PRACTICE OBSERVED

Practice Research

Waiting for the doctor

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Abstract

The best time interval between appointments in general practice surgeries where patients were allocated specific times to see their doctor was studied. A mathematical model which simulates the pattern of the arrival of patients and consultations at the surgery, and which can be run rapidly on computer, was constructed. The model can be applied to any general practitioner's surgery that operates an appointments system. The only inputs necessary are observations of the arrival times and consultation times of all patients at 10 of the doctor's surgeries. The scope of the reduction in waiting times that was attained in one practice is discussed.

Introduction

It is common practice for general practitioners in England and Wales to have appointment systems for their surgeries, but many patients continue to experience delays, in some cases of more than half an hour between the time of the appointment and seeing the doctor. Some delays may be inevitable owing to emergencies or unusually long consultations. More often, however, delays arise because the appointments system is not operated to the best effect and in particular because the interval between consecutive appointments has not been correctly specified.

Of course some doctors may be happy so long as they avoid gaps between consecutive consultations during a surgery, and this is more likely to be achieved by having shorter intervals between appointments. The danger then is that appointments will be made earlier than necessary, causing patients to wait longer, and these

delays increase as surgeries proceed. Many doctors are concerned to avoid having patients wait unnecessarily, and some doctors, knowing that the waiting room is full, may, if only subconsciously, rush consultations and give less than their full attention to patients.

The problem is therefore to find the right interval between appointments to optimise waiting times for both patients and doctors. Though this optimisation will always seek to reduce delays to a minimum, the quantity to be minimised need not be the simple total of patients' waiting time and doctor's slack time, in addition together these two factors an element of weighting may be applied to express the relative value that a doctor attaches to his or her time compared with a patient's time. There may be wide variations between different general practices, depending on the doctor's approach to consultations and on the punctuality of patients. Therefore, it cannot be said that an interval between appointments of 5 minutes is the best for all practices. The approach described in this paper will indicate the best interval between appointments for a practice.

When this best interval has been determined, however, it cannot be claimed that all problems of delay will be resolved. Because of the unpredictability in any general practice surgery the best planned appointments system can go awry. Nevertheless, there are advantages to be gained by applying to appointments systems the technique of mathematical simulation described in this paper. That technique uses the results of observations of one general practice to simulate further surgeries of that practice and, by experiment, to see which choice of appointment interval minimises delays.

Case study

Dr Who and Dr No are partners in general practice in a small town in the north of England. Their surgeries are held in a purpose built health centre, where appointments have been used for many years. For both Dr Who and Dr No appointments had been allocated at five minute intervals except at even half hour after the beginning of the surgery, which meant that 11 patients were due to arrive during the first hour of surgery, and 10 during each succeeding hour. This pattern was generally thought to be most

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of the wide fluctuations in the total waiting and slack times from surgery to surgery, largely because of the higher proportion of Dr No's patients who failed to keep their appointments. Thus the number of those failed appointments was different consistently between surgeries, upsetting any prearranged patterns of appointments. Whereas Dr No's unoccupied time at the simulated surgeries averaged 37 minutes per surgery compared with two minutes per actual surgery, Dr Who's waiting time for his patients was 94 minutes per simulated surgery compared with 178 minutes per actual surgery. As for Dr Who the results of computer runs suggested that it was possible to reduce the total waiting times of the patients in his practice by 94 minutes per simulated surgery compared with 178 minutes per actual surgery.

The most important recommendation for Dr No's surgeries was that steps should be taken to reduce the number of failed appointments. In addition, to move towards allocating appointments at an average of one every 9.2 minutes it was suggested that appointments should not be made every 15 minutes and 45 minutes past each hour as well as every 30 and 60 minutes past each hour as was the established practice.

These changes were implemented for Dr No in July 1985, and observations made a few months later showed that the number of failed appointments had been dramatically reduced. This so altered the four frequency distributions for Dr No's surgeries that fresh computer simulations were run and further recommendations made.

