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Population-Based Estimates of Life Expectancy After HIV Diagnosis. United States 2008 – 2011

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Abstract

Introduction—Using National HIV surveillance system data we estimated life expectancy and average years of life lost among person diagnosed with HIV infection during 2008–2011.

Methods—Population-based surveillance data, restricted to persons with diagnosed HIV infection age 13 years or older, from all 50 states and D.C. were used to estimate life expectancy after HIV diagnosis using the life table method. Generated estimates were compared with life expectancy in the general population in the same calendar year to calculate average years of life lost (AYLL). Life expectancy and average years of life lost were also estimated for subgroups by age, sex and race/ethnicity.

Results—The overall life expectancy after HIV diagnosis in the United States, increased 3.43 years from 25.43 (95% Confidence interval (CI) 25.37–25.49) in 2008, to 28.86 (95% CI 28.80–28.92) in 2011.

Improvements were observed irrespective of sex, race/ethnicity, transmission category and stage of disease at diagnosis, though the extent of improvement varied by different characteristics. Based on the life expectancy in the general population, in 2010 the AYLL, were 12.8 years for males and 16.5 years for females. By race/ethnicity, on average blacks (13.3 years) and whites (13.4 years) had fewer AYLL than Hispanic/Latinos (14.7).

Conclusions—Despite improvements in life expectancy among people diagnosed with an HIV infection during 2008–2011, disparities by sex and by race/ethnicity persist. Targeted efforts should continue to further reduce disparities and improve life expectancy after HIV diagnosis.

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Keywords

Life expectancy; HIV; population-based

Introduction

Introduction of highly active antiretroviral therapy (HAART) in the mid-1990s brought significant improvement in survival of people living with diagnosed human immunodeficiency virus (HIV) infection (PLWDH). Previous estimates of survival or life expectancy after HIV diagnosis showed an increase from 10.5 years in 1996 to 22.5 years, in 2005¹ among people who were diagnosed with an HIV infection during that period. As treatments have evolved further, it is plausible that life expectancy after an HIV diagnosis has improved since the last estimates. Survival and life expectancy are also important measures to determine disparities in HIV care and treatment outcomes, and contribute to monitoring national objectives to reduce disparities and HIV-related mortality set by National HIV/AIDS Strategy and the Healthy people 2020^{2,3}. Another quantitative measure of changes in life expectancy is the average years of life lost (AYLL), after a change in health status, such as diagnosis of a disease. The AYLL (also called potential years of life lost) is an estimate of the number of years of life 'lost' because of premature mortality occurring in a person with a certain health condition. At the population level, in HIV's context, AYLL represent the average number of additional years a person living with diagnosed HIV would have lived if that person had not died prematurely⁴. The knowledge of AYLL can be useful in drafting legislation and resource allocation, and serve as a measure of an individual's disease burden for improving planning for clinical care⁵.

While some estimates of mortality and life expectancy are available⁶⁻¹¹, the studies were either done outside of the United States or on a subset of PLWDH, such as those receiving care at a particular health care facility, and therefore did not represent large population-based estimates of life expectancy. The only large surveillance-data based estimates of life expectancy available from the United States¹ covered PLWDH, with HIV diagnosed by year 2005 and included data from only 25 states. With advancements in treatment and the potential impact on life expectancy following HIV diagnosis, these estimates need to be updated with new and more recent data representing the entire country.

We used National HIV Surveillance System (NHSS) data from all 50 states and Washington D.C. to estimate the life expectancy among people who were diagnosed with an HIV infection during 2008–2011. We also estimated AYLL in the year 2010 by comparing the life expectancy estimates generated by our analysis with the life expectancy of the general U.S. population for that year.

