

# Computer-Assisted Eye Examination

## VI. Identification and Correction of Errors in the Refractor III System for Subjective Examination

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### Abstract

A computer-assisted subjective eye examination was administered to 80 patients. They were also examined in the conventional manual way. The results of the computer-assisted examination were compared with those obtained by conventional subjective methods to identify errors of hardware, software, and optometric flow charting and other problems. An 87.5% satisfactory prescription level was found for the distance prescription. The 12.5% unsatisfactory results are accounted for by several kinds of error. The percentage of unsatisfactory refractive results was greater for near than for distance measures because of special flow-chart and software problems, which were subsequently corrected. With implementation of the changes initiated as a result of this investigation, satisfactory refractive results approaching 95% can be expected.

**Key Words:** refractive error, subjective examination, computer assistance, measurement errors, prescription evaluation

This paper deals with identifying the causes of the errors we reported in a previous communication on computer-assisted eye examinations.<sup>1</sup> In the series of 78 pa-

tient-volunteers we studied, we found about 17% unsatisfactory prescriptions. Of these, about 6% were identified as being avoidable with improvement in the hardware, software, and optometric flow charts. The causes of another 6% were not identifiable at that time. Still another 4% of the unsatisfactory prescriptions resulted from apparent "fundamental" problems of patient understanding or physical disability. In the current series of 80 patients (see "Appendix"), we attempted to determine during the measurements, the bases of those problems that were of unknown cause in the previous series.

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As described in our previous publication,<sup>1</sup> we compared the refractive prescriptions and acuities obtained by human clinicians and by the computer system on the same patient-volunteers. Because comparison of prescriptions is so complex, no rigorous method has been developed to accomplish it. Therefore, as discussed previously,<sup>1</sup> the results were judged by a clinical committee consisting of the optometrically trained authors and put into categories labeled *satisfactory* or *unsatisfactory*. The "satisfactory" category was subdivided into *good agreement* and *agreement*. The "unsatisfactory" category was split into *avoidable system error*, *fundamental (patient) error*, and *error of unknown cause*. These results are listed in Tables 1 and 2. The same essential procedures apply in the current work as in the previous one, which describes them in detail.<sup>1</sup>

## METHODS

Of the 80 patients examined, 56 were male and 24 female. Their ages ranged from 7-75 years with a mean of 40. Thirty-four were myopes, 36 hyperopes, 4 emmetropes, and 62 astigmats. Thirty-six were age 40 or older, and the near test was administered to them automatically. An example of the computer printout is shown in Fig. 1.

During the course of closely monitoring the patient taking the computerized test, errors and/or problems were noted. The observer identified the problem as it became apparent. This was done by questioning the patient, making direct observations, analyzing the results, or any combination of these in an attempt to pinpoint and classify the error. Some of the errors, which we call *mistakes*, were trivial in that there was spontaneous recovery with no effect on the final prescription, other than an in-

crease in the time required for the examination. Other errors did cause some discrepancy in the final computer-suggested prescription, but because of clinical measurement latitude the prescription was still considered satisfactory. In the worst cases, the error affected the final suggested prescription in a way that made it entirely unsatisfactory. Still other errors, such as those in the measurement of visual acuity, made for an unsatisfactory prescription, but could have been corrected by the clinician in reviewing the computer printout. The results presented here do not take into account the intelligent review by the doctor, which would improve the results by correcting some of the errors in a way that would make the results satisfactory. In other words, if the system is used to assist the doctor as planned, *the errors of the machine-doctor combination are expected to be even fewer than the figures found here would suggest.*

## RESULTS

### Eliminating Errors

*Hardware Errors.* The most common cause of error was unanticipated misuse of the response box during visual acuity measurement. Landolt Cs, or broken rings, are used to determine visual acuity. The patient's task is to look for the orientation of the gap in the circle, which can be in any one of the four cardinal positions. The pushbuttons on the response box are positioned in such a way that the patient pushes the button corresponding to the orientation of the gap shown on the screen—left, right, up, or down. Immediately after the button is pushed, the computer directs the slide projector to the next slide in the branching program.

TABLE 1. Computer-assisted determinations of the distance prescription and near add evaluated by a clinical committee in relation to values obtained by conventional manual methods.

| Committee Evaluation | Distance Prescription |        | Near Add |        |
|----------------------|-----------------------|--------|----------|--------|
|                      | No.                   | %      | No.      | %      |
| Satisfactory         | 70                    | 87.5   | 29       | 80.6   |
| Good agreement       | (59)                  | (73.8) | (24)     | (66.7) |
| Agreement            | (11)                  | (13.7) | (5)      | (13.9) |
| Unsatisfactory       | 10                    | 12.5   | 7        | 19.4   |
| Totals               | 80                    | 100    | 36       | 100    |

TABLE 2. Distribution of errors that occurred during the computer-assisted examination of 80 patients.

| Type of Error   | Patient Mistake<br>(Spontaneous<br>Recovery) | Patient Error<br>(No Spontaneous<br>Recovery) | Equipment<br>Breakdown |
|---|--|---|------------------------|
| <i>Hardware</i>                                       |  |   |                        |
| Response buttons during VA                            | 3(3.6%)                                      | 6(7.3%)                                       |                        |
| Response buttons—confusion                            | 4(4.9%)                                      |   |                        |
| Axis chatter  | 2(2.4%)                                      |   | 1(1.2%)                |
| 8-track cartridge tape decks                          |  |   | 1(1.2%)                |
| Projectors  | 2(2.4%)                                      |   |                        |
| Total <sup>a</sup>                                    | 11(13.4%)                                    | 6(7.3%)                                       | 2(2.4%)                |
| <i>Software &amp; flow charting</i>                   |  |   |                        |
| Inability to differentiate between 0.25 D steps       | 3(3.6%)                                      | 3(3.6%)                                       |                        |
| Selection of more minus and/or lower acuity           | 1(1.2%)                                      | 2(2.4%)                                       |                        |
| Fogging before final VA                               |  | 2(2.4%)                                       |                        |
| System failure before final VA                        |  |   | 2(2.4%)                |
| Total <sup>b</sup>                                    | 4(4.9%)                                      | 7(8.5%)                                       | 2(2.4%)                |
| Near add algorithm                                    |  | 7(19.4%)                                      |                        |
| <i>Fundamental error</i>                              |  |   | 3(3.6%)                |
| <i>Unknown miscellaneous</i>                          |  |   |                        |
| Unknown (recoverable by restarting examination)       |  |   | 2(2.4%)                |
| High room temperature (avoidable by air conditioning) |  |   | 1(1.2%)                |

<sup>a</sup> Total hardware errors that caused unsatisfactory results: 8(9.7%).

<sup>b</sup> Total software errors that caused unsatisfactory results (distance): 9(10.8%).

The error occurred when the patient pressed the button and held it down too long. This would allow the next slide to be displayed while the button continued to register the patient's answer for the previous slide.

The error was detected because the new orientation is always different from the previous one. Patients unknowingly made this error even when the targets were well above threshold. This made it possible to trace the cause of the problem directly. (The presentation is random except for this feature. This departure from randomness is necessary because if the slide were not changed, the patient would have a clue to the orientation of the ring from not having heard the movement of the slide projector. The patient does not know this feature, and for all practical purposes the presentation appears random.)

Patients who consistently held down the button so that it registered for the next slide (rather than just once or twice, from which there might have been recovery) ended up with an inaccurate visual acuity measurement, which affects the final suggested prescription, including the near add.

Correcting this error, once it was identi-

fied, was fairly simple. By the use of an "initial edge detector" circuit, the information accepted by the computer at the depression of the button was registered immediately. Continued depression or release of the button had no effect on the programs.

A mistake occurred when the patient, apparently confused, pushed the center button rather than a peripheral button. The center button is used mainly for a repetition of the verbal instructions. This mistake has no effect on the course of the examination other than lengthening it by the time required to replay the message. This mistake occurred four times.

Another error was anticipation of the "beeper," or ready tone. (The computer accepts input from the response box only after the tone has sounded.) Patients learn to avoid pushing the button too soon when they find that it causes the examination to stall. They then push the button again and activity continues. Improved hard- and software will allow faster acceptance.

