The remedy for the problem of unqualified practice lies in better medical qualification—a training which meets the needs of those worried and distrusting patients who cannot define their ills and who turn from one adviser to another till they find a listener.

The organization of a national health service will fail of its purpose if scope is not given in fullest measure for the relationship between doctor and patient to be one of personal trust and confidence and that continuity of interest in the individual patient which springs from professional "concern."

STATISTICS IN THE MEDICAL CURRICULUM?

BY

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In maintaining, with customary vigour, the value of statistics in the furtherance of medical research Prof. F. A. E. Crew was fain to admit that "the very mention of the word 'statistics' evokes a peculiarly strong emotional reaction on the part of the great majority of medical men and women. I think it is fair to say," he continued, "that by the profession as a whole an ignorance of, and a scornful and distrustful attitude towards, statistics are regarded as the praiseworthy attributes of a robust personality."¹ Whether that attitude is a prerogative of the medical profession is of course gravely open to doubt. The daily misuse of statistics of every shape and kind perhaps makes sceptics of us all—or, far worse, leads us to accept uncritically figures which fit in with our pet beliefs and to reject, equally uncritically, those that do not. With the doctor it may be, as I have suggested elsewhere,² that both selective and environmental factors contribute to this state of "allergy." The person who is taking up medicine as a career may well be one whose interests lie mainly with individuals—sick persons—and far less, if at all, with the statistical concept of the group. In his clinical training this attitude may be further encouraged by concentration on the specific case, by too close an attention to the average to the neglect of the variation round it, and by a communicable distrust passively or actively transferred from the teachers to the taught in a field in which controlled experiments are notoriously difficult.

The Present Dangers

However that may be, there is no doubt, I should say, that the present generation does look with rather more favour than the past upon the statistical approach to the problems of medicine, in the curative as well as in the preventive field. A superficial study of medical journals is sufficient to reveal that—in spite of the gloom which much of the flow of literature must continue to inspire in the mind of the statistical enthusiast. While that change is—to the statistician at least—all to the good, it may yet bring, I believe, its own dangers. Such dangers will arise if the writer or the reader does not really understand the basis of the methodology that is being applied. For instance, we may run the risk of passing from the situation in which it is too readily concluded that the reactions of Group A, treated in one way, differ materially from the reactions of

Group B, treated in another way, when in fact such a difference might quite easily have arisen merely by chance with the numbers involved, to the other extreme when, overawed by a spate of $\pm$ signs and technical tests of significance, it is humbly accepted that it is "mathematically proved" that Group A *does* differ from Group B and that therefore this must be due to the treatment, which as logic is even more indefensible. In other words, the uninstructed or half-instructed may be just as easily misled, perhaps more easily, by an appearance of "mathematical" exactitude as by the simpler and more old-fashioned methods of mishandling figures. If that were to occur, aided in other fields by the readiness with which right- or left-wing enthusiasts will continue, consciously or unconsciously, to find figures to fit their fancies, the pendulum will doubtless swing back and bring to the fore again the belief that statistics in medicine can be made to "prove" anything and are to be eschewed.

If that result is to be avoided, and a valuable method of research is to be given its proper place, the medical worker, and his readers, must be at least on speaking terms with the elements of statistical reasoning and methods of analysis, and thus be able themselves to weigh numerical evidence justly in the balance. In short, I should replace my querying title, "Statistics in the Medical Curriculum?" by "*What* Statistics in the Medical Curriculum?" (though I am well aware that some clinical teachers will prefer to read it as "*What!* Statistics in the Medical Curriculum?").

