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HIV Estimation and Projection in Bangladesh up to 2030

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Abstract

HIV epidemic models are mostly applied to describe the HIV epidemic in a proper way. It is inconvenient sometimes to enumerate the accurate number of individuals living with HIV, newly infected with HIV, or who have died of AIDS as a result of the response. With this backdrop, this paper attempts to estimate and project the HIV epidemic trend in Bangladesh. To analyze the epidemiological and demographical HIV/AIDS estimates and projections for the period 2018-2030 in the Spectrum software package, two models – AIDS Epidemic Model (AEM) and AIDS Impact Model (AIM) were used. Several nationally representative data sources and program data were used for the analysis. At the end of 2030, the number of PLHIV might reach up to 30743 which is 2.2 times higher than in 2018 where the estimated number of newly infected with HIV will be increased to 2,225 in 2030 from 1,596 which is nearly 1.5 times higher than in 2018. The percentage share of males in new infections showed a downward trend while females represent an upward trend from 2018 to 2030.The annual AIDS death will be eventually decreasing between 2018 and 2030. Among sub-population groups, the percentage of current HIV infections will significantly rise for the PWID and low-risk people mostly low-risk females. According to the mode of transmission, the principal source of HIV infection was needle sharing among adults (15+) in 2018 (37%), which will gradually decrease to 24% in 2030. It is indispensable to evaluate HIV prevention programs and guiding national HIV/AIDS policies in Bangladesh, by estimating HIV and regular updating of the estimates will improve the understanding of the HIV/AIDS epidemic.

Keywords: Key population, People living with HIV (PLHIV), New HIV infections, HIV Deaths

1. Background

AIDS is a viral disease that has become known as 'the plague of the century' (Haghdoost, 2011). Globally the general trend of HIV is upward, however, in several countries the trend is downward. According to UNAIDS, an estimated 37.9 million people were living with HIV (including 1.7 million children) and 1.7 million new HIV infections were identified along with 1.1 million who died from AIDS (UNAIDS, 2019).

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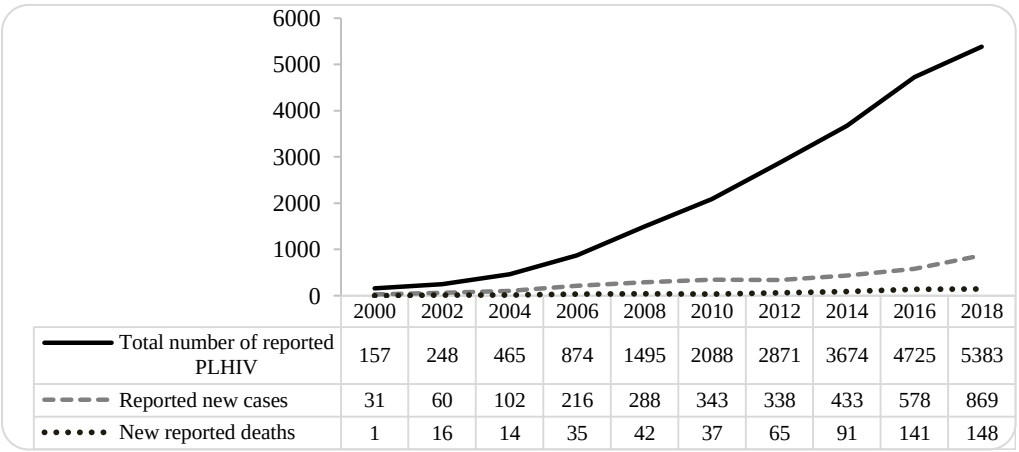
The government of Bangladesh (GOB) introduced an early response to the HIV (Human Immunodeficiency Virus) epidemic in the mid1980s. In 1989, the first case of HIV was diagnosed in Bangladesh, thereafter, there was a trend for increasing numbers of infections being recorded (MoHFW, 2015). Even though Bangladesh has still been considered a low-prevalence country for the HIV/AIDS epidemic, with an overall prevalence in the general population of less than 0.01 percent (over the years) it poses a major threat to an epidemic due to the high prevalence of HIV in the neighboring country (Sultana, 2019). Bangladesh is one of the seven countries in the Asia and the Pacific region where HIV new infections continue to increase (Stover, *et al*., 2006). Every year on World AIDS Day, the Ministry of Health and Family Welfare (MoHFW) releases statistics on the number of people living with HIV (PLHIV) and deaths from AIDS in Bangladesh, and these figures have been continuously growing as shown in Figure 1. As of October 2018, there were cumulatively 6,455 HIV reported cases (including FDMN cases) of whom 1,072 have died. In 2018, the reported number of PLHIV was 5,383 (ASP, 2018), with an estimated 13,800 PLHIV (ASP & UNAIDS, 2019).



