Screening for Visual Impairment

ERIC JOSEPHSON, Ph.D.

CAN A TELEPHONE survey effectively screen for visual impairment? To what extent is a telephone sample representative of households where visual impairment is present? Or, stated otherwise, will a telephone sample produce prevalence rates of visual impairment comparable to rates obtained by more traditional sampling methods; for example, personally interviewing a sample of all households (telephone and nontelephone) as in the National Health Survey and most other health studies? Is there under-reporting of visual impairment in telephone screening as compared with face-to-face interviews? How much trust should be placed in what people say about their eye trouble? Can acceptable data on visual acuity be obtained by nonmedical investigators conducting standardized vision tests in the homes of respondents?

These are the questions we sought to answer in a household survey of visual impairment. This study was designed and conducted by the American Foundation for the Blind in collaboration with Western Reserve University, in Cleveland during the winter and spring of 1963.

Dr. Josephson is research associate in the division of research and statistics at the American Foundation for the Blind, New York City. Collaborating with him in this study were Professor Marvin B. Sussman, chairman, department of sociology and anthropology, Western Reserve University, under whose auspices the study was administered; Paul B. Sheatsley, eastern representative, and Mrs. Ann F. Brunswick, study director, National Opinion Research Center, University of Chicago. The Center recruited and trained field staffs, collected data, and drafted a preliminary analysis of findings.

The investigation was supported in part by Public Health Service research grant No. NB 04282–01, and additional support came from the Cleveland Foundation and the American Foundation for the Blind.

The Problem

Visual impairment is open to varying definitions, and any study of persons with eye disorders must begin with some statement about the criteria used to identify them. In simple medical terms, blindness means anything less than 10 percent of "normal" vision, and according to recent estimates its prevalence is slightly more than 2 per 1,000 population, yielding a total of approximately 400,000 blind people (*1*). However, blindness as defined for purposes of welfare is arbitrary in the sense that it includes some persons who appear to function nearly as well as normally sighted people and excludes others who are limited in mobility and activity because of trouble in seeing.

In our study we adopted the functional criteria used by the National Health Survey (*2*) for studying visual impairment. That is, we interpreted "visual impairment" to include all persons who reported serious trouble in seeing, even wearing glasses, and "severe visual impairment" to include all persons who replied negatively to the question: "Can you see well enough to read ordinary newspaper print with glasses?" The National Health Survey has estimated that there are approximately 3½ million visually impaired persons (a rate of 19.8 per 1,000), of whom nearly 1 million have severely impaired vision (5.6 per 1,000 population).

In devising a strategy for locating cases of visual impairment, a basic assumption was that a fairly large probability sample of households would be essential to determine the magnitude of the condition and to provide a representative number of cases for analysis. Without such a sample, we would have missed both the "hidden" or unknown blind and the far greater number of persons who have severely impaired eyesight but are not regarded as blind.

In most States and large cities, those who become known to and listed by social agencies are chiefly the blind persons receiving public assistance or the people getting special services. As a result, serious bias exists in such lists, and we may assume that an important minority of the total blind population are unaccounted for because the agencies have been unable to reach them, such persons do not want to be reached, or they do not know they are blind. One of our aims was to test a method for getting information about this hidden group. As for visually impaired persons who are not regarded as blind, since no list or registration of such cases exists, there is no way to reach them other than through a household sample.

In view of the relatively low prevalence of visual impairment and the large number of persons to be screened, a household sampling based entirely on personal visits would have been prohibitively expensive. An alternative approach, and the one we followed, was to rely chiefly but not exclusively on telephone screening of households. Would such an approach introduce bias into the sample? In cities like Cleveland, more than three-fourths of all households have telephones. A special study which we made of 180 legally blind persons, drawn at random from the client list of the Cleveland Society for the Blind (the leading local private organization concerned with the welfare of the blind), showed that the proportion of blind persons with telephones was approximately the same as in the general population. In other words, a telephone sample was unlikely to discriminate against the blind. Moreover, a recent survey conducted by the California State Department of Public Health shows that considerable data on health can be obtained in telephone interviews and that with respect to validity, rate of return, and rate of completeness the telephone method is as reliable as mail questionnaires or personal interviews (*3*).

