



HIV estimates for 2018 in Ireland using Spectrum, a UNAIDS-supported modelling tool¹

October 2019

¹ Estimates published in this report replace all previous national estimates. The 2018 estimates should not be compared directly with previously published estimates: assumptions, methodologies and data used to produce the estimates have changed because our knowledge of the epidemic has improved and the data provided for use in the model have been refined.

Key Points:

- HPSC worked closely with UNAIDS to develop these national estimates using statistical modelling methods and available HIV surveillance data.
- The number of people living with HIV in Ireland at the end of 2018 is estimated to be 7,200 (95% CI 6,200-8,000).
- Approximately 90% (95% CI 78%-100%) of people living with HIV are estimated to be diagnosed while 10% remain undiagnosed (UNAIDS target: 90%).
- Approximately 88% (95% CI 77%-99%) of people who are diagnosed with HIV are estimated to be on antiretroviral therapy (ART) (UNAIDS target: 90%).
- Approximately 95% (95% CI 82%-100%) who are on ART are estimated to be virally suppressed (UNAIDS target: 90%).
- Overall, 76% (64%-84%) of all people living with HIV in Ireland are estimated to be virally suppressed (UNAIDS target: 73%).
- In total, we estimate that one in four people living with HIV in Ireland is not virally suppressed (includes people who are undiagnosed, people who are diagnosed but not on ART and people who are on ART but not virally suppressed).
- A focus on improving testing uptake and coverage is needed in order to decrease the number of people living with undiagnosed HIV.
- In addition, work is needed to ensure that everyone diagnosed with HIV in Ireland attends for HIV care and is offered HIV treatment.
- HPSC will continue to work with UNAIDS to further improve and refine the estimates in future years. It is vital that HIV surveillance data in Ireland is of sufficiently high quality and as complete as possible in order to ensure that the estimates are valid.

Contents

| | |
|---|----|
| 1. Background..... | 4 |
| 1.1 HIV Estimates | 4 |
| 1.2 Spectrum modelling software..... | 4 |
| 1.3 Continuum of HIV Care | 4 |
| 2. Methodology | 5 |
| 2.1 Data inputs..... | 5 |
| 2.2 Model fitting | 5 |
| 3. Results | 7 |
| 3.1 Generating estimates for Ireland..... | 7 |
| 3.2 Continuum of HIV care..... | 9 |
| 4. Discussion | 11 |
| 5. References | 13 |
| Report prepared by:..... | 14 |
| Acknowledgements..... | 14 |
| Suggested citation:..... | 14 |

1. Background

1.1 HIV Estimates

Accurate estimates of HIV incidence, the number of people living with HIV (PLHIV), and the proportion undiagnosed, are vital for understanding and responding to the HIV epidemic. Modelled estimates provide a scientifically appropriate way of describing the HIV epidemic and trends and are required because it is not possible to count the exact number of new infections, people living with HIV, or people who have died of AIDS-related causes. The Joint United Nations Program on HIV/AIDS (UNAIDS) and partners in many countries produce annual global, regional and country-specific estimates of HIV burden for use in national and global planning and monitoring. The national estimates are produced with oversight from the UNAIDS Reference Group on Estimates, Modelling and Projections (www.epidem.org).

1.2 Spectrum modelling software

UNAIDS supports the development of Spectrum, a freely available modelling tool which can be used directly by countries themselves or in conjunction with UNAIDS. Within Spectrum, there are various methods of modelling the epidemic, depending on the nature of the epidemic. For countries such as Ireland, where HIV transmission occurs largely among key populations at higher risk of HIV (concentrated epidemic), and where there are robust HIV case based reporting and strong vital registration systems, the CSAVR (case surveillance and vital registration) module is used.¹ The modelling process is iterative, in which models are reviewed and amended based on the findings and understanding of the HIV epidemic, with some modification of inputs to obtain a best fit to case diagnoses, CD4 count at diagnosis, and AIDS-related deaths reported to vital registration data.

