

# Computer-assisted Eye Examination. V. Preliminary Evaluation of the Refractor III System for Subjective Examination\*

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## ABSTRACT

*A computer-assisted subjective eye examination was administered to 78 patients as they volunteered. They were also examined in the conventional, manual way, some before and some after the computer-assisted examination. Results of the computer-assisted examination were compared to those obtained by conventional subjective methods. For the distance prescription, satisfactory agreement was obtained for 83% of the patients. The 17% unsatisfactory prescriptions were subdivided into about 6% avoidable errors (caused by errors in software, hardware, or optometric flow charts), about 6% errors of undetermined cause, and 4% fundamental errors (caused by patient's physical and mental impairment or confusion). A similar analysis is made for the near add. With further development of the system it is expected that between 90 and 96% of patients in an optometric clinic can be successfully examined by this computer-assisted method.*

Research and development to provide automation in eye examinations have been actively pursued for the past dozen years. The concept is that automation, with the powerful aid of computers, can have a salubrious effect on the delivery of eye examinations. Automation can increase access, reduce costs, reduce highly trained manpower requirements, and release doctors to increase their activities in other important aspects of eye and vision care which cannot be automated.

Previous publications have covered automated eye examination,<sup>1</sup> automated visual case history interview,<sup>2</sup> automatically determined visual acuity,<sup>3</sup> evaluation of physiological indices,<sup>4</sup> evaluation of visual evoked potential refraction,<sup>5</sup> and treatment of computer-actuated refractors<sup>6</sup> and their optical effectivity.<sup>7</sup> Three computer-actuated refractors have been developed, the latest and only clinically useful model being called the Refractor III System.<sup>6</sup> It has a refractive range of +26 to -24 D.S. and 0 to -9 D.C., all in eighth diopter steps; it also has various auxiliary optical devices such as crossed cylinders, prisms, Maddox rods, bichrome lenses, and pinholes. All lens powers, regardless of lens position, are automatically corrected for refraction at the spectacle plane.<sup>7</sup>

The System is programmed and run on a DEC PDP-8/E digital computer. It provides a subjective refraction in a manner similar to that performed by a human clinician. The instrument is programmed to find the maximum convex or minimum concave lens that provides maximum visual acuity. It is not comparable to retinoscopy, either manual or automated. Refractor III is designed to suggest a prescription that is subject to the approval of or modification by the doctor who is freed of the tasks of collecting, recording, and collating examination data.

The physical appearance of the System is

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similar to that of an ordinary refractor (Figs. 1 and 2). The physical and operational characteristics of the System are presented elsewhere.<sup>1-8</sup>

### PURPOSE

The purpose of this paper is to provide a preliminary evaluation of the subjective examinations generated by the Refractor III System. The System was installed for testing at the Optometry Clinic at Letterman Army Medical Center, Presidio, San Francisco, where a wide variety of patients is seen. The level of expected performance was not set high, since neither the

computer equipment (hardware) nor the programming (software) had had extensive testing. The optometric flow charts, which comprise the conduct of the examination, were for the most part new and untried. Some of them were found wanting in certain regards and had to be "debugged" or even completely revised. Some flow charts still require modification as a result of the testing to be described here.

The evaluation described in this report consists of a comparison of the prescription suggested by the computer with the prescription determined by the human clinician. Before comparisons can be made, there must be an

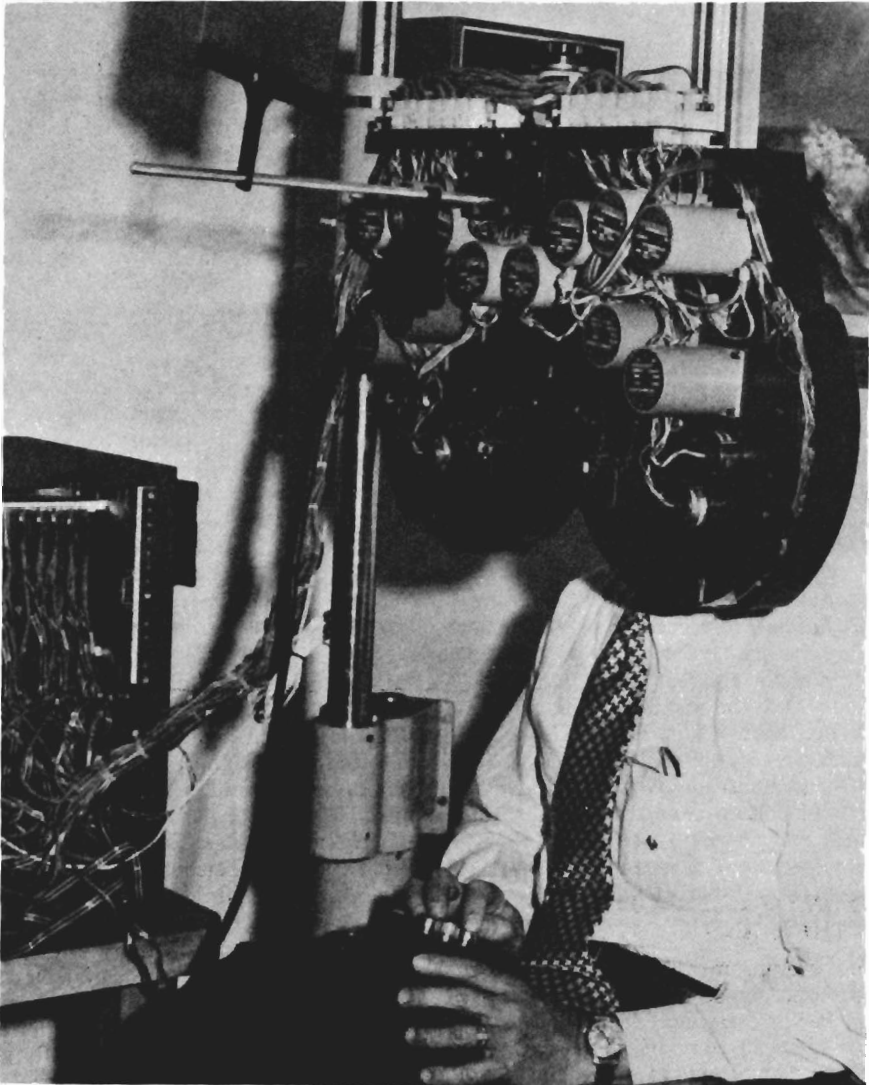


FIG. 1. Front view of Refractor III. The interface box is seen to the left. The response box is on the patient's lap.