Procedures

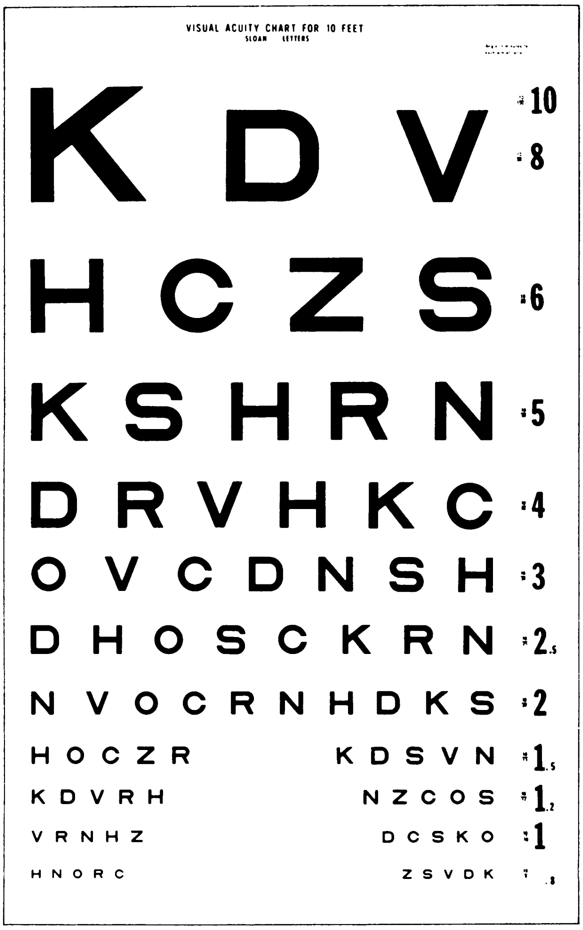
A random sample of 3,689 households was drawn from the most recent Cleveland city directory. This total was divided into a telephone sample of 2,778 homes and a nontelephone sample, including unlisted numbers, of 911 households. All telephone listings were assigned to interviewers for screening, but for economy we decided not to visit personally all nontelephone households in the sample; therefore, we drew a random subsample of approximately one-third, or 309, for screening purposes.

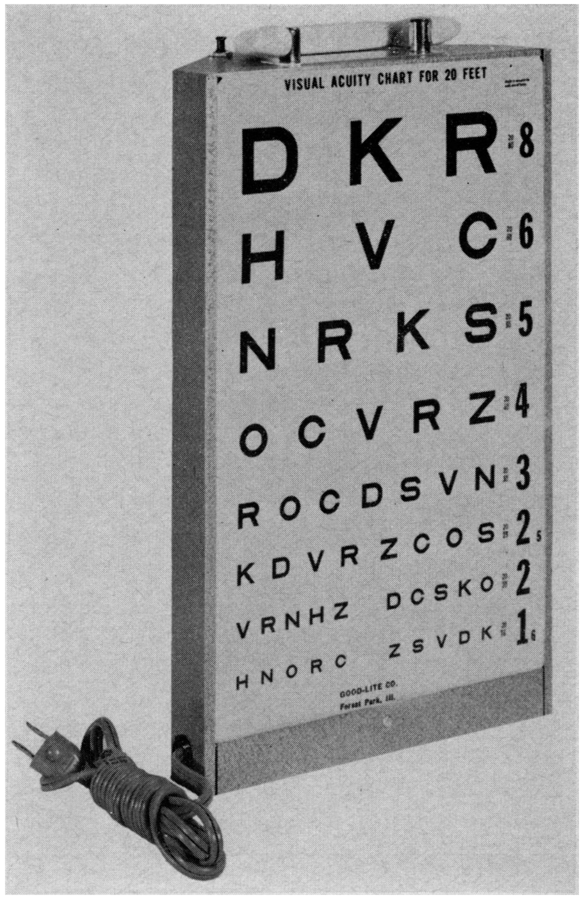
Screening questionnaires, identical in both samples, contained a checklist of health items adapted from the National Health Survey, including "serious trouble seeing even when wearing glasses." Intensive face-to-face interviews were then conducted with persons reported in the two screenings, either by themselves or by other family members, as having "serious trouble seeing." These interviews provided measures of the severity of visual impairment, including subjective appraisals by respondents and tests of visual acuity.

To measure distance vision we used the Good-Lite Co. electrically illuminated 20-foot visual acuity chart with a 10-foot Sloan letter card (see figure) to allow for the probability that most households do not contain 20-foot living rooms (*A*). We standardized the distance at which this test was administered by equipping each chart with a 10-foot cord and instructing interviewers to extend the cord to full length between the subject and the chart. Respondents who were either illiterate or unfamiliar with the Roman alphabet were shown the so-called tumbled E vision chart. This chart has no letters but displays a figure resembling the letter E in various positions. Subjects are asked to tell the examiner the direction in which the figure prongs are pointing. Visual acuity measures obtained with this chart are comparable with those derived from lettered charts.