Occasionally a patient may hold the response box too close to his body, thus muffling the transmission of the ready tone, which is generated in the response box. To overcome this the tone generator will be

NAME:  
 ADDRESS:  
 PHONE:  
 PATIENT'S SEX: F  
 PATIENT'S AGE: 40  
 OCCUPATION:  
 IDENTIFICATION NO.: 5623  
 REFERED BY: DR RUTLEDGE  
 LAST EYE EXAM: 1977  
 PLACE OF LAST EYE EXAM: LAMC  
  
 DATE OF R3 EXAM: 27--JUN--77 14:26:58  
 DATE OF PRINTOUT: 20--APR--78 13:49:59

| OD   | VA    | SPH   | CYL   | AX   | TIME  | OS    | VA    | SPH   | CYL  | AX | TIME |
|--|-------|-------|-------|------|-------|-------|-------|-------|------|----|------|
| VA W/O RX:                                     | 400   | PLANO |       |      | 0:57  | 400   | PLANO |       |      |    | 0:33 |
| VA (OLD RX)                                    | 20    | -2.75 | -0.50 | 67   | 0:53  | 20    | -2.75 | -0.75 | 91   |    | 0:55 |
| SEQUENTIAL SPHERICAL CORRECTION:               |       |       |       |      |       |       |       |       |      |    |      |
|  | -2.75 | -0.50 | 67    |      | 1:45  | -2.75 | -0.75 | 91    |      |    | 1:04 |
| FINAL X-CYL AXIS:                              |       |       |       |      |       |       |       |       |      |    |      |
|  | -2.75 | -0.50 | 64    |      | 1:56  | -2.75 | -0.75 | 85    |      |    | 0:53 |
| CYLINDRICAL POWER:                             |       |       |       |      |       |       |       |       |      |    |      |
|  | -2.87 | -0.25 | 64    |      | 1:24  | -2.87 | -0.50 | 85    |      |    | 0:42 |
| FINAL SPHERICAL CORRECTION:                    |       |       |       |      |       |       |       |       |      |    |      |
|  | -2.87 | -0.25 | 64    |      | 1:19  | -2.87 | -0.50 | 85    |      |    | 1:10 |
| FINAL CORRECTION:                              |       |       |       |      |       |       |       |       |      |    |      |
|  | 25    | -2.12 | -0.25 | 64   | 1:43  | 20    | -2.37 | -0.50 | 85   |    | 2:02 |
| SUGGESTED RX:                                  |       |       |       |      |       |       |       |       |      |    |      |
|  | 20    | -2.75 | -0.50 | 67   | 0:00  | 20    | -2.37 | -0.50 | 85   |    | 0:00 |
| NEAR TESTS:                                    |       |       |       |      |       |       |       |       |      |    |      |
| VARE   | AE    | TIME  | NRA   | VARF | AF    | TIME  | PRA   | VARD  | TIME |    |      |
|  | +0.25 |       | +1.25 | 25   | +1.37 | 0:23  | +1.00 | 25    | 0:52 |    |      |
| EFFECTIVE RX:                                  |       |       |       |      |       |       |       |       |      |    |      |
|  | +78   | -2.62 | -0.50 | 67   | 0:13  |       | -2.37 | -0.50 | 85   |    | 0:00 |
| TOTAL TIME FOR ENTIRE COMPUTER AIDED RX: 13:54 |       |       |       |      |       |       |       |       |      |    |      |

Fig. 1. Sample computer printout.

transferred from the response box to the loudspeaker.

Refractor III has generally proved extremely reliable. However, two minor problems have emerged. The first is called "axis chatter." This is a resident condition in which one of the discs containing the lenses

vibrates or oscillates slightly. There are several causes. Most frequently, axis chatter occurs when the system is not sufficiently warmed up. An initialization program that exercises all the moving parts now takes care of this problem.

When the room temperature is above 80

deg Fahrenheit there is a slight tendency for axis chatter to occur. It can be reduced in the short term, especially after periodic maintenance, by checking the connectors in the interface, gently moving the circuit boards. The long-term, permanent solution, which is in progress, is microprocessor control of the interface and stepping motors. This will eliminate any such problem (as well as increase the speed of the system).

There have been on occasion some minor problems with the occluders or shutters tending to stick, but this also is a warm-up problem. A planned redesign of the shutters should eliminate it entirely.

There were two problems with the two-cartridge tape decks. The first was a minor warm-up problem that affected the long-message deck in such a way that the wrong instructions were played. The major problem was with the short-message tape deck. For each examination the short messages "lens number 1" and "lens number 2" are played a minimum of 30 times. As a result of this continual normal wear and tear, the metal sensor and the tape head tend to malfunction. The metal sensor signals the system that the message has ended. The tape deck is then shut down until the next message is called. If the end of the message is not properly detected, the message may be played several times, as by a broken phonograph record. Although some patients were distracted by this repetition, all recovered spontaneously from this mistake. Only the total time taken by the examination was affected. Despite frequent preventive maintenance on the tape deck, errors still occurred.

The complete solution is to replace the electromechanical tape decks with a solid-state voice encoder-decoder. This voice encoder has been built to replace the short messages with a new integrated circuit chip (Harris Semiconductor Corp.) designed to use the principle of continuous delta modulation. It has now been operating perfectly for some months with an audio fidelity similar to that of the replaced magnetic tape.

An additional benefit of solid-state voice generation is that it shortens the time lapse between the two lens presentations. Previously, with the tape system, we were limited by the time it took for each loop of tape to complete its cycle. Now the second message

can be started at any time after the first without any necessary delay for mechanical reasons. Comparison of the two lenses by the patient is much easier, since there is no significant time delay between them. We are planning in due course to replace the long-message enunciator with all-solid-state electronics also. The mistakes mentioned here can be considered minor, since there was spontaneous recovery with no effect on the accuracy of the results. However, the time loss and annoyance that were caused will be eliminated.

The random-access Kodak Carousel slide projectors have proved very reliable. Only twice during the extensive testing described here did the slides jam and have to be released manually. One projector is used for distance targets and is included in the initialization exercise routine. The other, a near projector, will be included in the same routine shortly, which may help eliminate even infrequent jamming.

A solution to any possible slide-projector problem is the substitution of cathode-ray oscilloscope displays for the slides. We are currently examining this possibility to see whether it is technically and economically feasible. All-solid-state generation of the targets with cathode-ray presentation would presumably be even more reliable but may not be cost-effective or give an adequate image quality.

For the near test, the near screen automatically rotates in a frontal plane from above into position 40 cm before the patient's eyes. It has been noted that the screen does not always position itself squarely in front of the patient but stops a little short of or a little beyond the desired point. A redesign has remedied this minor problem.

A similar problem (which produced no errors in the results) was found in the light-emitting diode (LED) display unit that shows the current refractive values that are positioned for viewing in Refractor III. At times some wrong values were in evidence until the device was rewired. Again, this did not affect the results in any way, since it is used only in searching for errors in the refractor, such as would be caused by sticking, and none of these occurred.

*Software and Flow-chart Errors.* Unaided-acuity measurements are taken at the

start of the examination. Visual acuity is also measured through any objective finding (such as old prescriptions or retinoscopy). Some time was saved by changing the flow chart to avoid the visual acuity measurement through the objective results when these results are plano, because this is unnecessary repetition. Naked visual acuity is routinely measured initially.

In the sequential spherical routines a few patients could not distinguish between plus and minus 0.25 D steps when the two lenses were presented sequentially. Not being able to discriminate between them, these patients assumed the two presentations were equal and pushed the equal button. This error is not recoverable, because the program continues to change the lenses in a way that makes discrimination even more difficult, if not impossible. The flow charts have now been revised. If there is a change of 2.00 D from the starting point after the approximate spherical routine, the power factor of 1 (which defines steps of 0.25 D) will be changed to 2; that is, presentations will then be in 0.50 D steps. Should the error persist for 2.00 D, the test will exit to the next routine, keeping the value from the approximate spherical routine.