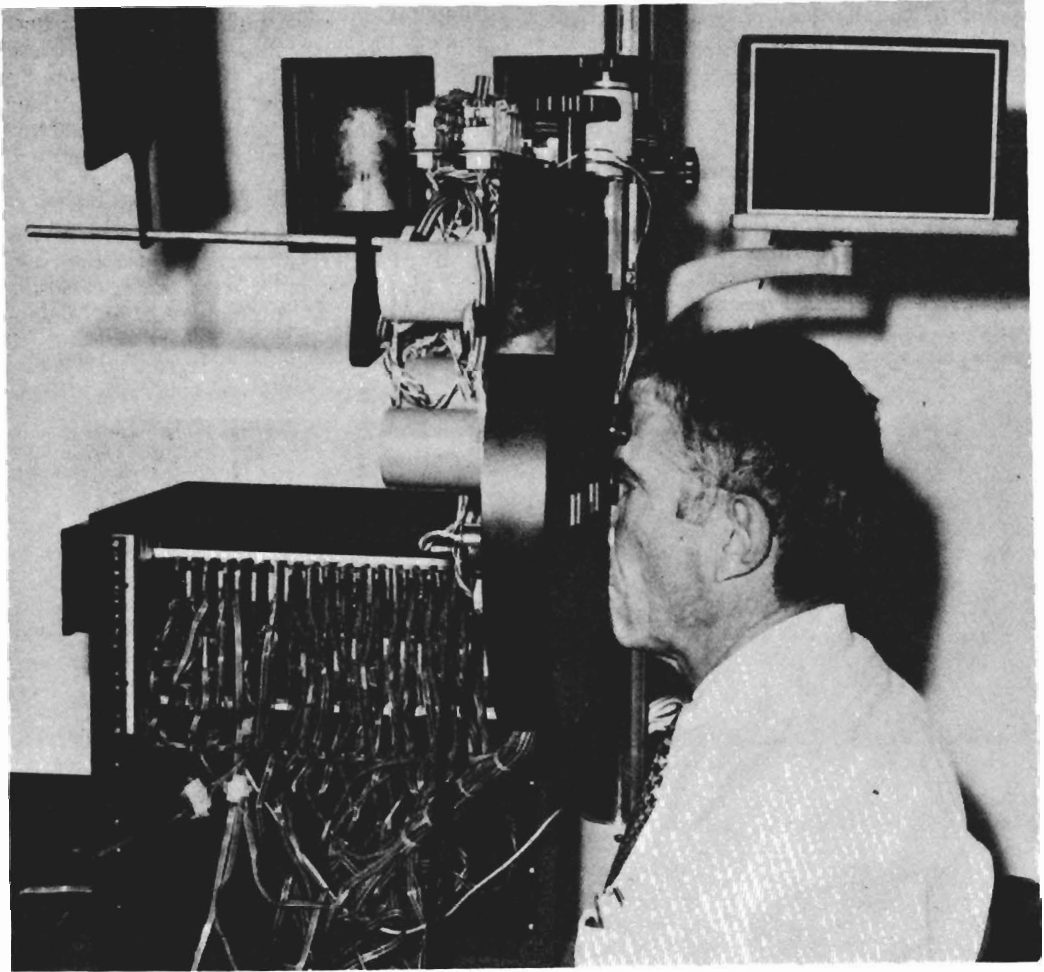


FIG. 2. Side view of Refractor III showing the loudspeaker at the upper right.

understanding of the range of error in clinical measurements and the circumstances under which differences may be significant. These differences can involve visual acuity, accommodation, and subsequent patient comfort and satisfaction, for which there is no valid method of measurement.

#### COMPARISON OF REFRACTIVE PRESCRIPTIONS AND ACUITY

There are three parameters for each eye in a basic ophthalmic prescription: the sphere power, the cylinder power, and the axis orientation. The problem in comparing these three parameters for each eye relates to what is a clinically significant difference. Initially, it may be asked what differences are barely noticeable to the patient.

Few clinicians would question that for the majority of people an eighth of a diopter is usually less than a just noticeable difference (JND) and is not significant; for many patients this statement would be true for a quarter of a diopter as well. For most people one-half diopter is clearly greater. Surely, any change in lens power which does not exceed a JND cannot be expected to be clinically significant, i.e., to make the difference in a lens prescription being satisfactory or unsatisfactory. On the other hand, if a lens power exceeds a JND, it does not necessarily follow that dissatisfaction with the prescription will occur. The latitude for acceptance of lens prescriptions is generally greater than the JND.

It is even more difficult to make a comparative judgment on the axis orientation. For a quarter diopter cylinder, large changes in the

axis may not show any significance or effect, sometimes even with the maximum change of 90°. The "just-noticeable" as well as the "tolerable" difference become less as the power increases. When the cylinder power is large, for example, 5 D, a difference of 5° is usually significant.

One method that has been used to provide a scale of significance is to take a JND at two ends of the scale and to make a linear interpolation between them. For example, if one assumes that at 10 D a change of 1 D is a JND, then 0.5 D would be a JND at 5 D, and 0.1 D at 1 D. The problem here is that 0.1 D may be less than a JND and 1 D may be much larger than a JND. In the final analysis, one is forced to judge this nonlinear function on the basis of clinical experience as a necessary compromise.

Another problem in comparison stems from the definition of a prescription. The word "prescription" is sometimes used in a somewhat incorrect sense. The prescription is the final "recipe" that is provided for the patient. The goal is to determine the refractive state of the eye. This value depends on the basic definition for it as well as the skill and method used to obtain it. The definition we have used for the computer system is the maximum convex or minimum concave lens for maximum visual acuity without activating accommodation. Maximum visual acuity is the endpoint. Some clinicians, on the basis of their training or clinical experience, may also justifiably modify this definition in several ways. They may not entirely trust the subjective responses of the patient and may modify their findings by some objective results, for example, retinoscopy. Or, if they feel the routine subjective endpoint is not clear-cut, they may use another method, such as the bichrome test (which utilizes the chromatic aberration of the eye), to provide what they feel is a more satisfactory finding. Because of the rigidly fixed definition by which the computer must operate, the computer tends to have more of a convex lens bias than do clinicians, since they are free to change their criteria. This factor may not be important because the patient may be satisfied and see well with either prescription. This idea is borne out in a teaching clinic where students learn to have a "convex lens bias" with certain instructors and not with others.