Of course, the optimal intervals for appointments for the surgeries of both Dr Who and Dr No would be different if coefficients of weighting other than 1 had been chosen. The scope of improvement that may be attained by implementing the recommendations arising from this model is shown by the fact that the total waiting times for doctors and patients could be halved, and

the average waiting time for a patient could be reduced to between a quarter and a half of its observed level.

Conclusion

Now that the model has been developed and computerised it may easily be applied to any general practitioner's surgeries that are run with appointments systems. For any doctor the necessary data can be observed from 10 separate surgeries and then fed into the model for the simulation experiments. A general practitioner who wishes to undertake such an exercise could either employ operational research consultants on contract, or if he or she has access to a moderately large computer, purchase a copy of the program that we have developed. In either case I would be pleased to hear from the general practitioner. Applying the method widely could lead to large savings of time for patients and doctors, improve the efficiency of primary care in the NHS, and contribute to a higher standard of medical care.

Reference

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A paper 17 February 1986.

Essays on Practice

The chief examiner's letter

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When the news leaked out that 74% of trainees sitting the membership examination of the Royal College of General Practitioners had passed the regional advisers' champagne cork started popping. They knew that for years the college had claimed that the diploma examination was the only valid assessment of vocational training in general practice. Indeed, in the document "Towards quality in general practice" the college had claimed that the examination assured a credible standard for entry into general practice. Hardly had the bottles been conveyed to the glass salver when an ex-cot in the shape of a letter from the chief examiner landed on the regional advisers' desks indicating worries and concerns over the performance of the trainees in the examination. Never mind that the vast majority of the examinees could now become members of the college, it was the view of the examiner that there was a "global frequency" of worrying features causing concern, and the regional advisers had better know about it. Never before had such a letter been received on behalf of the regional general practice subcommittees about training modelled according to national guidelines and almost invariably leading to certification for doctors who completed it. Yet the letter's criticism had been freely laced with such expressions as "majority", "most candi-

dates", "receive no teaching", "surprisingly high numbers", and "global frequency", leaving no doubt that a majority of candidates had a major source of weakness that worried the examiners.

This set the regional advisers a number of riddles. For what sort of college were their young colleagues attempting to join? Could it be a worthwhile institution if so many weak candidates could be admitted to its membership? A credibility gap had been opened up between the stated high ideals of the members of the college as expected to live up to and the apparent low standard of performance that could entitle 74% of examinees to membership. The inference was either that the college was yearning for new members so that it would accept anyone or that the chief examiner and colleagues had reached their judgments on misinterpretation of the evidence.

The college is well known as being jealous of its membership and fellowship rules and requires no expansion through inappropriate members. This leads to the next riddle: if the examiners had got it wrong what confidence could regional advisers have in the examiners? Yet this question answers itself by the training that the examiners are known to undergo and the rigour with which the examination is being constantly reviewed. There is no other royal college that has wrestled with the structure and process of their examination as this college has done. So taking all these factors together it looks as if the chief examiner's letter was written on a "bad day", hence the hyperbole.

But for the regional advisers the next riddle was the decision to give this letter the widest publicity. Every medical newspaper had blazoned headlines, and even the national papers contained letters expressing astonishment at the apparent ease of entry to college

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convenient for both patients and doctors, but little consideration had been given to whether it might be unpractical. The model described in this paper was developed to answer this question. During November 1984 detailed observations were made of 10 surgeries held by each doctor. Although these included both morning and afternoon surgeries, the time of day was not significant. For each surgery the times of all appointments that had been made in advance were listed, preserving the anonymity of patients, together with the actual times of arrival of patients and of the beginning and end of every consultation. The number of patients per surgery varied between eight and 22, and several patients failed to arrive at the surgery.

From these data four frequency distributions were observed for each doctor: *a*, the distribution of number of patients per surgery; *b*, the distribution of how punctually the doctor began each surgery; *c*, the distribution of patient punctuality—that is, how many minutes difference there was between patients' arrival times and their appointment times; and *d*, the distribution of the number of patients who failed to arrive, if the distribution of duration of consultation with the doctor. These distributions were the basis of the data fed into the simulation model described below and of the experimental runs that run the model.

