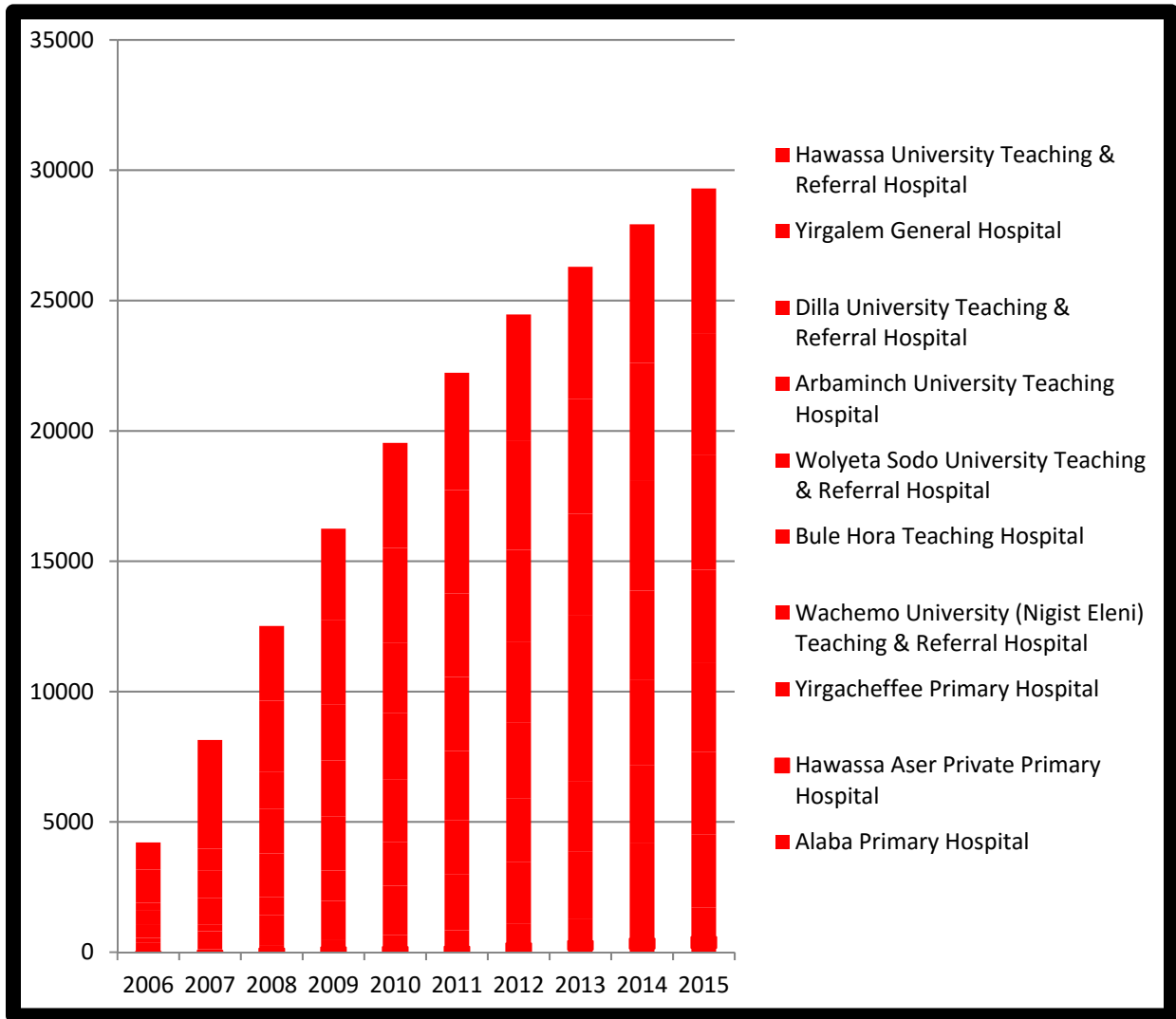
Figure 4: The statistic of histogram, depicting the regular increase in the pooled number of HIV positive persons per year after subtracting the number of deaths during each of the 10 consecutive years (2006 to 2015) at each of ten different hospitals, Southern Ethiopia.