	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018
Total number of reported PLHIV	157	248	465	874	1495	2088	2871	3674	4725	5383
Reported new cases	31	60	102	216	288	343	338	433	578	869
New reported deaths	1	16	14	35	42	37	65	91	141	148

Figure 1. HIV Situation in Bangladesh, 2000-2018

A well-planned response to describe the HIV epidemic and estimate the correct number requires accurate information about the disease over time. In such cases, HIV epidemic models are often the most appropriate way to describe the HIV epidemic (Haghdoost, 2011). After the recognition of HIV, the uncertainty about the present and future dimensions of HIV infections led to the development of many models to estimate the current extent of the HIV/AIDS epidemic and to make projections about its future. Some HIV/AIDS model uses reported data which can be used for short-term projections in such areas where case reporting is relatively reliable and complete. But there is a larger possibility of delayed reporting or incomplete reporting, in this circumstance such models need adjustments and the trend will continue in a similar pattern over the next few years which may not give valid projections. In the current

global financial climate, reliable estimates are necessary using some valid models to forecast the future trends of HIV cases.

Under these circumstances, this article attempts to estimate the HIV epidemics in Bangladesh as well as obtain the future projections of HIV infection using some analytical models. It is anticipated that the analysis of the findings will help the policymakers and relevant stakeholders to perceive the extent and trends of the HIV pandemic in Bangladesh and to develop country-specific HIV interventions.

2. Materials and Methods

Estimation and Projection Models

For the period 2018-2030, the AIDS Epidemic Model (AEM) and Spectrum model package were used to provide epidemiological and demographic HIV/AIDS estimates and forecasts. Initially, the AIDS Epidemic Model (AEM) was used to estimate HIV prevalence; however, by importing the existing AEM projection into Spectrum, the number of HIV positive people, new HIV infections, AIDS-related deaths, and those in need of ART (anti-retroviral treatment) can be easily estimated and projected.

The AIDS Epidemic Model (AEM) provides potential and realistic pictures of the HIV epidemic and was used mainly for estimating epidemiological and behavioral trends among HIV populations (Brown & Peerapatanapokin, W., 2004). On the other hand, Spectrum has accessibility to more extensive demographic data and can thus assess and predict the demographic, socioeconomic, and other consequences of HIV epidemics (Stover,*et al*., 2006) (Stover, *et al*, 2017). In Spectrum, one of the primary components of which is an AIDS Impact Model (AIM). AIDS Impact Model was used for projecting the consequences of the HIV epidemic, new infections, and AIDS deaths, ART need by age, and sex.

Model Input Assumptions

To produce a Spectrum model, a historical trend of several indicators was required for children and adults, the latter by sex. e. g.

- Adult and adolescent eligibility criteria for ART;
- Number of women getting PMTCT prophylaxis by regimen;
- ANC testing results (for consistency check) Adults receiving ART by sex and children getting ART;
- Children receiving cotrimoxazole and
- HIV status and viral suppression knowledge.

Using this model, the number of new infections can be calculated as (Huq, *et al.*,2020):

$$N_{new\_infection} = n_{contacts\_HIV}\, P_{per\_contact}$$

Where $n_{contacts\_HIV}$ denotes the total number of unprotected contacts with HIV positive partners which can be calculated as:

$$n_{contacts\_HIV} = size\ of\ risk\ group \times Frequency\ of\ contacts \times HIV\ prevalence\ of\ partners(\text{Chance to meet positive partners}) \times fraction\ unprotected$$

and,

$$P_{per\_contact} = transmission\ probability \times Adjustments\ for\ STI\ \&\ circumcision$$

Moreover, trends by regimen should be provided into the model in the number of women who are pregnant receiving ARVs for prophylaxis. Besides, to determine the impact of HIV, several demographics, epidemiological, and clinical information are optional.