The Need for Accuracy

To begin with, on the preventive side of medicine I believe that it is very important that the embryo doctor should be made fully aware of the uses to which statistics of mortality and morbidity are continuously put in public health work, epidemiology, and social medicine. He (or she) is not only sometimes, if he chooses, the consumer of those figures but, whether he chooses or not, is invariably their manufacturer. It is upon the original clinical judgment and diagnosis that the whole subsequent edifice must be built, and our attempts to illustrate the national trends of disease and death, and to solve the problems of epidemics and sickness as a community phenomenon, must be materially aided or hindered by the standard of accuracy that is possible at any given time and place. The student should therefore be taught that it is highly important that he give, so far as he can—as Farr wrote quite a long time ago (1839)—"an authentic name of the fatal disease." Such records are not merely ephemeral bits of paper to satisfy legal requirements but are fundamental to the national vital-statistical system and serious contributions to the problems of the preventive field.

Of course there will be difficulties; diagnosis and certification are not easy tasks, and the aids to them and their resulting accuracy must change from time to time. The medical statistician is perfectly aware of that. But if we await perfection we shall wait for ever, and so long as we are not ignorant of the imperfections much can be learnt from these imperfect records of mortality and sickness. The medical student, in my view, should, to encourage his interest in this field, be shown at some point in his clinical studies the main uses to which are put the raw material of which he is the producer and briefly how they are statistically treated—for example, by reference to publications of the Registrar-General. In short, as inevitable producer he should be encouraged to give of his best in this respect in his medical career, and as possible consumer he should be made aware of the limitations of the resulting data and thus be able to take a balanced view of them. It

¹ "The Role of Statistics in the Furtherance of Medical Research." *Trans. Faculty of Actuaries*, 1945.

² "Statistics in Medicine." *Trans. Manchester Statist. Soc.*, 1947.

may be said that without instruction he will automatically acquire this latter characteristic. I do not myself feel so certain. During the course of a single committee meeting I have heard a distinguished surgeon reject as quite valueless the death certificates obtained in a follow-up of patients with cancer and yet express the greatest interest in the cancer mortality data by site of growth published by the Registrar-General. He apparently saw no inconsistency in this attitude towards material obtained from precisely the same sources, and such an attitude is by no means rare.

Although, naturally, I should not subscribe to the view that the statistician is merely one who hopes, by the slow and patient accumulation of errors, finally to arrive at the truth, I should maintain that in spite of recognized individual errors we can from mortality and morbidity data reach at least valuable indications of population characteristics and their changes in space and time. But that, I believe, needs demonstration by simple teaching. For instance, we have the rise in mortality from tuberculosis during years of war. Some part, however, of that change may well be artificial if, as is customary, the death rate be based upon the experience of civilians only. The more physically fit part of, at least, the male population at young adult ages is being continuously withdrawn into the fighting Services, and the civilian death rate is therefore adversely affected merely as a result of the inevitable changes in the "make-up" of the population at risk. On the other hand, we can see that some part of the rise—particularly at ages relatively or entirely unaffected by the call-up—must certainly be real, whether it be the result of overcrowding, new working environments, bad feeding, and so on. Again, in spite of errors of diagnosis in the records of cancer mortality, we can be sure that they will not account for the population characteristics revealed—the increasing rate of mortality as we pass down the social scale, the excessive death rate in occupations closely concerned with alcohol, the geographical differences in mortality of certain sites to be found even within this country.

The medical student, before he completes his course, should also be made familiar with the simpler vital-statistical rates—for example, the neonatal rate, the infant mortality and maternal mortality rates, the crude death rate and its limitations. Those figures, no doubt, lie more in the province of the public health worker, but they are now cheerfully bandied about in the daily press, and a professionally trained man or woman should have a sound knowledge of their derivation and meaning.

A More Fundamental Question

Passing from this specific field of vital statistics, and the general practitioner's contributions to it, a more fundamental question is whether the medical student should in his training be taught the more general aspects of statistical thought and its simpler methodology. In my opening paragraphs I have more than implied that he should, and this is, not unnaturally, the view taken in a report recently issued by the Council of the Royal Statistical Society.¹ Apart from the need for professional statisticians and for schools of pure statistical teaching and research, it is in this report strongly urged that all students in the social and natural sciences should "have some familiarity with statistical ideas and the most common methods, as part of their background knowledge." For every worker who has need to use statistical methods many, it is pointed out, have occasion to appreciate results and arguments having

a statistical basis—the medical man, I should add for example, in assessing clinical trials of a method of treatment or tests of preventive inoculation, in assessing the results of a follow-up of patients, and so on. In short, "the statistical approach is so fundamental to the modern way of looking at things—the affairs of everyday life as well as scientific theories and experiments—that it should form part of the mental equipment of the educated man, which it is not at present."