1.3 Continuum of HIV Care

One of the benefits in producing modelling estimates for Ireland is to provide data for the continuum of HIV care. The continuum of HIV care is one of the central measures through which the public health response to HIV is evaluated. In 2014, UNAIDS established the 90-90-90 targets, the aim being that by 2020; 90% of people living with HIV being diagnosed; 90% of people diagnosed receiving ART; and 90% of people on treatment being virally suppressed and unable to pass on infection.² This translates to 90% of people living with HIV being diagnosed, 81% of people living with HIV receiving ART, and 73% of people living with HIV being virally suppressed.

2. Methodology

2.1 Data inputs

A UNAIDS led process for developing estimates was chosen for Ireland, whereby the Health Protection Surveillance Centre (HPSC) provided input into the development of the estimates, reviewed outputs and approved the results. UNAIDS carried out the modelling using the Spectrum software.

In March 2019, UNAIDS provided an excel file to HPSC which was pre-populated with non-identifiable aggregate data (which HPSC had provided to UNAIDS in previous years). This was updated by HPSC and returned to UNAIDS where it was uploaded to Spectrum. Inputs to the modelling software include demographic, epidemiological and programme data. Demographic data on population size, age and sex distribution, life expectancy, fertility, and other parameters are provided within the modelling software by UNAIDS and were obtained from WPP 2017 (<https://worldpopulationprospects.info/>), Institute of Health Metrics and Evaluation (IHME) and the World Health Organization (WHO). Epidemiological and programme data were provided by HPSC and other partners. Table 1 describes the data provided by HPSC.

2.2 Model fitting

Once the Irish data were inputted to Spectrum, the tool searched for a HIV incidence curve which matched as closely as possible the estimates of new HIV diagnoses, including CD4 count (which is a proxy for time from infection to diagnosis) and AIDS deaths (estimated AIDS deaths which are adjusted for missing years, reporting incompleteness and misclassification of cause of death). Once this incidence curve was reviewed, modified accordingly and agreed by HPSC and UNAIDS, it was then used to derive the estimated (a) national adult HIV prevalence, (b) number of people living with HIV, (c) number of new HIV infections and (d) number of AIDS deaths, among other estimates by age and sex. The estimation software calculated uncertainty bounds (confidence intervals) around each estimate. These define the range within which the true value lies.

Table 1: Data inputs from Ireland for Spectrum modelling

| Section | Data item | Irish data available |
|--|---|--|
| Treatment eligibility | CD4 count threshold for eligibility for treatment for adults and children | Provided from 2000 to 2018 |
| Prevention of Mother to Child Transmission | Number or percent of women infected with HIV who are receiving prophylaxis | Number of pregnant women receiving ART was provided from 2000 to 2018 by the Rainbow Clinic, Our Lady's Children's Hospital, Crumlin |
| ART Adults | Number of adults receiving ART by sex | This was available by sex in 2010 ³ from a national treatment audit. It was also available for males and females combined in 2017 ⁴ , from a national treatment audit. |
| | Number of adults receiving ART by CD4 count | Not available |
| | Number of adults receiving ART by age group | Not available |
| ART Children | Number of children receiving ART | Provided for 2015-2018 by the Rainbow Clinic, Our Lady's Children's Hospital, Crumlin |
| | Number of children receiving ART by age group | Not available |
| | Number of children receiving cotrimoxazole | Estimate given |
| Case and Mortality Data | Number of HIV diagnoses per year | Provided from 1986 to 2018 – by year of diagnosis |
| | Number of HIV diagnoses per year (excluding those diagnosed previously) | Provided from 2011 to 2018 – by year of diagnosis |
| | Mean CD4 count at HIV diagnosis (excluding those diagnosed previously) | Provided from 2011-2018 |
| | AIDS-related mortality estimates, adjusted for missing data and garbage codes | Provided by UNAIDS (Source: IHME and WHO) |
| | People living with HIV who know their status | Estimated as 90% of PLHIV – reference used from study in an Irish Hospital. ⁵ |
| 90-90-90 data | People on ART | Estimated as 5,700 in 2018 – based on the treatment audit which found 5,227 people on ART in 2017 |