The AEM, on the other hand, has more rigid input requirements than Spectrum. The inputs assume several behavioral and epidemiological indicators as inputs:

- Biological data trends: HIV prevalence, STI prevalence, circumcision in males;
- Behavioral data trends (sexual): Frequency of sexual activity, condom use with different partners, duration of sex work/clienthood (for turnover);
- Behavioral data trends (injecting): Frequency of injection, level of needle sharing, duration;
- Sizes of key populations: Entered as a percentage of adult male or female population;
- Programmatic data trends: Number receiving ART by gender and
- Unit cost data: Unit cost for each program/KP.

Data Source

HIV/AIDS epidemiological data were driven from National Serological and Behavioral Surveillance Reports, Bangladesh Demographic and Health Surveys, and other nationally representative surveys conducted by ICDDR, B, Save the Children, WHO, UNICEF, and the Ministry of Health and Family Welfare's AIDS/STD Program (ASP) to generate historical trends and short-term HIV projections for key indicators (e.g. the number of people living with HIV, the number of new HIV infections, the number of PMTCT, the annual death rate due to AIDS and treatment coverage (ART) for AIDS). These indicators are useful to evaluate the epidemic trends and to observe the overall impact of the national response and in planning for future needs.

Data Limitations

Although most of the data existed, some of the indicators were based on sample size, based on assumptions, e.g. IDU high-risk network and mortality, mobility among key population groups, male circumcision. Additionally, in the case of Key Populations, HIV prevalence numbers for transgender individuals were adjusted because the data is only available for Transgender sex worker people. These modifications have been made with the assistance of specialists from the National HIV Epidemic Estimation Working Group and public health professionals.

3. Results

Epidemiological Estimates and Projections up to 2030

Figure 2 represents the model estimates which reveal that the total number of PLHIV is 13,846 in 2018 and this might reach up to 30,743 by 2030 which is 2.2 times higher than in 2018. The projected number of new HIV-infected population will rise to 2,225 in 2030which is nearly 1.5 times higher compared to the epidemiological estimate in 2018 (1,596). Above all, it can be inferred that the number of HIV-positive people and newly infected people in Bangladesh will continue to grow in the future years

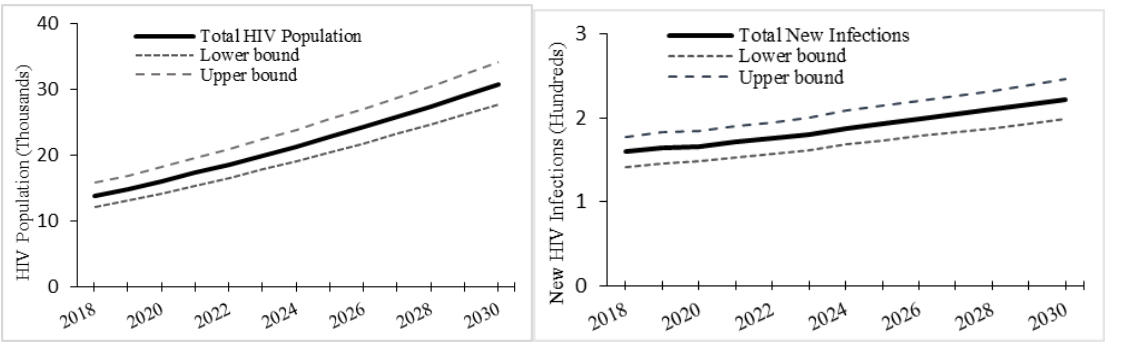


Figure 2. Estimated Number of HIV/AIDS People and New Infections (2018-2030**)**

Percentage of New Infection by Gender Distribution (2018-30)

The projected number of new HIV infections by gender indicates a greater percentage of males (67.5%) than females (32.5%) in 2018. For generalized epidemics, the assumption was that there would be more males infected than females, whereas later in the epidemic there would be more females. The ratio of males to females decreases slowly from 2.07 at the ending of 2018, stabilizing at 1.65 after ten years. The projection of new infections among males represents a downward trend where the projection among females represents an upward trend from 2018 to 2030 (Figure 3).