Methods

As part of NHSS, all states and the District of Columbia have reported cases of acquired immunodeficiency syndrome (AIDS) to the Centers for Disease Control and Prevention (CDC) since the early 1980s. Starting in 1994, jurisdictions that adopted confidential name-based HIV surveillance started reported cases of HIV infection to CDC. By April of 2008,

all 50 states and District of Columbia had implemented confidential name-based HIV surveillance. In this analysis, NHSS data from entire country were used to estimate the life expectancy after HIV diagnosis among adults and adolescents (≥ 13 years of age) during 2008–2011. All data reported to the CDC through June 2013 were used. This allowed for a minimum period of 18 month for reporting of deaths occurring by the end of 2011. All deaths, irrespective of cause, among people with diagnosed HIV infection were included in this analysis and data were adjusted for reporting delays and missing risk factors^{12,13}.

Following National Center for Health Statistics' (NCHS) approach, we modeled life expectancy after HIV diagnosis, using the period life table method¹⁴ that is based on the mortality experience of a hypothetical cohort and assumes that the age-specific death rates remain unchanged in future years. This means that persons who will be in a given age bracket in the future will experience the same age-specific death rates as the one experienced by persons currently in that age bracket. We used an exponential model for estimating age-specific death rates, in which the death rates within one year after diagnosis of HIV and deaths rates more than one year after diagnosis were estimated separately, because the death rates in the two time periods are quite different¹⁵.

We estimated overall life expectancy in each of the four years of diagnosis (2008–2011) as well as by selected characteristics of interest that included sex at birth, race/ethnicity, HIV stage at diagnosis and HIV transmission category. Race/ethnicity was categorized into four categories; black/African American (hereafter referred to as black), Hispanic/Latino, white and 'other races' representing a cumulative category for all minority races/ethnicities other than blacks and Hispanics/Latinos. HIV stage at diagnosis was categorized into two categories; stage 3 [AIDS] vs. other that included persons whose stage at diagnosis was unknown. We also estimated life expectancy separately for males and females by the four HIV transmission categories among males [male-to-male sexual contact, injection-drug use (IDU), male-to-male sexual contact *and* IDU, and heterosexual contact), and by two transmission categories among females (IDU and heterosexual contact].

We estimated AYLL by sex and by the age at HIV diagnosis, by subtracting the estimated life expectancy of the person with an HIV diagnosis from the life expectancy of an individual of the same age and sex, in the general population in 2010, using NCHS vital statistics data for 2010¹⁴.

Results

In the four years from 2008 to 2011, an estimated total of 184,749 persons were diagnosed with HIV in the United States. The total number of diagnoses each year decreased from 2008 through 2011. This decrease was also observed across both sexes, most races/ethnicities, and by stage of disease at diagnosis. However, the distribution of diagnoses by sex, race/ethnicity and stage at diagnosis remained similar across the years. By transmission category, a similar decline was observed except among males with infection attributed to male-to-male sexual contact [hereafter referred to as men who have sex with men (MSM)], which showed a slight increase (<2%) in numbers from 2008 to 2011 (Table 1).

In the four-year period from 2008 to 2011, the overall average life expectancy after HIV diagnosis in the United States, increased 3.43 years from 25.43 (95% Confidence interval (CI) 25.37–25.49) in 2008, to 28.86 (95% CI 28.80–28.92) in 2011, representing a 13.5% increase over the four year period with an average and fairly steady increase of about 4.5% per year. Life expectancy in each of the 4 years represented a statistically significant increase from the previous year, as determined by the non-overlapping 95% CIs. Although improvements were observed in both sexes, the life expectancy was better for males as compared to females. In each year from 2008 to 2011, males generally had higher life expectancy than females and also experienced a larger increase in life expectancy (3.64 years) compared with females (2.64 years). Persons with late-stage disease at diagnosis (stage 3 [AIDS]) had a life expectancy that was on average 6.6 years lower than that for persons with HIV not classified as stage 3. This pattern and the magnitude of difference were consistent across all 4 years (table 2).

