

Original papers

Minimum size of the AIDS epidemic in Ireland

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Abstract

We examine data on the incidence of AIDS since the epidemic started in Ireland in 1982. From this data we make short term predictions on the lower bound of the number of AIDS cases likely to occur in future years. By the year 2001 we expect to see at least a total of 1850 AIDS cases in Ireland. For the two largest risk groups in Ireland, homosexual/bisexual and intravenous drug users (IDU's), separate predictions are made. The rate of increase in the latter group is higher and we expect to see a total of 720 AIDS cases by the year 2001 in the homo/bisexual group and 1,100 in the IDU group. These predictions show an increase in rates. It must be emphasised that these numbers do not include new cases of infection after January 1992, which would further inflate the rates.

Introduction

The prevalence of HIV and AIDS in Ireland is a growing problem. Statistics emanating from the Department of Health¹ have received wide press coverage. However there has been little analysis of the rate of spread of the disease or attempts to extrapolate to the future. Projections of the size of the AIDS epidemic, i.e. future numbers of AIDS cases, are of major importance for future health care and prevention. Here we make projections of the AIDS epidemic based on the "back-projection" method. This does not require knowledge of the number of seropositive individuals, or of the proportion of infected individuals in whom AIDS will develop. Moreover, our projections do not extrapolate a curve fitted to the AIDS incidence data. The method follows the work of Brookmeyer and Gail for the AIDS epidemic in the United States.^{2,3}

Methods

Calculations are based on two sources of data: first the incidence of AIDS in Ireland up to January 1992 by annual time period of diagnosis as reported to the Department of Health (Table 1); and second the distribution of incubation periods taken from studies in the literature together with the median incubation time. The incubation period is the time between first infection with HIV and the development of AIDS and the median is the time by which 50% of the infected population develop AIDS. Four different values for the median incubation time were considered: 4.3 years, 8.0 years, 10.0 years and 12.0 years, and predictions were obtained for each.* The assumption of 4.3 years comes from an American study of incubation periods among those infected by blood transfusions.⁴ A study based on the San Francisco City Clinic Cohort of homosexual men found a median time of ten years.⁵ In Biggar's international registry of seroconvertors the median was eight years again in homosexual men.⁶ A US study of 343 IDU's reported a median incubation period of 10 years.⁷ We consider 12.0 years because of the problem of onset confounding i.e. individuals likely to develop AIDS quickly got infected early on in the epidemic. Thus, as the length of time since the epidemic started increases, we may see a lengthening of the incubation period. The "back-projection" method estimates N the minimum size of the AIDS epidemic i.e. the number that will develop AIDS i.e. the minimum size of the present HIV population.

Results.

Table 1 displays the number of annual AIDS cases in Ireland for the total population and by risk group.

Table 2 shows the projected cumulative and new cases of AIDS versus time for the various median incubation times. A graphical display can be seen in Figure 1. The Table indicates that short term projections are not nearly as sensitive to the assumed incubation period as are the long term projections or the estimates of N. For the median of 8.0 years the estimate is 1850 with 95% confidence limits (800, 2900).

Table 1 - Cases of AIDS

| | 1982 | '83 | '84 | '85 | '86 | '87 | '88 | '89 | '90 | '91 | Total |
|------------------------------------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|------------|
| Homo/bisexual | 2 | 0 | 1 | 1 | 1 | 6 | 21 | 17 | 22 | 23 | 94 |
| I.V. drugs users | 0 | 0 | 0 | 1 | 1 | 9 | 10 | 21 | 27 | 31 | 100 |
| Homo/bisexual/ I.V. drugs users | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 2 | 0 | 0 | 7 |
| Haemophiliacs | 0 | 0 | 1 | 0 | 3 | 3 | 3 | 6 | 1 | 3 | 20 |
| Heterosexual | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 8 | 11 | 23 |
| Babies born to I.V. drugs users | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 1 | 2 | 1 | 8 |
| Heterosexual Mothers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Undetermined | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 1 | 1 | 5 |
| Total | 2 | 1 | 3 | 5 | 6 | 20 | 38 | 51 | 61 | 71 | 258 |