The determination of visual acuity can be considered a fairly absolute measurement in the hands of a given examiner with given equipment. However, visual acuity measurements may differ between examiners, due to such factors as differences in the method of presentation, the viewing time allowed, or the number of correct responses required. Different

equipment may also yield different measurements because of variations in contrast, illumination, or form. The patient also, of course, varies somewhat in his performance. For these reasons one cannot directly compare absolute visual acuities between examiners; this point also applies to comparisons between a computer system and a human examiner. Still, the acuity measurement should agree within one line on the visual acuity chart.

## METHODS

Seventy-eight patients between the ages of 12 and 71 years were examined at the Letterman Army Medical Center. They were accepted as they volunteered consecutively. All were cooperative. (The computer-assisted system, as designed, would be easy to fool by a malingerer because its programs were not planned to overcome deceit.) Included were active-duty personnel, retired personnel, dependents, and a group of civil service persons and students. The patients were examined by optometrists using standard, manual refraction procedures as well as by the computer system. The order of examining the patients (manually or with the computer) was mixed. The choice was primarily governed by administrative convenience. This order did not seem to be of any importance. A typical computer printout is shown in Fig. 3.

For about half the patients the prescription for their present glasses or their retinoscopy measurement was entered into the computer before testing, and the System used these "objective results" to increase the speed and to reduce the initial uncertainty of the procedure, as does the human clinician. When the computer system is not provided with "objective results," it is operating under a relative handicap. When the System operated in this mode, a special subroutine called "approximate sphere" was automatically used to try to compensate for this lack of information.

The visual acuity criteria for the automated System were as follows. In the fine-step sequence for determining visual acuity, two correct responses to the orientations of the Landolt broken rings led to the automatic presentation of the next smaller ring. A single error brought back into view the next larger ring. Two more correct responses again brought back the smaller ring. If the response was in error, the sequence was complete. In summary, the acuity value was registered when on two occasions two correct responses were followed by one incorrect response on the next smaller ring.

The prescriptions were compared and evaluated by the optometric authors. Three categories were used, the first two comprising the Satisfactory group.

Computer-suggested Rx			Clinician Rx	
RE	+1.12	20/15	+0.75	20/20
LE	+1.62	20/15	+1.50 = -0.25 ax 175	20/20
ADD	+1.00		+1.00	

Remarks: The agreement is good.

51.	May 26	#2603	Age 54	Sex M	Rating U-UE/NA
Computer-suggested Rx				Clinician Rx	
RE	-3.00 = -0.75 ax 52	20/15		-3.00 = -0.50 ax 55	20/20
LE	-1.25 = -0.25 ax 154	20/25		-3.75	20/20
ADD	not valid				

Remarks: Good agreement on RE but inadequate concave lens on LE as indicated by poor acuity finding. Near test therefore not valid.

52.	May 26	#9825	Age 60	Sex F	Rating G/G
Computer-suggested Rx				Clinician Rx	
RE	plano = -0.25 ax 36	20/35		plano = -0.50 ax 20	20/20
LE	+0.25 = -0.25 ax 168	20/20		+0.50 = -0.25 ax 165	20/20
ADD	+2.62			+2.25	

Remarks: At distance both eyes agree within clinical limits of measurement except, perhaps, for the visual acuity of the right eye, automatically recorded as 20/35. This is an error due to an intermittent "bug" in the program. There is no 20/35, only 20/25, 20/30, and 20/40. This print out should read 20/25 which is in reasonable agreement.

53.	May 26	#2216	Age 63	Sex M	Rating G/G
Computer-suggested Rx				Clinician Rx	
RE	+1.00 = -0.25 ax 86	20/20		+0.75	20/20
LE	+1.62 = -0.50 ax 89	20/15		+1.50 = -0.25 ax 100	20/20
ADD	+2.12			+2.00	

Remarks: Good agreement.

54.	May 24	#2346	Age 19	Sex F	Rating G
Computer-suggested Rx				Clinician Rx	
RE	-2.87 = -0.50 ax 13	20/20		-3.00 = -0.75 ax 25	20/20
LE	-2.25 = -0.75 ax 95	20/20		-3.00 = -0.75 ax 125	20/20

Remarks: Old Rx available with 20/40 and 20/30. On the right eye powers of sphere and cylinder are in good agreement  $\leq 0.25$  D. Axis cylinder difference  $12^\circ$  although visual acuity is 20/20. On the left eye the cylinder powers are in good agreement, but the axes differ by  $30^\circ$  which is probably significant. The computer has less concave lens, which is better assuming the 20/20 acuity is valid. Further evidence is that the old Rx had less concave lens in the left than in the right eye.

55.	May 24	#8975	Age 37	Sex M	Rating G
Computer-suggested Rx				Clinician Rx	
RE	+0.75	20/15		+0.75	20/20
LE	+0.62 = -0.25 ax 7	20/15		+0.75 = -0.25 ax 10	20/20

Remarks: Both prescriptions are virtually identical, i.e.,  $\leq 0.12$  D power and  $3^\circ$  for a minimum cylinder.

56.	May 22	#1136	Age 33	Sex M	Rating G
Computer-suggested Rx				Clinician Rx	
RE	+1.37	20/15		+0.50	20/20
LE	+1.37	20/20		+0.50 = -0.25 ax 165	20/20

Remarks: The computer found +0.87 more convex lens which is perhaps better than the clinician's finding if the visual acuities are valid. This is supported by the patient's chief complaint, problems with close work.

57.	May 20	#0399	Age 29	Sex F	Rating G
Computer-suggested Rx				Clinician Rx	
RE	-2.12	20/30		-2.25 = -0.25 ax 124	20/20
LE	-2.50 = -0.25 ax 51	20/20		-2.25 = -0.50 ax 52	20/15-2

Remarks: The wrong objective results (those for a different patient) were entered, but the program overcame them. The sphere is within 0.25, but the equivalent sphere of the RE may not have quite enough concave

of all these instructors seem, by and large, satisfied regardless of the bias. Our Agreement category reflects this latitude, which should not be considered an error. In any case, the original data are presented in the Appendix.

