

Automated Health Testing in a Medical Group Practice

Effects on physician behavior and economic influences

JAMES G. RONEY, MD, PhD, MPH, and HILLIARD D. ESTES, MD, MPH

HEALTH TESTING by means of automated techniques has progressed considerably in the past decade in terms of technology, economics, and consumer and provider interest (1-4). To date, this approach has been most broadly applied in industrial health programs (5). However, the literature contains few reports of efforts to examine the effect of automated health testing (AHT) on provider behavior and the economic impact of such testing on providers (6-8). In this report, we examine the behavioral and economic influence of the introduction of an AHT system in January 1970 on a large multispecialty group practice in Palo Alto, Calif.

The use of AHT in this project was different from that in many other projects (9). The testing was designed primarily to assist physicians in their normal practice by providing them with information on patients that was obtained by the use of automated equipment operated by health support personnel (10). All patients were referred for testing by physicians, and they represented a reasonable cross section of the sick

and well persons seen in normal practice. The health testing results were sent, without professional opinion, to the referring physician. Followup data were obtained from the referring physicians' clinical records (11,12).

The AHT system provided a medical history; physical measurements including height, weight, blood pressure, temperature, vision, ocular tension, hearing, and spirometry; chest X-ray; electrocardiogram; hematology; blood chemistry; and urinalysis. The resulting information was prepared in a format for inclusion in the patient's medical record. The cost to the patient for the health assessment, excluding consultation or therapy, was approximately \$100. The AHT itself was priced at \$40 at first and later increased to \$55; the average cost was about \$50. The fee for the patient's visit, after the physician received the AHT results, was \$30 to \$45.

An important restriction on the research was that the information-gathering procedure should not interfere with nor alter the ways in which physicians practice medicine in a group. Thus, information gathering was limited to data produced by the AHT system and data normally generated by the group practice—appointment sheets, patients' records, and business office records.

Between February 9, 1970, and June 30, 1972, a total of 7,379 persons received the automated health tests, and 6,400 or 86.7 percent of these were patients referred by the group practice physicians. The percentage distribution of these patients by age and sex was as follows:

□Dr. Roney is president, Applied Health Research Corporation, Los Altos, Calif. Dr. Estes was formerly medical director, AML, Palo Alto Medical Clinic, Palo Alto, Calif. This paper is adapted from one presented at the 32d annual meeting of the Society for Applied Anthropology, Tucson, Ariz., April 12, 1973. The study was funded by the National Center for Health Services Research and Development, Public Health Service, project No. PH 110-68-52. Tearsheet requests to James G. Roney, Jr., MD, Applied Health Research Corporation, 600 University Ave., Los Altos, Calif. 94022.

Age group (years)	Male	Female	Total
Under 20	1.6	2.3	1.9
20-29	11.2	13.9	12.6
30-39	21.4	14.0	17.6
40-49	23.1	21.7	22.4
50-59	22.9	24.3	23.7
60-69	13.0	14.4	13.7
70-79	5.5	7.7	6.6
80 or over	1.2	1.8	1.5

Acceptance of AHT

The acceptance of AHT was examined within and outside the group practice. Outside the group, 381 physicians either sent patients to the AHT laboratory or went through the procedure themselves. Most of these were local physicians or patients, but some came from the east coast. One local physician, a general practitioner, referred 162 patients to the AHT laboratory. A total of 979 patients (13.3 percent of the total) were referred from outside the group practice.

Referrals within the group practice were examined in greater detail than the referrals outside the group. During the period studied there was a gradual, steady growth in numbers of patients and referring physicians. The 6,400 patients referred within the group practice were examined from the standpoint of specialty of the referring physician, individual physicians, temporal factors, physicians' characteristics, and periodicity of repeat referrals for individual patients.

Physician specialty. At the time of the study the medical group consisted of 118 physicians. Only 78 of these were considered to be potential referral sources for the AHT laboratory because they spent most of their professional time providing diagnostic and therapeutic services for patients. Radiologists, pathologists, anesthesiologists, research physicians, and physicians nearing retirement were excluded. Pediatricians were also excluded because at the time of the study the program was not adapted for pediatric patients.