Table 2 - Projected cumulative and (new cases) of AIDS: total population

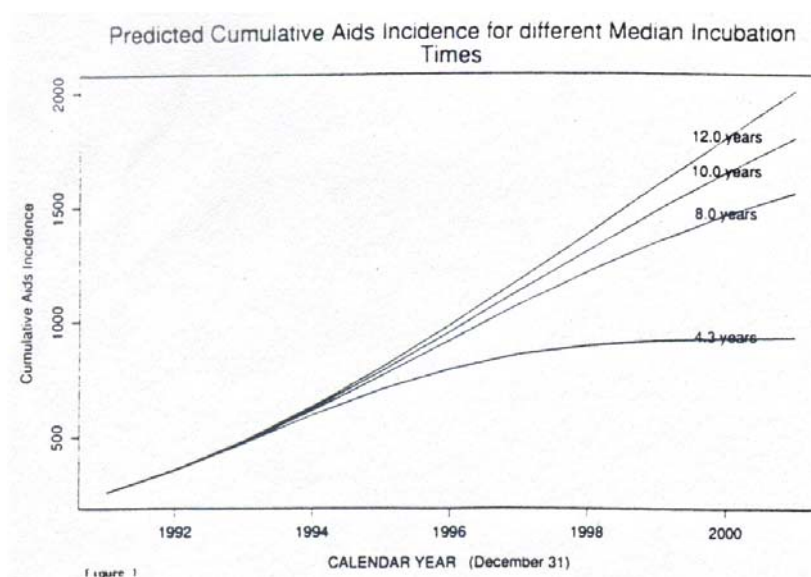
| Year | Median Incubation Time | | | |
|--------------|------------------------|--------------------|--------------------|--------------------|
| | 4.33 | 8.0 (137) | 10.0 | 12.0 |
| 1992 | 356 (98) | 357 (99) | 359 (101) | 360 (102) |
| 1993 | 473 (117) | 477 (120) | 481 (122) | 484 (124) |
| 1994 | 595 (122) | 614 (137) | 624 (143) | 632 (148) |
| 1995 | 705 (110) | 764 (150) | 783 (159) | 799 (167) |
| 1996 | 794 (89) | 919 (155) | 955 (172) | 984 (185) |
| 1997 | 856 (62) | 1072 (153) | 1133 (178) | 1181 (197) |
| 1998 | 894 (38) | 1218 (146) | 1311 (178) | 1386 (205) |
| 1999 | 915 (21) | 1351 (133) | 1486 (175) | 1595 (209) |
| 2000 | 924 (9) | 1467 (116) | 1653 (167) | 1804 (209) |
| 2001 | 928 (4) | 1565 (98) | 1807 (154) | 2007 (203) |
| Total | 930 (671) | 1850 (1591) | 2540 (2281) | 3440 (3181) |

Table 3 - Projected cumulative and (new cases) of AIDS

| Year | Homo/bisexual | Intravenous drug users |
|-------------------------------|------------------|------------------------|
| 1992 | 132 (38) | 151 (51) |
| 1993 | 177 (45) | 217 (66) |
| 1994 | 230 (53) | 297 (80) |
| 1995 | 288 (58) | 387 (90) |
| 1996 | 349 (61) | 483 (96) |
| 1997 | 409 (60) | 580 (97) |
| 1998 | 467 (58) | 674 (94) |
| 1999 | 519 (52) | 761 (87) |
| 2000 | 566 (47) | 839 (78) |
| 2001 | 605 (39) | 905 (66) |
| Total size of epidemic | 720 (625) | 1100 (999) |

Table 4 - Cumulative AIDS cases (%) reported by March 31st 1992

| | Ireland | UK |
|-----------------------|---------|------|
| Homo/bisexual | 36.1 | 76.5 |
| IOU | 39.5 | 4.5 |
| Homo/bisexual IDU | 2.6 | 1.5 |
| Haemophiliac | 7.5 | 5.3 |
| Transfusion recipient | 0.0 | 1.4 |
| Heterosexual | 9.0 | 8.5 |
| Mother to child | 3.4 | 1.0 |
| Other/Unknown | 1.9 | 1.3 |



The data for the Homosexual/Bisexual group was analysed in a similar way and the results are shown in Table 3. Using a median incubation of 8.0 years the estimate of N was 720 with 95% confidence limits (170, 570).

