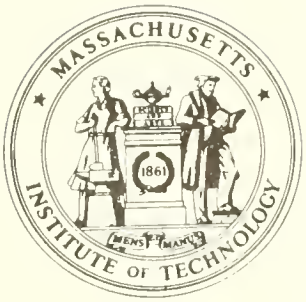

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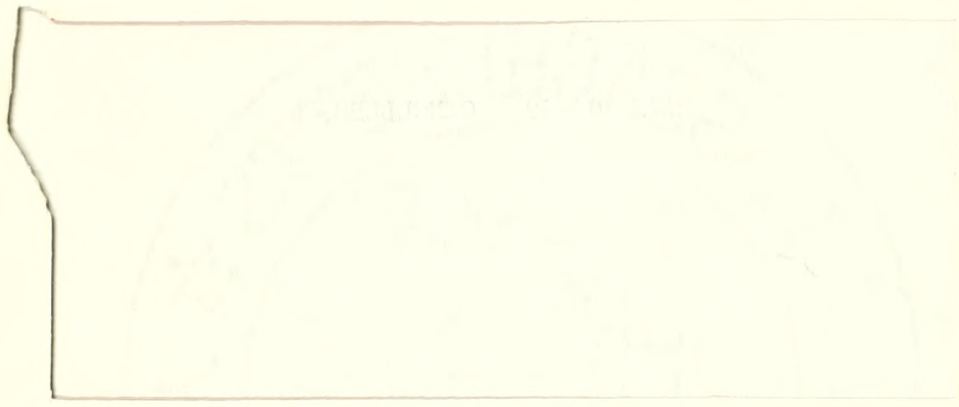

# IMPLICATIONS OF ON-LINE COMPUTER SCHEDULING FOR THE NO SHOW RATE IN HOSPITAL OUTPATIENT DEPARTMENTS

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by

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## Introduction

"Step child of the hospital" and "bargain-basement medicine" are familiar pejorative terms frequently associated with ambulatory care. In recent years, however, with the advent of Medicare and all its ramifications, the dramatically spiraling costs of medical care, and the increasing pressure on inpatient facilities, hospital outpatient services are gradually achieving a prominent role as an essential component in the provision of total health care.

Increased importance of the ambulatory arm of the hosptial has, in turn, cast increased attention upon its shortcomings. Most of these inadequacies are not new, merely more evident. Long patient waiting times and other outpatient care problems have been noted recently,[1] but they were also strongly indicted by a British Ministry of Health study team in 1955,[2] and by many others in the interim.[3] Several schemes have been suggested to overcome the waiting problem and other outpatient department difficulties.[4] But, as cited by Sussman, et. al., in their 1967 study, crowded conditions, long waits, rotating physician assignments, and shortages of personnel still conspire to perpetuate the image of second class care.[5]

The necessity for making more effective use of the outpatient facility is well-documented.[6,7,8] Economically, it is far more prudent to utilize inpatient facilities only for acute medical treatment. The trend in recent years is promising. Between 1965 and 1967, admissions per bed for nongovernmental nonprofit hospitals, with approximately the same number

of total beds available, decreased 1.5 percent. For the same period and type of hospital, the average number of outpatient visits increased by 15.2 percent.[9] While these figures may indicate a laudable trend toward greater emphasis on preventive care, they also undoubtedly reflect the impact of expanded third-party coverage (notably Medicare, Medicaid, Blue Cross, Blue Shield) for outpatient services.