To record near vision we used the Lebensohn card (*B*) at 14 inches for both the Snellen and Jaeger tests. All tests measured best corrected vision; that is, subjects were asked to put on glasses if they used them. Interviewers were trained in the use of these devices by a local ophthalmologist.

Each respondent who said he had been ex-





Sloan letter card used for testing visual acuity at 10 feet with Good-Lite Co. electrically illuminated 20-foot chart

amined within the past 3 years was asked to sign a release authorizing us to approach his physician for validating information. The few persons who had not been examined during this period were invited to have clinical examinations at our expense. These two sources provided data for checking results of our vision tests. Physicians were asked for measurements of distance and near visual acuity and field of vision, along with brief diagnostic information about the primary and secondary conditions leading to the impairment.

Screening Results

Interviews were completed with 2,014, or 73 percent, of the 2,778 originally assigned telephone household listings. Unfortunately, we were forced to rely on an obsolete city directory, and as a result more than one-sixth of the 309 originally assigned nontelephone listings turned out to be vacant or demolished dwelling units. However, personal screening interviews were completed with 183, or 77 percent, of all existing nontelephone households assigned. A third of the nontelephone households contacted had obtained listed telephone numbers since the appearance of the original directory, and nearly one-fifth had unlisted numbers. In other words, only two-thirds of these households legitimately belonged in the nontelephone sample; that is, they either had no telephones or had unlisted numbers. The total of completed screenings was 2,197 households containing 7,192 persons.

We found, as have other researchers, that telephone screening costs only one-third as much as personal screening of households. The average cost of 2,014 telephone screenings was

$1.50; the average cost of 183 personal screenings was $4.50. The telephone method offers considerable economy. Does it also provide representative data?

Comparing characteristics of individuals in the total sample (telephone and nontelephone) with census data for Cleveland, we find an identical distribution of age and an almost identical distribution of men and women (table 1). Our sample had a slightly higher proportion of Negroes, but this difference may be because the census data were collected almost 3 years before our study was started and hence do not reflect the greater concentration of Negroes in the city since 1960. Also, we obtained information on race from households, and since census data were collected only for individuals in Cleveland, for comparison we projected household data for individuals in the sample. Comparing the racial distribution for households, the sample characteristics were almost identical to the distribution reported by the census.

Our sample had proportionately more persons in the lower socioeconomic groups than reported by the census. While only one-fourth of Cleveland's families reported a total annual income of less than $4,000 in 1960, our corresponding figure was two-fifths of the total sample of households in 1963.

In general, our telephone sample closely matched census figures. The greatest differences were between telephone and nontelephone households and also within the relatively small nontelephone sample itself. The nontelephone sample included more young people and disproportionately more Negroes than the telephone sample. Heads of households had less education and family income was lower in the nontelephone group.

Because the screening questionnaire included a checklist of chronic conditions and impairments adapted from the National Health Survey, the prevalence rates we obtained may be compared with reports from that study. In our total sample of 7,192 persons (6,499 telephone and 693 nontelephone) the prevalence of

Table 1. Percent distribution of telephone and nontelephone sample characteristics, city of Cleveland

Characteristics	Total city population [1]	Samples [2]		
		Total N=7,192	Telephone N=6,499	Nontelephone N=693
Age:				
Under 65	90	90	89	94
Under 45	69	69	65	80
45–64	21	21	24	14
65 and over	10	10	11	6
65–74	7	7	8	3
75 and over	3	3	3	3
Sex:				
Men	49	48	48	49
Women	51	52	52	51
Race:				
White	71	68	71	56
Negro	29	31	26	44
Other	----	----	1	----
Refused	----	----	2	----
Family income:				
$0–$2,000	10	19	16	27
$2,000–$3,999	15	21	20	25
$4,000–$6,999	39	37	38	33
$7,000–$9,999	23	12	12	9
$10,000+	13	5	6	4
Refused	----	6	8	2

[1] U.S. census.

[2] Actual numbers reporting varied somewhat from item to item. All reported numbers are unweighted. Percent distributions for the total sample are based on a weighting of nontelephone cases by a factor of 3 since we subsampled ⅓ of the assigned nontelephone households. This weighting restores the proper balance in the overall proportion of telephone and nontelephone households.