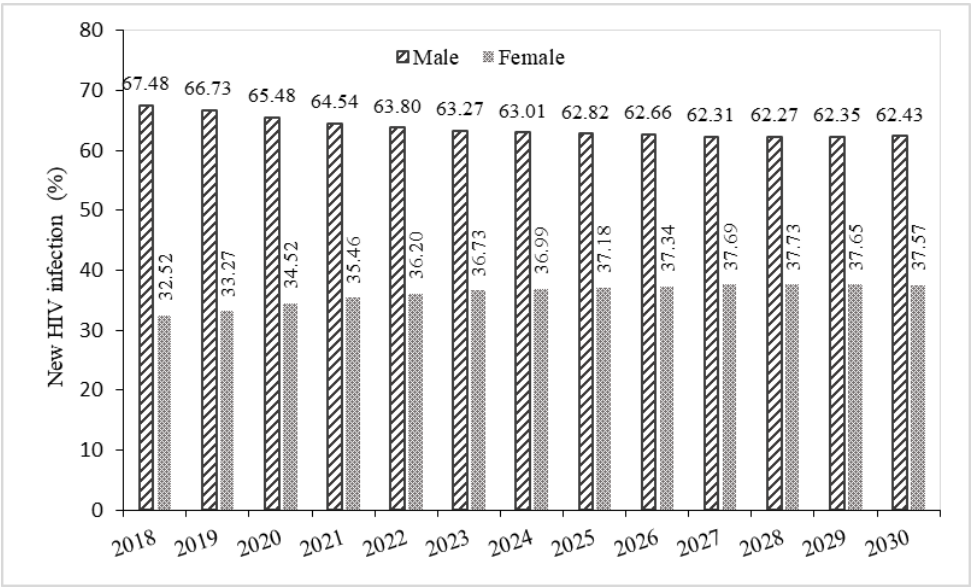


Figure 3. Projection of New HIV Infections by Gender Distribution (2018-2030)

Number of New Infections among Different Age Groups

The different age distribution reveals that there will not be any significant changes in the estimated number of new HIV infections among children (0-14), young (15-24), and adult (25+) population i.e., the number should be slightly changed in the upcoming years. HIV infection is significantly increasing mostly among the adult (25+) population from 2018 to 2030 compared to the young population and children. More specifically, the projection of current infections among adults (25+) will increase up to 1897 in 2030, as compared to 1329 in 2018.

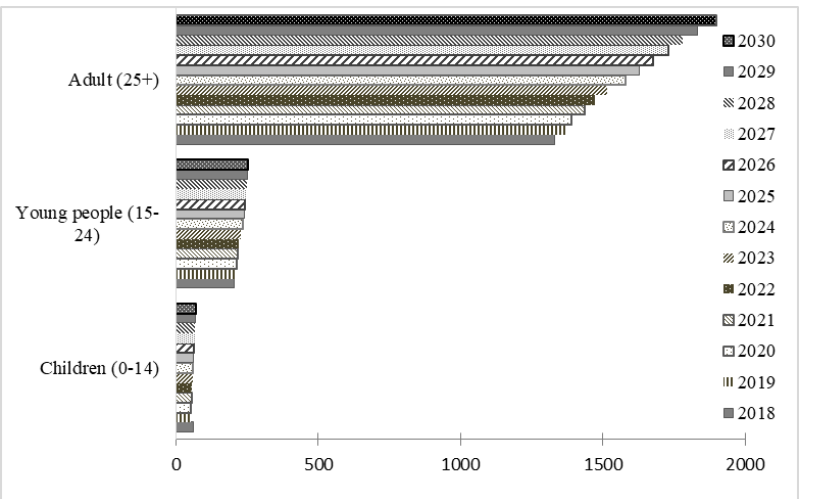


Figure 4. Estimated Number of New Infections among Different Age Groups

HIV Epidemic by Age and Gender Distribution

Table 1 represents the projection of the HIV epidemic for the year 2018-2030 by different age groups and gender. While the number of HIV positive cases, new HIV infections, and ART patients will grow yearly from 2018 through 2030, despite considerable variance in estimates across age groups and gender, annual AIDS deaths will gradually decrease.