By race/ethnicity, Hispanics/Latinos had a longer life expectancy than any other race/ethnicity throughout 2008–2011 (table 2). The lowest life expectancy in 2008 was observed in blacks (23.68), whereas ‘other races’ (minorities other than blacks and Hispanics/Latinos), had the lowest life expectancy in years 2009–2011. The largest difference between any two races/ethnicities was observed in 2010, when Hispanics/Latinos had a life expectancy 5 years longer than ‘other races’. The difference between life expectancies of Hispanics/Latinos and blacks that was 4.59 years in 2008 shrank steadily over the four-year period to 2.34 years in 2011. When comparing whites with blacks similar shrinking of difference, with eventual reversal was observed. In the year 2008, whites experienced 2.02 years longer life expectancy than blacks. However, this difference consistently reduced in the following years to 0.46 years in 2010 and eventually reversed to 0.68 years favoring blacks (table 2). While all races/ethnicities experienced an improvement in life expectancy 2008–2011, blacks experienced the largest gain (4.78 years), followed by Hispanics/Latinos (2.52 years), whites (2.08 years) and other races (1.42 years). Percent wise, blacks’ life expectancy increased by 20.2%, Hispanics/Latinos 8.9%, whites 8.1% and other races 5.8% (Table 2).

By transmission category, among males, in each year from 2008 to 2010, the longest life expectancy was observed among MSM, followed by males with infection attributed to male-to-male sexual contact *and* IDU, heterosexual contact, and finally IDU (table 2). In 2011, life expectancy of MSM (32.30, 95% CI 32.22–32.39) was 12.06 years (60%) higher than the life expectancy of males with infection attributed to IDU (20.24, 95% CI 20.0–20.48). Among females, in each of the four years life expectancy was higher among those with infection attributed to heterosexual contact compared with those with infection attributed to IDU. In 2011, females with infection attributed to heterosexual contact had a life expectancy of 27.90, 95% CI 27.75–28.05 vs. 21.36, 95% CI 21.08–21.64, among females who inject drugs. This represents a 6.54 years (31%) higher life expectancy in females with infection attributed to heterosexual contact, compared with females whose HIV infection was attributed to IDU. Persons in all transmission categories and both sexes experienced significant increases in life expectancy from 2008 to 2011. Percent wise, from 2008 to 2011, the largest (14.2%, 2.66 years) and smallest (7.6%, 1.96 years) increases were among females with infection attributed to IDU and heterosexual contact, respectively. Among

males, increases of 13.4% (2.39 years), 12.8% (3.00 years), 12.7% (2.65 years) and 10.2% (3.00 years) were observed in males with infection attributed to IDU, male-to-male sexual contact and IDU, heterosexual contact, and male-to-male sexual contact, respectively (Table 2).

Although overall, females had lower life expectancy than males, when limited to either injection-drug use or heterosexual contact, the life expectancy among females was longer than that among males. Females who injected drugs had 1-2 years longer life expectancy than males who injected drugs, while the life expectancy among females with HIV infection attributed to heterosexual contact was about 4-5 years longer than males with infection attributed to heterosexual contact.

Using the life expectancy in the general population by age, sex and race as reference, in 2010 the AYLL were 12.80 years for males and 16.53 years for females. At ages, 20, 40, 60 and 80 years, males who were diagnosed with an HIV infection in 2010, had AYLL of 17.57, 14.14, 10.35 and 6.16 years respectively. For females diagnosed with HIV infection in 2010, at ages 20,40, 60 and 80 years the AYLL were 24.53, 18.29, 12.08 and 7.31 years respectively. By race/ethnicity, on average blacks (13.26 years) and whites (13.43 years) had fewer AYLL than Hispanic/Latinos (14.72). Life expectancy along with AYLL, among persons diagnosed with HIV infection in year 2010 at five-year age intervals and sex are presented in table 3. Estimated AYLL at age at diagnosis in 2010, by sex and by race/ethnicity are graphically presented in figures 1 and 2 respectively.

Discussion

The life expectancy of people who were diagnosed with an HIV infection during 2008–2011 presented in this paper represents the first estimates using data from all 50 U.S. states and the District of Columbia (D.C.). The results show that the life expectancy improved over the four-year interval 2008–2011 for all populations from 25.43 years in 2008 to 28.86 years in 2011, representing an increase in life expectancy of 3.43 years or 13.5%. While similar life expectancy estimates have been reported by other studies in the era of HAART^{9,16}, the direct comparison of results is difficult, as the published estimates in contemporary literature show large variation because of varying methodologies, time spans studied, and populations of interest. Our results also indicate that during 2008–2011, the life expectancy for persons diagnosed with HIV infection has continued to improve since the publication of last estimates using more limited HIV surveillance data from 25 states, that compared pre- and post-HAART eras¹.