3. Results

3.1 Generating estimates for Ireland

UNAIDS generated a number of potential incidence curves using the Irish data. These were shared with HPSC and reviewed by both UNAIDS and HPSC for plausibility and best fit. In particular, the issue of inward and outward migration and determining whether HIV was acquired inside or outside the country caused some issues. A large proportion of HIV diagnoses in Ireland is among those who are not born in Ireland (63% in 2017) and a large proportion of people diagnosed with HIV in Ireland has been previously diagnosed HIV positive abroad (39% in 2017). To estimate incidence in Ireland, the final model was run with HIV diagnoses excluding people who were previously diagnosed HIV positive abroad for 2011 to 2018 (these data are not available for previous years). In addition, all HIV diagnoses from 1986 to 1993 were included to inform the model fitting in the historical period. The mean CD4 count at diagnosis was also included in the final model (excluding people who were previously diagnosed HIV positive). Although it was felt that by including the mean CD4 count at diagnosis in the model resulted in the estimate of new HIV infections being slightly too high (approx. 350 in the final model for 2018), when CD4 counts were excluded from the model, the estimated number of people living with HIV was too low (approx. 5,000 per year) and the estimated number of AIDS deaths was too high (30-40 in 2019). UNAIDS advised that we chose the model which provided the best estimate of people living with HIV and AIDS deaths.

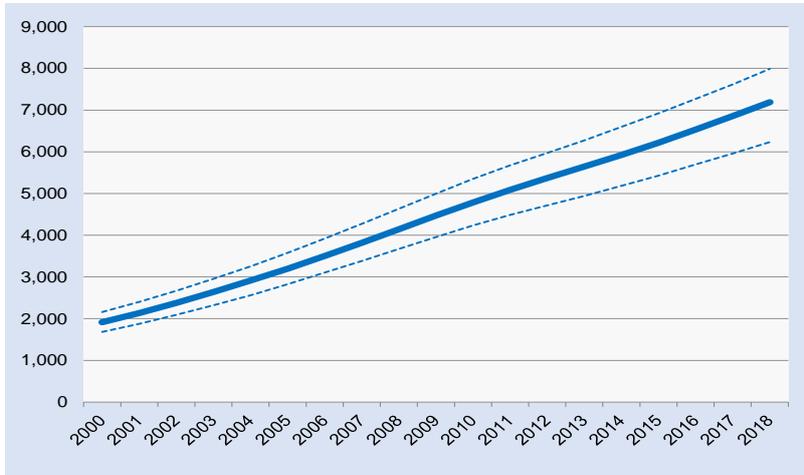
After a number of iterations, the final set of estimates was formally approved by UNAIDS and HPSC in June 2019 and are shown in Table 2 and Figure 1. The estimates are also publicly available on the UNAIDS website at <https://www.unaids.org/en/regionscountries/countries/ireland>

Table 2: HIV and AIDS Estimates for Ireland, 2018

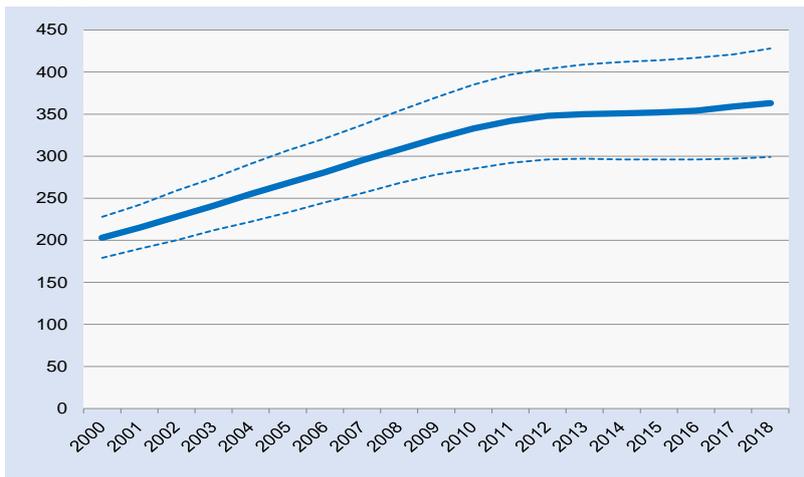
| | Estimates (rounded with 95% confidence intervals) |
|---|--|
| Adults and children living with HIV (n) | 7,200 [6,200 – 8,000] |
| Adult aged 15 to 49 years HIV prevalence rate (%) | 0.20 [0.18 - 0.22] |
| Adults and children newly infected with HIV (n) | <500 |
| HIV incidence per 1,000 population (all ages) | 0.08 [0.06 - 0.09] |
| Adult and child deaths due to AIDS (n) | <100 |