Of the 78 physicians, 39 referred fewer than 10 patients during the study period. This minimal-user category included all the physicians in the specialties of allergy, neurology, dermatology, psychiatry, urology, ophthalmology, and otolaryngology, as well as most of the surgeons.

Nine, or 12 percent of all the physicians, referred 10-24 patients. This group included about one-fourth of the internists, one-eighth of the surgeons, and one-third of the occupational medicine physicians.

Eighteen, or 25 percent of the physicians, referred 25-99 patients; they comprised almost half of the internists, almost two-thirds of the general and family practice physicians, almost two-thirds of the obstetrician-gynecologists, and one-third of those in occupational medicine. The 12 physicians who referred 100 or more patients included 25 percent of the internists and 70 percent of the general and family practitioners.

More than half of all referrals were from internists, and nearly half were from general and family practice physicians. All other specialties had minimal referrals—3 percent or less of the total (table 1). There were few referrals from occupational medicine physicians because the AHT was too expensive for routine preplacement and similar types of examinations. On the other hand, health examinations of executives in the group practice were performed largely by the internists.

The percentages of physicians in the various specialties who referred patients to the AHT laboratory varied from the early to the later period of the study. The percentage of internists increased while the percentage of general and family practice physicians declined. Also, the "other" or miscellaneous category declined, probably as a result of an initial curiosity about the AHT laboratory which was satisfied by one or a few referrals.

In summary, by the end of the study the behavior of physicians, according to specialty, was established in relation to the use of the AHT laboratory. The specialties of internal medicine and general and family practice accounted for more than 90 percent of the referrals.

Individual physicians. The number of patients referred per physician ranged from 1 to 954, with a mean of 70.

The volume of physician referrals from February 1970 to June 1972 was as follows:

Referral volume category	Number of physicians	Patients	
		Number	Percent
High (100 or more)	12	5,097	79.6
Moderate (25-99)	18	999	15.6
Low (10-24)	9	164	2.6
Minimal (less than 10)	39	140	2.2
Total	78	6,400	100.0

The high-volume physicians were evenly distributed between internal medicine and general and family

Table 1. Sources of patient referrals to automated health testing laboratory, by specialty, initial phase Feb. 9, 1970-Apr. 14, 1971; second phase Apr. 15, 1971-June 30, 1972

Specialty	Number of physicians	Initial phase patients		Second phase patients		Total patients	
		Number	Percent	Number	Percent	Number	Percent
Internal medicine	27	1,195	43.8	2,102	57.2	3,297	51.5
General and family practice	7	1,321	48.5	1,415	38.5	2,736	42.7
Obstetrics-gynecology	5	65	2.4	127	3.5	192	3.0
Occupational medicine	3	32	1.2	19	0.5	51	0.8
Other	36	111	4.1	13	0.4	124	1.9
Total	78	2,724	100.0	3,676	100.1	6,400	99.9

NOTE: Data from clinic records.

practice. Moderate-volume physicians were mostly internal medicine specialists. The low-volume physicians, primarily internists, accounted for 2.6 percent of the referrals.

Temporal factors. The high-volume referral physicians showed a general increase in referrals over ten 3-month periods. Some seasonal variation occurred; for example, the second quarter of each calendar year was a period of relatively high referral activity and the fourth quarter was low. There was considerable variation in referrals by individual physicians—some physicians increased their referrals, some stayed about the same, and others reached a peak in the second year and then declined.

For 1971, referrals to AHT were examined as a percentage of total office patient load of the high-volume referral physicians (table 2). Individually, the percentage among physicians ranged from 2.1 to 13.3 percent, with a mean of 5.9 percent. Over time, there was also variation individually but not much change as a group; the percentage remained about 6 percent.

Physicians' characteristics. Physician categorization by volume of referral to the health testing laboratory was examined for association with other characteristics, for example, medical school, years since graduation from medical school, and years as a member of the group practice.