Table 2. Health conditions of 569 people in telephone screening and personal re-interviews [1]

Condition	Agreed: Yes to both		Agreed: No to both		Disagreed: No on phone, yes in person		Disagreed: Yes on phone, no in person		Net change of disagreement	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Serious trouble seeing	0	-------	568	99. 8	1	0. 2	0	-------	+1	+0. 2
Ever wear eyeglasses	243	42. 7	288	50. 6	18	3. 2	20	3. 5	−2	−. 3
Arthritis, rheumatism	25	4. 4	515	90. 5	19	3. 3	10	1. 8	+9	+1. 5
Heart, high blood pressure	25	4. 4	532	93. 5	9	1. 6	3	. 5	+6	+1. 1
Varicose veins	12	2. 1	540	94. 9	11	1. 9	6	1. 1	+5	+. 8
Repeated trouble with back or spine	6	1. 1	548	96. 3	8	1. 4	7	1. 2	+1	+. 2
Diabetes	9	1. 6	558	98. 1	1	. 2	1	. 2	-------	-------
Deafness, serious trouble hearing	6	1. 1	554	97. 3	6	1. 1	3	. 5	+3	+. 6
Wear hearing aid	3	. 5	565	99. 3	0	-------	1	. 2	−1	−. 2
Use cane regularly	2	. 4	563	98. 8	2	. 4	2	. 4	-------	-------

[1] Individuals for whom no "serious trouble seeing" was reported in the original telephone screening.

NOTE: Not all inconsistencies between the telephone and personal interviews can be attributed to inaccurate reporting alone as some recording errors may have been made. In addition, a period of 1 to 3 months occurred between the 2 interviews, thus raising the possibility of finding conditions in the personal interview which had not existed at the time of the original telephone screening.

all reported cases of visual impairment (23.8 per 1,000) was fairly close to the National Health Survey figure (19.8 per 1,000). In our telephone sample the rate of reported impairments was even closer (19.3 per 1,000) but the prevalence of visual impairment in our nontelephone sample (37.5 per 1,000) was nearly twice that reported by the National Health Survey or by our telephone sample. What explains the apparently higher rate of visual impairment in the nontelephone group?

We have evidence that persons with severe visual impairment generally are low in socioeconomic status. Data from the National Health Survey indicate that the prevalence of severe visual impairment among families with an annual income under $2,000 is nearly nine times the rate among families with an income of $7,000 or more (*4*).

Apart from characteristics of the telephone and nontelephone populations, which may explain variation in the prevalence of visual impairment, there remains the question whether this variation can be attributed to the use of different interviewing techniques. Numerous studies show wide discrepancies between the number of diseases or conditions reported in household interviews and those found by medical examination. Also, the reliability of household interviews varies with the conditions being reported. For example, in a study by Trussell, Elinson, and Levin (*5*), diseases of the eye first reported in household interviews were relatively well matched with later clinical evaluations, while diseases of the respiratory system were poorly matched. On the other hand, relatively few of the eye-disease cases found by clinical evaluation were matched with conditions previously reported in family interviews.

A primary objective of our study was to determine whether telephone screening increases under-reporting of visual impairment. To check, we undertook a special reliability study and randomly selected for personal re-interviews a sample of 220 households (569 persons) which had not reported any cases of visual impairment in the original telephone screening. In all households we interviewed the original telephone respondent, and the questionnaire included the same health items that had been used in our first screening except that respondents were now questioned face-to-face. The re-interviews uncovered only one new case of visual impairment previously unreported. Further questioning about the duration and degree of impairment revealed that it was not severe; the person was reported as able, with correction, to read ordinary newspaper print.

Our reliability check thus suggested, at least for visual impairment, that the difference between prevalence rates in our telephone and nontelephone samples was not caused by variation in interviewing techniques. On the other hand, we found somewhat greater inconsistencies between the two sets of interviews with regard to other health conditions, which may be partly explained by the 1- to 3-month intervals between the original screenings and the follow-ups and also by the more unstable nature of some of the other conditions (table 2).

In our study, as in a number of other epidemiologic surveys, evidence showed that respondents are more likely to report their own chronic conditions or impairments than those of other household members (*6*). However, we had no evidence that this tendency was related to the interviewing techniques, that is, telephone versus nontelephone.

Vision Tests

As noted earlier, we originally planned to interview personally all individuals reported as having serious trouble seeing. Our two screenings (telephone and nontelephone) uncovered 152 such persons and 127, or 84 percent, were successfully interviewed during March and April 1963. Of these, 122 were actually given vision tests in their homes.