Computer Scheduling of the OPD

The increasing use of ambulatory facilities has intensified the search for more effective methods of resource allocation as well as improved techniques of patient service. One technique that appears to have considerable merit is computer scheduling of ambulatory services and, in the past decade, a small number of such systems have been reported. Most of these use a scheduling card which has been prepunched with a doctor's name and available appointment time. To make an appointment, the clerk simply pulls the appropriate card and writes information identifying the patient. This patient information is then keypunched, and the cards are later read into the computer. Reports, such as doctors schedules and medical record pulling lists, can be generated as often as necessary.[10,11]

More recently, a few "on-line" computer scheduling systems have been established. In this case, the clerk types the appointment request directly into the computer from a teletypewriter or cathode ray tube. Appointments may be scheduled automatically, or the terminal may display

information from accumulated schedule data which allows the clerk to pick the most convenient appointment from those still available. As each transaction is made, the computer updates the status of future schedules. A few such systems are currently in use;[12,13,14] others of a similar nature are under development.[15,16]

On the surface, rapid accessibility to schedules and patient data, plus the extensive manipulative ability of the computer, would appear to be highly beneficial to scheduling personnel. However, specific advantages to a hospital outpatient department of on-line computer scheduling are still not fully understood. The question remains as to whether on-line computers can be justified on a cost/benefit basis.

To determine the value of on-line computer scheduling for a large and diversified outpatient department, the administration of the Massachusetts General Hospital (MGH) established a systems study group in 1967. Coordinated by the Laboratory of Computer Science, the project team had the dual objectives of studying the characteristics of the existing scheduling system and recommending possible changes.

Approximately a dozen studies were performed to analyze the variables affecting current procedures and their implications for on-line scheduling. One major study, reported here, involved an extensive evaluation of the factors affecting the tendency of patients "not to show" for their appointments.

For several years, the overall "no show" rate at the MGH and Massachusetts Eye and Ear Infirmary Clinics has approximated 20 percent (i.e.,

20 percent of all patients scheduled for appointments failed to appear without cancelling). It was felt that if the factors which influence patients not to keep their appointments could be determined, two possible benefits might accrue. First, the no show rate might be lowered, thereby reducing the variability for demand of physician services.* Second, even if the no show rate could not be reduced, adjustments in the scheduling process could be made for the differing no show tendencies of various classes of patients. In this way, the appointment clerks would be able to estimate more accurately the number of patients who would actually arrive at the clinic on any given day.

Methodology of Study

Two major types of data were collected to study the no show problem. First, clinic data recorded by OPD personnel was collected from existing files. This information was used to assess the probability of patients not attending the clinic in relation to the variables of: 1) source of patient appointment, 2) the time interval between the date the appointment was issued and when it was scheduled, 3) the use of a system for

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*To illustrate this point, assume the following factors are known: 1) the physician wants to see an average of 9 patients per day; 2) there is an expected 25 percent no show rate; and 3) 12 patients have scheduled appointments. Consequently, one would expect that on a normal day between 6 and 12 patients will arrive. If the doctor expects an average of 9 patients, on the days when 12 arrive he will be overworked. On the days when only 6 arrive, he will have 33 percent of his time unused. On the other hand, with the no show rate reduced to 10 percent and 10 patients scheduled, the average number of patients arriving will still be 9, but on a normal day the range of patients seen will vary only from 7 to 10. Hence, both the probability of overwork and of idle resources is greatly diminished with a lower no show rate.

rescheduling some patients who have missed appointments without first consulting these patients about the appointment or date and time (referred to as an "automatic follow-up"), and 4) the patient's previous history of arriving for scheduled appointments. Secondly, subjective "attitudinal" data was sought from patients to determine the reasons they failed to arrive for appointments.

During the fiscal year 1967-1968, there were over 237,000 patient visits to the 62 clinics constituting the Combined Clinics of the MGH and MEEI. Twelve of these clinics were selected for the no show study: Cardiac, Dermatology, Diabetes, Endocrine, Fracture, Glaucoma, Gastroenterology, Urology, and four general medical clinics. The stratified sample, based on differing no show rates as well as clinic characteristics, yielded 774 missed appointments from 3,684 scheduled visits during a three week period - a no show rate of 21 percent. A control group equal in size to the no show group was selected at random by clinic from the 2,910 patients who did arrive for their appointments.