The overall number of HIV-infected people is predicted to be13846 with 392 children (0-14) and 13454 adults (15+) in 2018, subsequently, it is increasing and reached a peak in 2030 (527 children, 30215 adults cases). The overall number of new HIV infections is predicted to be 1596 in 2018, with 62 infections in the children (0–14) and 1,534 infections in the adults (15+). The projection till 2030 indicates, the number will increase up to 72 in the children and 2,153 in the adults (15+).

Gender segregation reveals the number of male PLHIV will be increased from 8863 in 2018 to 19329 till 2030, where female PLHIV will be increased from 519 in 2018 to 836 till 2030. The number of new HIV infection cases increased from 1077 cases in 2018 to 1389 in 2030 among males and females, the number increased significantly from 519 in 2018 to 836 in 2030.The estimated annual AIDS deaths among children and adults are 578 in 2018 and the estimated number of deaths will begin to decline slightly, falling to 255 in 2030. The estimated number on ART will be estimated to be 20,969 in 2030 as compared to 2,757 in 2018 which is 8 times higher over the period.

Table 1. Estimated Number of HIV Epidemic in Bangladesh among Different Age Groups and Gender, 2018-2030

Indicators	**Estimated Number of People**							
	Age Distribution	**2018**	**2020**	**2022**	**2024**	**2026**	**2028**	**2030**
PLHIV	Children (0-14)	392	407	423	442	467	499	527
	Adult (15+)	13,454	15,634	18,149	20,866	23,796	26,925	30,215
New HIV Infections	Children (0-14)	62	54	58	61	65	69	72
	Adult (15+)	1,534	1,603	1,696	1,815	1,922	2,030	2,153
Annual AIDS Deaths	Children (0-14)	34	32	33	30	27	29	31
	Adult (15+)	544	301	252	239	215	211	224
Number on ART	Children (0-14)	123	131	139	172	200	211	221
	Adult (15+)	2,634	6,006	8,789	12,349	15,699	18,164	20,749
Indicators	**Gender Distribution**	**2018**	**2020**	**2022**	**2024**	**2026**	**2028**	**2030**
PLHIV	Male	8,863	10,318	11,925	13,608	15,408	17,317	19,329
	Female	4,983	5,722	6,647	7,700	8,855	10,106	11,413

Indicators	Estimated Number of People							
	Age Distribution	2018	2020	2022	2024	2026	2028	2030
New HIV Infections	Male	1,077	1,085	1,119	1,182	1,245	1,307	1,389
	Female	519	572	635	694	742	792	836
Annual AIDS Deaths	Male	354	183	155	147	128	123	129
	Female	224	150	130	122	114	117	126
Number on ART	Male	1,797	4,226	5,942	8,091	10,093	11,598	13,171
	Female	960	1,912	2,986	4,431	5,806	6,777	7,798

The Number of New HIV Infections by Mode of Transmission among Adults (15+)

Figure 5 reveals that the leading source of HIV infection was needle sharing among the adult population (15+) 574 (37%) in 2018 and it will gradually decrease to 504 (24%) in 2030. The proportion of new infections due to unprotected male-to-male sexual intercourse has climbed from 8% in 2018 to 14% in 2030. Whereas casual sex, the heterosexual relationship among spouses (wife to husband) should remain stable in upcoming years (2018 to 2030). Moreover, in 2018, transmission stands at 384 from husband-to-wife, and sex work at 377, and by the year 2020, these numbers should be 589 and 620 respectively.