Initially the program called for a check of cylindrical power even when no cylindrical axis was found. This increased the time for the test but did not cause any error. The time was also affected when the sequential spherical routine was repeated after determining that there was no cylindrical power or axis. This step is unnecessary, since just before the cylindrical routine, the sequential sphere was refined. The flow charts and software have been revised to direct that the next test be the final visual acuity check when no cylindrical power is required.

A fogging test in the final visual acuity routine was incorporated early in the design of the flow charts to ensure that the prescription is based on the maximum convex power consistent with good visual acuity. In this process, fogging takes place before a check is made on the final visual acuity. This has affected several patients, who had difficulty when they were fogged. The predicted acuities with fogging did not work for everyone, perhaps as a result of unsteady accommodation. The flow chart is

to be revised to ensure that the visual acuity is determined in advance of fogging. It may also be desirable to omit the fogging test in patients of presbyopic age, because the likelihood of prescribing insufficient convex or too much concave lens is small with little or no accommodation.

Early in the programming, the suggested prescription was not selected with the most convex correction that gave the best visual acuity, because of a software error. This accounted for six of the inaccurate results. This problem has been corrected.

The near test suffered the greatest percentage of errors because any errors incurred here are superimposed on those of the distance test. Obviously an accurate near finding depends on a good distance finding, and in two instances the near test was not rated because of an error in the distance finding. Near tests are performed on patients 40 years old or more to correct for presbyopia when necessary. Some patients tend to be hesitant in their responses and seem to dislike the forced-choice aspect of the Landolt-ring visual acuity test, especially when the rings are subthreshold.

A major error was found in the near-test flow chart. A tentative near add is selected using age as the criterion (from Donders's table). This lens is used as the starting point from which the negative relative accommodation (NRA) and positive relative accommodation (PRA) are determined; their sum is used to compute the add for the 40-cm test distance. The error here arises when the patient indicates that the letters are initially blurred before the first response for the initial NRA determination. The program could not determine whether the tentative add is too small or not. (An undercorrection occurs when patients understate their age.) The solution to this problem is to keep adding convex lenses up to a maximum of +3.00 D. The tentative add will then be the first lens with which the patient sees the letters clearly. The NRA and PRA are then computed from this reference rather than from the table value.

Another error in the suggested-near-add routine emerged in the software for the computation of the final add by the averaging of the NRA and PRA values. This has been corrected.

**Fundamental Errors.** As pointed out in the previous paper, fundamental errors will occur in a small group of patients who, because of mental or physical problems, cannot follow the instructions or interact with the system adequately. The percentage of fundamental errors can be reduced by special techniques including functional prostheses and training. The percentage of fundamental errors in the current series agrees substantially with that in the earlier series, about 4%.

**Unidentified and Miscellaneous Errors.** Miscellaneous errors include those from a high-room-temperature condition, which rendered the system unreliable. One case was considered unsatisfactory for this reason. There were also two instances of breakdowns for no apparent reason; they have been classified as unidentified, but the most likely cause is a programming error where the next routine called turned out to be an undefined field.

**Comparison of Refractive Measures**

The clinical evaluation committee consisted of this paper's optometrically trained authors who considered suggestions from the other clinicians who examined some of the patients. The judgments were not based on any rigid formulation, because of the well-known difficulty in predicting the clinical significance of differences in prescriptions. Clinical judgment alone was used. However, the judgments of the clinical committee which categorized the degree of

agreement or lack of it were examined by comparing those judgments with the calculated differences of equivalent sphere and the vector resultant cylindrical power. (This analysis was suggested by Professor Merton Flom.) It was found that the committee as a whole considered (without being conscious of it) good agreement to be within 0.32 D equivalent sphere and 0.28 D cylinder, and agreement 0.56 equivalent sphere and 0.50 D cylinder. For the near add, good-agreement judgments were within 0.56 DS and agreement 0.75 DS. These values were obtained from the curves in Figs. 2-4 for equivalent sphere (73% good agreement and 85% agreement), cylinder (74% good agreement and 85% agreement), and for the near add (62% good agreement and 81% agreement). Despite the consideration of visual acuity and perhaps other factors (such as the difference between a convex and concave lens difference of the same magnitude), the criteria seem based mainly on power differences.

Table 3 shows the mean differences between the manual and computer results for spherical equivalent, cylinder vector, and add. This shows any systematic error that would not be evident in the cumulative frequencies of Figs. 2-4.

It can be seen that eliminating the sources of error described should make it possible to approach a 95% satisfactory operation. It should also be noted that of the potential 5% unsatisfactory results, most of these would be identifiable either because

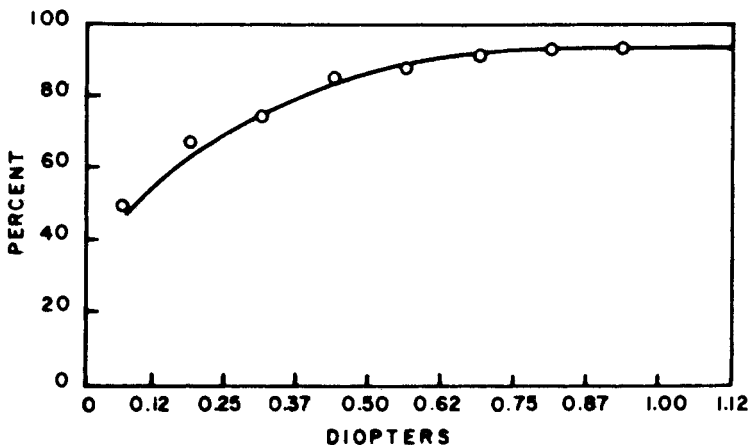


FIG. 2. Cumulative percentage of spherical equivalent power differences between manual and computer-generated prescriptions for each of the 160 eyes.

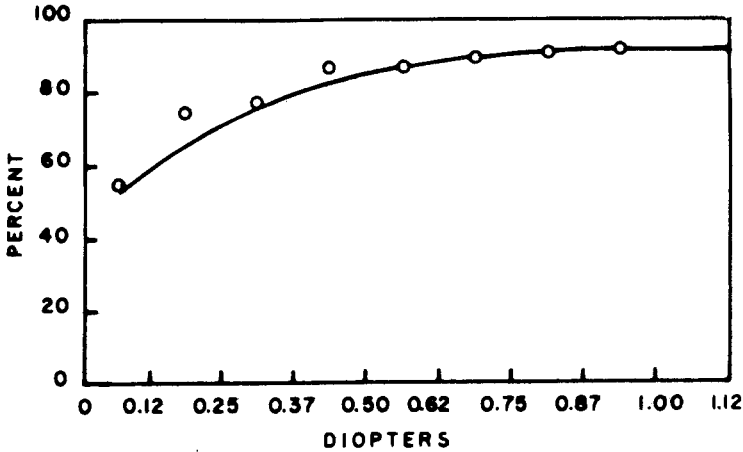


FIG. 3. Cumulative percentage of cylinder power differences between manual and computer-generated prescriptions for each of the 160 eyes.

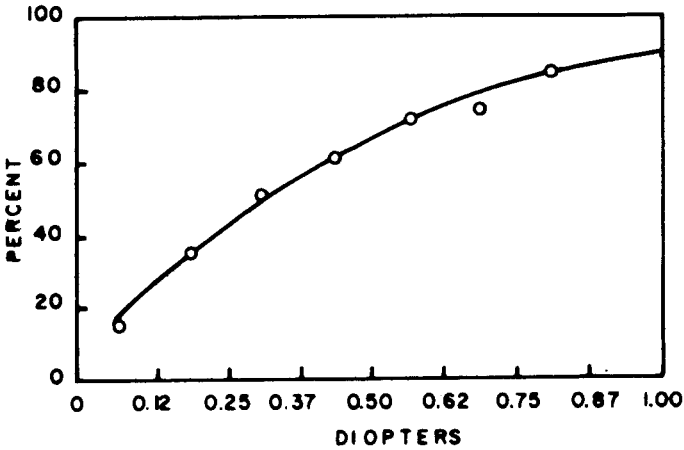


FIG. 4. Cumulative percentage of near add differences between manual and computer-generated prescriptions for 36 patients.