The group physicians were graduated from 32 different medical schools. There was no association of medical school of graduation with volume of referral. The group physicians as a whole had graduated from medical school 22.8 years before mid-year 1972. High-volume referral physicians were about the same vintage, moderate-volume physicians were graduated more recently, and the others earlier.

The mean number of years the physicians had been members of the group was 14.3. High-volume referral

Table 2. Number and percent of total office patients referred to automated health testing by high-volume referral physicians, Jan. 1, 1971–Dec. 31, 1971

High-volume referral physicians	Total number office patients	Patients referred	
		Number	Percent
General and family practice	4,792	401	8.4
Internal medicine ..	2,558	341	13.3
General and family practice	4,296	224	5.2
General and family practice	3,876	216	5.6
Internal medicine ..	1,420	103	7.3
General and family practice	6,331	178	2.8
Internal medicine ..	2,910	230	7.9
General and family practice	4,141	86	2.1
Total	30,324	1,779	5.9

NOTE: Data from group practice appointment sheets.

physicians had a similar period of association, moderate-volume physicians had a shorter period, and minimal- and low-volume physicians had a longer period of association with the group.

On the whole, none of the preceding characteristics seemed to have a significant influence on the referral behavior of physicians.

Repeat referrals. Another measure of acceptance of AHT was the percentage of repeat referrals for the same patient, which indicated the incorporation of AHT in the periodic health evaluation of that patient. During 1971 (the third year of the project) repeat visits increased steadily. In January the percentage of referrals for patients who had been tested previously was 4.1; by December the percentage had risen to 22.1.

Effect of AHT on Physician Behavior

The effect of the introduction of AHT on medical prac-

Table 3. Comparison of office visits, by physician referral volume before¹ and after² the introduction of automated health testing, July 1, 1969–March 31, 1972

Physician referral volume	Number of visits per day		Duration of visits (minutes)	
	Before	After	Before	After
<i>General and family practice</i>				
High volume, total	26.8	24.0	13.9	16.5
Physician A	27.7	25.9	13.6	15.2
Physician B	27.0	25.5	14.9	16.0
Physician C	25.4	23.0	13.2	15.6
Physician D .....	.....	21.0	.....	18.4
Physician F .....	.....	23.4	.....	17.5
Low volume, physician E .....	.....	26.9	.....	15.4
<i>Internal medicine</i>				
High volume, total	12.3	12.9	31.0	28.7
Physician U	12.8	13.5	31.0	31.3
Physician X	17.0	14.2	21.8	26.9
Physician YY .....	.....	12.5	.....	25.1
Physician V	11.1	11.1	33.2	29.5
Low volume, total	11.5	11.5	30.3	30.9
Physician Y	12.9	12.5	25.9	28.6
Physician W	10.9	11.8	32.1	29.3
Physician Z	10.7	10.7	33.2	34.5

¹July 1–Dec. 31, 1969. ²Jan. 1, 1970–Mar. 31, 1972.

Table 4. Comparison of percentages of types of office visits, by physician referral volume before¹ and after² the introduction of automated health testing

Types of office visits	General and family practice physicians		Internists	
	Before	After	Before	After
<i>High volume³</i>				
Routine initial visit for new patient	6.0	4.1	2.5	1.5
Complete initial visit for established patient or minor illness	1.2	1.1	.7	.6
Complete initial visit for new patient or major illness . . . . .	.7	.1	5.8	2.9
Brief followup visit	5.7	5.9	1.3	1.4
Routine followup visit	67.3	53.4	4.0	4.4
Followup visit with more than routine professional care	10.6	25.7	69.9	70.3
Prolonged followup visit	3.4	3.5	1.5	1.5
Followup visit with complete re-examination	1.3	.9	1.1	1.0
Periodic re-examination	3.8	5.2	13.2	16.4
<i>Low volume⁴</i>				
Routine initial visit for new patient	10.7	9.6	9.9	8.4
Complete initial visit for established patient or minor illness . . . . .	.2	.1	2.2	1.6
Complete initial visit for new patient or major illness . . . . .	.9	1.0	6.3	4.1
Brief followup visit	2.2	2.1	0.0	.1
Routine followup visit	71.1	73.0	9.9	7.7
Followup visit with more than routine professional care	8.9	9.6	49.9	54.3
Prolonged followup visit	3.3	1.4	3.7	6.1
Followup visit with complete re-examination . . . . .	.3	.4	.8	.8
Periodic re-examination	2.4	2.9	17.3	17.0