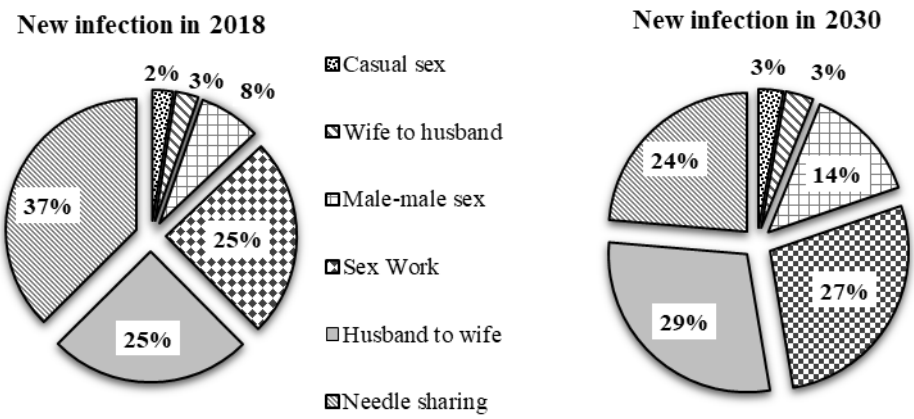


Figure 5. Estimated Number of New Infections by Mode of Transmission among Adults (15+)

People Currently Living with HIV among Adult (15+)

The number of PLHIV among adults (15+) is estimated to be 13,476 in 2018 and might reach 24,564 by 2030, i.e., increasing over the period. (Figure 6). The rapid increase in HIV prevalence among many key population groups indicates that there will be no substantial change in the number of MSW, TG, FSW, and MSM between 2018 and 2030, indicating that the number will remain stable in the coming years. In comparison, between 2018 and 2030, the number of current HIV infections will increase dramatically

among PWID and low-risk individuals. In 2030, the number of current HIV infections among low-risk females would increase to 8259, up from 4481 in 2018.

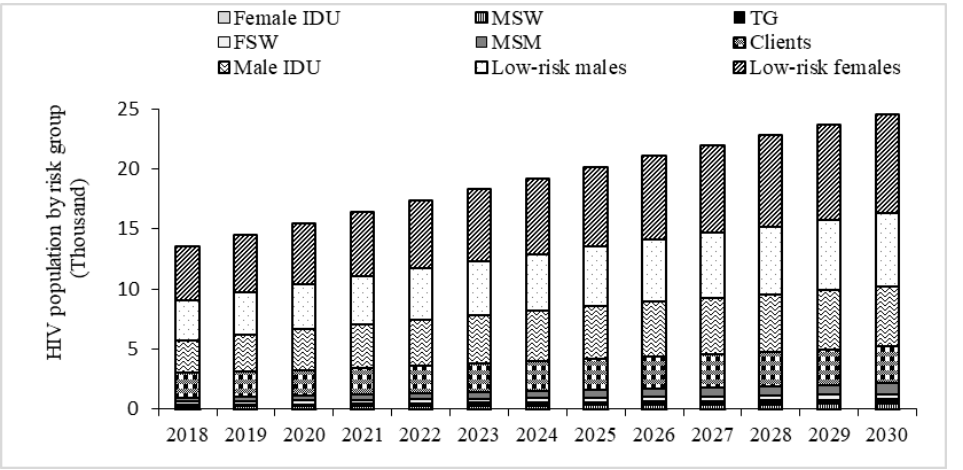


Figure 6. The Estimated Number of People Living with HIV (PLHIV) among Adults (15+)

4. Discussion

The present scenario of the HIV epidemic in Bangladesh is still in its early stages, even though the upward trend of the number of cases reported annually is low but steady. The main focus of this research article was to present the epidemiological profile of HIV infection in the country. More crucially, in the next years, the rising rate of new HIV infections among females will be more severe than among males, needing a greater focus on females. Additionally, HIV transmission occurs mostly through the exchange of discarded needles and syringes between PWID from unprotected paid sex with sex workers and unprotected male to male sex. To address this problem, effective HIV prevention initiatives are urgently needed.

5. Conclusion

Evaluating the scale and patterns of Bangladesh's HIV pandemic, it is anticipated that the analysis of the findings will help the policymakers and relevant stakeholders not only to counteract the deadly consequences of the disease but also to assess the effectiveness of different HIV control or prevention programs that have already been taken in the country. The future projections of the epidemic will also generate evidence to take appropriate measures and design effective prevention programs in Bangladesh.

Limitations

This study utilizes the information up to the year 2018. Situations may have changed by this time which could not be captured by this study due to data limitations.

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