The various measures of visual impairment—our tests of near and distance acuity, answers to a series of questions about the trouble visually impaired respondents had in seeing, and reports from physicians—gave us an opportunity to correlate what people told us with actual tests of vision.

About 26 percent of the 127 visually impaired respondents interviewed replied negatively to the question: "Can you see well enough to read ordinary newspaper print with glasses?" This is the criterion by which the National Health Survey identifies the "severely visually impaired" population. It is worth noting that the Health Survey reports an almost identical proportion (28 percent) of all persons with visual impairments in this category.

However, since we administered our own tests of visual acuity, we have had a chance to compare the two sets of findings. Table 3 shows the relationship between reported ability of 122 persons to read ordinary newspaper print and their actual performance in reading the Jaeger near-vision card at 14 inches. Thirty-seven percent were unable to read 8-point standard newspaper print or smaller type on the near-vision test. Almost one-fourth of those who said they were able to read newspaper print could not read 8-point type. Conversely, approximately one-fifth of those who said that they were unable to read newspaper print could read 8-point or smaller type in the Jaeger test.

Table 3. Association between reported ability to read ordinary newspaper print and performance in Jaeger near-vision test [1]

Visual acuity level	Reported ability to read ordinary newspaper print with glasses (percent)		
	Total (N=122)[2]	Able to read (N=87)[2]	Unable to read (N=35)[2]
Totally blind	2		10
Light perception	4		14
Less than 20/170	5		22
20/170	5	5	5
20/130	4	3	7
20/100	5	6	5
20/80	5	3	9
20/70	3	1	7
20/65	4	5	
20/50 [3]	17	19	9
20/40	5	6	5
20/30	20	24	7
20/25	17	23	
20/20	4	5	
Total	100	100	100

[1] Tested at 14 inches.
[2] Actual number. In computing percentages, the number of visually impaired persons from the nontelephone sample has been weighted by a factor of 3.
[3] Level of acuity needed to read newspaper text.

We do not offer these results as conclusive evidence of unreliability in the National Health Survey criterion for defining severe impairment, especially as we tested near vision at 14 inches and since distance or size of type was not specified in the Health Survey question regarding ability to read newspaper print. Furthermore, we did not learn whether persons claiming ability to read newspaper print, but unable to read 8-point type on the Jaeger test, could in fact do so for a sustained period of time. Nevertheless, this correlation of verbal reports and test results suggests that any measure of visual impairment based entirely on what people report is subject to error.

Verbal reports, of course, are hardly adequate to identify all blind persons, particularly those who have more than light perception, which is usually defined as the ability to see light but not its source. Consequently, to distinguish the blind we relied on our test of visual acuity. All respondents who scored 20/200 or less on the 10-foot Sloan letter chart were considered to be blind. We found that 10 percent of the reported cases of visual impairment fell into this category, a figure which could have been expected from the proportion of estimated blindness (2 per 1,000 population) in the total universe of visual impairment as defined by the National Health Survey (19.8 per 1,000 population).

We attempted to check results of the vision tests against reports from physicians. Eighty-four persons (79 percent) who said they had been examined within the past 3 years signed releases authorizing us to obtain information about them from their physicians. Medical reports were obtained on 55 persons, or nearly two-thirds of the ones who had signed. In addition, clinical examinations were arranged for nearly half (14) of the respondents who had not been examined within the previous 3 years. As a result, we obtained clinical data consisting of distance and near-vision acuity and brief diagnostic information on 69, or 54 percent, of the visually impaired respondents.

The 2 sets of observations for the 69 clinically validated cases varied considerably (table 4). According to the physicians, 48 percent of the group had 20/25 vision or better; in contrast only 29 percent were so scored by our interviewers. At the other end of the scale, clinical reports indicated that only 3 percent had light perception or were totally blind; according to our vision tests, the figure was 8 percent.

Identical test results were obtained in only 22 percent of the cases. Furthermore, in most instances of disagreement, the interviewers recorded less distance vision; that is, more visual impairment than the physicians. For the 53 persons without clinical validations, our data suggest that the distribution of visual acuity scores was not significantly different from the clinically validated.