¹July 1–Dec. 31, 1969. ²Jan. 1, 1970–June 30, 1971. ³Includes 5 general and family practice physicians and 4 internists. ⁴In-

cludes 1 general and family practice physician and 3 internists.

tice was examined in terms of office visits and procedures ordered. The numbers of physicians included in various comparisons depended on the availability of data. Basically, the analysis consisted of a 4-cell comparison of high-volume and less than high-volume referral physicians before and after the introduction of AHT for both general and family practice and internal medicine.

Office visits. The number, duration, and types of office visits, based on the Relative Value Studies classification (13), were examined for the period July 1, 1969, through March 31, 1972. This period consisted of 11 quarters; the first 2 represented the period before AHT was introduced, and the last 9 quarters were the period after AHT was introduced. The results of the comparison of the two periods are shown in table 3.

A comparison of visits before and after the introduction of AHT among general and family practice practitioners showed a mean decrease of 2.8 patients per day. Part of this decrease may be attributed to the practice behavior of physicians D and F, whose data were not available for the first 4 quarters. Even if we exclude these two physicians, there was a decrease of 1.9 patients per day.

Among the internists with high-volume referrals, there was a mean increase of 0.6 patient per day. Physician YY, whose data were available for only the last 3 quarters, did not change this percentage of increase. For the other internists, there was no change. The general and family practice physicians with high-volume referrals had an increase in mean duration of visits of 2.6 minutes. Without physicians D and F, the increase was 2 minutes. High-volume referral internists had a decrease in mean duration of visits of 2.3

minutes; without physician YY, it was 1.9 minutes. The internists who had less than 100 referrals to AHT had an increase of 0.6 minute per visit.

A comparison of the percentages of the types of visits, as classified in the Relative Value Studies, is shown in table 4; the first 2 quarters represent the period before and the last 6 quarters represent the period after the introduction of AHT.

For general and family practice physicians with high-volume referrals to AHT, there was a decrease in the percentage of routine followup visits and a marked increase in followup visits with more professional care. This shift is consistent with the increase in duration of visits. For the general and family practice physicians with low-volume referrals, there were no major shifts in distribution of visits except for a decrease in prolonged followup visits.

The types of visits for high-volume referral internists did not change markedly. There was a relative decrease in percentage of routine initial and complete major initial visits and a relative increase in periodic re-examinations. Internists with low-volume referrals also showed a decline in routine initial and complete major initial visits. In addition, they had a decrease in routine followup visits and an increase in followup visits with more professional care and prolonged followup visits.

More marked than the changes that occurred after the introduction of AHT were the consistent differences between high- and low-volume users of AHT both before and after the introduction with regard to types of office visits and the procedures ordered by physicians.

The preceding limited data suggest that automated health testing may affect physicians' practices in different ways. General and family practice physicians

Table 5. Percentages of procedures ordered per 100 visits by 13 physicians, by physician referral volume before¹ and after² introduction of automated health testing, July 1, 1969–June 30, 1971

Procedure	General and family practice physicians ³		Internists ⁴	
	Before	After	Before	After
High volume, total	128.7	102.5	314.1	270.1
Photofluorography	4.5	1.7	11.5	4.6
Chest film	3.3	2.4	11.8	14.2
Other X-ray	13.2	10.5	10.4	10.7
Blood chemistry panel	4.6	2.1	19.4	16.5
Urine miniculture	0.3	4.3	1.6	2.1
Complete blood count	5.3	3.5	21.0	17.9
Protein-bound iodine	2.2	1.3	2.4	1.7
Glucose tolerance	0.5	0.6	2.0	1.6
Cervical cytology	5.5	6.0	9.3	8.9
Electrocardiogram	2.1	1.0	17.8	16.6
Other	87.3	69.2	207.4	174.2
Low volume, total	114.8	109.3	354.4	340.2
Photofluorography	1.7	0.8	11.3	5.1
Chest film	4.0	5.9	16.9	18.7
Other X-ray	11.9	10.1	16.1	15.0
Blood chemistry panel	4.5	4.5	24.6	23.7
Urine miniculture	1.0	3.3	0.2	1.2
Complete blood count	5.8	5.0	27.3	25.8
Protein-bound iodine	1.3	0.8	6.2	5.0
Glucose tolerance	0.2	0.5	1.2	2.1
Cervical cytology	10.2	7.7	8.1	7.5
Electrocardiogram	2.1	2.1	20.4	19.3
Other	72.2	68.4	222.1	216.9

