Round Table

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AIDS Projections Are Too High

ALEXANDER LANGMUIR

Among the many projections that epidemiologists have made for the future incidence of AIDS in the United States, those of one senior epidemiologist stand out as consistently more moderate. He is Alexander D. Langmuir, chief epidemiologist from 1949 to 1970 for the Centers for Disease Control (CDC) in Atlanta, Georgia, USA. He is now engaged in what he terms an "active retirement," during which he has been following, among other things, the AIDS surveillance reports from the CDC and the AIDS literature. From time to time he has expressed his views when requested, for example to B. D. Colen, science editor of Newsday, *in an interview published 13 October 1987, and in testimony given to the U.S. Presidential Commission on the Immunodeficiency Virus Epidemic in Washington, D.C., on 10 December 1987. The following article has been condensed from these two sources. It is published here with Dr. Langmuir's permission.*

My long-held view, which is now becoming widely known, is that most of the projections of the incidence of AIDS in the United States are too high.

The active practice of epidemiology has been my professional career for 50 years. During this time I have become increasingly intrigued with epidemic theory, namely, the effort to divine the laws governing the occurrence and course of epidemics and to express them in mathematical terms. Progress in this field over a century and a half has been disappointingly slow. The factors involved are too complex, varied, and intangible, and the measurements are too imprecise to be amenable to mathematical expression, even with the aid of computers.

Back in 1840, however, a great epidemiologist in London named William Farr made an observation that in a very special way has stood the test of time. He noted that epidemic smallpox seemed to follow an orderly path. He fitted a curve to his data which we now recognize to be a normal curve, the simple Gaussian "cocked hat" curve that provides the basis for classical statistics. His later admirers promulgated Farr's Law, which simply states that the rise and fall of an epidemic follows the lines of a normal curve.

During an epizootic of cattle plague in London in 1865–1866, when the incidence seemed to be increasing disastrously, Farr predicted that the epizootic would soon crest and rapidly decline. He was right. Thus began the hazardous game of predicting the course of epidemics.

I am known among my friends as temerarious Alex, foolishly courageous in making predictions. I have been right some of the time, and wrong on many occasions. I persist in this trait for several reasons. First of all, it is exciting to be at the cutting edge of an unresolved epidemic problem and sometimes even over the edge. More seriously, to make reasonably responsible predictions about a disease demands at least the beginning of an understanding of the underlying theory of the disease. When predictions are fulfilled, one gains confidence in going

forward toward a more complete theory. When predictions fail, one picks up the pieces, reevaluates the basic premises, and starts over.

Regarding AIDS, my feeling is that the epidemic is not about to break out of the recognized high-risk groups and overwhelm the rest of the population. At present, the weekly AIDS surveillance reports issued by the U.S. Centers for Disease Control (CDC) have a category called "heterosexuals." It is a small group, about 4% of the total. The report's footnotes show that about 50% of this group is made up of spouses and sexual partners of homosexuals/bisexuals, intravenous drug abusers, hemophiliacs, and transfusion recipients—the four high-risk categories. The other half are individuals with extensive overseas contacts of some kind; they have been born in or lived for years in certain Third World countries. They may not know how they got their infection, but the CDC classifies them as heterosexuals. The important point is that this "heterosexual" group is small and is not increasing significantly faster than the other, more frequent categories of cases. The long-predicted breakout of the epidemic to the general population has not materialized. In my opinion, this would have occurred by now if it were going to happen at all.

More specifically, studies of homosexuals have shown that those at greatest risk are those who engage in receptive anal intercourse. This and the inoculation of contaminated blood by intravenous drug abusers appear to be the dominant ways that the AIDS virus spreads. Thus, spread to the general population seems most unlikely.

The epidemic theorist must be concerned primarily with the rate at which a disease spreads. To have an epidemic, one case must give rise to more than one case, not necessarily a lot more, but at least a little bit more. If, on the average, one case gives rise to less than one case, the epidemic dies out. Everything I have seen says that, outside of the known high-risk groups, the rate of AIDS' spread is insufficient for epidemic survival.

I first indulged my obsession concerning AIDS in October 1985. I was "drafted" by Dr. Fred Robbins, then President of the Institute of Medicine of the National Academy of Sciences in Washington. He was organizing a panel discussion at the annual meeting on the epidemiology of AIDS. He asked me to open the discussion and to "be provocative." I quoted William Farr as the basis for questioning the commonly held view that the incidence of AIDS would continue its geometric increase to the point of Black Death.

Considering the four transmission categories separately, none could continue increasing geometrically for long. Most of the multi-partnered homosexuals are already infected. We are still seeing new cases in this group because the incubation period is longer than anticipated. We will not know how many cases will occur until we have measured the incubation period more accurately. But, essentially, new infections among homosexuals will only be arising among new homosexuals, to be measured roughly by the birth rate. This situation does not spell continued geometric increase.