In the category of Unsatisfactory, it is important to identify the type of problem. Hardware or software problems can be remedied and avoided in the future. Problems in the optometric concepts designed into the flow charts can be remedied by reformulation. However, if the patient becomes confused, cannot follow instructions, or does not want to accept the computer system, the remedy is neither apparent nor easy; for these patients the basic concept may be at fault. This type of error would be fundamental in contrast to the readily correctable ones.

## RESULTS

Categorization of the lens prescriptions obtained by the computer are shown in Table 1. Approximately 83% of the patients were provided with a prescription from the computer system that was judged to be satisfactory. For 17% of the patients, the prescriptions were judged to be unsatisfactory. Errors of a type that can be overcome with improved hardware, software, and flow charts affected about 6% of the sample. Errors associated with mental or physical inability or lack of desire to accept or respond to the instructions affected an additional 4% of the sample. For about 6% of the sample, the computer prescription was unsatisfactory for unknown reasons. On the basis of these results we conclude that about 90% of patients can receive a satisfactory prescription once the obvious instrument failures are corrected. If the undetermined causes of errors are correctable, as many as 96% of the patients could receive a satisfactory prescription. Four

TABLE 1. Evaluation of computer-assisted refractive error determinations based on comparison with conventional clinical methods

	Number	%
Satisfactory	65	83.4
Good agreement	(57)	(73.1)
Agreement	(8)	(10.3)
Unsatisfactory	13	16.6
Avoidable system error	(5)	(6.4)
Fundamental patient error	(3)	(3.8)
Error of unknown cause	(5)	(6.4)
	78	100

TABLE 2. Evaluation of computer-assisted determination of lens addition for near based on comparison with conventional clinical methods

	Number	%
Satisfactory	19	67.9
Good Agreement	(18)	(64.3)
Agreement	(1)	(3.6)
Unsatisfactory	9	32.1
Avoidable system error	(8)	(28.6)
Fundamental patient error	(1)	(3.6)
Error of unknown cause	(0)	(0)
	28	100

percent of the patients do not seem to be able to cope with an automated system.

The near-lens addition obtained by the computer was evaluated for those presbyopic patients whose distance prescription was considered satisfactory (Table 2). Of 28 such patients, 68% received a "useful" add, and 32% did not. Avoidable errors for the near add were large (29%) because of "bugs" in the programming and flow chart, all of which are correctable. Early in the trials it was clear that our flow chart for the near add had faults. With a new flow chart that we have devised, we expect that the results for the near add will be as good as those obtained for the distance prescription. There were few fundamental errors registered for near because patients making this kind of error were screened out in the distance test.

## DISCUSSION

The most difficult part of the evaluation we performed was in deciding whether a given difference in prescriptions was clinically significant, i.e., whether one prescription would be satisfactory and the other unsatisfactory. It was less difficult to determine which of two prescriptions would be more satisfactory because such a judgment is relative rather than absolute. Visual acuity helped us in this relative judgment. Also of value to us was the plus-bias rule, i.e., for the same acuity, more convex lens is preferred.

A valid method for assessing differences which are difficult to categorize is to provide the patient with two pairs of glasses, one with the clinician's result, and one with the computer's. The patient would not know the source of each prescription. After a suitable time, the patient reports whether he prefers one or the other, or if he judges them to be equal. Furthermore, when there is a preference, the patient should be asked whether the less-preferred pre-

scription is adequate. Such a method was not used in this initial evaluation for reasons of economy and protection of human subjects.

Several courses of action are indicated. First, the System should be improved mechanically, electronically, and in the optometric flow charts. Our goal is to obtain virtually no unsatisfactory results caused by avoidable errors. Second, an effort must be made to determine the cause of the unknown errors. Are they really avoidable errors or are they fundamental errors? Third, patients who make fundamental errors should be studied to determine whether these errors can be overcome. For example, fundamental errors due to poor hearing could perhaps be overcome with special earphones or other aids for the partially deaf. If the error stems from the patient's confusion in pushing the response buttons, a separate training device might prove useful. The patient could practice on the device until a simple test is passed and then proceed to the computer-assisted examination.

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#### APPENDIX

##### Ratings

G = good agreement  
A = agreement  
U = unsatisfactory

AE = avoidable error  
UE = unknown origin error  
FE = fundamental error

distance/add

NA = not applicable

1.	June 22	#6456	Age 26	Sex M	Rating G
Computer-suggested Rx				Clinician Rx	
RE	-0.12		20/15	-0.12	20/20
LE	-0.12		20/15	-0.12	20/20

Remarks: Good agreement.

2.	June 22	#8810	Age 28	Sex M	Rating A
Computer-suggested Rx				Clinician Rx	
RE	plano = -0.50 ax 91		20/30	-0.50 = -0.50 ax 100	20/20-
LE	-0.62 = -0.25 ax 84		20/20	-0.75 = -0.50 ax 87	20/20-

Remarks: Agreement is good for the left eye, but less so for the right where the visual acuity appears less than maximum.

3.	June 22	#2726	Age 24	Sex F	Rating G
Computer-suggested Rx				Clinician Rx	

RE	-0.12 = -0.25 ax 62	20/15	plano	20/15
LE	-0.12 = -0.25 ax 86	20/15	plano	20/15

Remarks: Good agreement.

4.	June 22	#9099	Age 50	Sex M	Rating G/G
Computer-suggested Rx				Clinician Rx	
RE	+0.50 = -0.50 ax 19	20/15		plano = -0.50 ax 22	20/20
LE	-0.62 = -0.50 ax 180	20/15		-1.00 = -0.50 ax 2	20/20
ADD	+2.00			+2.25	

Remarks: Good agreement.

5.	June 21	#6996	Age 35	Sex F	Rating A
Computer-suggested Rx				Clinician Rx	
RE	-2.62		20/20	-1.75 = 0.50 ax 175	20/25+
LE	-1.62 = -0.50 ax 170	20/20		-1.25 = 0.50 ax 5	20/25+

Remarks: This patient was considered to have "weird" or unexpected responses by the clinician. Nevertheless the comparison is in agreement although there seems to be a tendency toward too much concave lens on the right eye.