¹July–December 31, 1969. ²Jan. 1, 1970–June 30, 1971.

³5 high volume, 1 low volume. ⁴4 high volume, 3 low volume.

may spend more time with patients because the additional information provided by AHT requires further investigation. On the other hand, internists may average less time because some of their functions may have been performed by the AHT laboratory.

Procedures ordered by physicians. Data on the ordering of selected diagnostic procedures, available for July 1, 1969–June 30, 1971, were also examined for possible effects of the use of AHT. The first two quarters represented the before experience and the other six quarters the after experience. Included in this analysis were 13 physicians—5 high-volume and 1 low-volume general and family practice physicians and 4 high-volume and 3 low-volume referral internists (table 5).

Among the general practitioners, the percentage for all procedures decreased from 128.7 to 102.5 per 100 visits for the high-volume referral physicians—a 20.4 percent reduction—whereas for the low-volume physicians the percentage decreased from 114.8 to 109.3 procedures per 100 visits—a 4.8 percent reduction.

Differences were also noted in the individual procedures ordered by high- and low-volume physicians. For example, high-volume general practitioners ordered 27.3 percent fewer chest films, whereas the low-volume general practitioners ordered 47.5 percent more. The high-volume general practitioners also ordered 54.3 percent fewer blood chemistry panels and 52.4 percent fewer electrocardiograms, but the percentages for the low-volume physicians remained the same. Other differences were of lesser magnitude (table 5).

Apart from the differences in magnitude of change,

there were also differences between high- and low-volume general physicians' ordering of procedures before the introduction of AHT. The high-volume physicians ordered relatively more photofluorography and protein-bound iodine determinations but fewer other X-rays and cervical cytology.

For the high-volume referral internists, ordered procedures declined by 14 percent and for the low-volume internists the decline was 4 percent (table 5). Some differences were also seen in the ordering of individual procedures by the internists. Ordering of chest films increased by 20.3 percent among the high-volume and by 10.7 percent among the low-volume internists. Ordering of glucose tolerance tests declined by 20 percent among the high-volume internists but increased 75 percent among the low-volume internists.

Before AHT, there were differences in the ordering of procedures by high- and low-volume internists; the low-volume internists tended to order more procedures per visit. However, the opposite was true for the general and family practice physicians. These differences tend to support the previous explanation of differences in number and duration of visits among general physicians and internists.

Total revenue. For this study, revenue generated by physicians includes three components—physician visits, physician-performed procedures and materials (for example, injectables or splints), and physician-ordered procedures. For comparability of data, we calculated the rate of revenue generated per hour because individual physicians work varying amounts of time. Table 6 shows the revenue generated by 12 physicians before and after AHT. During the period

Table 6. Physician-generated revenue per hour, by physician referral volume before¹ and after² introduction of automated health testing

Physician referral volume	Revenue generated	
	Before	After
General and family practice		
High volume, total	\$105.60	\$ 88.47
Physician A	100.28	89.59
Physician B	94.16	84.79
Physician C	129.67	98.18
Physician D		81.73
Physician F		87.39
Low volume, physician E		106.01
Internal medicine		
High volume, total	98.83	95.60
Physician U	82.41	73.64
Physician X	150.09	103.99
Physician V	104.96	110.82
Low volume, total	95.17	86.34
Physician Y		83.36
Physician W	118.33	105.23
Physician Z	77.41	72.15

¹July 1–Dec. 31, 1969. ²Jan. 1, 1970–June 30, 1971.

studied, a general decline occurred in the rate of revenue generation, possibly a consequence of a business recession.