Information concerning patients who missed appointments and the control group was taken from four sources. First, clinic copies of appointment slips provided information concerning the patient's name and address, the source of appointment, and appointment date. Second, the clinic attendance log indicated whether or not the patient arrived for the appointment. Third, the medical record provided the number of interim no shows since the patient's last visit, information as to whether an appointment was booked as an automatic follow-up of a previous no show,

and the date of the last appointment kept in the individual study clinic. The fourth data source was a questionnaire sent to both the no show and control groups. A letter describing the Clinics' interest in improving their services was mailed with the questionnaire two days after the patient's date of expected or actual attendance. This letter emphasized both the confidentiality of the responses and the need for cooperation; it was signed by the physician serving as chairman of the Clinics Committee. The questionnaire was short and easy to complete.

Findings of the Study - Clinic Data

Several interesting conclusions were drawn from the data available from the appointment slips, the attendance log, and the medical record. These conclusions, as previously stated, concerned the effect of four major variables on the no show rate.

Source of Appointments: Meaningful differences were found in the no show rate depending on the patient's source of appointment. As indicated in Table 1, patients scheduled through the Emergency Ward had a no show rate of 34 percent. This is a significantly* higher percentage than the no show rate of patients scheduled at other locations. In contrast, no show rates for patients who had been discharged recently from the hospital or who had been given return appointments from the same clinic were below the average no show rate. These findings

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*When the word "significant" is used, the .01 level in a chi square contingency table is indicated.

were anticipated because patients treated in the Emergency Ward are more likely to be transients who are seeking immediate care and less likely to initiate or to sustain a continuing association with the hospital. On the other hand, patients who have just been treated at a particular clinic, or who have just recovered from an illness serious enough to place them in a hospital, are most apt to expect or need follow-up care and will therefore probably keep their appointments.

Recency of Scheduling Appointment: The interval between the date an appointment was issued and the actual date of the appointment is referred to as the "appointment interval." On the average this interval was two weeks longer for the no show group than for the control group. Another indication of the importance of this interval is shown in Figure 1, which strongly suggests that as the appointment interval increases, there is a higher percentage of no shows. As could be expected, patients are more likely to show up for appointments which have been made in the recent past.

Automatic Follow-up System: Many clinics have a system of automatically scheduling the patient another appointment by mail if he fails to show up for a scheduled appointment. This practice results in a significantly greater than average no show rate. More than twice as many no show patients as control patients had their appointments made in this manner. Whereas the normal no show rate for all patients was 21 percent, 37 percent of the automatic follow-up patients were no shows.

History of Previous No Shows: The clinic data also confirmed that no show patients tend to be repeaters. A study of each patient's no show history was performed for both the no show and control groups. Of the no show patients, 22 percent had been no shows on their previous scheduled clinic visit; in the control group, only 10 percent were no shows on their previous visit (a significant difference). The tendency to have several consecutive no shows also was apparent. Seven patients in the no show group had failed to keep their appointments for seven consecutive times since their last visit to the clinics. A few of these missed appointments were cancellations but most were no shows.

Findings of the Study - Questionnaire Data

For the no show group, the response rate to the initial questionnaire mailing was 44.9 percent. For the control group, the figure was 55.1 percent. A follow up mailing to both groups raised the final response rate to 60.7 percent and 71.7 percent respectively.

Three types of questions were asked of each patient on the questionnaire. Both the no show and control groups received (1) a limited set of multiple choice questions inquiring about two aspects of their previous visit to the clinic and (2) an open-ended question asking the patient to list any "general problems" he had encountered in his previous contacts with the clinics. In addition, each patient in the no show group was asked to check from a list of possible causes the reason(s) he had failed to arrive for his last appointment.

Table 2 shows the reasons given by the no show group for failing to keep their appointments. Patients could choose more than one reason for not keeping an appointment, and there was an average of 1.5 responses per patient. Responses to the questions focused attention on three major areas. These were communication failure, waiting time, and "same day service."

