Middle Articles

MEDICAL EDUCATION

A Measure of Sliding Sand

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Summary: The Royal Commission on Medical Education recommends that the ratio of doctors to population should undergo an exponential expansion after 1975. It is suggested that the Commission does not appear to have fully recognized the implications of this proposal, nor to have considered other possible modes of expansion, which would result in substantially different estimates of future needs.

Introduction

The Report of the Royal Commission on Medical Education¹ includes estimates of the number of doctors required in this country after 1975. In 1995 a total of 119,800 is recommended compared with a figure of 62,700 for 1965. The Commission bases its estimate on its assessment of previous trends. Other factors, such as changes in the age structure of the population, merely modify the total already reached by this means. This is a reasonable procedure, but if the assessment is mistaken the estimate is correspondingly unreliable.

The trend recognized by the Commission in the doctor-population quotient (the number of doctors per million population) from 1911 to 1961, with which their short-term estimate for 1975 is also consistent, is an exponential curve of the form $y=Ce^{kx}$ where k is 1.25%. In laying the basis for estimates of subsequent requirements the Commission considers no other form of extrapolation, though several are possible. Of these the most obvious is a straight line, and regression analysis of the observed values of the quotient confirms a high degree of correlation both for a straight line and for the curve selected. No evidence supporting the choice of an exponential curve is given in the report, and alternatives, such as a linear expansion, appear to have been uncritically rejected or ignored.

It is notable that the fact that the curve is exponential is nowhere mentioned in the report, while from internal evidence it is uncertain whether the Commission realized the implications of using an expansion of this type. The report contains a number of references to the "remarkably steady rate" at which the quotient rose and the "remarkable regularity that could be seen in the trend" throughout the period 1911-61. A regular and steady increase is characteristic of a linear relationship, while for an exponential curve a steady rate of rise is hardly an appropriate description.

Some Doubts

The doubts raised by the use of these terms to describe previous trends are heightened by the statement that the curve shown in the graph on p. 134 of the report represents a "con-

stant rate of increase of 1.25% annually." The rate of increase of the function $y=Ce^{kx}$ is given by $dy/dx=ky$. This is manifestly not constant, but *variable*, so that the rate of increase in the doctor-population quotient increases as the quotient increases. One might concede that the Commission has used the term "constant rate of increase" in other than a strictly mathematical sense. But, aside from the fact that this is not a concession one should be asked to make in a statistical section of a royal commission report, such a usage could mislead both reader and author.

× Observed values. ● 1975 value expected on basis of plans in 1966. ○ 1975 value derived from the Commission's short-term estimate. A. Trend of 1.25% annual increase, with Commission's long-term projection. B. Regression line of observed values and Commission's estimate for 1975, with linear long-term projection. Source: Royal Commission on Medical Education.

There is further evidence of misunderstanding in the observation that in the later part of the period 1911-61 "the rate of increase seems to have accelerated a little," and in the consequent caution in assuming that the quotient "rose no more quickly towards the end of the period than at the beginning." First to find worthy of remark and then to reject the one attribute which is uniquely the property of the curve adopted suggests some confusion of thought. With an exponential curve

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¹ Royal Commission on Medical Education 1965-68. Report, 1968. London, H.M.S.O.

the rate of increase is, of course, accelerating all the time, and if acceleration were a significant finding, which it is not, the fact need neither occasion surprise nor require suppression.

Table 3 on p. 141 of the report gives the doctor-population quotients for each of two years in 17 selected countries. It has again been arbitrarily assumed that the quotient in each country has increased exponentially, as if the Commission supposed that expansion could proceed in no other way. There is no evidence to justify this assumption, or indeed any other, from only two observed values.

All these considerations cast doubt on the validity of the selection of the curve used, suggest that the Commission may have wrongly supposed that they were actually dealing with a constant rate of increase, and indicate the need for a re-examination of long-term estimates.