TABLE 3. Mean refractive measures obtained with computer and manual subjective methods. Differences in means are also tabulated.

|                   | Computer | Manual | Difference |
|-------------------|----------|--------|------------|
| Equivalent sphere | -0.74    | -0.83  | 0.09       |
| Cylinder vector   | —        | —      | 0.17       |
| Add               | +1.77    | +1.87  | 0.10       |

the system does not operate at all, providing no suggested prescription, or because the doctor in charge reviews the records and finds the results inconsistent.

All the errors described above in hardware and in software or flow charting have been, so far as possible, eliminated or minimized. Elimination of axis chatter and room-temperature problems, for example,

requires major changes in the hardware. It is expected that the microprocessor interface control currently under design and construction will substantially correct these problems. In addition, microprocessor control will speed up the testing considerably, since it is estimated that it will increase the speed of Refractor III itself.

Other improvements in the flow charts will also increase the speed of operation. One particular example is the programming of reaction time in order to present the option of a faster pace to those patients who can respond more quickly. Other improvements in speed can come from the substitution of a dual flexible-disc storage system in place of the DEC tapes. The additional speed of access to mass storage

will eliminate current delays that occur while the patient awaits the spinning of the digital magnetic-tape reels.

**DISCUSSION**

It should be emphasized that the errors we uncovered occur for a relatively small percentage of the patients. However, since it is important that our system be improved to a level of about 95% satisfactory response, the failures are emphasized and discussed while the successes are not mentioned.

Now that most of the errors in the previous tests have been identified and corrected, we are embarking on a test of another series of patients to demonstrate the potential percentage of satisfactory results under clinical operating conditions. If this rate approaches 95%, as we expect, then, we believe, this system will be satisfactory for routine clinical use.

If this level of satisfactory operation is achieved, one might still ask what will happen to the 5% of patients who get no satisfactory prescription from the system. The inaccurate prescriptions of those having fundamental difficulties with the system should be obvious to the reviewing clinician, as will faulty results caused by any general or major system failure. These occurrences are undesirable economically, but from a health-service viewpoint easily identified and corrected manually. The only question remains in the case where the results are not satisfactory but difficult for the doctor in charge to evaluate as such. Errors in prescriptions do no irreversible harm. They may produce unsatisfactory acuity or discomfort but do no physiological damage (except perhaps in infants, who are not examined by this method<sup>2,3</sup>). In our next series of tests we will pay particular

attention to this question by comparing the computer-aided clinician's prescription with that of the nonaided clinician. The total system we are testing is the clinician aided by the Refractor III system, not the latter alone. This total system is expected to provide as satisfactory a level of service as the unaided clinician but at markedly reduced cost<sup>4</sup> and increased access.<sup>5</sup>

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**APPENDIX**

**Ratings**

G = good agreement  
U = unsatisfactory

A = agreement  
/ = ratings for distance/near

|                                 |          |        |              |          |
|---------------------------------|----------|--------|--------------|----------|
| Date: 1976/1977                 | I.D. No. |        |              |          |
| 1. August 23                    | 1389     | Age 22 | Sex M        | Rating G |
| Computer-suggested Rx           |          |        | Clinician Rx |          |
| RE +0.12 DS                     |          | 20/15  | -0.25 DS     | 20/15    |
| LE -0.50 DS                     |          | 20/15  | -0.25 DS     | 20/15    |
| <i>Remarks: Good agreement.</i> |          |        |              |          |

2. August 20 0001 Age 15 Sex M Rating U  
 Computer-suggested Rx  
 RE -5.75 = -1.25x14  
 LE -5.87 = -1.00x2  
 Add +3.87 DS  
*Remarks:* Undetermined reason for breakdown and software error. Patient could not differentiate between 0.25 DS steps.
3. August 26 1058 Age 25 Sex M Rating G  
 Computer-suggested Rx  
 RE -5.75 = -1.25x14  
 LE -5.87 = -1.00x2  
 Add +3.87 DS  
*Remarks:* Good agreement. Suggested Rx in left eye has slightly more plus but equivalent acuity to that of clinician.
4. August 26 5187 Age 55 Sex F Rating G/U  
 Computer-suggested Rx  
 RE +1.75 DS  
 LE +1.50 DS  
 Add +3.87 DS  
*Remarks:* Near add is unsatisfactory because of software error.
5. August 30 7459 Age 22 Sex M Rating G  
 Computer-suggested Rx  
 RE -0.50 = -1.00x100  
 LE -0.25 = -0.50x72  
 Add +2.12 DS  
*Remarks:* Good agreement.
6. August 30 9590 Age 60 Sex M Rating G/G  
 Computer-suggested Rx  
 RE +1.00 = -0.50x68  
 LE +1.75 = -1.25x102  
 Add +2.12 DS  
*Remarks:* Good agreement.
7. September 1 9461 Age 24 Sex M Rating G  
 Computer-suggested Rx  
 RE -2.62 = -1.00x180  
 LE -1.50 = -0.50x161  
 Add +2.37 DS  
*Remarks:* Good agreement. Suggested Rx shows slightly more convex lens, but the acuities appear to support it.
8. September 1 8559 Age 15 Sex F Rating G  
 Computer-suggested Rx  
 RE -4.87 = -0.50x7  
 LE -4.50 = -0.50x12  
 Add +2.37 DS  
*Remarks:* Good agreement.
9. September 2 0019 Age 57 Sex M Rating G/G  
 Computer-suggested Rx  
 RE +1.25 = -0.50x75  
 LE +1.12 = -0.75x89  
 Add +2.37 DS  
*Remarks:* Good agreement. Suggested add is slightly high as working distance is greater than test distance.
10. September 2 2538 Age 46 Sex M Rating G/U  
 Computer-suggested Rx  
 RE -1.00 = -3.25x9  
 LE -3.00 = -2.00x180  
 Add plano  
*Remarks:* Software error, no add suggested when indicated.
11. September 2 5301 Age 57 Sex M Rating A/A  
 Computer-suggested Rx  
 RE Plano  
 LE Plano  
 Add +2.62 DS  
*Remarks:* Patient was hesitant and at times unsure of instructions in spite of repeated explanations. Computer selected Rx with lower acuities. Partial fundamental and software errors involved.