For general and family practice, the low-volume physician generated a higher income than the high-volume physicians (table 6). The income generation of the high-volume referral physicians declined by 16.2 percent after AHT was introduced. No data were available for comparable calculations for the low-volume physician. Among the internists, the high-volume physicians generated a higher income than the low-volume ones. After AHT, the income rate declined less (3.7 percent) among the high-volume than among the low-volume internists (9.3 percent).

Distribution of components of revenue generated. The percentage of total physician-generated revenue was calculated for each of the three components (table 7). For all six general practitioners the relative increase in percentage of revenue was attributable to visits, but the percentage was greater for the high-volume physicians. Revenue from physician-performed procedures and materials declined for both high- and low-volume general physicians. For physician-ordered procedures,

however, revenue declined for the high-volume referral physicians and increased for the low-volume physicians. Among the internists, there was an increase in percentage of revenue attributable to visits and a decline in the other two components for both the high- and low-volume internists.

The percentages of revenue attributable to visits are comparable for the general physicians and internists. However, the percentage of revenue from physician-performed procedures and materials for the internists was about half that for the general physicians, whereas the revenue from physician-ordered procedures was about one-third greater for the internists.

The results of this analysis suggest that automated health testing does not reduce total physician-generated revenue, at least among internists. Further, there is little indication of a shift in percentages of the components of revenue generation, except for a decline in the percentage of revenue attributable to physician-ordered procedures among general and family practice physicians.

Effects of AHT on Patients

Although there were no comparable data for patients who were not referred to the AHT laboratory, the services and results were documented for the patients who were referred. The documentation included additional diagnostic procedures, referrals and consultations, surgery, and new diagnoses. From February 9, 1970, to February 9, 1972, 6,144 additional procedures were performed on 5,000 patients—1.2 procedures per patient. Blood chemistries, cytological examinations, and radiological procedures accounted for three-fourths of these.

There were 908 referrals or consultations among the 5,000 patients, or 18.2 per 100 patients; most of these were for proctosigmoidoscopy, surgery, internal medicine, urology, and ophthalmology. Surgery was performed on 125 patients, most commonly for hernia repair, hysterectomy, and skin tumors.

Significant diagnoses not previously recorded in the patients' clinical records were considered to be new diagnoses. However, since some of the patients were new to the group practice and did not have clinical records, their new diagnoses may tend to inflate the number of new diagnoses.

Table 7. Percentages of components of revenue generated by physicians, by physician referral volume before¹ and after² introduction of automated health testing

Components of revenue	High-volume referral		Low-volume referral	
	Before	After	Before	After
General and family practice, 6 physicians:				
Physician visits	53.2	56.3	48.6	50.0
Physician-performed procedures	14.3	13.8	23.4	20.0
Physician-ordered procedures	32.5	29.6	28.0	30.1
Internal medicine, 6 physicians:				
Physician visits	49.4	53.9	49.1	54.5
Physician-performed procedures	7.8	6.2	10.0	7.7
Physician-ordered procedures	42.9	39.9	40.9	37.8

¹July 1–Dec. 31, 1969. ²Jan. 1, 1970–June 30, 1971.

Among the 5,000 patients, there were 2,268 new diagnoses, or 1 for every 2.2 patients, as follows:

Diagnostic category	Number of diagnoses
Endocrine-metabolic	558
Cardiovascular	283
Gastrointestinal	280
Musculoskeletal	223
Gynecologic	208
Dermatological	170
Neurological, ophthalmological, otolaryngological	164
Psychiatric	114
Genitourinary	108
Hematological	88
Respiratory	72

Conclusions

We did not expect that any major effects of automated health testing would emerge from this study because, even among the high-volume referral physicians, referrals to AHT amounted to only about 6 percent of the total patient load. This expectation was realized. However, the following results of the study suggest influences by the introduction of AHT which may have some significance for further development of AHT in medical practice and may stimulate further investigation.