The objections outlined are not merely academic, but have important practical consequences. An exponential curve is not at all a likely way for expansion to proceed. Table 3 carries the ludicrous implication that Czechoslovakia, for example, is liable to double the proportion of doctors every 14 years, even if the wrong figure given, 5.3%, is corrected to 5.0%. In Great Britain the annual growth rate of 1.3% finally recommended by the Commission would result in one doctor for fewer than 200 people within 100 years, while in 500 years all would be doctors. Population growth itself tends to be exponential, and an exponential function of an exponential function is a measure of sliding sand indeed.

One could accept a *constant* ratio of doctors to population as intellectually inoffensive, as one could, also, a ratio with a *constant rate of increase* (linear). The former would automatically allow for population changes without alteration of standards, while the latter could, in addition, be adjusted to variations in the scope and quality of medical services required by external factors. At least there would be two millennia before the ratio of doctors to population reached 1 in 40.

If one extrapolates on the regression line (shown in the Chart), which is consistent both with observed values and with the estimates for 1965 and 1975, the number of doctors required would be 86,800 in 1985 and 103,100 in 1995. These figures are respectively nearly 10,000 and over 16,000 below the Commission's recommendations. An additional provision of 10,000 doctors in 10 years is equivalent to the output of five new medical schools, and these must be supplied in addition to the basic expansion necessary between 1965 and 1985 for an increase of 24,000 demanded by a merely linear extrapolation of previous trends.

This example is given, not as a recommended alternative estimate, but as an indication of the order of difference which results from a change in the basis of long-term projection. The difficulties of forecasting are obvious, and the Commission rightly observes that any estimate must be tentative. It remains true, however, that, even though the challenge of competing priorities is likely in practice to restrain expansion, the results of the adoption of an erroneous or suspect basis could be serious.

CONTEMPORARY THEMES

National Poisons Information Service: Fifth Annual Report for the Year Ended 31 December 1968

During the 12 months ended 31 December 1968 the demands made on the service again increased. The total number of calls received was about 33% more than in 1967, largely due to a greater load on Cardiff and London (Tables I and II). Not that this necessarily reflects a higher incidence of poisoning in the United Kingdom and the Republic of Ireland, but simply that doctors are tending more to seek advice about the poisoned patients with whom they have to deal.

TABLE I.—*Inquiries Answered*

	Plants	Drugs	Household	Agriculture	Industry	Miscellaneous	Total
Belfast ..	24	204	202	28	14	3	475
Cardiff ..	69	208	218	29	18	70	612
Dublin ..	64	606	395	71	28	30	1,194
Edinburgh	67	459	359	89	84	52	1,110
London ..	623	3,550	2,492	399	288	115	7,467

TABLE II.—*Number of Children and Adults*

	Children	Adults	Unknown	Total
Belfast ..	391	89	4	484
Cardiff ..	485	127	—	612
Dublin ..	754	311	129	1,194
Edinburgh	738	368	28	1,154
London ..	4,891	2,335	423	7,649

Another feature is that the calls arise predominantly and more than ever from hospitals. This may be explained, in part,

by general practitioners referring suspected cases of poisoning more promptly to hospitals and also because patients and their relatives are inclined to go straight to an accident and emergency centre rather than seek help from their own doctor, who may not be immediately available.

From the fatalities brought to notice in this service, it is evident, as previously, that drugs and medicines are the principal lethal agents. Where other materials have been to blame they have nearly always been taken with intent.

Notable among the inquiries are those concerned with over-dosage from antidepressant drugs—amitriptyline, nortriptyline, protriptyline, imipramine, etc.—sometimes alone, but often with other products. Characteristically the patients are depressed and desperate people who, not finding sufficient relief from the therapeutic doses they have been prescribed, resort to an excess, not necessarily with the object of self-destruction but more as an appeal for help and attention. Seldom are they short of a supply of tablets or capsules for this purpose, and, to judge by the size of the containers, there is no need to hoard. Each prescription quantity is more than sufficient.

Agricultural and horticultural chemicals continue to display what is almost an exemplary record. Serious poisoning from occupational exposure is virtually unknown, which is probably a tribute to the voluntary control arrangements which obtain in this country and the respect which users have for the recommendations for handling. The weed-killer paraquat has, unfortunately, been involved in a few tragic cases, some of them