|   |                   |      |        |                   |            |
|---|-------------------|------|--------|-------------------|------------|
| 12.   | September 7       | 2765 | Age 36 | Sex M             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -1.75 = -0.50x36  |      | 20/15  | -1.75 = -0.50x36  | 20/15      |
| LE  | -2.25 DS          |      | 20/15  | -2.25 DS          | 20/15      |
| <i>Remarks:</i> Good agreement.   |                   |      |        |                   |            |
| 13.   | September 9       | 0002 | Age 15 | Sex F             | Rating A   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | plano             |      | 20/20  | Plano = -0.50x10  | 20/20      |
| LE  | plano             |      | 20/25  | Plano = -0.50x7   | 20/15      |
| <i>Remarks:</i> Software error; computer failed to select Rx with better acuity.  |                   |      |        |                   |            |
| 14.   | September 9       | 0003 | Age 14 | Sex M             | Rating U   |
| <i>Remarks:</i> Test was terminated because of fundamental errors. Also software errors were in evidence, patient could not differentiate between +/-0.25 D steps. Hardware errors—no coordination between message played and slide displayed.        |                   |      |        |                   |            |
| 15.   | September 7       | 9720 | Age 17 | Sex M             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -3.12 = -0.75x7   |      | 20/15  | -3.12 = -0.75x7   | 20/15      |
| LE  | -3.00 = -0.25x180 |      | 20/15  | -3.00 = -0.75x174 | 20/20      |
| <i>Remarks:</i> Good agreement. Suggested Rx has lower cylindrical power but better acuity in left eye.   |                   |      |        |                   |            |
| 16.   | September 13      | 7849 | Age 69 | Sex M             | Rating G/G |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | +1.25 = -0.50x93  |      | 20/60  | +1.25 = -0.50x93  | 20/60      |
| LE  | +1.00 = -0.75x91  |      | 20/60  | +1.00 = -0.75x91  | 20/60      |
| Add   | +2.25 DS          |      |        | Add +2.25 DS      |            |
| <i>Remarks:</i> Patient had cataracts. Hardware errors—patient pushed the button down too long during acuity tests. As a result, suggested Rx was identical to objective result. Note that the clinician used the same finding for identical results. |                   |      |        |                   |            |
| 17.   | September 13      | 4469 | Age 22 | Sex M             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | +1.00 = -0.50x102 |      | 20/20  | +0.75 = -0.50x120 | 20/15      |
| LE  | +1.25 = -0.75x60  |      | 20/15  | +1.25 = -0.75x60  | 20/15      |
| <i>Remarks:</i> Good agreement. Software error—Rx with best acuity not suggested.   |                   |      |        |                   |            |
| 18.   | September 13      | 6894 | Age 57 | Sex M             | Rating A/G |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -0.37 DS          |      | 20/40  | +0.25 = -0.25x82  | 20/30      |
| LE  | +0.50 = -0.25x171 |      | 20/20  | +0.50 = -0.25x171 | 20/20      |
| Add   | +2.12 DS          |      |        | Add +2.00 DS      |            |
| <i>Remarks:</i> Software error—suggested Rx has more concave lens but lower acuity.   |                   |      |        |                   |            |
| 19.   | September 14      | 0008 | Age 54 | Sex F             | Rating A/U |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | +2.37 = -1.25x7   |      | 20/25  | +2.50 = -0.50x171 | 20/30      |
| LE  | +2.50 DS          |      | 20/25  | +2.50 DS          | 20/25      |
| Add   | +3.62 DS          |      |        | Add +1.25 DS      |            |
| <i>Remarks:</i> Software error—over-plused in add.  |                   |      |        |                   |            |
| 20.   | September 14      | 8012 | Age 21 | Sex M             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -4.00 = -0.25x100 |      | 20/20  | -4.00 = -0.25x100 | 20/20      |
| LE  | -3.37 = -0.50x95  |      | 20/20  | -4.00 = -0.75x95  | 20/20      |
| <i>Remarks:</i> Good agreement. Left VA is acceptable with suggested Rx in spite of less concave lens.  |                   |      |        |                   |            |
| 21.   | September 16      | 0004 | Age 30 | Sex M             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | plano             |      | 20/15  | Plano             | 20/15      |
| LE  | plano             |      | 20/15  | Plano             | 20/15      |
| <i>Remarks:</i> Good agreement.   |                   |      |        |                   |            |

|   |                   |      |        |                   |            |
|---|-------------------|------|--------|-------------------|------------|
| 22.   | September 21      | 3865 | Age 47 | Sex M             | Rating G/G |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -4.37 = -1.00x106 |      | 20/20  | -5.00 = -0.75x110 | 20/20      |
| LE  | -4.75 = -0.75x72  |      | 20/20  | -4.50 = -0.75x65  | 20/20      |
| Add   | +1.87 DS          |      |        | Add +1.50 DS      |            |
| <i>Remarks:</i> Good agreement.   |                   |      |        |                   |            |
| 23.   | September 21      | 2099 | Age 21 | Sex M             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -0.87 DS          |      | 20/15  | -0.75 DS          | 20/20      |
| LE  | -0.75 = -0.25x84  |      | 20/15  | -0.50 DS          | 20/15      |
| <i>Remarks:</i> Good agreement.   |                   |      |        |                   |            |
| 24.   | September 24      | 9453 | Age 24 | Sex M             | Rating A   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | +0.12 DS          |      | 20/400 | Plano             | 20/20      |
| LE  | +0.37 DS          |      | 20/15  | Plano             | 20/15      |
| <i>Remarks:</i> Software error—patient could not differentiate between +/-0.25 D steps. Hardware error also, acuities inaccurate as button on response box was kept depressed too long. |                   |      |        |                   |            |
| 25.   | September 20      | 0005 | Age 33 | Sex M             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | +5.00 = -2.00x71  |      | 20/25  | +5.25 = -2.00x75  | 20/25      |
| LE  | +4.37 = -1.50x102 |      | 20/25  | +4.75 = -1.25x95  | 20/25      |
| <i>Remarks:</i> Software error—suggested Rx has less convex lens despite identical acuities.  |                   |      |        |                   |            |
| 26.   | September 20      | 0006 | Age 18 | Sex M             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -1.62 DS          |      | 20/15  | -1.50 DS          | 20/15      |
| LE  | -1.62 DS          |      | 20/15  | -1.50 DS          | 20/15      |
| <i>Remarks:</i> Good agreement.   |                   |      |        |                   |            |
| 27.   | September 27      | 4829 | Age 62 | Sex F             | Rating U   |
| <i>Remarks:</i> Hardware error—test terminated due to axis chatter.   |                   |      |        |                   |            |
| 28.   | September 27      | 2717 | Age 57 | Sex M             | Rating A/G |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -2.50 DS          |      | 20/400 | -3.00 DS          | 20/40      |
| LE  | -3.62 DS          |      | 20/400 | -3.25 = -0.75x75  | 20/40      |
| Add   | +2.50 DS          |      |        | Add +3.00 DS      |            |
| <i>Remarks:</i> Hardware error—acuities inaccurate, button depressed too long. Add shows good agreement.  |                   |      |        |                   |            |
| 29.   | September 28      | 0007 | Age 21 | Sex M             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -1.25 DS          |      | 20/15  | -1.50 DS          | 20/15      |
| LE  | -1.25 = -0.25x165 |      | 20/15  | -1.75 = -0.25x165 | 20/15      |
| <i>Remarks:</i> Good agreement. Suggested Rx has less concave lens but acuities are identical.  |                   |      |        |                   |            |
| 30.   | October 15        | 5451 | Age 27 | Sex M             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | +0.37             |      | 20/15  | Plano = -0.25x91  | 20/15      |
| LE  | plano             |      | 20/15  | Plano = -0.25x40  | 20/15      |
| <i>Remarks:</i> Good agreement.   |                   |      |        |                   |            |
| 31.   | October 15        | 0008 | Age 60 | Sex M             | Rating A/G |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | plano             |      | 20/25  | -0.75 DS          | 20/20      |
| LE  | plano             |      | 20/25  | Plano = -1.00x180 | 20/20      |
| Add   | +1.87 DS          |      |        | Add +2.25 DS      |            |
| <i>Remarks:</i> Hardware error—patient depressed button too long during acuity check. However, suggested Rx is acceptable.  |                   |      |        |                   |            |