Various practical considerations arose in compiling the data. Firstly, the waiting time of a patient who had arrived at the surgery in advance of the appointed time was measured from the time of the appointment. Secondly, if a patient arrived early and was the next available patient on the list when the doctor became free then that patient was seen by the doctor at that time, even if it was earlier than the time of the appointment. This sometimes led to a reordering of the list of patients for consultation compared with their appointments, and it could also increase the waiting time of patients who were thereby demoted in the order, even if they were not late for their own appointments. Thirdly, if two patients arrived and were seen by the doctor together—for instance, a parent and child—then they were treated as one patient for the purpose of punctuality, the earlier of their two appointment times being taken as their time of arrival. The time of consultation with the doctor was divided into two equal halves to give individual consultation times. Fourthly, when the patient saw a nurse in the treatment room before consulting the doctor the time of the patient's arrival to see the doctor was taken as the time when treatment by the nurse was completed. Finally, only patients who consulted the doctor for general medical services on the National Health Service were considered in the observations.

Observations from Dr Who's surgeries.—There were 146 appointments for Dr Who's 10 surgeries, and only two of these appointments were not kept because one patient failed to arrive and the other telephoned to cancel the appointment, which was then re-filled. Of the 144 appointments kept, patient punctuality varied about a mean SD time of 6 to 6.5 minutes early. The average duration of consultation with Dr Who was 6.1 minutes. Over the 10 surgeries the total patient waiting time was 707 minutes, giving an average of 71 minutes per surgery and an overall average of five minutes per patient; the longest waiting time for any patient was 24 minutes. The total unoccupied time of Dr Who during the 10 surgeries was 58 minutes, an average of six minutes per surgery.

Observations from Dr No's surgeries.—There were 162 appointments for Dr No's 10 surgeries, but 19 were not kept. The average time of arrival for the other 143 patients was 17 minutes before the time of appointment. The average duration of consultation with Dr No was 7.9 minutes, and the total waiting time of his patients was 1762 minutes, giving averages of 176 minutes per surgery and 12.5 minutes per patient; the longest waiting time for any patient was 42 minutes. The total unoccupied time of Dr No during the 10 surgeries was 23 minutes, or an average of two minutes per surgery.

At first sight these observations indicated that there was scope for improvement in the appointments systems of both doctors, but particularly for Dr No. The evidence showed the variations that arise in the waiting patterns for different doctors and between patients in the same practice

When the separate allocations of random numbers have been made for all four frequency distributions, each in accordance with the observations of a particular doctor's surgeries, the simulation model can be run with random numbers drawn from tables, from a "baggy drum", or by a computer program. For each run of the model the only other parameter to be assigned is the time interval between appointments, and after each run the total waiting time for patients and slack time for the doctor can be calculated. By repeating such runs a picture in some built up of how the model responds to changes in the time interval between appointments, and the optimum level of this time interval can be estimated. No two runs, however, are identical, and there may be considerable variation in the total waiting time for runs with the same time interval between appointments. As with all simulation models, the results are never exact but offer the best guide as to how the system may be optimized.

Performing simulation runs "by hand" soon becomes tedious, and it is much quicker if the process can be computerized. So a computer program has been developed at this centre to provide fast operation of the model. The program is written in BASIC computer language for running on an HP8000 computer, but it may easily be adapted for other computer systems with similar facilities. For any doctor the data comprising the allocation of random number blocks for the four frequency distributions, together with a coefficient for weighting the doctor's slack time in relation to patients' waiting time, are fed into the computer to be stored on a file, and any run of the program will, for a specified appointments interval, simulate as many surgeries as required. The time interval between appointments can be specified in tenths of a minute, such precision might seem an unnecessary and impractical refinement, but in practice allocating appointments every five minutes except, say, on every quarter of an hour corresponds to an appointments interval of 15 minutes. This computer program is a flexible tool for simulating surgeries. For each simulation it can provide a tabulated printout showing for each patient the time of arrival, start and finish of the consultation, waiting time, and the time of consultation. The last two items are then totaled for the whole surgery, and those totals can be averaged over all the surgeries in that run of simulations.