Figure 1: Estimated numbers of (a) People living with HIV (b) New HIV infections and (c) Deaths in Ireland, 2000 to 2018²

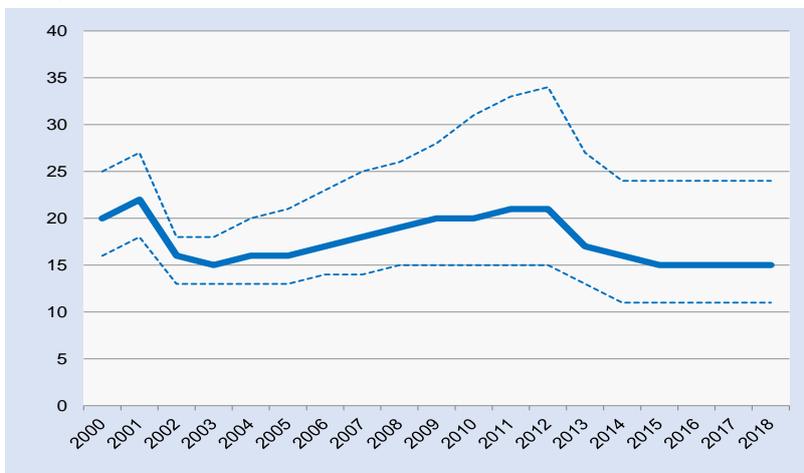
(a) People living with HIV



(b) New HIV infections



(c) Deaths



² Solid line represents the point estimate for each year and the dotted lines represent the lower and upper 95% confidence intervals

3.2 Continuum of HIV care

The estimates produced for the continuum of HIV care in Ireland are described below and shown in Table 3. A treatment audit of HIV services was carried out in early 2018⁵ by the Sexual Health and Crisis Pregnancy Programme (SHCPP) in collaboration with clinical staff from each HIV service and data from the audit were used to derive some of the estimates for 2018.

3.2.1 Number of people living with HIV

This was estimated to be 7,200 at the end of 2018 (see section 3.1). This includes people who are living with diagnosed HIV and people living with undiagnosed HIV.

3.2.2 Number of people living with diagnosed HIV

In Ireland, we cannot directly count the number of people living with HIV who know their HIV status. In previous years, UNAIDS used data from Spectrum to estimate the proportion undiagnosed (e.g. 13% in 2017) but experts at UNAIDS felt that additional investigations were required to demonstrate their accuracy.

Firstly, to estimate the number of people living with HIV in Ireland who are in care at the end of 2018, we added the number of people in HIV care at the end of 2017 from the national treatment audit (n=5,317) to the approximate number of people newly diagnosed with HIV who are assumed to have attended for HIV care in 2018 (estimated to be approximately 500 based on 524 new HIV diagnoses in 2018). This resulted in an estimated number of people in care at the end of 2018 of approximately 5,800.

In order to further account for the people who know their status but were not in care, we used data from a study of an adult tertiary hospital in Dublin.⁵ They found that 10.5% of people who were linked to care were confirmed as not being retained in care (excluding those who died, emigrated or transferred their care). Using this proportion, we increased the number of people who know their status to account for people diagnosed but not in care. The resulting estimate for the number of people living with diagnosed HIV in Ireland at the end of 2018 was approximately 6,500.

3.2.3 Number of people living with HIV who are on ART

Since July 2017, the HSE recommends that all HIV positive people attending HIV services in Ireland are offered antiretroviral therapy (ART) as soon as possible and are informed of the benefits of ART in reducing HIV infectiousness and improving their health. The exact number of people on ART at the end of 2018 is not known. However, using the number of people on ART at the end of 2017 from the national

treatment audit (n=5,227) and the approximate number of people newly diagnosed with HIV who are assumed to have initiated treatment in 2018 (estimated to be approximately 500 based on 524 new HIV diagnoses in 2018), we estimated that the number of adults on ART at the end of 2018 to be approximately 5,700.