6.	June 21	#9458	Age 50	Sex M	Rating U-FE/NA
Computer-suggested Rx				Clinician Rx	
RE	+2.00 = -0.25 ax 7	20/30		+0.75	20/20
LE	+0.87	20/20		+0.25	20/20
ADD	+1.00			+1.50	

Remarks: The agreement is unsatisfactory on the right eye and the system is at fault as indicated by the poor acuity. The patient had difficulty in following instructions even after repeated instruction. The clinician noted that this patient required "a slow and careful examination." This kind of patient is not suitable for automated examinations without special extended preparation or training.

7.	June 21	#0206	Age 57	Sex M	Rating G/G
Computer-suggested Rx				Clinician Rx	
RE	+0.87	20/20		+0.50 = -0.25 ax 110	20/20
LE	+0.75 = -0.25 ax 38	20/15		+0.25 = -0.25 ax 40	20/20
ADD	+2.12			Trifocal +2.50 and +1.25	

Remarks: Good agreement.

8.	June 21	#9520	Age 19	Sex F	Rating G
Computer-suggested Rx				Clinician Rx	
RE	+0.37	20/15		+0.50	20/20
LE	+0.37	20/15		+0.50	20/20

Remarks: Good agreement.

9.	June 21	#9000	Age 49	Sex M	Rating G/U-AE
Computer-suggested Rx				Clinician Rx	
RE	-1.25 = -0.50 ax 96	20/20		-1.50 = -0.50 ax 110	20/20
LE	-3.12 = -0.75 ax 4	20/20		-3.25 = -0.50 ax 15	20/20
ADD	+3.62			+1.75	

Remarks: Good agreement for distance, but a "bug" in the near add program caused the NRA to be taken twice and summed, causing too large a value. This program is to be replaced.

10.	June 21	#5558	Age 25	Sex M	Rating U-UE
Computer-suggested Rx				Clinician Rx	
RE	-0.87 = -0.75 ax 137	20/100		-2.50 = -1.00 ax 145	20/20
LE	+2.87 = -1.25 ax 19	20/400		-1.50 = -2.00 ax 15	20/25

Remarks: The system results were unsatisfactory for unknown reasons.

11.	June 17	#2155	Age 56	Sex F	Rating G/G
Computer-suggested Rx				Clinician Rx	
RE	-0.25 = -0.50 ax 106	20/20		-0.25 = -0.50 ax 90	20/15
LE	-1.25 = -0.50 ax 112	20/15		-1.50 = -0.50 ax 112	20/15

ADD +2.37 +2.25  
 Remarks: Good agreement.

12. June 17 #6028 Age 24 Sex M Rating G  
 Computer-suggested Rx Clinician Rx  
 RE -0.87 20/15 -1.00 20/15  
 LE -0.62 20/15 -0.50 20/15  
 Remarks: Good agreement.

13. June 17 #2076 Age 42? Sex F Rating G/G  
 Computer-suggested Rx Clinician Rx  
 RE +0.62 20/20 +0.50 = -0.25 ax 138 20/20+  
 LE +0.37 20/400 plano = -0.25 ax 77 20/20+  
 ADD +2.00 +2.25  
 Remarks: Good agreement. A computer error printed out 20/400 instead of 20/20 which is obvious to the reviewer who can read in the printout a plano VA of 20/20. Based on appearance this patient understated her age by at least ten years, but there was no problem because of this.

14. June 17 #1244 Age 52 Sex F Rating G/G  
 Computer-suggested Rx Clinician Rx  
 RE +0.37 20/20 plano = -0.25 ax 43 20/20  
 LE +0.12 20/25 plano = -0.25 ax 93 20/20  
 ADD +1.75 +1.75  
 Remarks: Good agreement.

15. June 16 #0001 Age 53 Sex F Rating G/G  
 Computer-suggested Rx Clinician Rx  
 RE -1.12 = -0.50 ax 27 20/20 -1.00 = -0.50 ax 37 20/15 -1  
 LE -1.87 = -0.25 ax 177 20/20 -1.50 = -0.25 ax 158 20/15  
 ADD +2.75 +2.00  
 Remarks: Good agreement.

16. June 16 #9952 Age 54 Sex F Rating G/G  
 Computer-suggested Rx Clinician Rx  
 RE +0.37 = -0.25 ax 50 20/20 +0.50 = -0.75 ax 58 20/20+  
 LE +0.75 = -1.00 ax 85 20/20 +0.50 = -1.25 ax 78 20/15 -  
 ADD +2.25 +2.25  
 Remarks: Good agreement.

17. June 16 #2290 Age 23 Sex M Rating G  
 Computer-suggested Rx Clinician Rx  
 RE -2.37 = -1.00 ax 48 20/15 -2.25 = -1.25 ax 45 20/20  
 LE -2.37 = -0.25 ax 36 20/15 -2.25 = -0.50 ax 20 20/20  
 Remarks: Good agreement.

18. June 16 #9100 Age 25 Sex M Rating G  
 Computer-suggested Rx Clinician Rx  
 RE -2.25 = -0.25 ax 82 20/400 -2.50 20/15  
 LE -1.87 20/15 -2.25 20/15  
 Remarks: Good agreement. A slide projector error caused an error in the acuity printed out for the right eye but this would be obvious from the visual acuity through the objective results.

19. June 16 #7576 Age 54 Sex F Rating G/U-AE  
 Computer-suggested Rx Clinician Rx  
 RE +1.00 = -0.50 ax 109 20/20 +1.25 = -0.75 ax 102 20/15  
 LE +0.87 = -0.25 ax 132 20/15 +1.12 = -0.25 ax 148 20/15 -2  
 ADD see remarks +2.25  
 Remarks: Good agreement. The "bug" in the add program did not produce an add.

20. June 15 #4154 Age 67 Sex M Rating A/G

Computer-suggested Rx				Clinician Rx			
RE	+1.87 = -1.25 ax 76	20/30		+1.50 = -1.50 ax 82		20/25	
LE	+1.87 = -1.00 ax 102	20/30		+1.00 = -1.25 ax 112		20/25	
ADD	+2.12			+2.25			

*Remarks:* Although the suggested Rx seems to have a convex lens bias, the prescription may be usable. The add agrees well. This patient had difficulty in remembering the instructions.