Results

The data obtained from observing the surgeries of Dr Who and Dr No were fed into the model described above, and over 200 computer runs were completed for each doctor's surgeries in turn. At this stage no weighting had been done of the doctor's slack time relative to patient waiting time—that is, the coefficient of weighting was equated to 1.

For Dr Who's surgeries the runs suggested that the optimal time interval between appointments was 6.9 minutes, and 30 runs with that time interval produced an average waiting time per patient of 1.3 minutes, about a quarter of the average waiting time observed at Dr Who's actual surgeries. The longest waiting time for any patient was 18.3 minutes compared with 24 minutes at the surgeries observed. On the other hand, the unoccupied time of Dr Who at the simulated surgeries produced an average of 22 minutes per surgery, compared with an average of six minutes at the surgeries observed. Increases or decreases in the appointments interval, however, tended to increase the corresponding average waiting time and slack time, and the equalled 39 minutes per surgery for the computer runs compared with an average of 77 minutes for Dr Who's surgeries. The computer runs suggested that the total waiting time spent by Dr Who's patients in the same over-see period was 15 minutes, and the total unoccupied time of the doctor was 6.9 minutes. Of course, it is impractical to give patients appointments every 6.9 minutes, but this interval corresponds to almost nine patients an hour, and the same effect may be achieved by giving appointments every 9.2 minutes, except at 30, 45, and 60 minutes past each hour. It was therefore suggested that the appointments pattern for Dr Who should be changed accordingly.

These changes were implemented by Dr Who with effect from July 1985, and further observations of his surgeries were made during December 1985, covering 142 appointments. The average waiting time for patients was 31 minutes per surgery and 2.1 minutes per patient, while Dr Who's average unoccupied time was 13.7 minutes per surgery. The longest waiting time for any patient was 15 minutes, although there was a patient who arrived rather than 39 minutes achieved at the simulated surgeries, it was not a great improvement on the 77 minutes observed at Dr No's surgeries in November 1984. The total waiting time of Dr Who and his patients could be halved would nearly have been realized if, after some unoccupied time, Dr Who always resumed his surgery immediately a new patient arrived rather than waiting for the next patient to arrive. This would have been achieved by Dr No. So similar experiments indicated an optimal appointments interval of 9.2 minutes, with a corresponding average waiting time per patient of four minutes compared with 12.5 minutes at Dr No's surgeries. In the simulated runs the longest waiting time for any patient was 52.8 minutes compared with 42 minutes at the surgeries, and this anomaly arose because

membership by ill prepared doctors. Had the college not just issued a document on "Quality in general practice"? Yet it seemed that this was underpinned by recruiting members who were deficient in many parameters of general practice knowledge. Regional advisers could only share in the resulting embarrassment. On cool reflection there was another bug in the system. The chief examiner's letter had been written as though there was a "constant" called examination and all the variables related to the stimuli provided by training. The resultant "product" was consequent upon what had been "done to it", rather than to any innate qualities of the raw material—the trainee. For the examiners to express such a mechanistic view of training is worrying. The cohort of trainees sitting the examination is as variable as it could possibly be within a single profession. They are drawn from three year schemes—that is, just three years from full registration—right up to doctors who are changing careers after many years and who may have one or two higher medical diplomas already. Not only is existing experience so different but so is intelligence, motivation, and commitment. It is on this great span of educational, cultural, and personality differences that training operates and quite validly may result in a wide spectrum of performance under all conditions including academic examinations.

The view of the training unit—the training practice—perceived by the examiners was through the eyes of these very variable candidates. It therefore seems unwise for examiners to claim "that the examiner is marking the practice rather than the candidate"—and that on a brief encounter under the stressful conditions of an oral examination. This judgment bordered on arrogance when, in the complex chemistry of service learning and teaching, opportunities have to be melded to the personalities of trainee and trainer and the interaction of their various skills. It points to the examiners apparently having a simplistic view of service training, reducing it to an induced "stimulus-response" behaviour pattern. This set another riddle before regional advisers regarding the training process: laying the foundation for a young doctor to work in a chosen branch of medicine and to recognise the need for life long

professional and self development. The training period should provide a strategy for maintaining competence by being up to date and by maintaining enthusiasm. But should training help a trainee to pass the membership examination? The criticism of the examiners has some validity only if a general opinion exists that training should be directed at, among other things, coaching trainees for the examination.