3.2.4 Number of people living with HIV who are virally suppressed

With effective treatment, people living with HIV can achieve an undetectable viral load.³ We do not have exact data for the number of people who were virally suppressed at the end of 2018. However, using the proportion of people who were virally suppressed at the end of 2017 from the national treatment audit (95%) and assuming that treatment regimens are likely to be very similar in 2018, we estimated that approximately 5,400 people were virally suppressed at the end of 2018.

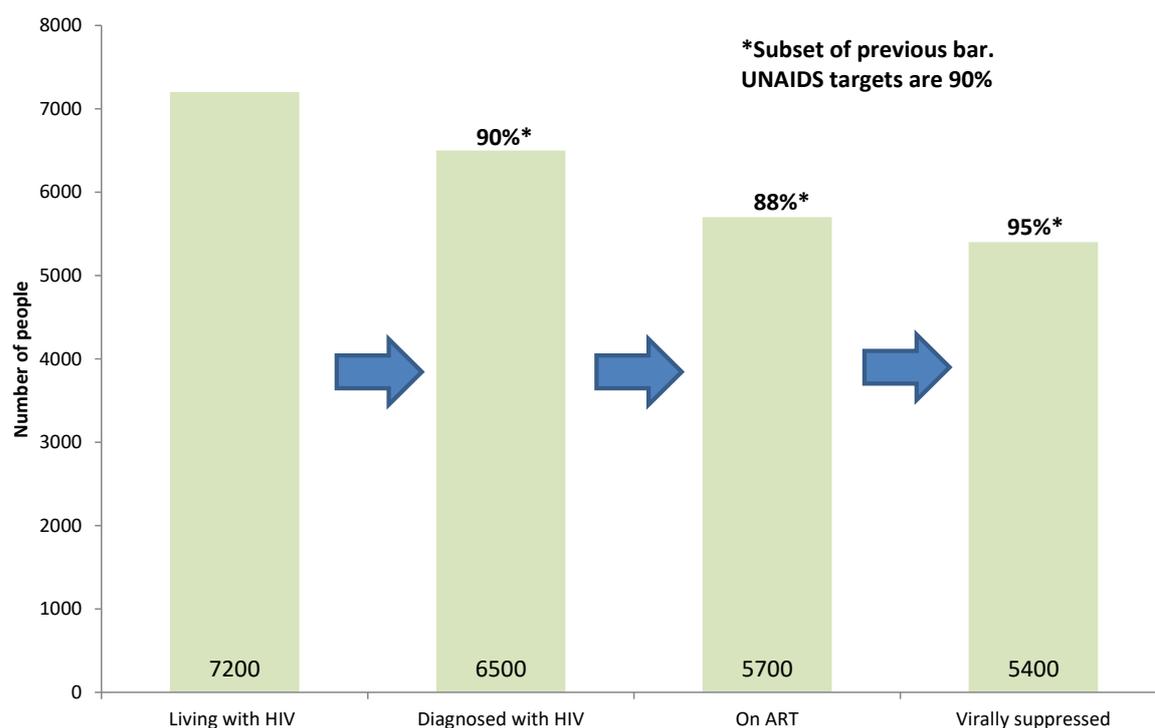
Table 3: HIV testing and treatment cascade, 2018 estimates

| Indicator | Rounded estimates (with 95% CI) ⁴ |
|---|---|
| Number of people living with HIV | 7,200 (6,200-8,000) |
| Number of PLHIV who know their status | 6,500 |
| Proportion of PLHIV who know their status (1 st 90) | 90% (78%-100%) |
| Number of PLHIV who are on ART | 5,700 |
| Proportion of people with diagnosed HIV who are on ART (2 nd 90) | 88% (77%-99%) |
| Number of PLHIV who have suppressed viral loads ³ | 5,400 |
| Proportion of people on ART who have suppressed viral loads ³ (3 rd 90) | 95% (82%-100%) |
| Proportion of PLHIV who have suppressed viral loads ³ | 76% (64%-84%) |

³ For the purposes of modelling, a viral load of less than 200 copies/ml is considered to be virally suppressed

⁴ The uncertainty interval has been calculated based on the uncertainty that arises from the modelling to obtain the estimated number of PLHIV. This does not capture the additional uncertainty arising from the programme data.