MSM consistently had longer life expectancy than persons with HIV infection attributed to any other transmission category and on average expected to live more than a decade longer than persons with HIV infection attributed to IDU; who in turn had a worse life expectancy than persons in any other transmission category, consistent with earlier findings¹⁷. The high mortality among persons who inject drug may be due to other risk factors related to IDU that lead to premature mortality, such as cigarette smoking, comorbidities, drug overdose and barriers to accessing HIV care and medications. A recent study found that among a cohort of approximately 18,000 HIV-infected individuals, smokers suffered from higher mortality

than non-smokers (mortality rate ratio; 1.94, 95% CI 1.56–2.41)^{18,19}. Persons who inject drugs are also more likely to have other comorbidities, such as hepatitis-C infection and mental illnesses, and also face health-care access challenges²⁰⁻²³. A study in New York City found that among HIV-HCV co-infected individuals, 60% had their infection attributed to injection drug use²².

Additionally, the role of social determinants of health such as low education, high poverty, discrimination and low access to and poor retention in health care that negatively affect life expectancy cannot be ruled out²⁴⁻²⁸. All these factors have been shown to have an association with IDU²⁹⁻³¹

Life expectancy of females was lower than that of males, and since life expectancy of females in the general population is longer than that of males, the AYLLS for females in 2010, were higher than for males at all ages at diagnosis. We found that in 2011 the life expectancy of younger females (<40 years at HIV diagnosis) was less than that of males that were the same age at HIV diagnosis. However this pattern reversed in older age groups, with females who were 40 years of age or older at HIV diagnosis, had slightly better life expectancy than men who were diagnosed at age 40 or older. Since men with infection attributed to male-to-male sexual contact have longer life expectancy than men with infection attributed to other causes and because a large proportion of HIV-infected MSM are diagnosed at a young age³², it helps explain the better life expectancy seen among males in the younger age groups. This explanation is further supported by the fact that when comparisons across sex are made within the transmission categories common to both sexes, i.e., injection drug use and heterosexual contact, females have longer life expectancy than males (table 2).

Hispanics/Latinos had higher AYLL in 2010, than either blacks or whites, and the difference between Hispanics and whites, and Hispanics and blacks, increased slightly with increasing age at diagnosis until about age 50 and then reduced a little as age at diagnosis pushed into older years (Figure 2). Hispanics/Latinos are more likely to enter care late and are more likely to discontinue treatment than whites^{33,34}, which helps explain the higher AYLL among Hispanics/Latinos infected with HIV. Although life expectancy of blacks in the general population is slightly lower than that of whites, and blacks with diagnosed HIV have a higher rate of death than whites diagnosed with HIV, the life expectancy of the two groups was similar, with blacks showing a slightly longer life expectancy than whites in 2011. The apparent paradox is explained by the fact that HIV tends to be diagnosed at an earlier age in blacks as compared to whites. Indeed, among person diagnosed with HIV in 2011; among blacks 27.4% were diagnosed before reaching 25 years of age, and 53.4% were diagnosed before age 35. The percentages among whites were 13.6 and 39.8 respectively³⁵.

The results of these analyses can be a useful resource for clinicians as well as policy makers. They can guide patient-provider communications on prognoses and expectations after an HIV diagnosis; whereas policy makers may find these results to be a useful guide for estimating costs for care and resource allocation.

Our estimates' biggest strength is that they are based on data from the entire country with documented high completeness of reporting, instead of a sub-sample of states. However, there still are a few limitations of our analysis. Not all HIV diagnoses may have been included, as some states offer anonymous HIV testing, which are not reported to HIV surveillance. Additionally person who are HIV infected, but not yet diagnosed are also not included in the surveillance data. However these factors are unlikely to have a significant impact on our estimates as it has been estimated that HIV-infected, yet undiagnosed persons make up only about 12.8% of the total persons infected with HIV in the United States³⁶.