A Suggested Course of Training

While that outlook may ultimately be realized through the teaching of statistics in schools, at present it falls to the universities to inculcate it. The Council of the Royal Statistical Society is, therefore, led to propose three main types of courses of tuition—namely: (a) a short elementary course for at least all students in the social and natural sciences, requiring no special mathematical ability but designed to familiarize students with statistical ideas and the most commonly used elementary methods; (b) an ancillary course of a somewhat more advanced type to enable students to utilize properly statistical methods in their chosen science; and (c) an advanced course for those of mathematical bent.

To my present thesis the last is clearly irrelevant, but the question of the ancillary course is rather more difficult. The Royal Statistical Society's report argues that it is "desirable that this second type of course should be taken by most students of the social and biological sciences in all universities, as part of the normal curriculum for a first degree. We realize that this may be regarded as a revolutionary proposal, and that there are great practical difficulties in adding further work to existing programmes; but it is impossible to escape the conclusion that the scientific worker in the social and biological fields who has not a sound grasp of the statistical approach and its simpler methods of application is seriously handicapped when appreciating quantitative laws and attempting the interpretation of observational data."

To what extent is that applicable to the doctor in training? For those who intend to embark upon research or take up scientific work of one kind or another such a course is, I believe, most definitely needed. But for the bulk of medical students bent on general or consultant practice I suggest, at present, it would be wiser to restrict ourselves to (a), the short elementary course. Some ten lectures (or even fewer) on basic ideas and simple methods of handling and interpreting quantitative data would be sufficient for that purpose, with the addition—and this is fundamental—of some practical arithmetical work. For all teachers of statistics are, I believe, in agreement on at least this one point, that without practical applications by the student the teacher's instruction may be largely wasted. Many of the students would, no doubt, never again apply the methods in their field of work (any more than they personally apply, say, their instruction in bacteriology), but they would at least acquire the necessary background—be grounded in thinking about numerical material, its limitations and its meaning, and thus be less liable to accept at their face value results based upon unwarranted comparisons, upon so-called "controls," or upon a quantitatively exceedingly slender foundation.

The Statistical Method in Practice

They would be taught, I reiterate, to *think* about figures, constructively or destructively as appropriate, about their own and those published or put about by other persons. At present that thought is often entirely lacking or is

¹ "The Teaching of Statistics in Universities and University Colleges." A report of the Council of the Royal Statistical Society printed in advance of the *Journal* of the Society, 1947, 110. Price 6d.

misguided through lack of a knowledge of how to set about it or through ignorance of statistical concepts. A few simple examples from "real life" might clarify that assertion. In 1946, for instance, I made for the British Medical Association an inquiry into the pre-war incomes of general practitioners—information which was required for submission to the Spens Committee on levels of remuneration in the new health service. It was impracticable to seek this information from all practitioners, and a sample was taken—how is highly important but not relevant to my present point. Let us suppose that out of a total of 20,000 practitioners 5,000 were picked at random to give a representative cross-section. Of these 5,000, however, only 3,000 respond. In other words, the original sample which the statistician is satisfied will, within limits, give the right answers is replaced by a smaller sample which may not be at all representative of the total population. If those who choose to answer are those earning good incomes the resulting figures are too high; if persons earning a lot are too busy to bother with forms they are too low. The actual motives or habits leading to answering are unknown, and there is no means of determining whether or no they are associated with earning capacity. But, on the other hand, some persons do not see why the numbers should not be made up to the original 5,000 required by taking another sample and adding in their replies—there were plenty of practitioners left who had not been approached. The fundamental statistical requirement of quality as well as quantity is overlooked. No mere increase in numbers can produce the representative cross-section sought if those who are willing to respond are basically not representative themselves. Whatever the size of the sample it remains biased. For very similar reasons the follow-up of patients to determine the upshot of treatment may give an erroneous answer if only a proportion of the original treated group can be traced, say, five years later. The question turns upon whether the lost-sight-of are likely to be different in their state of health from the traced—have they more frequently disappeared through death or, on the other hand, through survival in good health and a consequent movement to a distance? Is the sample that can be found representative of the original group?