Communication Failure: The reason indicated most frequently for failure to arrive, a "communication problem," includes three related patient responses: 1) "I thought the appointment was cancelled," 2) "I did not know about the appointment," and 3) "I thought the appointment was for another time." By adding the percent of patients who forgot their appointment, the combined total suggests that almost half of all patients who missed their appointment might not have done so if a more effective communication system were in operation These findings are comparable to those of a similar study performed at the USPHS Hospital in New Orleans.[17]

Data from clinic records tends to substantiate the veracity of those patients who claimed "not knowing about" or "having forgotten" their appointments. As shown in Table 3, only 26 percent of the control group's appointments were made more than two months in advance of the visit; the comparable figure for the no show group was 35 percent. However, for the subset of the no show group who had "forgotten" their appointments, 59 percent had appointments made more than two months in advance; 67 percent of the patients who "did not know about their

appointments" had at least a two-month appointment-visit interval. The differences are significant and strongly suggest that the patients were replying truthfully to the questionnaire. Their responses document the need to eliminate scheduling of distant future appointments and/or to communicate with patients shortly before the appointment date.

Waiting Time: Only 12 percent of the no show patients checked "it takes too long to see the doctor" as the reason for not arriving for their appointment. The extensive wait to see a doctor was, however, by far the most significant problem stated by patients who answered the open-ended question asking what "general problems" they had in dealing with the clinics. As seen in Table 4, almost 20 percent of the responses to this question concerned the amount of waiting. The next major category of negative response by comparison contained only 5 percent.

It is relevant to note that 11 percent of those returning their questionnaire reversed the intent of the "What problems do you have" question and praised the Clinics. Of equal importance, two thirds of the patients who replied to the question indicated no problems whatsoever. (Again, the figures total more than 100 percent because a few patients made several comments.)

"Same day" Services: A majority of patients have one or more of a variety of tests ordered during their clinic visit. These procedures may be performed the same day, or the patient may be requested to return at a later date. In an attempt to compare the reactions of patients during their previous visit, the questionnaire included an inquiry about

such procedures. Some 78 percent of the control patients who had tests performed reported that all their tests had been completed on the same day, whereas only 70 percent of the no show patients reported this experience. The difference suggests that the ability to have all appointments and tests completed on the same day is important to the patient and may affect both his attitude and the no show rate.

Scheduling Improvements Without a Computer

The primary purpose of this study was to evaluate potential advantages of on-line computer scheduling with regard to the no show problem faced by hospital outpatient departments. Several areas of possible improvement have been identified. Many of these advantages could be realized simply through improvements in the manual system.

The no show rate could be reduced in the present manual scheduling system by any of the following means:

1) discarding or modifying the automatic follow-up appointment procedure,

2) eliminating or reducing the number of appointments made for more than six months in the future,

3) minimizing the "communication gap" by requiring patients to confirm appointments made far in advance and automatic follow-up appointments (if this procedure is continued), and

4) sending reminder cards to patients within a short time of their appointments.

It is essential to emphasize that the standard of medical practice cannot

be compromised merely to create a more efficient scheduling system. Some clinics may still desire to schedule certain types of patients on an automatic follow-up basis. Furthermore, physicians may feel it is important for various patients to return for 6 or 12 month evaluations. Although improved utilization of both facilities and other resources is an important goal, appointments could not be denied to patients if such a procedure detracts from optimal medical care. Effective methods must be found to maintain medically-worthwhile, but administratively-poor practices.

Specific Advantages of the Computer

Although several changes can be made in the manual system to affect favorably the no show rate, an on-line computer system can meet both medical and administrative needs. If necessary, current scheduling practices can be followed - but adjustments can be made for their affects. Rapid accessibility to large data files combined with the computer's manipulative capability can be utilized to provide:

1) a more efficient clerical system for closing the communication gap. The manual system of patient confirmation suggested above requires extensive searching of appointment sheets and recording of data by clerks. The computer, on the other hand, can be programmed to create from its appointment files automatic machine-readable confirmation postcards. When returned, the cards can be re-entered into the computer to confirm the appointment automatically without any manual clerical work. At a particular point in time, all nonconfirmed time can be made available by

the system for the scheduling of new appointments.