Another limitation of our estimates is that we did not take into account the influence of comorbidities, HIV treatment and viral load suppression status, all of which influence mortality and thus the life expectancy. Also, some deaths among persons with HIV may not yet have been reported to surveillance. Therefore our estimates could be an over or underestimate of the true life expectancy after HIV diagnosis. However, we do not expect any systematic association with any of the factors that can lead to net over- or under-estimation of life expectancy. For this reason and because we used a very large dataset covering the entire country with high degree of completeness, we expect our estimates to be reliable estimates.

In summary, our analysis shows that the persons diagnosed with an HIV infection during 2008–2011, experience better life expectancy than those diagnosed in previous years and that the life expectancy continued to improve during 2008–2011, with consequent reduction in AYLL, overall and across all sex, race and transmission categories. However, the life expectancy of PLWDH still remains shorter than the life expectancy of the general population of the United States. While further improvements in the life expectancy of HIV-infected person is possible as treatment regimens continue to evolve, with improvements the role of other factors (e.g. early diagnosis, availability and access to treatment, adherence to treatment, side effects of antiretroviral therapy etc.) come to play a greater role in determining the period one can expect to live after an HIV diagnosis³⁷⁻⁴⁰. Our analysis demonstrates that the life expectancy after HIV diagnosis has continued to improve in HAART era. As the proportion of persons living with HIV who know their status (i.e. diagnosed) continue to increase and the access to HAART and adherence to treatment continue to improve, more accurate estimates should be generated in the future for continued monitoring of the progress of the status of the disease. Not all sub-groups show similar improvements in life expectancy, therefore individualized treatment plans, taking into consideration the actual needs and challenges of each subgroup can help improve life expectancy in these subgroups and reduce disparities.

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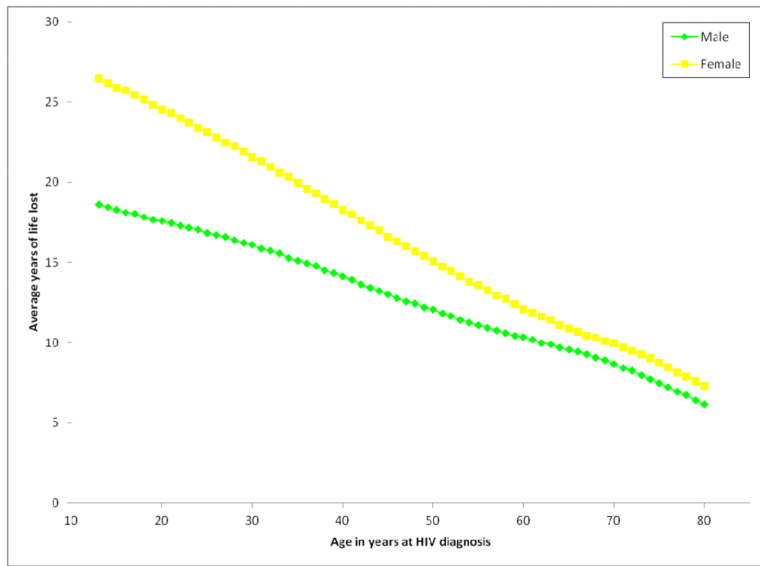


Figure 1. Estimated average years of life lost after HIV diagnosis in 2010, by sex, United States.