- Individual physicians differed in their use and acceptance of the AHT laboratory. The service was used mostly by general and family practice physicians and internists.
- High- and low-volume referral physicians practiced medicine differently before AHT was introduced.
- Physician-generated revenue declined during the study period; this decline was attributable to a business recession. Among the internists, the decline was less for the high-volume than for the low-volume referral physicians. This finding indicates that the use of AHT may not reduce the cost of medical care, at least in the short term.
- General and family practice physicians and internists were affected differently by the use of AHT. The general physicians tended to see fewer patients for longer visits in which they provided more professional care and ordered fewer procedures after AHT was in-

roduced. Internists, on the other hand, saw more patients for shorter visits and performed more periodic re-examinations, but they also ordered fewer procedures.

- Patients benefited from AHT; the results of their tests were followed up, when necessary, with additional diagnostic procedures, referrals, and consultations. Such followup often resulted in new diagnoses and therapy and sometimes surgery.

References

1. Collen, M. F., et al.: Cost analysis of a multiphasic screening program. *N Engl J Med* 280: 1043-1045, May 8, 1969.
2. Collen, M. F., et al.: Dollar cost per positive test for automated multiphasic screening. *N Engl J Med* 283: 459-463, Aug. 27, 1970.
3. Collen, M. F., Guidelines for multiphasic health checkups. *Arch Intern Med* 127: 99-100, January 1971.
4. Howe, H. F.: Application of automated multiphasic health testing in clinical medicine. The current state of the art. *JAMA* 219: 885-889, Feb. 14, 1972.
5. Periodic employee health inventorying. *J Occup Med*, special issue, June 14, 1972.
6. Bates, B., and Mulinare, J.: Physicians' use and opinions of screening tests in ambulatory practice. *JAMA* 214: 2173-2180, Dec. 21, 1970.
7. Kaku, K., Gilbert, F. I., Jr., and Sachs, R. R.: Comparison of health appraisals by nurses and physicians. *Public Health Rep* 85: 1042-1046, December 1970.
8. Von Oeyen, P.: Opinions of Rhode Island physicians on automated multiphasic screening. *Health Serv Rep* 87: 366-374, April 1972.
9. Washington/Alaska Regional Medical Program Conference Report: Multitesting/database acquisition. Current approaches. Medical Computer Services Assoc., Seattle, Wash., Mar. 16-17, 1973.
10. Phillips, T. J.: The annual physical examination? *Postgrad Med* 51: 154-158, January 1972.
11. Breckenridge, R. L.: Experience with automated multiphasic health testing. *Ind Med Surg* 40: 18-23, October 1971.
12. Bates, B., et al.: Clinical evaluation and multiphasic screening. A comparison of yields. *Ann Intern Med* 75: 929-931, December 1971.
13. California Medical Association: California relative value studies. Committee on Relative Value Studies, San Francisco, 1969.

SYNOPSIS

RONEY, JAMES G. (Applied Health Research Corporation, Los Altos, Calif.) and **ESTES, HILLIARD D.**: Automated health testing in a medical group practice. *Public Health Reports*, Vol. 90, March-April 1975, pp. 126-132.

An automated health testing (AHT) laboratory was introduced into a large medical group practice in January 1970. The impact of AHT was studied by means of a matrix of before and after its introduction and the physicians with high and low volumes of referrals

to this service. An epidemiologic data-gathering approach was used to obtain information with minimal interference with normal clinic operation during a 3-year period. Data were obtained from the business office, appointment rosters, AHT laboratory results, and clinic records.

AHT was accepted and used more frequently by the general and family practice physicians and internists than by the other physicians in the group practice. After AHT was introduced, the general physicians saw fewer patients

but held longer visits, performed more procedures, and ordered fewer tests. On the other hand, the internists saw more patients but held shorter visits, performed more periodic re-examinations, and ordered fewer tests.

The study findings indicate that in the short term AHT does not appear to reduce the cost of medical care. However, patients benefited from followup of AHT results; often, this followup resulted in significant newly diagnosed diseases or conditions, treatment, and sometimes surgery.