|   |             |      |        |                   |            |
|---|-------------|------|--------|-------------------|------------|
| 32.   | October 18  | 0131 | Age 70 | Sex M             | Rating G/U |
| Computer-suggested Rx   |             |      |        | Clinician Rx      |            |
| RE -3.87 = -1.25x47   |             |      | 20/30  | -4.25 = -1.00x60  | 20/30      |
| LE -4.25 = -1.00x106  |             |      | 20/30  | -4.25 = -1.00x105 | 20/30      |
| Add +1.62 DS  |             |      |        | Add +2.50 DS      |            |
| <i>Remarks:</i> Distance Rx is acceptable but near add is not. Software error in near flow chart.   |             |      |        |                   |            |
| 33.   | October 18  | 8950 | Age 28 | Sex F             | Rating G   |
| Computer-suggested Rx   |             |      |        | Clinician Rx      |            |
| RE -0.62 DS   |             |      | 20/15  | -0.50 DS          | 20/20      |
| LE -0.50 = -0.25x89   |             |      | 20/25  | -0.75 DS          | 20/25      |
| <i>Remarks:</i> Good agreement. Patient has slight amblyopia in left eye. The patient also had some difficulty differentiating +/-0.25 DS steps.    |             |      |        |                   |            |
| 34.   | November 1  | 0009 | Age 24 | Sex F             | Rating G   |
| Computer-suggested Rx   |             |      |        | Clinician Rx      |            |
| RE -3.75 = -0.25x24   |             |      | 20/15  | -3.75 = -0.25x24  | 20/15      |
| LE -4.37 DS   |             |      | 20/15  | -4.50 = -0.25x105 | 20/20      |
| <i>Remarks:</i> Good agreement.   |             |      |        |                   |            |
| 35.   | November 1  | 0010 | Age 46 | Sex F             | Rating U   |
| <i>Remarks:</i> Test was terminated as a result of a complete breakdown, probably from both hardware and software errors.                           |             |      |        |                   |            |
| 36.   | November 8  | 0011 | Age 64 | Sex M             | Rating G/G |
| Computer-suggested Rx   |             |      |        | Clinician Rx      |            |
| RE +3.00 = -0.75x172  |             |      | 20/15  | +3.00 = -1.25x165 | 20/25      |
| LE +2.75 = -0.50x180  |             |      | 20/25  | +2.75 = -0.50x179 | 20/25      |
| Add +2.62 DS  |             |      |        | Add +2.00 DS      |            |
| <i>Remarks:</i> Good agreement. Suggested add appears to be on the high side because the clinician add was adjusted for a greater working distance. |             |      |        |                   |            |
| 37.   | November 8  | 1043 | Age 74 | Sex F             | Rating G/G |
| Computer-suggested Rx   |             |      |        | Clinician Rx      |            |
| RE +2.25 = -1.00x110  |             |      | 20/40  | +2.25 = -1.00x110 | 20/40      |
| LE +3.25 = -1.50x81   |             |      | 20/30  | +3.25 = -1.50x80  | 20/30      |
| Add +2.75 DS  |             |      |        | Add +2.25 DS      |            |
| <i>Remarks:</i> Good agreement. Suggested near add has slightly more plus.  |             |      |        |                   |            |
| 38.   | November 8  | 0928 | Age 54 | Sex M             | Rating G/G |
| Computer-suggested Rx   |             |      |        | Clinician Rx      |            |
| RE -0.62 DS   |             |      | 20/15  | -1.00 DS          | 20/15      |
| LE -1.87 DS   |             |      | 20/15  | -1.75 DS          | 20/20      |
| Add +1.87 DS  |             |      |        | Add +1.50 DS      |            |
| <i>Remarks:</i> Good agreement.   |             |      |        |                   |            |
| 39.   | November 8  | 0012 | Age 10 | Sex M             | Rating G   |
| Computer-suggested Rx   |             |      |        | Clinician Rx      |            |
| RE -0.12 DS   |             |      | 20/15  | Plano             | 20/20      |
| LE -1.50 = -1.25x60   |             |      | 20/15  | -1.50 = -1.25x60  | 20/15      |
| <i>Remarks:</i> Good agreement.   |             |      |        |                   |            |
| 40.   | November 15 | 7718 | Age 27 | Sex M             | Rating G   |
| Computer-suggested Rx   |             |      |        | Clinician Rx      |            |
| RE -2.50 = -1.25x115  |             |      | 20/20  | -2.75 = -1.25x110 | 20/40      |
| LE -1.50 = -1.25x60   |             |      | 20/15  | -1.50 = -1.25x60  | 20/15      |
| <i>Remarks:</i> Good agreement. Minor hardware error (axis chatter).  |             |      |        |                   |            |
| 41.   | November 15 | 0455 | Age 25 | Sex F             | Rating U   |
| <i>Remarks:</i> System failure. Patient pushed "repeat message" button inadvertently several times; software error.                                 |             |      |        |                   |            |

|   |                   |      |        |                   |            |
|---|-------------------|------|--------|-------------------|------------|
| 42.   | November 15       | 3163 | Age 25 | Sex F             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -2.62 DS          |      | 20/25  | -3.00 DS          | 20/25      |
| LE  | -3.50 DS          |      | 20/25  | -3.50 DS          | 20/25      |
| <i>Remarks:</i> Good agreement.   |                   |      |        |                   |            |
| 43.   | November 29       | 2594 | Age 24 | Sex F             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -3.50 DS          |      | 20/20  | -3.50 DS          | 20/20      |
| LE  | -3.50 = -0.25x44  |      | 20/20  | -3.50 DS          | 20/25      |
| <i>Remarks:</i> Good agreement.   |                   |      |        |                   |            |
| 44.   | November 29       | 2603 | Age 44 | Sex M             | Rating G/G |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | +0.62 = -0.25x86  |      | 20/15  | +0.25 = -0.50x85  | 20/15      |
| LE  | +0.75 = -0.75x96  |      | 20/15  | +0.50 = -1.25x100 | 20/15      |
| Add   | +1.87 DS          |      |        | Add +2.25 DS      |            |
| <i>Remarks:</i> Good agreement.   |                   |      |        |                   |            |
| 45.   | December 9        | 0013 | Age 56 | Sex M             | Rating G/G |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | +1.00 DS          |      | 20/25  | +1.00 DS          | 20/25      |
| LE  | +0.75 DS          |      | 20/20  | +0.75 DS          | 20/20      |
| Add   | +2.50 DS          |      |        | Add +2.25 DS      |            |
| <i>Remarks:</i> Good agreement.   |                   |      |        |                   |            |
| 46.   | December 13       | 4101 | Age 44 | Sex M             | Rating G/G |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | +1.00 = -0.25x170 |      | 20/20  | +1.00 DS          | 20/20      |
| LE  | +0.62 DS          |      | 20/20  | +0.50 DS          | 20/20      |
| Add   | +1.25             |      |        | Add +1.00 DS      |            |
| <i>Remarks:</i> Good agreement. Suggested near add is slightly high for the patient's age but compares well with the clinician Rx. Minor software error—patient had some difficulty differentiating between +/-0.25 DS steps. |                   |      |        |                   |            |
| 47.   | December 13       | 5451 | Age 20 | Sex F             | Rating A   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -0.50 = -0.25x180 |      | 20/15  | -0.50 = -0.25x180 | 20/15      |
| LE  | plano             |      | 20/20  | -0.25 = -0.50x170 | 20/20      |
| <i>Remarks:</i> Suggested Rx for left eye is acceptable in view of the good visual acuity.  |                   |      |        |                   |            |
| 48.   | December 22       | 4862 | Age 62 | Sex M             | Rating U   |
| <i>Remarks:</i> Fundamental error—short attention span. The patient had difficulty concentrating.   |                   |      |        |                   |            |
| 49.   | December 22       | 1340 | Age 20 | Sex M             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | plano             |      | 20/15  | Plano             | 20/15      |
| LE  | plano             |      | 20/15  | Plano             | 20/15      |
| <i>Remarks:</i> Good agreement. Patient inadvertently pushed "repeat message" button several times—spontaneous recovery.  |                   |      |        |                   |            |
| 50.   | December 22       | 4474 | Age 19 | Sex M             | Rating G   |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | -3.50 DS          |      | 20/25  | -3.25 DS          | 20/20      |
| LE  | -3.75 = -0.50x75  |      | 20/20  | -3.75 = -0.50x75  | 20/20      |
| <i>Remarks:</i> Good agreement. Software error—slightly more concave lens with lower acuity suggested in right eye.   |                   |      |        |                   |            |
| 51.   | December 29       | 9461 | Age 65 | Sex M             | Rating A/U |
| Computer-suggested Rx   |                   |      |        |                   |            |
| RE  | +2.25 DS          |      | 20/30  | +2.00 DS          | 20/20      |
| LE  | +2.50 = -0.75x74  |      | 20/25  | +1.25 = -0.75x70  | 20/20      |
| Add   | +1.37 DS          |      |        | Add +2.50 DS      |            |
| <i>Remarks:</i> On the basis of the LE acuity, the suggested Rx is probably useful.   |                   |      |        |                   |            |