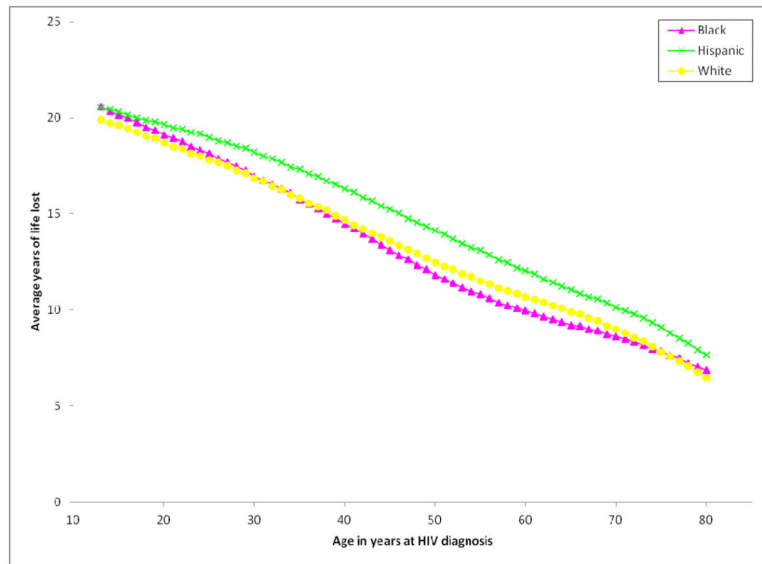


Figure 2. Estimated average years of life lost after HIV diagnosis in 2010, by race/ethnicity, United States.

Table 1

Estimated numbers of diagnoses of HIV infection among adults and adolescents, by selected characteristics, 2008–2011, United States.

Year of diagnosis	2008	2009	2010	2011
<i>Number of diagnoses</i> ¹	49,061	46,403	44,931	44,354
Sex	n (%)	n (%)	n (%)	n (%)
<i>Male</i>	37,154 (75.7)	35,794 (77.1)	35,045 (78.0)	35,011 (78.9)
<i>Female</i>	11,908 (24.3)	10,610 (22.9)	9,886 (22.0)	9,343 (21.1)
Race/Ethnicity				
<i>Black/African American</i>	23,520 (47.9)	22,026 (47.5)	21,285 (47.4)	20,837 (47.0)
<i>Hispanic/Latino</i>	9,633 (19.6)	9,356 (20.2)	9,065 (20.2)	9,198 (20.7)
<i>White</i>	13,510 (27.5)	12,757 (27.5)	12,419 (27.6)	12,147 (27.4)
<i>Other races/ethnicities</i>	2,400 (4.9)	2,264 (4.9)	2,162 (4.8)	2,172 (4.9)
Stage at diagnosis				
<i>Stage 3 (within 3 months)</i>	14,188 (28.9)	13,454 (29.0)	13,176 (29.3)	12,737 (28.7)
<i>Not stage 3</i> ²	34,873 (71.1)	32,949 (71.0)	31,755 (70.7)	31,616 (71.3)
Transmission Category—Males				
<i>Male-to-male sexual contact (MSM)</i>	27,315 (73.5)	27,081 (75.7)	27,021 (77.1)	27,608 (78.9)
<i>Injection drug use (IDU)</i>	2,993 (8.1)	2,542 (7.1)	2,265 (6.5)	1,991 (5.7)
<i>Male-to-male sexual contact and injection drug use (MSM-IDU)</i>	1,720 (4.6)	1,546 (4.3)	1,465 (4.2)	1,291 (3.7)
<i>Heterosexual contact</i>	5,073 (13.7)	4,572 (12.8)	4,241 (12.1)	4,068 (11.6)
Transmission Category—Females				
<i>Injection drug use (IDU)</i>	2,003 (16.8)	1,724 (16.2)	1,472 (14.9)	1,324 (14.2)
<i>Heterosexual contact</i>	9,860 (82.8)	8,831 (83.2)	8,352 (84.5)	7,939 (85.0)

¹Totals include persons with HIV transmission attributed to infrequent causes such as hemophilia etc.

²Includes stage unknown

Table 2

Life expectancy of persons diagnosed with HIV infection by year of diagnosis, overall and by selected characteristics, 2008–2011, United States.