Identical reasoning applies to the other transmission categories: I.V. drug abusers, hemophiliacs, and transfusion recipients. I stated categorically, on the basis of my epidemiologic judgment, that no biological system, surely not an epidemic, can increase geometrically for long. In fact, the then already well-known "increase in the doubling time" precluded such a conclusion. I even hazarded a forecast—prediction is too strong a word—that the epidemic would crest in "mid-summer of 1986." This caused no

Table 1. Semiannual incidence of AIDS in the United States from 1982 through 1986, by year of diagnosis and transmission category.[a]

Year	Half-year	Male homosexuals/ bisexuals	I.V. drug abusers	Male homosexual/ bisexual drug abusers	Transfusion recipients	Hemophiliacs	Hetero-sexuals[b]	Unknown	Total
1982	Jan–June	223	56	23	1	2	34	14	353
	July–Dec	399	109	71	7	4	33	20	643
1983	Jan–June	754	216	117	13	8	66	33	1,207
	July–Dec	982	296	160	27	4	65	46	1,580
1984	Jan–June	1,618	410	214	40	24	96	72	2,474
	July–Dec	2,118	553	300	49	25	120	75	3,240
1985	Jan–June	2,982	755	343	103	34	153	91	4,461
	July–Dec	3,735	951	378	106	68	193	154	5,585
1986	Jan–June	4,570	1,142	528	183	60	278	190	6,951
	July–Dec	5,496	1,263	610	202	82	315	259	8,227
Total		22,877	5,751	2,744	731	311	1,353	954	34,721
Percentage		65.9	16.6	7.9	2.1	0.9	3.9	2.7	100.0

[a]Figures corrected for delayed reporting due to the lag from the date of diagnosis to the date the report was received by the CDC. The corrections were made specific for each transmission category and month of diagnosis.

[b]The heterosexual category consists of contacts of AIDS-infected persons plus individuals exposed overseas.

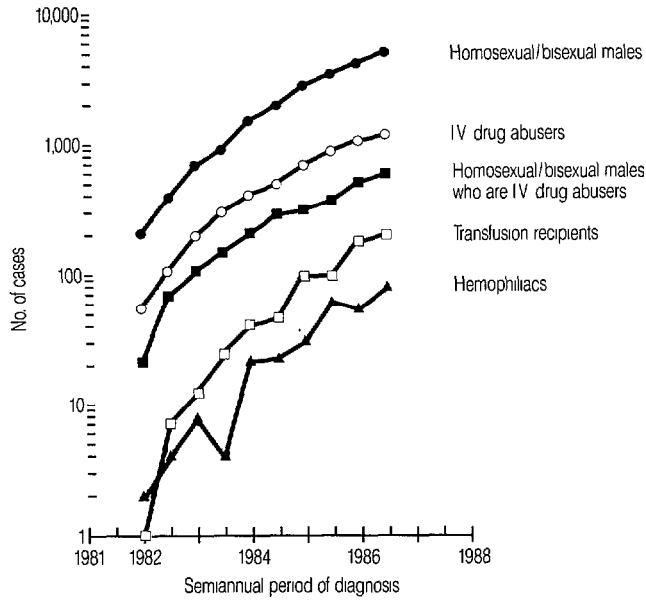

Figure 1. Trends in the semiannual incidence of AIDS in the United States from 1982 through 1986, by year of diagnosis and transmission category. The data charted have been corrected for delayed reporting.

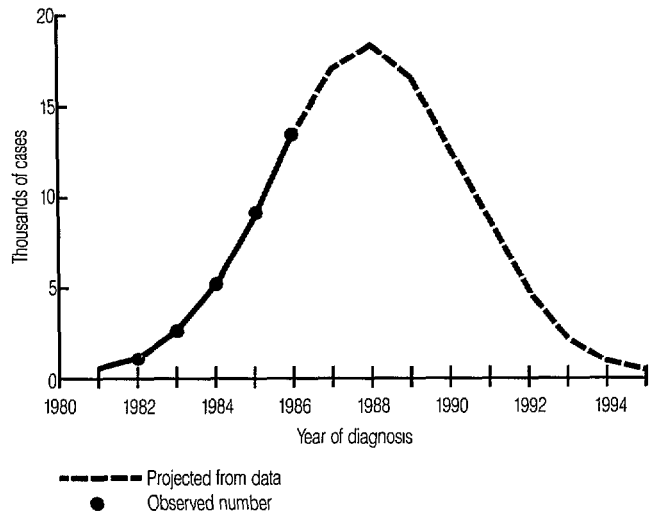

Figure 2. A projection of the annual incidence of AIDS cases in the United States among homosexual/bisexual males and I.V. drug abusers combined, by date of diagnosis, in 1982 through 1986 with projections to 1995. The 1982–1986 data have been corrected for delayed reporting. The projected curve is based on the assumption that the average of the second ratios for 1985 and 1986, namely 0.8490, will remain constant through 1995.

Table 2. The annual incidence of AIDS cases in the United States among homosexual/bisexual males and I.V. drug abusers combined, by date of diagnosis, in 1982 through 1986 with projections to 1995. The 1982–1986 data have been corrected for delayed reporting. The projected data, shown in parentheses, are based on the assumption of a constant second ratio in 1985 and 1986.