Finally a similar analysis was undertaken for the Intravenous Drug Users group. Using a median incubation period of 8.0 years the estimate of N was 1100 with 95% confidence limits (360,1840). Yearly cases are shown in Table 3. It must be emphasised that the results of Tables 2 and 3 assume no new infections after January 1991.

Discussion

There have been many papers in the literature, for example the Cox report⁹, which predict the size of the AIDS epidemic incorporating new cases of infection. These methods are based partly on direct extrapolation for past trends using empirical 'curve fitting' techniques based on the choice of a suitable mathematical function. Unfortunately, however, many different functions are consistent with the historical data and very different predictions can be generated even over a quite modest time range. These methods are outside the scope of this paper. Instead we focus on estimating a lower bound on the size of the epidemic. The uncertainty in this method is that the incubation distribution has to be estimated as it is not known exactly. Clearly the evolution of AIDS in Ireland to date has been dominated by the homosexual and intravenous drug user transmission groups. Recent years have seen quite different patterns of AIDS incidence in these two groups. It is therefore appropriate to examine predictions in these groups separately.¹⁰ The model of the incubation distribution used fitted well for all values of the median chosen both for the population as a whole and in each of the risk groups. However as the literature suggests that a median incubation period of

eight years is very likely the results based on eight years are the most appropriate. While there have been many studies documenting progression rates in the homo/bisexual risk group information about intravenous drug users is less well documented. However the largest study to date on IV drug users shows no evidence for differences in progression rates between the two risk groups. Our results show that there will be at least a seven-fold increase in the number developing Aids in future years. The number contracting Aids yearly will rise from its present figure of 71 to a minimum of 100 for 1992 and increasing to a minimum of 155 in 1996. Approximately two-thirds of these cases will come from the I.D.U. population. The total number of Aids cases from this group we expect to rise from the present figure of 100 to 1,100. In 1991 there were 31 cases in this group but by 1994 we expect to see a minimum of 100 cases per year in the group. The numbers contracting AIDS in the homosexual/bisexual risk group will also increase, even with no new infections. The present total will rise from 94 to 720 arising from a yearly rate of about 50 cases. These projections are in excess of the number of positive HIV-antibody tests reported by the Virus Reference Laboratory at UCD By December 1991 they reported a total of 1,156 positive tests. 619 were I.D.U.'s and 188 were Homosexuals/Bisexuals. Thus it is estimated only 25% of positives in the Homosexual/bisexual group have been tested while in the IDU's about 56% of positives have been tested. Even assuming a best case scenario, where we assume that the median incubation distribution is approximately four years, then we estimate that the minimum size of the epidemic will rise from the present total of 258 to 930. 370 of these will be from the Homosexual/bisexual risk group with 570 from the IDU drug user group. This still indicates under testing in the Homo/bisexual group which must be a cause for concern.

It is interesting also to compare Irish data with that in the UK In 1990 the AIDS incidence rate per million population in the UK was 18.3, a decrease from the 1990 rate of 19.8. In Ireland the incidence rate per million population was 17.4 in 1990 and rose to 20.3 in 1991. As pointed out in the report of the Society of Actuaries in Ireland last year" the distribution of AIDS cases over the transmission groups is very different between Ireland and the UK This can be seen in Table 4.

In the UK the majority of cases occur in the homo/bisexual group while the percentage of IDU cases is very small. A consequence of this is that there is now a levelling off of the epidemic in the U. because of changed practices in the homo/bisexual group while in Ireland it is still growing because of the risk in the IDU group. Only two other European countries, Italy and Spain¹², have a higher proportion of AIDS cases in the IDU risk group. The rate of growth of AIDS in this risk group must now be a cause for concern in this country.

*We assume the incubation distribution is Weibull and is modelled by $F(t) = \exp(-\lambda t^y)$, where the shape parameter y is 2.286 and λ , determines the median.

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