2) a system of adjusting schedules to reflect the varying no show rates of the different classes of patients scheduled. On a manual basis, it is very difficult, if not impossible, to determine the number of patients with varying no show tendencies who produce the probabilistic target figure of arrivals which best utilize clinic physician resources. The computer, however, has the ability to check each patient with regard to significant variables and subsequently to compute a "probability of arrival." As each appointment is scheduled, the remaining openings for each clinic session can be continuously updated.

3) "same day service" for patients. With an on-line system, a scheduler can use the computational power of the computer to search for the day or days in which all appointments needed by a patient are available. In a manual system, this search requires telephone calls and extensive clerical time so that it often is not performed effectively. A prerequisite to this capability, however, is an individual appointment system which minimizes patient waiting time[18] and makes multi-scheduling of both clinics and ancillary services more feasible.

4) a continuing check on the factors which influence the no show rate. The relationship between variables such as have been described here and the no show rate can be monitored routinely as a by-product of the actual scheduling of appointments. In this way, the process of adjustment for the no show problem can be improved periodically.

Summary

Both data taken from clinic records and attitudinal data from questionnaires has been used in evaluating the implications of the no show rate for on-line computer scheduling of outpatient appointments. Data from clinic records isolated four variables which significantly affected patient attendance in the 12 clinics studied. No show rates vary widely depending upon: a) the source of the patient appointment, b) the length of the interval between the time the appointment is issued and the date of the appointment, c) the presence or absence of an automatic follow-up procedure, and d) the patient's recent record with regard to no shows. Data obtained through questionnaires identified a communication problem as the principal cause of no shows. This finding was substantiated by a close correlation between the date an appointment was issued and the number of patients who indicated that they had forgotten their appointments or did not know about them.

Several modifications in the current manually-operated scheduling system could reduce the no show rate and the variability of the demands on clinic resources. High no show rates among various classes of patients have been identified, and this information could be used to make appropriate adjustments in the scheduling process. However, if these changes are introduced on a manual basis, the desired standard of medical practice may be compromised. Among the advantages of on-line computer scheduling is the capability of accommodating fluctuations in a manner consistent

with professional standards. The subsequent increase in flexibility should permit ambulatory care to be more responsive to the needs of its recipients. As a consequence, more efficient use could be made of limited facilities and perhaps the image of second class care, too long associated with the outpatient department, would be ameliorated.

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Table 1

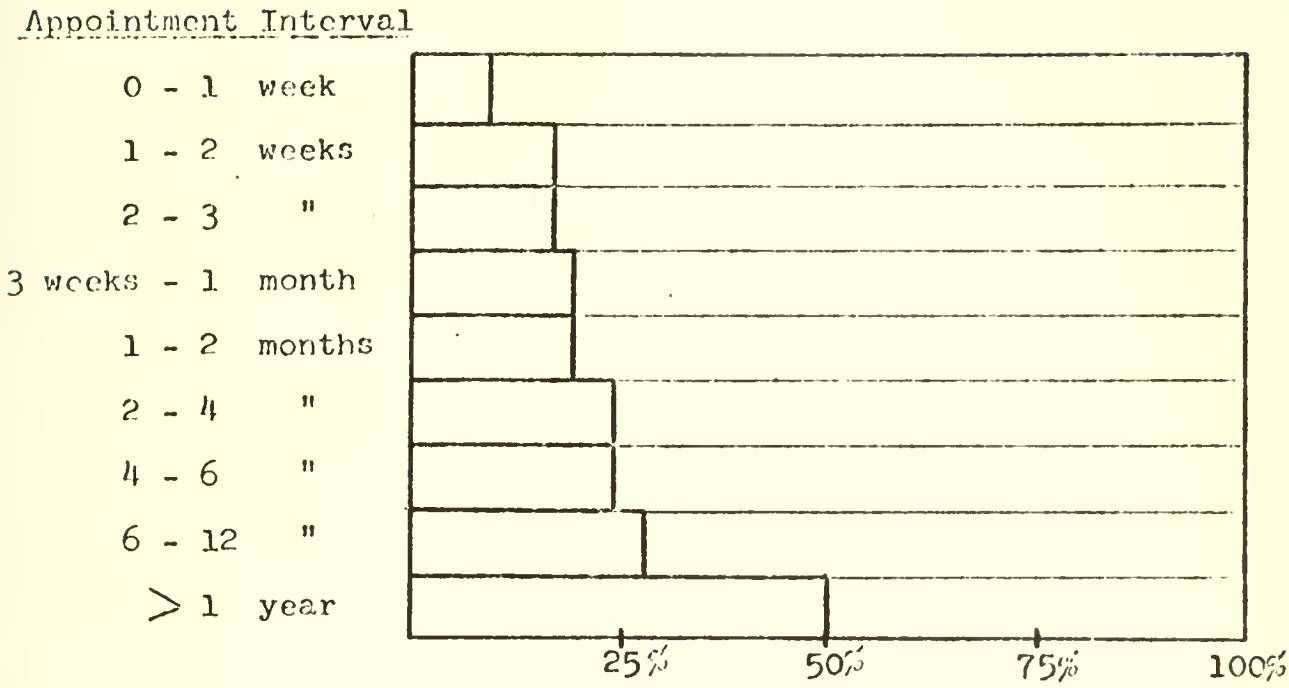
Patient No-Show Rate by Appointment Source