Figure 3: Continuum of HIV Care in Ireland, 2018



4. Discussion

The aim of this ongoing work is to develop valid estimates of the number of people living with HIV in Ireland and the number of people with diagnosed and undiagnosed HIV which can then be used to monitor the HIV continuum of care for Ireland.

The UNAIDS Spectrum modelling software provides countries with scientifically based estimates relating to their HIV epidemic that are comparable across countries. HPSC and UNAIDS are confident that the actual numbers of people living with HIV or people who have died from AIDS-related causes lie within the reported ranges. Deriving the estimates for Ireland was an iterative process, in which models were reviewed and revised by HPSC and UNAIDS, with modifications as previously described to obtain a best fit for the data. As HPSC does not have a statistician or a statistical modeller, the expertise of modelling staff at UNAIDS and Imperial College London was invaluable. Working with UNAIDS to develop these estimates was a very useful learning process.

People who have an undetectable viral load cannot transmit the virus to their sexual partners.^{6,7} Viral suppression is therefore key to the UNAIDS aim of eliminating the HIV epidemic by 2030. The proportion of all people living with HIV in Ireland at the end of 2018 who have suppressed viral loads was 76%. This exceeds the UNAIDS threshold (73%) for what will be required by 2020 in order to end the HIV epidemic

by 2030. However, the number of people with transmissible levels of HIV in Ireland is estimated to be approximately 1,800 (24% of people living with HIV) and includes people who are undiagnosed, diagnosed but untreated and treated but not virally suppressed. In order to achieve the updated targets set in the UNAIDS “Fast-Track strategy to end the AIDS epidemic by 2030”⁸ (95% of people living with HIV knowing their HIV status; 95% of people who know their status on treatment; and 95% of people on treatment with suppressed viral loads), further work is needed in Ireland to improve testing uptake and coverage in order to reduce the number of people living with undiagnosed HIV and to ensure that people who have been diagnosed are engaged in care and offered treatment.

The accuracy of the Spectrum estimates depends on the availability and quality of the data used in the model. It is important that the HIV surveillance system in Ireland gathers high quality and complete data in particular in relation to CD4 count at diagnosis, country of birth, history of previous diagnosis and probable route of transmission. Data on recency of HIV infection which is currently being collected in Ireland could also be useful in establishing time from infection to diagnosis and developing estimates of incidence.⁹

In Ireland, approximately 40% of HIV diagnoses are among people who have been previously diagnosed abroad, the majority of whom arrive in Ireland already on antiretroviral therapy (ART) and virally suppressed.¹⁰ This aspect of the HIV epidemic in Ireland poses challenges for obtaining modelled estimates. Previous work carried out by HPSC in collaboration with ECDC and using the ECDC HIV modelling tool, was considered to be unreliable due to the fact that migration was not accounted for in the model. Further work is being undertaken by ECDC to improve the modelling tool to account for migration. While Spectrum does not explicitly account for out-migration of HIV positive people, there are in- and out-migration components to population estimates obtained from WPP 2017 (<https://worldpopulationprospects.info/country/ireland/>), Institute of Health Metrics and Evaluation (IHME) and the World Health Organization (WHO). This assumes that the in- and out-migration of HIV positive people follows the same pattern as the general population; this assumption is likely to be valid as we have no evidence to suggest there is differential in- or out migration of HIV positive people.

Ongoing collaborative work between HPSC, UNAIDS and other partners will lead to more accurate estimates for Ireland. Spectrum is being modified and improved on an ongoing basis by UNAIDS, based on the latest available scientific and statistical methods. UNAIDS are continuing to address the issues of migration within the UNAIDS Reference Group and with input from ECDC and other countries in the European Union. It is also hoped that it will be possible to generate estimates by key population in future versions of Spectrum. Future treatment audits by SHCPP and HIV services in Ireland will provide timely data on the number of people in HIV care, on ART and virally suppressed.

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