Year	No. of cases	First ratio[a]	Second ratio[b]
1982	881		
1983	2,525	2.8661	
1984	5,213	2.0646	0.7203
1985	9,144	1.7541	0.8496
1986	13,609	1.4883	0.8485
1987	(17,197)	(1.2636)	(0.8490)
1988	(18,450)	(1.0729)	(0.8490)
1989	(16,807)	(0.9109)	(0.8490)
1990	(12,999)	(0.7734)	(0.8490)
1991	(8,536)	(0.6567)	(0.8490)
1992	(4,759)	(0.5575)	(0.8490)
1993	(2,253)	(0.4734)	(0.8490)
1994	(979)	(0.4019)	(0.8490)
1995	(340)	(0.3413)	(0.8490)

[a]The first ratio is measured by dividing the number of cases in a specified year by the number in the preceding year. It expresses one plus the rate of change, e.g., 2.8661 equals 186.61% increase.

[b]The second ratio is measured by dividing the first ratio for any specified year by that for the preceding year. It expresses the acceleration (deceleration) of the rate of change. For all normal curves the second ratio is a constant less than 1.0.

ripple of interest in the panel. They went on discussing other matters. No mention was made of it in the book summarizing the whole meeting.

It is just as well. The forecast missed. The incidence continued to increase, to some alarmingly, although the rate of increase steadily dampened and the doubling time lengthened. I was wrong.

My colleague Dennis Bregman and I have persisted. Reassessment of our failure led to what we think are clear explanations. In 1985 I had grossly underestimated the length of the incubation period. I had assumed it was two to three years. In this error I had ample company. We now believe it is 8 to 10 years and highly variable.

The second error was an underestimate of the lag in reporting due to the long interval between the date of first diagnosis and the date the report is received by CDC. This gave a false sense of an impending turnover in the curve.

Bregman and I now present what we believe to be adequately adjusted data in Table 1. The data, graphed in Figure 1 on a standard semilogarithmic scale which shows relative change and reflects comparative trends, reveal the steep upward trends in 1982, 1983, and 1984—the logarithmic phase of the epidemic. Then all of the curves veer off to the right with increasing speed.

The curves are astonishingly parallel, a phenomenon we did not expect to find but which we believe to be of great significance. The essential congruity of the curves must mean that some overriding force, or rather a composite of many forces (in mathematical terms a vector or resultant), is exerting an approximately equal effect on all four transmission categories in spite of the wide divergence among these groups.

Any epidemiologist who accepts William Farr as a role model cannot resist the temptation to apply his law to these data. To obtain the most stable data for curve fitting, we have combined the number of cases in homosexuals/bisexuals and I.V. drug abusers into annual totals, shown in Table 2. Using the simplest of arithmetic procedures, we have fitted a normal curve. The fit is excellent, as shown in Figure 2. The projected crest occurs in 1988 and the ensuing decline is symmetric, reaching a low point by 1995. The total projection for homosexual/bisexual and I.V. drug abuser cases is 130,000. Since this estimate applies to 90% of the total cases, the estimate must be increased by at least 10%.

We make no claim of great precision for this projection. In fact we assume a wide range. We rather expect from general

considerations that the decline will not be wholly symmetrical. Rather, it will probably be slower. We have not included any allowance for a continuing endemic incidence although from considerations already mentioned we expect it to be low. The important point is that if Farr's Law has any reasonable validity, the epidemic should crest at an early date and then progressively decline. The total number of projected cases will be about 150,000, approximately half the figure of most projections that have been made so far. Time will tell.

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Projection of AIDS Cases, USA

JAMES CHIN[1]

Since the initial recognition of AIDS in 1981, this worldwide epidemic (pandemic) has been beset by some extreme misconceptions. Among the first of these misconceptions was the belief that AIDS would only be a disease of homosexual/bisexual men and intravenous drug users. When this was shown not to be true, some "scientists" began to spread the alarming misconception that within a couple of decades AIDS would kill almost every man, woman, and child on this planet. That extreme view, based more on social-political motivation than fact, has been dismissed as science fiction by the medical and scientific communities.

Although the ultimate dimensions of the AIDS pandemic are not yet known, our current solid knowledge of HIV transmission and our understanding of the first five to ten years of the natural history of HIV infections enables us to begin to forecast the general scope of the AIDS problem with increasing confidence for up to the next five years.

Virtually all AIDS researchers and public health epidemiologists are predicting that in most areas of the world there will be a five- to tenfold AIDS case increase within the next five years. However, one solitary yet highly respected voice has been raised to challenge this mainstream scientific thinking regarding the future increase. Dr. Alexander Langmuir, former chief epidemiologist for the United States Centers for Disease Control (CDC), has predicted that the AIDS epidemic in the United States will peak in mid-1988 and virtually disappear as a public health problem by 1995. This paper will critique Dr. Langmuir's prediction and provide a simple model that projects an AIDS case increase in the United States similar to that estimated by the current AIDS staff at CDC.

PROBLEMS ASSOCIATED WITH THE USE OF REPORTED AIDS CASE DATA

In countries where clinical diagnosis and reporting of AIDS cases are relatively accurate and complete, the observed pattern and prevalence of the reported cases can be used as a reasonable approxima-

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