What explains the discrepancies between clinical and home examinations? It must be observed that our tests were not intended as substitutes for clinical examinations. Thus for comparison with clinical reports, the results of our 10-foot distance tests were converted into standard 20-foot measurements by multiplying them by two. For closer approximation of 20-foot testing with the apparatus we used, how-

Table 4. Percent distribution of visual acuity scores

Visual acuity level	Clinically validated		Not clinically validated, tested at home (N=53) [1]	All respondents, tested at home (N=122) [1]
	Clinical reports (N=69) [1]	Tested at home (N=69) [1]		
20/16–20/25	48	29	38	34
20/30	13	18	10	14
20/40	16	13	21	15
20/50	8	4	8	6
20/60	----	12	3	7
20/70–20/80	3	7	1	5
20/100	----	5	8	6
20/120	----	1	1	1
20/160	----	2	2	1
20/200 but more than light perception	9	1	1	1
Light perception	2	6	4	6
Totally blind	1	2	4	3
Total	100	100	100	100

[1] Actual number. In computing percentages, the number of visually impaired persons from the nontelephone sample has been weighted by a factor of 3.

ever, one should place a pair of 0.25 lenses over the patient's eyes or eyeglasses during the visual acuity test. This we were unable to do in our study.

Although reporting physicians suggested that many patients underestimated the elapsed time since their most recent visit, there is no evidence from our study that the inconsistency between our distance tests and what physicians reported was caused by the time lag between their examinations and our tests. Indeed, a surprisingly large proportion of our respondents had been examined within a few months before our two contacts with them and some of them afterward.

There is reason to believe, however, that physicians differ in their vision-testing procedures, not only as compared with our household examinations but among themselves as well. Wide variation among physicians in arriving at a diagnosis, along with errors and inconsistencies in diagnoses, have been reported elsewhere (*7*). In our study there was so little uniformity among physicians in the distance at which they conducted near-vision tests and in reporting that we were unable to compare their findings with our near-vision tests. While there was greater uniformity in physicians' procedures for testing and reporting distance vision, we can make no definitive statement about the reliability of our vision-testing procedures or the physicians' reports. However, we feel that our fairly simple vision tests achieved at least one objective—a check against self-reported disability.

Conclusions

Any visual impairment study using the telephone for screening must be supplemented by a sample of nontelephone households, in view of important demographic differences between telephone and nontelephone populations and the possibility that such differences may be associated with the prevalence of the condition. The proportion of interviews completed with assigned listings would be much higher than in our study if up-to-date directories were available.

As for the reliability of the telephone strategy in collecting impairment data, we conclude that our approach is as dependable as personal interviews for screening to determine crude rates of visual impairment and other chronic conditions. Telephone screening is economical, costing about one-third as much as personal interviews. Vision tests can be given in homes by nonmedical investigators. Such tests offer a useful check against self-reporting of visual impairment. However, more research is needed on the general reliability of vision testing (medical and nonmedical), particularly at the lower ranges of visual acuity. In view of suspected differences in testing procedures, what needs to be explored, it seems to me, is variation not only in different testing devices (*8*) but among different observers using the same device.

REFERENCES

(*1*) Hurlin, R. G.: Estimated prevalence of blindness in the United States and in individual States, 1960. Sightsav Rev 32:1, spring 1962.

(*2*) U.S. National Health Survey: Selected impairments by etiology and activity limitation, United States, July 1959–June 1961. PHS Publication No. 584–B35. U.S. Government Printing Office, Washington, D.C., 1962.

(*3*) Hochstim, J. R.: Comparison of three information-gathering strategies in a population study of sociomedical variables. *In* Proceedings of the social statistics section, American Statistical Association, Washington, D.C., 1962.

(*4*) U.S. National Center for Health Statistics: Medical care, health status, and family income, United States. PHS Publication No. 1000, series 10, No. 9. U.S. Government Printing Office, Washington, D.C., 1964.

(*5*) Trussell, R. E., Elinson, J., and Levin, M. L.: Comparisons of various methods of estimating the prevalence of disease in a community: The Hunterdon County study. Amer J Public Health 46: 173–182, February 1956.

(*6*) U.S. National Health Survey: Health interview responses compared with medical records. PHS Publication No. 584–D5. U.S. Government Printing Office, Washington, D.C., 1961.

(*7*) Sanders, B. S.: Completeness and reliability of diagnoses in therapeutic practice. Paper presented at 91st meeting, American Public Health Association, Kansas City, Mo., November 1963.

(*8*) U.S. National Center for Health Statistics: Comparison of two vision-testing devices. PHS Publication No. 1000, series 2, No. 1. U.S. Government Printing Office, Washington, D.C., 1963.

EQUIPMENT REFERENCES

(*A*) Good-Lite model A translucent eye chart. Good-Lite Co., Forest Park, Ill.

(*B*) Lebensohn near-vision test chart. Matalene Surgical Instruments Co., New York.