The next riddle is presented by this very assumption, for most trainees are members or fellows of the college. Are we now to assume that college membership is so little influenced by the college philosophy that trainee members or fellows are content to see their trainees ill prepared for the membership examination of their own college? If membership of the college does not make trainees undertake their training responsibilities with the same care as regional general practice subcommittees operating lists of waffly criteria or for the Joint Committee on Postgraduate Training for General Practice, signalling training standards from a distance. Many of the chief examiner's criticisms were to be expected for some candidates sitting any examination under the sun. Waving the big stick has never influenced such candidates. But the criticism of the training process from a second hand view is another matter.

It is risks as it does nothing to compensate for inaccuracies in reporting. To state that an increasing number of candidates "receive no teaching", knowing that trainees are specifically paid for teaching is such a serious matter we should now have the evidence on which the chief examiner relies. Advisers are the officers of regional organizations that promote the appointment and payment of trainees who take the money but apparently do not exercise their responsibilities. As stated above, I have endeavoured to give the widest view formulated on second hand evidence gathered under unusual conditions. We should keep our cool, however, taught in the practices or not. 74% of trainees still passed the examination. The biggest riddle is what sort of a college have we that sought the widest publicity for this letter? The advisers could be expected to understand the caricature, but the public at large would not possess the necessary enlightenment.

100 YEARS AGO

Dr J. D. Thomson, of the United States Marine Hospital Service, gives some further interesting details in the *New York Medical Record*, of the class of French-Canadian among whom the peculiarly hereditary affection, which we last week referred to under the title of "myxoma" or "data," is standing out as the large camp-better, in which was a very hot fire, when someone cried, "Grab the furnace!" No sooner were the words said, than the poor fellow obeyed the order, and, as a result, fell a scorching pain on each hand on the nearly red-hot pipe, thus rendering him unfit for work in the woods for some weeks. I could, were it not for saving up valuable space, enumerate instance after instance fully as peculiar as the above. In brief, it may be stated that any time and under any circumstances, with the slightest provocation, and almost instantaneously on being spoken to, one of these fellows will obey any command, imitate any action, without regard to its nature, trivial or serious. He will leap on a table, or over a stove, or into a river or pond, throw any article or weapon he may have in hand in any direction indicated, will repeat any sentence or exclamation. So serious a matter is this, that made of the lumber men absolutely refuse to admit a man known as a "lumber" into their camps. I find they are not wholly devoid of French-Canadian, as occasionally a Canadian of Irish parentage will exhibit the same symptoms. As stated above, I have endeavoured, when possible, to investigate as to the cause of this peculiar and distressing condition, and while I find, without doubt, that primarily it is due to an inherited nervousness, the immediate cause is in taking such children, when small, and, while firmly held, tickling them until convulsive symptoms appear. This seems to be the source of such cases as have made inquiries of. Whatever the cause, the condition of one must more easily acquired than lost, as it firmly clings to its victim far into adult life. (*British Medical Journal* 1886:120.)

Simulation model

Having observed the surgeries of Dr Who and Dr No, I constructed a mathematical model which can represent the surgeries of any general practitioner who uses an appointments system. The model employs basic techniques of mathematical simulation with four Monte Carlo assignments of random numbers, one for each of the four frequency distributions listed above. For each assignment 100 random numbers are divided into blocks with sizes as accurate as possible in proportion to the different frequencies being represented. For example, if 15 out of, say, 150 patients arrived six minutes early for their appointments then a block consisting of 10 of the 100 random numbers would be allocated to the "six minutes early" frequency in the punctuality distribution, and in drawing a random number falling within that block we have the simulation of a patient who arrived six minutes early for his appointment. As mentioned above one block of random numbers for this distribution may be assigned to the category of patients who fail to arrive at the surgery.