21.	June 15	#7090	Age 64	Sex M	Rating U-AE/U-AE
Computer-suggested Rx				Clinician Rx	
RE	+4.00 = -0.25 ax 92	20/50		+2.00 = -0.25 ax 82	20/20
LE	+4.50 = -0.25 ax 75	20/200		+2.25 = -0.75 ax 88	20/20
ADD	see remarks			+2.25	

*Remarks:* The system provided too much convex lens despite entering retinoscopy values of  
RE +1.50 20/15  
LE +1.50 20/20

Up through the final cross cylinder axis the findings were in excellent agreement. Although it is not clear whether some "bug" caused this problem, a new sequence program under development would have given the objective results as the Rx which would have been useful. A software "bug" in the add program prevented a finding.

22.	June 15	#3004	Age 30	Sex M	Rating G
Computer-suggested Rx				Clinician Rx	
RE	-0.62	20/15		-0.50	20/20
LE	-0.37	20/20		-0.50	20/20

*Remarks:* Good agreement.

23.	June 15	#3083	Age 56	Sex M	Rating U-AE/NA
Computer-suggested Rx				Clinician Rx	
RE	+1.12	20/15		+1.50 = -0.25 ax 100	20/20
LE	+3.37 = -2.00 ax 96	20/30		+1.75 = -0.75 ax 80	20/20
ADD	+1.50			+2.00	

*Remarks:* Good agreement on the right eye but too much convex lens on the left which appears to be compensated for in part by the additional concave cylinder. This happened for unknown reasons during the approximate sphere routine but presumably would have been avoided if there had been objective results, e.g., retinoscopy. The add is not applicable because of the difference in the distance values.

24.	June 15	#9396	Age 54	Sex M	Rating A/G
Computer-suggested Rx				Clinician Rx	
RE	+4.62 = -2.75 ax 2	20/25		+4.25 = -2.75 ax 3	20/25
LE	+5.62 = -3.25 ax 170	20/40		+4.75 = -4.25 ax 167	20/20
ADD	+1.75			+2.25	

*Remarks:* Good agreement on the right eye but too much convex sphere and/or too little concave cylinder on the left. Total reading power is in good agreement.

25.	June 14	#3304	Age 62	Sex M	Rating G/A
Computer-suggested Rx				Clinician Rx	
RE	+1.00	20/25		+1.25	20/20
LE	+1.62 = -0.75 ax 119	20/25		+1.75 = -0.75 ax 108	20/20
ADD	+2.87			+2.00	

*Remarks:* Good agreement on distance tests. Add high, apparently because the patient was confused about the near test instructions and had diplopia at times.

26.	June 14	#0455	Age 57	Sex F	Rating G/U-AE
Computer-suggested Rx				Clinician Rx	
RE	+0.25 = -0.75 ax 81	20/20		plano = -0.75 ax 80	20/20
LE	plano = -0.25 ax 91	20/20		-0.25	20/20
ADD	see remarks			+2.25	

*Remarks:* Good agreement on distance prescriptions. Software "bugs" prevented a valid near test for the add.

27.	June 14	#3329	Age 51	Sex M	Rating G/G
Computer-suggested Rx					
RE	+0.62 = -0.50 ax 92	20/15		Clinician Rx	20/20
LE	+0.50 = -0.75 ax 89	20/15		plano	20/20
ADD	+1.87			-0.25 = -0.25 ax 90	20/20
				+2.00	
<i>Remarks:</i> Good agreement.					
28.	June 14	#5425	Age 60	Sex F	Rating G/U-AE
Computer-suggested Rx					
RE	+1.75 = -0.25 ax 139	20/25		Clinician Rx	20/20
LE	+1.25 = -0.25 ax 38	20/25		+1.75 = -0.50 ax 152	20/20
ADD	see remarks			+1.50 = -0.25 ax 47	20/20
				+2.00	
<i>Remarks:</i> Good agreement. No add printout because of software problem.					
29.	June 14	#0551	Age 71	Sex M	Rating U-FE/U/FE
Computer-suggested Rx					
RE	+1.50 = -0.25 ax 108	20/15		Clinician Rx	20/20
LE	+2.37 = -2.00 ax 98	20/15		+0.75 = -0.50 ax 95	20/20
ADD	see remarks			+0.25 = -0.50 ax 65	20/20
				+2.00	
<i>Remarks:</i> The poor health of this patient made him a poor candidate for an automated examination. He had had two strokes and his memory is poor for lens comparisons. Also his hearing is subnormal and he had difficulty hearing the instructions. The test was terminated before the near tests were performed.					
30.	June 11	#3284	Age 41	Sex F	Rating G/G
Computer-suggested Rx					
RE	plano = -0.75 ax 98	20/20		Clinician Rx	20/20
LE	-0.12	20/20		-0.25 = -1.00 ax 100	20/20
ADD	+0.62			-0.25	20/20
				+1.00	
<i>Remarks:</i> Good agreement. The system's convex lens bias at distance makes the total near correction agree better than it might appear from the adds alone.					
31.	June 11	#7603	Age 20	Sex F	Rating A
Computer-suggested Rx					
RE	-0.37	20/20		Clinician Rx	20/20
LE	+0.12	20/25		-0.25	20/20
				-0.50	20/20
<i>Remarks:</i> This patient had 20/25 acuity without lenses and glasses were not prescribed.					
32.	June 9	#9843	Age 19	Sex M	Rating G
Computer-suggested Rx					
RE	+0.87	20/15		Clinician Rx	20/20
LE	+0.62	20/15		+0.75	20/20
				+0.75	20/20
<i>Remarks:</i> Good agreement.					
33.	June 9	#1150	Age 20	Sex M	Rating G
Computer-suggested Rx					
RE	-0.75 = -0.25 ax 119	20/15		Clinician Rx	20/20
LE	-0.87	20/15		-1.00	20/20
				-1.00	20/20
<i>Remarks:</i> Good agreement.					
34.	June 9	#5098	Age 23	Sex M	Rating G
Computer-suggested Rx					
RE	-5.75	20/15		Clinician Rx	20/20
LE	-5.12 = -0.50 ax 61	20/15		-5.00 = -0.25 ax 100	20/20
				-4.75 = -0.50 ax 50	20/20
<i>Remarks:</i> The system showed slightly more concave lens which is probably a wearable prescription as indicated by the excellent acuity through it.					
35.	June 9	#2119	Age 18	Sex M	Rating G
Computer-suggested Rx					
				Clinician Rx	

RE	-6.00 = -1.25 ax 157	20/15	-6.00 = -1.25 ax 152	20/15
LE	-5.62 = -1.00 ax 26	20/15	-5.75 = -1.00 ax 28	20/15

Remarks: Good agreement.