| Appointment Source | Number of Scheduled Patients | No-Show Rate % |
|---|---|---|
| 1. Emergency Ward | 97 | 34% |
| 2. Same clinic, mail or phone | 987 | 25% |
| 3. Another clinic | 178 | 24% |
| 4. Same clinic, in person | 2288 | 19% |
| 5. Hospital discharge | 134 | 16% |
| | 3684 | 21% |

Figure 1

Percent No-Show

by Appointment Interval*




*Number of days between the day the appointment was made and the date of the appointment.

Table 2

Patients' Reasons for Failing to Keep Their Appointments

| Reason | Percent of No-Show Patients* |
|---|---|
| | % |
| Communication problem | 34 |
| Too sick to come | 18 |
| Forgot appointment | 14 |
| Did not have enough money | 12 |
| Takes too long to see doctor | 12 |
| Felt better | 11 |
| Too far from hospital to come | 8 |
| Being treated by own doctor | 7 |
| Unable to get transportation | 7 |
| Weather was bad | 6 |
| Member of family was sick | 5 |
| Patient hospitalized or in nursing home | 4 |
| Miscellaneous | 15 |

*Percent based on total of 436 patients responding.

Table 3

Relationship Between Appt. Interval and Two Reasons for Missed Appointment

| Time Between Date Appt. Issued and Date Appt. Scheduled | Cumulative % of Control Patients | Cumulative % of All No-show Patients | Cumulative % of Patients Who Forgot Appt. | Cumulative % of Patients Who Did Not Know Had Appointment |
|---|---|---|---|---|
| | % | % | % | % |
| > Year | 0 | 1 | 2 | 0 |
| 6-12 months | 7 | 12 | 20 | 23 |
| 4-6 months | 13 | 19 | 31 | 44 |
| 2-4 months | 26 | 35 | 59 | 67 |
| 1-2 months | 45 | 53 | 77 | 82 |
| 3-4 weeks | 58 | 66 | 88 | 88 |
| 2-3 weeks | 72 | 77 | 88 | 91 |
| 1-2 weeks | 89 | 94 | 94 | 97 |
| 0-7 days | 100 | 100 | 100 | 100 |

Table 4

Percent of Patients Responding to Open-Ended Question

by Type of Problem

| Type of Problem | Percent of Patients* |
|---|---|
| No Problems | 66 |
| Long Wait (in clinic or for appointment) | 20 |
| Praise | 11 |
| Dissatisfaction With Care | 5 |
| Money Problems | 4 |
| Dissatisfaction With Personnel | 3 |
| Medical Record or Report Problem | 2 |
| Inconvenient Appointment Time or Day | 1 |
| Transportation Problems | 1 |
| Sickness or Death of Patient or Relative | 1 |
| Miscellaneous Problems | 1 |

* Percent based on total of 836 patients responding to problem question

## Footnotes

1. Johnson, Walter L. and Rosenfield, Leonard S.: "Factors Affecting Waiting Time in Ambulatory Care Services," Health Services Research, Vol. 3, No. 4, 286-295, 1968.