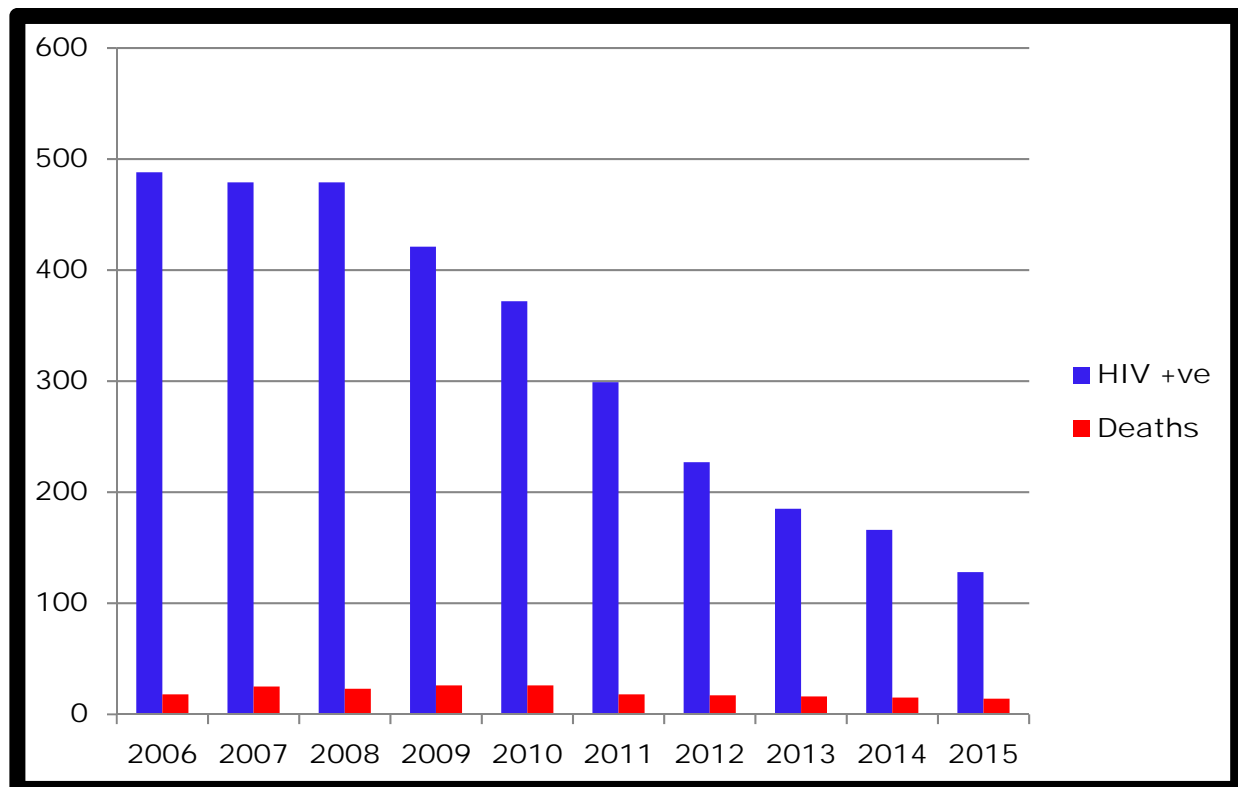
Figure 5: The statistical graph of multiple curves, showing the increase in the pooled quantity of HIV positive persons alive after subtracting the number of deaths during each of the 10 consecutive years (2006 to 2015) at each of ten different hospitals, Southern Ethiopia.