Year of diagnosis	2008	2009	2010	2011
<i>Number of Diagnoses</i> ³	49,061	46,403	44,931	44,354
	<i>ELE (95% CI)</i> ⁴	<i>ELE (95% CI)</i> ²	<i>ELE (95% CI)</i> ²	<i>ELE (95% CI)</i> ²
Overall Life Expectancy	25.43 (25.37–25.49)	26.22 (26.16–26.28)	27.33 (27.27–27.39)	28.86 (28.8–28.92)
Sex				
<i>Males</i>	26.03 (25.96–26.1)	26.88 (26.81–26.95)	28.13 (28.06–28.19)	29.67 (29.60–29.74)
<i>Females</i>	23.75 (23.62–23.89)	24.32 (24.19–24.44)	25.01 (24.88–25.14)	26.40 (26.27–26.52)
Race/Ethnicity				
<i>Black/African American</i>	23.68 (23.59–23.76)	24.76 (24.67–24.85)	26.39 (26.3–26.48)	28.45 (28.37–28.54)
<i>Hispanic/Latino</i>	28.27 (28.12–28.41)	28.89 (28.75–29.03)	29.84 (29.70–29.97)	30.79 (30.65–30.93)
<i>White</i>	25.69 (25.59–25.8)	26.26 (26.15–26.36)	26.85 (26.74–26.95)	27.77 (27.66–27.88)
<i>Other races/ethnicities</i>	24.71 (24.49–24.93)	24.32 (24.18–24.46)	24.83 (24.6–25.05)	26.13 (25.97–26.29)
Stage at diagnosis				
<i>Stage 3</i>	20.81 (20.67–20.95)	21.69 (21.55–21.83)	22.59 (22.45–22.73)	24.00 (23.86–24.14)
<i>Other than stage 3</i> ⁵	27.39 (27.32–27.45)	28.08 (28.02–28.14)	29.32 (29.26–29.38)	30.83 (30.78–30.89)
Transmission Category—Males				
<i>Male-to-male sexual contact (MSM)</i>	29.31 (29.22–29.41)	30.23 (30.14–30.32)	31.18 (31.09–31.27)	32.30 (32.22–32.39)
<i>Injection drug use (IDU)</i>	17.86 (17.67–18.04)	17.98 (17.79–18.17)	18.62 (18.40–18.84)	20.24 (20.00–20.48)
<i>Male-to-male sexual contact and injection drug use (MSM-IDU)</i>	23.31 (23.08–23.55)	23.25 (22.98–23.52)	24.87 (24.60–25.13)	26.31 (26.03–26.59)
<i>Heterosexual contact</i>	20.80 (20.63–20.97)	21.61 (21.43–21.80)	22.49 (22.32–22.66)	23.45 (23.28–23.61)
Transmission Category—Females				
<i>Injection drug use (IDU)</i>	18.70 (18.47–18.94)	19.76 (19.53–20.00)	20.45 (20.17–20.72)	21.36 (21.08–21.64)
<i>Heterosexual contact</i>	25.94 (25.77–26.11)	26.08 (25.93–26.24)	26.49 (26.34–26.65)	27.90 (27.75–28.05)

³Totals include persons with HIV transmission attributed to infrequent causes such as hemophilia etc.

⁴Estimated life expectancy and 95% confidence intervals.

⁵Includes stage unknown

Table 3

Estimated life expectancy and average years of life lost, among persons diagnosed with HIV infection in 2010, by sex and at age at diagnosis by 5 year intervals, United States.

Age at Diagnosis (years)	Estimated Life Expectancy		Average years of life lost	
	Male	Female	Male	Female
15	43.62	40.70	18.28	25.90
20	39.53	37.17	17.57	24.53
25	35.55	33.74	16.85	23.16
30	31.69	30.43	16.11	21.57
35	27.96	27.22	15.14	19.98
40	24.36	24.11	14.14	18.29
45	20.89	21.08	13.01	16.62
50	17.54	18.12	12.06	15.08
55	14.30	15.21	11.10	13.59
60	11.15	12.32	10.35	12.08
65	8.12	9.42	9.58	10.88
70	5.53	6.54	8.67	9.96
75	3.52	4.15	7.48	8.75
80	2.04	2.39	6.16	7.31