36.	June 9	#3310	Age 43	Sex M	Rating G/U-AE
Computer-suggested Rx			Clinician Rx		
RE	+0.62 = -0.50 ax 50	20/15	+0.75 = -0.50 ax 35	20/15	
LE	+1.12 = -0.50 ax 112	20/15	+1.12 = -0.50 ax 105	20/15	
ADD	+3.25		+1.00		

Remarks: A "bug" in the Near Add program caused the NRA to be taken twice and summed. This caused the printout add to be too high. The PRA was taken, but the "bug" prevented it from being printed out.

37.	June 7	#0925	Age 26	Sex M	Rating G
Computer-suggested Rx			Clinician Rx		
RE	+0.50 = -0.25 ax 180	20/15	+0.50 = -0.50 ax 180	20/20	
LE	+0.62	20/15	+0.75 = -0.25 ax 10	20/20	

Remarks: Good agreement.

38.	June 7	#0489	Age 28	Sex F	Rating G
Computer-suggested Rx			Clinician Rx		
RE	+0.37	20/15	plano	20/20	
LE	+0.37	20/15	+0.25	20/20-	

Remarks: Good agreement.

39.	June 7	#8435	Age 20	Sex M	Rating U-AE
Computer-suggested Rx			Clinician Rx		
RE	-3.62 = -2.00 ax 103	20/30	-4.50 = -0.25 ax 90	20/20	
LE	-4.25 = -0.25 ax 98	20/15	-4.50 = -0.25 ax 97	20/20	

Remarks: The left eye showed good agreement. The computer clearly failed on the right eye, apparently because of a "bug" in the program which is being corrected. The objective results of the old Rx showed only 20/60 visual acuity. According to the flow chart the next test should have been the approximate sphere because the objective results are considered not good enough for a starting point. However, this cut-off apparently is at 20/100 instead of 20/50. Thus there was not enough concave lens to see the letter chart and the patient accepted concave cylinder erroneously.

40.	June 4	#1783	Age 63	Sex M	Rating G
Computer-suggested Rx			Clinician Rx		
RE	+2.37 = -1.25 ax 19	20/20	+2.25 = -1.00 ax 5	20/40	
LE	+2.00 = -1.00 ax 175	20/15	+2.00 = -0.75 ax 165	20/25	
ADD	+2.37		+2.00		

Remarks: Good agreement.

41.	June 4	#1412	Age 20	Sex F	Rating G
Computer-suggested Rx			Clinician Rx		
RE	+0.87	20/20	+0.50	20/20	
LE	+3.62 = -0.50 ax 132	20/25	+2.00	20/25	

Remarks: This patient has a history of amblyopia in the left eye, which accounts for his poorer acuity. The acuities indicate that the computer-suggested Rx would be useful for the clinician if one were required as determined by the patient interview or history.

42.	June 3	#0081	Age 24	Sex M	Rating G
Computer-suggested Rx			Clinician Rx		
RE	-0.62 = -0.50 ax 91	20/15	-1.25 = -0.25 ax 90	20/20	
LE	-1.12	20/15	-1.00 = -0.25 ax 105	20/20	

Remarks: Good agreement. The slight convex bias on the right eye is supported by a good acuity finding.

43.	June 3	#1749	Age 52	Sex F	Rating G/G
Computer-suggested Rx			Clinician Rx		
RE	+0.62	20/15	+0.75		

LE	+0.62	20/15	+0.75 = -0.50 ax 10
ADD	+1.75		+2.50 at 14 inches (35½ cm)

*Remarks:* Good agreement even on the left eye considering the acuity. The add would probably have been too low for 35 cm, but this would be taken into account by the clinician reviewing the printout.

44.	June 2	#5796	Age 44 (?)	Sex F	Rating G/U-AE
Computer-suggested Rx			Clinician Rx		
RE	+0.75 = -0.25 ax 177	20/15	+0.75 = -0.25 ax 150	20/20	
LE	+0.25 = -0.25 ax 59	20/15	+0.25 = -0.25 ax 30	20/20	
ADD	see remarks		+2.00		

*Remarks:* The distance corrections are in good agreement. The system did not produce an add because the empirical add starting point was too low. The program is being corrected to compensate for this possibility. From her appearance it is believed that this patient understated her age by about 10 years, which may account for the problem.

45.	June 2	#3388	Age 40	Sex F	Rating U-AE/NA
Computer-suggested Rx			Clinician Rx		
RE	-1.00 = -0.25 ax 170	20/40	+0.75 = -0.50 ax 165	20/20	
LE	+0.87 = -0.50 ax 10	20/400	+1.00 = -0.50 ax 5	20/20	
ADD	see remarks		+0.25		

*Remarks:* The left eye Rx's are in good agreement, but the visual acuity is wrong because of a machine failure which is being investigated. The right eye received too much concave lens. The problem seems to be a "bug" in the program which occurred when the previous patient had objective results. The sequencer assumed zero acuity on this patient since there were no objective results and presented too large a diopter difference for choice on the approximate spherical test (i.e.,  $\pm 4$  D instead of  $\pm 1$  D.)

46.	June 2	#2723	Age 57	Sex M	Rating G/G
Computer-suggested Rx			Clinician Rx		
RE	+1.25 = -0.25 ax 91	20/15	+1.00 = -0.50 ax 83	20/20	
LE	+1.00 = 0.25 106	20/20	+0.75 = -0.25 ax 115	20/20	
ADD	+2.00		+2.25		

*Remarks:* Good agreement.

47.	June 2	#2718	Age 18	Sex M	Rating G
Computer-suggested Rx			Clinician Rx		
RE	-0.87 = -0.50 ax 79	20/15	-0.75 = -1.25 ax 90	20/20	
LE	-0.62 = -0.50 ax 74	20/15	-0.50 = -1.25 ax 85	20/20	

*Remarks:* The corrections are in good agreement. Although the cylinders differ by 0.75 D, there was good acuity with both methods.