2. Nuffield Provincial Hospitals Trust: Studies in the Function and Design of Hospitals, Chapter 2, "The Outpatient Service," Oxford University Press, 1955.

3. For example see:

   Welch, J. D.: "Appointment Systems in Hospital Outpatient Departments," Operational Research Quarterly, Vol. 15, No. 2, 224-232, September, 1964, or

   Nuffield Provincial Hospitals Trust: Waiting in Outpatient Departments: A Survey of Outpatient Appointment Systems, Oxford University Press, 1965.

4. For example see:

   Fetter, R. B., and Thompson, J. D.: "Patient Waiting Time and Doctors' Idle Time in the Outpatient Setting," Health Services Research, Vol. 1 No. 1, 66-90, Summer, 1966, or

   Soriano, A.: "Comparisons of Two Scheduling Systems," Operations Research, Vol. 14, 338-397, May-June, 1966.

5. Sussman, M. D., Caplan, E. K., Haug, M. R., and Stern, M. R.: The Walking Patient: A Study in Outpatient Care, Cleveland, Western Research University Press, 1967.

6. Report of the National Advisory Committee on Health Manpower, Vol. 1 p. 65, U. S. Government Printing Office, Washington, D. C., 1967.

7. Weinerman, E. R.: "Changing Patterns in Medical Care: Their Implications for Ambulatory Services," Hospitals, Vol. 39, No. 24, 67-74, December 16, 1965.

8. Weinerman, E. R.: "Yale Studies in Ambulatory Medical Care, IV. Outpatient Clinic Services in the Teaching Hospital," New England Journal of Medicine, Vol. 272, No. 18, 947-954, May 6, 1965.

9. "The Nation's Hospitals: A Statistical Profile," AHA Guide Issue, Vol. 43, No. 15, p. 444, August 1, 1968.

10. Paulson, I. S.: "A Mechanized System for Outpatient Clinics," Hospitals J.A.H.A., Vol. 40, No. 18, 80-86, September 16, 1966.

11. Poe, Daniel J.: "Organizing Outpatients to Cure Clinic Chaos," Medical Record News, Vol. 38, No. 2, 117-121, April, 1967.

12. Smith, Robert M.: "Better Patient Care Through Electronics," Management Services, Vol. 5, No. 3, 52-57, May-June, 1968.

13. Case History: Puerto Rico Medical Center Service Corporation, Educational Publication on the Marketing Services Department of the National Cash Register Co., Dayton, Ohio, October, 1967.

14. Erat, K., Jesseman, A. G., and Walker, J. E. C.: "The Application of a Time-Shared Computer to the Appointment System of a Hospital Outpatient Department," Proceedings of I.F.I.P.S. Congress, Edinburgh, North Holland Publishing Company, Amsterdam, Holland, 1968.

15. Hershberg, P. J., Rockart, J., and Harrison, R.: "A Symptom Scoring System for Subspecialty Classification," Proceedings of the Annual Conference on Engineering in Medicine and Biology, Houston, Texas, 1968.

16. Brown, H. H.: "A Computer Assisted Appointment System," Proceedings of the Annual Conference on Engineering in Medicine and Biology, Houston, Texas, 1968.

17. Walsh, J. J., Benton, J. L., and Arnold, I. G., "Why Patients Break Appointments," Hospital Topics, Vol. 45, No. 2, 67-72, February, 1967.

18. Nuffield Provincial Hospitals Trust: Waiting in Outpatient Departments: A Survey of Outpatient Appointment Systems, op. cit., p. 60.