|  |                   |      |        |              |                         |
|--|-------------------|------|--------|--------------|-------------------------|
| 52.  | December 29       | 0015 | Age 54 | Sex F        | Rating G/G              |
| Computer-suggested Rx  |                   |      |        |              |                         |
| RE   | +1.00 DS          |      | 20/20  | Clinician Rx | +1.00 DS 20/20          |
| LE   | +0.75 DS          |      | 20/20  |              | +0.75 DS 20/20          |
| Add  | +2.12 DS          |      |        | Add          | +1.75 DS                |
| <i>Remarks:</i> Good agreement.  |                   |      |        |              |                         |
| 53.  | December 29       | 2473 | Age 62 | Sex M        | Rating A/A              |
| Computer-suggested Rx  |                   |      |        |              |                         |
| RE   | plano             |      | 20/20  | Clinician Rx | +1.00 = -0.50x85 20/25  |
| LE   | +2.00 = -1.00x85  |      | 20/20  |              | +2.00 = -1.00x85 20/20  |
| Add  | +2.62 DS          |      |        | Add          | +1.75 DS                |
| <i>Remarks:</i> Agreement for both far and near tests.   |                   |      |        |              |                         |
| 54.  | December 29       | 3025 | Age 16 | Sex F        | Rating G                |
| Computer-suggested Rx  |                   |      |        |              |                         |
| RE   | +0.37 DS          |      | 20/15  | Clinician Rx | Plano 20/20             |
| LE   | +0.37 DS          |      | 20/15  |              | Plano 20/15             |
| <i>Remarks:</i> Good agreement.  |                   |      |        |              |                         |
| 55.  | December 29       | 5424 | Age 25 | Sex M        | Rating G                |
| Computer-suggested Rx  |                   |      |        |              |                         |
| RE   | -2.12 = -1.75x41  |      | 20/25  | Clinician Rx | -2.25 = -1.00x45 20/30  |
| LE   | -1.75 = -1.25x151 |      | 20/15  |              | -1.75 = -1.25x150 20/15 |
| <i>Remarks:</i> Good agreement.  |                   |      |        |              |                         |
| 56.  | December 30       | 2742 | Age 75 | Sex M        | Rating G/G              |
| Computer-suggested Rx  |                   |      |        |              |                         |
| RE   | +1.50 = -1.25x65  |      | 20/60  | Clinician Rx | +1.50 = -1.25x65 20/60  |
| LE   | plano             |      | 20/30  |              | +1.00 = -1.00x110 20/50 |
| Add  | +2.50 DS          |      |        | Add          | +3.00 DS                |
| <i>Remarks:</i> Refraction difficult because of hypertensive and diabetic retinopathy. Minor hardware error—"repeat" button pushed inadvertently several times. Because of retinopathy, the patient is less discriminating of differences in lens power. |                   |      |        |              |                         |
| 57.  | January 3         | 5377 | Age 67 | Sex F        | Rating G/U              |
| Computer-suggested Rx  |                   |      |        |              |                         |
| RE   | +1.25 = -0.25x84  |      | 20/20  | Clinician Rx | +1.50 = -0.75x85 20/20  |
| LE   | +1.12 = -0.50x117 |      | 20/20  |              | +0.75 = -0.75x110 20/20 |
| Add  | +1.50 DS          |      |        | Add          | +2.50 DS                |
| <i>Remarks:</i> Near add is unsatisfactory due to fundamental error. Patient had some confusion regarding the near tests.  |                   |      |        |              |                         |
| 58.  | January 3         | 3485 | Age 45 | Sex M        | Rating G/U              |
| Computer-suggested Rx  |                   |      |        |              |                         |
| RE   | +0.37 = -0.50x19  |      | 20/15  | Clinician Rx | Plano = -0.25x40 20/20  |
| LE   | plano             |      | 20/15  |              | Plano = -0.50x177 20/15 |
| Add  | +0.37 DS          |      |        | Add          | +1.25 DS                |
| <i>Remarks:</i> Software error during NRA/PRA test for the near add.   |                   |      |        |              |                         |
| 59.  | January 3         | 2167 | Age 70 | Sex F        | Rating G/G              |
| Computer-suggested Rx  |                   |      |        |              |                         |
| RE   | +1.25 = -1.00x62  |      | 20/25  | Clinician Rx | +1.25 = -1.00x62 20/25  |
| LE   | plano             |      | 20/15  |              | +0.25 = -0.50x105 20/15 |
| Add  | +2.50 DS          |      |        | Add          | +2.50 DS                |
| <i>Remarks:</i> Good agreement. Minor hardware error—axis chatter, also center button pushed inadvertently. Both had spontaneous recovery.   |                   |      |        |              |                         |
| 60.  | January 4         | 0016 | Age 26 | Sex M        | Rating G                |
| Computer-suggested Rx  |                   |      |        |              |                         |
| RE   | +0.50 = -0.25x67  |      | 20/15  | Clinician Rx | +0.25 = -0.50x65 20/15  |
| LE   | plano             |      | 20/15  |              | +0.25 = -0.25x107 20/15 |
| <i>Remarks:</i> Good agreement. Patient had some difficulty differentiating 0.25 steps.  |                   |      |        |              |                         |

|   |            |      |        |                   |            |
|---|------------|------|--------|-------------------|------------|
| 61.   | January 4  | 0017 | Age 18 | Sex M             | Rating U   |
| Computer-suggested Rx   |            |      |        | Clinician Rx      |            |
| RE plano  |            |      | 20/15  | +0.25 = -0.50x102 | 20/15      |
| LE +1.12 DS   |            |      | 20/15  | +0.75 DS          | 20/15      |
| <i>Remarks:</i> Suggested Rx over-plused in LE. Software error—fogging began before acuities were taken. Confused depressing of "repeat" button.                          |            |      |        |                   |            |
| 62.   | January 5  | 8767 | Age 54 | Sex M             | Rating G/G |
| Computer-suggested Rx   |            |      |        | Clinician Rx      |            |
| RE +2.12 DS   |            |      | 20/20  | +2.00 DS          | 20/20      |
| LE +3.00 = -0.25x109  |            |      | 20/15  | +2.25 = -0.25x163 | 20/20      |
| Add +2.12 DS  |            |      |        | Add +2.25 DS      |            |
| <i>Remarks:</i> Good agreement. Cylinder axis for left eye is significantly different, perhaps because the patient may not require any cylinder at all.                   |            |      |        |                   |            |
| 63.   | January 5  | 0018 | Age 42 | Sex F             | Rating G/G |
| Computer-suggested Rx   |            |      |        | Clinician Rx      |            |
| RE +0.87 DS   |            |      | 20/15  | +1.00 DS          | 20/20      |
| LE +1.37 DS   |            |      | 20/20  | +1.25 DS          | 20/15      |
| Add +0.62 DS  |            |      |        | Add +0.50 DS      |            |
| <i>Remarks:</i> Good agreement.   |            |      |        |                   |            |
| 64.   | January 5  | 0019 | Age 68 | Sex F             | Rating A/A |
| Computer-suggested Rx   |            |      |        | Clinician Rx      |            |
| RE +1.00 = -0.50x175  |            |      | 20/25  | +1.25 DS          | 20/20      |
| LE +0.75 = -0.75x20   |            |      | 20/20  | +1.25 = -0.50x20  | 20/20      |
| Add +1.87 DS  |            |      |        | Add +2.50 DS      |            |
| <i>Remarks:</i> Patient may have been slightly over-minused for the suggested Rx. Near add affected by distance results.  |            |      |        |                   |            |
| 65.   | January 5  | 0020 | Age 51 | Sex F             | Rating G/G |
| Computer-suggested Rx   |            |      |        | Clinician Rx      |            |
| RE plano  |            |      | 20/15  | Plano             | 20/15      |
| LE plano  |            |      | 20/15  | Plano             | 20/15      |
| Add +2.00 DS  |            |      |        | Add +2.25 DS      |            |
| <i>Remarks:</i> Good agreement.   |            |      |        |                   |            |
| 66.   | January 10 | 0021 | Age 20 | Sex M             | Rating G   |
| Computer-suggested Rx   |            |      |        | Clinician Rx      |            |
| RE -2.25 = -1.50x103  |            |      | 20/20  | -2.25 = -1.25x113 | 20/20      |
| LE -1.75 = -1.75x74   |            |      | 20/15  | -2.00 = -1.75x68  | 20/20      |
| <i>Remarks:</i> Good agreement.   |            |      |        |                   |            |
| 67.   | January 10 | 8003 | Age 41 | Sex M             | Rating G/G |
| Computer-suggested Rx   |            |      |        | Clinician Rx      |            |
| RE -0.25 = -1.25x10   |            |      | 20/20  | Plano = -1.25x12  | 20/20      |
| LE +0.75 = -1.25x13   |            |      | 20/20  | +0.75 = -1.25x12  | 20/20      |
| Add +0.87 DS  |            |      |        | Add plano         |            |
| <i>Remarks:</i> Patient apparently not in need of an add, however, all persons age 40 and above are tested at near.   |            |      |        |                   |            |
| 68.   | January 13 | 0022 | Age 43 | Sex F             | Rating U   |
| Computer-suggested Rx   |            |      |        | Clinician Rx      |            |
| RE none   |            |      |        | +1.50 DS          | 20/20      |
| LE none   |            |      |        | +1.25 DS          | 20/20      |
| Add none  |            |      |        | Add +2.00 DS      |            |
| <i>Remarks:</i> Fundamental error—examination was terminated as patient was not able to respond correctly in spite of assistance. Patient also had a language difficulty. |            |      |        |                   |            |
| 69.   | January 13 | 5627 | Age 55 | Sex F             | Rating G/G |
| Computer-suggested Rx   |            |      |        | Clinician Rx      |            |
| RE -1.00 DS   |            |      | 20/20  | -1.75 DS          | 20/20      |
| LE -0.75 = -0.25x109  |            |      | 20/20  | -1.25 = -0.50x103 | 20/20      |
| Add +1.50 DS  |            |      |        | Add +1.75 DS      |            |
| <i>Remarks:</i> Good agreement, considering that clinician's Rx appears to be more concave lens-biased since the suggested Rx showed good acuity with less minus lens.    |            |      |        |                   |            |

