Discussion : The laboratory and patient records

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I think we are all indebted to Professor Knox and Professor Holland for their papers introducing the role of computers in automation and data processing. I believe these introductory papers are all the more necessary as most of you, like me, have probably had no direct experience of electronic computers in the laboratory. I presume that you will have watched their development, almost from afar. I, myself, first became aware of the great potentialities in the computer in relation to its use in defining protein structures. It seems a far cry from that period, a little over 10 years ago, when electron defraction patterns were being analysed with the help of computers on the other side of the globe. In this brief period of approximately 10 years, computers have moved through two new generations, as the experts tell us. It is still only 10 years ago that the transistor was used in computers, and now 'microminiaturization' is making a double contribution. In addition to advantages in the production of computers, there is the intrinsic advantage of small size. The time taken for the computer's core store to communicate with other parts of the computer depends on the speed of electricity, which is one foot per nanosecond. For this reason access time is measured in nanoseconds or fractions of a microsecond, and the smaller the instrument, the greater the speed with which it may operate. The extraordinarily rapid way in which computers are being developed suggests that by the time most of us will have computers in our hospital laboratories they will have reached a stage of development which is well in advance of that we know today.

In attempting to obtain some perspective on the application of computers in hospital laboratories, it may be worth asking what their role is in the laboratories of district general hospitals. The Department of Health plans that these hospitals will serve populations of 160,000 to 200,000 persons. Recently we made an assessment of the biochemistry service in my city—Leeds—which has a population of about 500,000, and therefore would be suitable for, say, two large district general hospitals. At the present time three biochemistry laboratories in Leeds are examining approximately 100,000 specimens and reporting on 400,000 estimations. The cost of this is close to £100,000 per year. On the basis of a doubling of service work, the rate of which is determined by the way in which clinicians think, and increasingly they think in chemical terms, we may anticipate that in four to five years twice the number of specimens will be handled and probably many more determinations. A large district general hospital must, therefore, anticipate something like 100,000 specimens and over 400,000 analyses, and must also allow for further expansion at the current or higher rate for some time in the future.

To provide for a service of these dimensions is a large task. I know of no realistic assessment of the way in which we can provide for this load, other than one based on a highly developed system combining analytical equipment and computers. The arrangement will include instruments that receive and identify specimens, guide them through analytical channels, controlling the quality of the analyses at a level suitable for clinical needs, gather together the information on individual patients, perhaps provide an initial sorting or assessment of the results, and print them out in a form which is most easily assimilated by our clinical colleagues. In the whole of this process there should be no intervention of human hands. Our staff will be occupied with programming the equipment and maintaining it.

Professor Knox has emphasized that the computer can do with data anything that can be done with data. In practice, however, this may mean that the computer can do with data anything that one can afford. Already one can anticipate the rough cost of equipment for a district general hospital. The computer for the biochemistry laboratory (which should be able to serve other disciplines too) will cost between £25,000 and £50,000. In addition to this there will be required analytical equipment approaching £25,000, and the data-handling and print-out facilities may well amount to £5,000 or more, depending on where the print-out arrangements are installed and how many outlets there are. These costs, then, amount to something like £75,000, and, if they are amortized over a period of seven to 10 years, represent a yearly financial requirement of £7,000 to £10,000. This is not a large sum in relation to the annual costs indicated above of approximately £100,000 to provide a similar volume of work in one city. This laboratory 'core' should be able to analyse about 75% of the specimens at a cost of 2 to 3 shillings per specimen. The experience of automation in many fields is that a smaller number of staff is required, but these require a substantially higher level of training. In view of the fact that 80% of the costs of hospital laboratories are labour costs, there should be a real saving. At the present time one cannot estimate the extent of this saving, and it may be more realistic to refer to it as a reduction in the rate of increase of the costs. Ultimately it should be possible to provide the service in a much more economical way than we do in the present circumstances. I would like to emphasize the uncertainty about what are the most advantageous technical components at the present time. My assessment of our discussions today is that we should allow for a wide variety of equipment of both continuous and discrete types of analysis.

Turning now to Professor Knox's comments on the general nature of computers, he emphasizes the necessity to think in more precise formal terms, if we are going to be able to use computers to handle the digital information such as a biochemistry laboratory is producing, and also the more complex concepts of medical science. I found his account of the structure of medical information particularly stimulating. In part, I think, his appeal is that not merely we in the hospital laboratories, but our clinical colleagues, should be encouraged to think in more logical, concise, and quantitative terms. This is a point which is already emphasized in the Report of the Royal

Commission on Medical Education. It is particularly important that at the time when the doctors of the future are learning new patterns of approach to medical information they should be given the instruction and help which is necessary to cope with these problems in the future. Although we in our own everyday laboratory practice can make a contribution towards this, it is essentially a task which has to be attempted at the grass roots of medical education in the medical schools. One can only hope that the recommendations that doctors should be taught to think quantitatively will not be entombed in the Todd Report.

Professor Holland has focused on a number of problems concerning the yield of individual laboratory procedures. It is absolutely essential that we should approach our laboratory work from the point of view of its overall productivity in diagnosis and in control of patient therapy. I hope that Professor Holland will pursue this a great deal further and that others will join him. Nevertheless I have some reservations about one of the assumptions, at least, with which he began his studies, namely, that the importance of a determination will be represented by the frequency with which it is mentioned in the case summary. For example, a number of clinicians consider that every patient should have his or her blood urea determined in order to detect the occasional case of renal failure which clinical observation misses. I would expect these to be discovered with a frequency much less than one in 100. The fact that it was not worth recording in 99% of case summaries would not worry me in the least. Professor Holland's early studies in this field also direct attention to the importance of keeping the accuracy of our laboratory analyses under

constant review. We must ask, What accuracy is justified by clinical needs? Tonks introduced the concept that the reproducibility of laboratory analyses should be at a quarter or a sixth of the normal range. This is a very helpful way of approaching the subject objectively, and I missed this concept in the discussion of the reproducibility of haematological equipment earlier today.

We should not assume that the accuracy should be as great as possible. This may be uneconomical. There are, however, economic advantages in increased accuracy. For instance, it is common knowledge that clinical colleagues often ask for analyses to be repeated where the results do not fit in with their clinical expectations. Some of these may be justified by the inadequacy of laboratory techniques. My own experience is that such repeated requests are on the decline. Nevertheless they may still add to the load. More important, one cannot expect to dispense with these requests based on doubts reached intuitively, until accuracy and reproducibility are within carefully defined limits, and the yield of useful information can be measured objectively. The type of study which Professor Holland has given us is an early step in that direction.

There is another way, too, in which inaccuracy affects the load of analyses. Serum chloride analyses have little justification, other than as a means of making it possible to detect the occasional analytical error which shows up in an imbalance of anions and cations. However, this is a very crude and inadequate way of controlling the accuracy of anions and cations. The sooner methods of quality control are equal to the task will we be able to drop serum chloride analyses from the repertoire of the hospital laboratory.