These HIV positive people were under regular care of medical service at each of the ten hospitals during the period of 10 consecutive years.

Table 1: The unpooled average number of new positive people for HIV in each of ten hospitals per year during 10 consecutive years and the average number of deaths due to HIV/AIDS in each of ten hospitals per year during the 10 consecutive years (2006 to 2015), Southern Ethiopia.

Year	Unpooled average number of new positive persons for HIV in each of ten hospitals per year during 10 consecutive years	Average number of deaths due to HIV/AIDS in each of the ten hospitals per year during 10 consecutive years
2006	488	18
2007	479	25
2008	479	23
2009	421	26
2010	372	26
2011	299	18
2012	227	17
2013	185	16
2014	166	15
2015	128	14

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Figure 2: The unpooled average number of new HIV positive people registered (**blue bar**) in each of ten hospitals per year during 10 consecutive years (2006 to 2015) and the similar relative decrease in the average number of deaths due to HIV/AIDS among those under regular care of medical service (**short red bar**) in each of the ten hospitals per year during the 10 consecutive years.

The statistic of the histogram (Fig. 2) above had showed that the unpooled number of new individuals infected with HIV & registered in each of the 10 consecutive years was regularly declining year after year. More or less there was also a marked decrease in the number of deaths among HIV positive persons who were under the regular service of medical care in each of the ten hospitals targeted at for the study.

V. Discussion

At the national level, this is a cross-sectional type of investigative study to work out the status of controlling HIV/AIDS epidemics in Southern Ethiopia. The major role players in the management of controlling the damage caused by HIV/AIDS epidemics are:

►national leaders as they are policy makers,

►professionals of quality health performance in providing a safeguarding care of medical

service for HIV positive persons, and

►cooperative, disciplined, and punctual utilization of the safeguarding care of medical services

by the client HIV positive people in health centers.

When it was observed for 10 consecutive years, the unpooled average number of new positive people for HIV in each of ten hospitals per year was declining and the corresponding/respective average number of deaths due to HIV/AIDS in each of the ten hospitals per year had also been pushed to decline (Table 1; Fig. 2). In the population of pooled average number of HIV positive people the percentile death rate was insignificant as it had been less than 5%, being in the range of 3.13% to 0.47% (Table 2; Fig. 3). This was so because the number of HIV positive people being alive in the study area had been increasing year after year whereas the percentile number of deaths due to HIV/AIDS was decreasing year after year during the same time.

The actual spectacular and continuous increasing trend in the pooled number of HIV positive people alive after subtracting the number of deaths during each of 10 consecutive years (i.e., 2006 to 2015) at each of the ten hospitals was directly observed in Table 3 and Figs. 4 & 5. This was the very reason for why the percentile number of death rate due to HIV/AIDS had been found to be insignificant in relation to the continuous increasing population size of HIV positive people alive year after year. Health professionals, were able to bring the percentile death rate due to HIV/AIDS down to the insignificant level mentioned above.

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Routine screening for intestinal parasitic infections in HIV positive people is of great validity to safeguard the patients by giving optional treatments promptly [27-37]. Ethiopian Anti-Retroviral Therapy (ART) Guidelines adopted from WHO Guidelines which involved the administration of CD4 to increase (boost) the immunity of the HIV/AIDS patients had been fully implemented. Despite the implementation of these guidelines of effective therapy, a few HIV infected persons died due to HIV/AIDS because of their own failure to follow the advice of medical care provider professionals to maintain them safe and alive [38]. The pandemic spread of HIV is being reined in by the performance of highly active antiretroviral therapy and reliable preventive measures. In spite of such achievements, it has been reported that in the United States alone, approximately 50,000 people are newly diagnosed (i. e., registered positive) for HIV annually and one in five people living with HIV are unaware of the fact that they are infected.

It must be clear that the number of new infected people with HIV in each of the new consecutive years is declining whereas the pooled number of HIV positive people alive in communities is spectacularly increasing. This means that the population size of HIV positive people is vividly in the trend of increasing in human communities so that the chance (probability) of getting infection with HIV is very high if one:

► is involved in multiple engagement of sex, and

► fails to implement preventative strategies such as being abstain or remain loyal to one to one

   sexual partnership.

The results of this study can be very strongly confirmed by the fact that Ethiopian health professionals are openly warning the public through mass-media about the sudden rise of HIV infections in some parts of Ethiopia currently.