|  |                   |      |        |                   |            |
|--|-------------------|------|--------|-------------------|------------|
| 70.  | January 13        | 6381 | Age 51 | Sex M             | Rating G/G |
| Computer-suggested Rx  |                   |      |        | Clinician Rx      |            |
| RE   | +0.75 DS          |      | 20/20  | +0.62 = -0.25x75  | 20/20      |
| LE   | +0.50 DS          |      | 20/20  | +0.75 = -0.25x75  | 20/20      |
| Add  | +0.50 DS          |      |        | Add +0.50 DS      |            |
| <i>Remarks: Good agreement.</i>  |                   |      |        |                   |            |
| 71.  | January 17        | 0023 | Age 22 | Sex M             | Rating U   |
| Computer-suggested Rx  |                   |      |        | Clinician Rx      |            |
| RE   | -5.62 DS          |      | 20/50  | -6.25 = -0.50x166 | 20/15      |
| LE   | -7.25 = -0.25x14  |      | 20/15  | -5.50 = -0.50x5   | 20/15      |
| <i>Remarks: Unsatisfactory results. Hardware error caused by room temperature above 80 deg Fahrenheit.</i>   |                   |      |        |                   |            |
| 72.  | January 17        | 0024 | Age 22 | Sex F             | Rating G   |
| Computer-suggested Rx  |                   |      |        | Clinician Rx      |            |
| RE   | -2.75 = -0.75x95  |      | 20/20  | -2.75 = -0.75x95  | 20/20      |
| LE   | -3.37 = -0.25x180 |      | 20/20  | -3.25 DS          | 20/20      |
| <i>Remarks: Good agreement. Hardware error—patient kept button down several times during visual acuity check but there was spontaneous recovery.</i> |                   |      |        |                   |            |
| 73.  | January 20        | 7917 | Age 23 | Sex M             | Rating G   |
| Computer-suggested Rx  |                   |      |        | Clinician Rx      |            |
| RE   | -3.87 = -1.00x19  |      | 20/15  | -3.75 = -1.00x16  | 20/15      |
| LE   | -4.12 = -0.50x69  |      | 20/15  | -4.00 = -0.50x15  | 20/15      |
| <i>Remarks: Good agreement because of good acuity despite axis difference in the left eye.</i>   |                   |      |        |                   |            |
| 74.  | January 20        | 7461 | Age 59 | Sex M             | Rating G/U |
| Computer-suggested Rx  |                   |      |        | Clinician Rx      |            |
| RE   | +1.75 = -0.25x148 |      | 20/15  | +1.25 DS          | 20/25      |
| LE   | +1.12 = -0.50x41  |      | 20/20  | +0.75 = -0.75x35  | 20/20      |
| Add  | +1.37 DS          |      |        | Add +2.50 DS      |            |
| <i>Remarks: Software error—near test was inaccurate. Minor hardware error—patient kept button down too long during visual acuity check.</i>          |                   |      |        |                   |            |
| 75.  | January 24        | 3312 | Age 71 | Sex M             | Rating G/A |
| Computer-suggested Rx  |                   |      |        | Clinician Rx      |            |
| RE   | +0.75 = -1.25x6   |      | 20/20  | +0.75 = -1.25x5   | 20/20      |
| LE   | +0.50 = -1.25x21  |      | 20/20  | +0.75 = -1.00x15  | 20/20      |
| Add  | +3.12 DS          |      |        | Add +2.50 DS      |            |
| <i>Remarks: Software error—inaccurate near test.</i>   |                   |      |        |                   |            |
| 76.  | January 24        | 4101 | Age 18 | Sex M             | Rating G   |
| Computer-suggested Rx  |                   |      |        | Clinician Rx      |            |
| RE   | -3.00 DS          |      | 20/15  | -3.25 DS          | 20/15      |
| LE   | -2.50 DS          |      | 20/15  | -2.50 DS          | 20/15      |
| <i>Remarks: Good agreement.</i>  |                   |      |        |                   |            |
| 77.  | January 27        | 8398 | Age 56 | Sex F             | Rating G/G |
| Computer-suggested Rx  |                   |      |        | Clinician Rx      |            |
| RE   | +1.25 = -1.00x171 |      | 20/15  | +1.00 = -1.00x165 | 20/20      |
| LE   | +1.00 = -1.00x1   |      | 20/20  | +1.25 = 1.00x10   | 20/20      |
| Add  | +2.87 DS          |      |        | Add +2.25         |            |
| <i>Remarks: Good agreement.</i>  |                   |      |        |                   |            |
| 78.  | January 31        | 5394 | Age 60 | Sex M             | Rating G/G |
| Computer-suggested Rx  |                   |      |        | Clinician Rx      |            |
| RE   | plano             |      | 20/15  | -0.25 DS          | 20/20      |
| LE   | plano             |      | 20/20  | -0.25 = -0.75x20  | 20/20      |
| Add  | +2.00 DS          |      |        | Add +2.25 DS      |            |
| <i>Remarks: Good agreement.</i>  |                   |      |        |                   |            |
| 79.  | January 31        | 1306 | Age 49 | Sex M             | Rating G/U |
| Computer-suggested Rx  |                   |      |        | Clinician Rx      |            |
| RE   | +0.50 = -0.25x85  |      | 20/25  | +0.50 = -0.25x85  | 20/25      |
| LE   | +0.37 DS          |      | 20/20  | +0.50 = -0.25x90  | 20/20      |
| Add  | +0.37 DS          |      |        | Add +1.75 DS      |            |
| <i>Remarks: Software error—inaccurate near test.</i>   |                   |      |        |                   |            |

|                       |            |      |        |              |          |
|-----------------------|------------|------|--------|--------------|----------|
| 80.                   | January 31 | 9191 | Age 65 | Sex M        | Rating U |
| Computer-suggested Rx |            |      |        | Clinician Rx |          |
| RE                    | plano      |      | 20/400 | -0.50 DS     | 20/40    |
| LE                    | -2.37 DS   |      | 20/80  | -0.75 DS     | 20/20    |
| Add                   | +3.62 DS   |      |        | Add +2.50 DS |          |

*Remarks:* Hardware error—patient kept button down too long during acuity determination. As a result acuities are inaccurate. Near test is not rated since it is affected by the incorrect distance Rx.