In the field of association equally simple, but still overlooked, difficulties arise. For instance, we may note that children who contract a disease after inoculation against it die less frequently than uninoculated patients. We must, however, consider whether the two groups are comparable except with regard to the state of inoculation. The inoculated might be of school age and the uninoculated of pre-school age, and we should then expect to see a lower fatality rate in the former compared with the latter, quite apart from inoculation, since the fatality rate normally declines with age. Or we have the uncontrolled observation that patients with a given disease have such-and-such a characteristic or antecedent, and overlook the essential need to know whether they have that characteristic or antecedent any more frequently than happier mortals who do not contract that disease. It all seems distressingly obvious when it is written down; it always does—but the faculty of common sense is not so common. The same mistakes continue to crop up, and the same inefficient numerical treatments continue to be applied to data.

Conclusion

Arithmetic guided by logic has been given as a fairly accurate definition of simple statistical methods, and it is that kind of teaching that would, it is my belief, be of real benefit to the medical student. It should introduce him not only to such general viewpoints as those given above,

to be borne in mind in considering statistical evidence, but also teach him the appropriate methods of handling and presenting data, and familiarize him with the statistical concepts of variability, the ideas lying behind elementary tests of significance, simple means of measuring and interpreting associations, and so on. Such teaching would also, I believe, be of undoubted value to the medical practitioner who found at one stage of his career or another that he wanted to set about a piece of original work—and surprisingly many are drawn to it. How should he set about making the appropriate observations? How many will he need? In what form shall the records be made to ensure completeness and to facilitate subsequent analysis? Will it be sufficient to observe the affected individuals, or must the unaffected be equally carefully included in the inquiry? Must the exposed to risk be enumerated? Will such-and-such a method denote an effective experiment and lead to a clear answer? Will a control group be required, and what, if so, is a satisfactory way of obtaining it? Will it be necessary to have full records for all the population under study, or if a sample be sufficient what is the best means of drawing the sample? And so on. The specific questions involved and the answers to them will, of course, vary from inquiry to inquiry. But the basic ideas behind them will be very similar. Some acquaintance with those ideas will certainly help to make less frequent, at the end of perhaps months of patient work, that unhappiest of statements beginning, "If only I had realized I should need . . ." How often at present does the statistical consultant have to echo sadly, "If only!"

THE FUTURE OF PUBLIC HEALTH EDUCATION

BY

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When a medical student graduates he generally seeks further hospital experience in the first instance, so that he may practise under the canopy of skilled supervision. After that he ought to spend at least a year as an assistant in general practice; and military service should not tempt him to cut down this period of valuable training in the field, whether he intends to specialize or not. The majority of young medical men and women are well content, when this preparatory phase is over, to build up their life-work in general practice—the most strenuous and the most satisfying of all medical careers. Some of the others will turn to the special branches of medicine, probably because one of these has already stirred their imagination.

The prospect of a career in the public health service does not illuminate the mind with great intensity; but it is a steady light to many who see in it an opportunity for promoting social welfare. There are medical men and women to-day who discover that their interests move towards health rather than sickness; others find that their talents lie in administration; and others, again, believe that a general background of training in preventive and social medicine is a good foundation for practice in certain branches of the national medical service—such as paediatrics, industrial medicine, infectious disease, or bacteriology.

One of the objects of the postgraduate course of education in public health is to lay good foundations for careers in preventive medicine. The course as it stands to-day is