Conclusion

Although the unpooled average number of new HIV positive people registered per year is declining, it is obvious that the pooled number of HIV positive people alive in human communities is rising up year after year and as a result the probability of being infected with this pathogenic virus is very high if one fails to be careful. Any person positive for HIV must be disciplined being cooperative with the medical care service provider experts' advice in order to be safeguarded and alive like any other uninfected person; otherwise, the devastating and horrifying tragedy can happen without delay. The average number of death rates due to HIV/AIDS in relation to the average number of pooled HIV positive people alive had been far less than 5%, being in the range of 0.47% to 3.13%. This achievement in medical care management is nearly equivalent to stopping death caused by HIV/AIDS!!

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Conflict of interest

I confirm that I don't have any competitive conflict of interest with any body.

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Ethics

Ethical permission/clearance to carry out this study was obtained from:- Dilla University,

Medical Directors/Managers of the ten different hospitals found in Southern Ethiopia.

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APPENDIX:

Original number (unprocessed raw data) of people positive for HIV/AIDS registered per year; taken directly from Databases, of 10 consecutive years (2006 to 2015), found at each of the ten different hospitals.

Year ➝	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015

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Name of Hospital										
Alaba Primary Hospital								40[†] (2)	69 (1)[‡]	50 (9)	30 (10)
Hawassa Aser Private Primary Hospital	18	38	80	50	10	15	90	15	5	40 (1)
Yirgacheffee Primary Hospital	35 (9)	66 (9)	74 (10)	144 (10)	177 (8)	174 (3)	119 (9)	121 (4)	123 (3)	136 (7)
Wachemo University (Nigist Eleni) Teaching & Referral Hospital	321(14)	410 (28)	472 (16)	371 (10)	407 (14)	270 (13)	243 (15)	186 (14)	156 (20)	127 (20)
Bule Hora Teaching Hospital	200 (15)	258 (15)	466 (35)	465 (25)	526 (32)	380 (41)	373 (29)	289 (37)	232 (31)	200 (19)
Wolyeta Sodo University Teaching & Referral Hospital	548 (53)	594 (51)	578 (43)	376 (28)	319 (11)	263 (16)	236 (21)	197 (16)	178 (17)	138 (18)
Arbaminch University Teaching Hospital	580 (30)	547 (35)	601 (21)	469 (44)	390 (56)	298 (43)	246 (40)	171 (28)	157 (22)	155 (30)
Dilla University Teaching & Referral Hospital	356 (54)	529 (59)	611 (54)	691 (48)	570 (44)	468 (17)	346 (26)	348 (34)	296 (15)	222 (15)
Yirgalem General Hospital	1283 (9)	789 (16)	667 (21)	516 (16)	387 (14)	329 (11)	240 (10)	187 (7)	134 (4)	101 (3)
Hawassa University Teaching & Referral Hospital	1047 (3)	1078 (10)	765 (15	705 (52)	561 (48)	495 (18)	340 (18)	271 (21)	2274 (28)	274 (22)

[†]In each box, the number outside of parenthesis "represents the number of new persons infected with HIV per year during 10 consecutive years".

[‡]In each box, the number in parenthesis adjacent to & on the right side of the number of HIV positive persons, "represents the number of deaths due to HIV/AIDS in each of ten hospitals per year during the 10 consecutive years".

Note:

1. Alaba Primary Hospital did not have database of HIV/AIDS from 2006 to 2011 because it was established in 2012 and that was why the original data were collected only in the last four years.

2. No numbers of deaths due to HIV/AIDS were recorded in Hawassa Aser Private Primary Hospital for it was not a government hospital and the government did not provide it with resources of giving regular medical care for HIV patients. As the result whenever persons were found positive for HIV, in Hawassa Aser Private Primary Hospital, had been sent immediately to government hospitals for regular medical care service.

3. It was only this raw datum (stated as an Appendix) that was used in:

-four of the Tables (Tables 1, 2, 3, 4), and

- four of the Figures (Figs. 2, 3, 4, 5) of this paper.