48.	June 2	#8122	Age 44	Sex F	Rating U-UE/NA
Computer-suggested Rx			Clinician Rx		
RE	+2.12 = -2.00 ax 88	20/70	plano	20/20	
LE	+0.37	20/15	+0.25	20/20	
ADD	see remarks		+1.00		

*Remarks:* The left eye prescription agrees, but the right eye was given too much convex sphere and concave cylinder. However, a clinician reviewing the printout could have caught this error by noting the poor acuity with it in contrast to 20/20 with plano on the beginning acuity determination. Since the distance prescription for the RE was in error, the add is not considered.

49.	May 26	#5627	Age 64	Sex F	Rating U-UE/NA
Computer-suggested Rx			Clinician Rx		
RE	+2.87 = -1.25 ax 54	20/20	+2.75 = -1.25 ax 68	20/20	
LE	+1.87	20/50	+2.75 = -1.00 ax 115	20/20	
ADD	see remarks		+2.50		

*Remarks:* The right eye findings are in reasonable agreement, but the left eye is undercorrected, both according to the clinician's finding, and the system acuity recorded as 20/50. Because of the error in the left eye, the add is not considered.

50.	May 26	#7109	Age 44	Sex M	Rating G/G
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Computer-suggested Rx				Clinician Rx	
RE	+1.12	20/15		+0.75	20/20
LE	+1.62	20/15		+1.50 = -0.25 ax 175	20/20
ADD	+1.00			+1.00	

Remarks: The agreement is good.

51.	May 26	#2603	Age 54	Sex M	Rating U-UE/NA
Computer-suggested Rx				Clinician Rx	
RE	-3.00 = -0.75 ax 52	20/15		-3.00 = -0.50 ax 55	20/20
LE	-1.25 = -0.25 ax 154	20/25		-3.75	20/20
ADD	not valid				

Remarks: Good agreement on RE but inadequate concave lens on LE as indicated by poor acuity finding. Near test therefore not valid.

52.	May 26	#9825	Age 60	Sex F	Rating G/G
Computer-suggested Rx				Clinician Rx	
RE	plano = -0.25 ax 36	20/35		plano = -0.50 ax 20	20/20
LE	+0.25 = -0.25 ax 168	20/20		+0.50 = -0.25 ax 165	20/20
ADD	+2.62			+2.25	

Remarks: At distance both eyes agree within clinical limits of measurement except, perhaps, for the visual acuity of the right eye, automatically recorded as 20/35. This is an error due to an intermittent "bug" in the program. There is no 20/35, only 20/25, 20/30, and 20/40. This print out should read 20/25 which is in reasonable agreement.

53.	May 26	#2216	Age 63	Sex M	Rating G/G
Computer-suggested Rx				Clinician Rx	
RE	+1.00 = -0.25 ax 86	20/20		+0.75	20/20
LE	+1.62 = -0.50 ax 89	20/15		+1.50 = -0.25 ax 100	20/20
ADD	+2.12			+2.00	

Remarks: Good agreement.

54.	May 24	#2346	Age 19	Sex F	Rating G
Computer-suggested Rx				Clinician Rx	
RE	-2.87 = -0.50 ax 13	20/20		-3.00 = -0.75 ax 25	20/20
LE	-2.25 = -0.75 ax 95	20/20		-3.00 = -0.75 ax 125	20/20

Remarks: Old Rx available with 20/40 and 20/30. On the right eye powers of sphere and cylinder are in good agreement  $\leq 0.25$  D. Axis cylinder difference  $12^\circ$  although visual acuity is 20/20. On the left eye the cylinder powers are in good agreement, but the axes differ by  $30^\circ$  which is probably significant. The computer has less concave lens, which is better assuming the 20/20 acuity is valid. Further evidence is that the old Rx had less concave lens in the left than in the right eye.

55.	May 24	#8975	Age 37	Sex M	Rating G
Computer-suggested Rx				Clinician Rx	
RE	+0.75	20/15		+0.75	20/20
LE	+0.62 = -0.25 ax 7	20/15		+0.75 = -0.25 ax 10	20/20

Remarks: Both prescriptions are virtually identical, i.e.,  $\leq 0.12$  D power and  $3^\circ$  for a minimum cylinder.

56.	May 22	#1136	Age 33	Sex M	Rating G
Computer-suggested Rx				Clinician Rx	
RE	+1.37	20/15		+0.50	20/20
LE	+1.37	20/20		+0.50 = -0.25 ax 165	20/20

Remarks: The computer found +0.87 more convex lens which is perhaps better than the clinician's finding if the visual acuities are valid. This is supported by the patient's chief complaint, problems with close work.

57.	May 20	#0399	Age 29	Sex F	Rating G
Computer-suggested Rx				Clinician Rx	
RE	-2.12	20/30		-2.25 = -0.25 ax 124	20/20
LE	-2.50 = -0.25 ax 51	20/20		-2.25 = -0.50 ax 52	20/15-2

Remarks: The wrong objective results (those for a different patient) were entered, but the program overcame them. The sphere is within 0.25, but the equivalent sphere of the RE may not have quite enough concave

lens since the acuity is 20/30. The computer found a RE cylinder close to that of the clinician ( $-0.25$  ax 130), but it was rejected.

58.	May 20	#5816	Age 19	Sex M	Rating G
Computer-suggested Rx			Clinician Rx		
RE	+1.00 = $-0.25$ ax 98	20/15		+0.50	20/20
LE	+1.75 = $-0.25$ ax 78	20/20		+1.00	20/20

*Remarks:* The computer shows its programmed convex lens bias. The patient was available for recall on May 26 when the clinician tested his acuity with the computer-suggested Rx. Each eye measured 20/20 which confirmed the probable usefulness of the latter.

59.	May 18	#6936	Age 13	Sex F	Rating G
Computer-suggested Rx			Clinician Rx		
RE	-1.37	20/20		-1.50	20/20
LE	-1.37	20/20		-1.50	20/20

*Remarks:* Good agreement.

60.	May 18	#5117	Age 44	Sex M	Rating G/G
Computer-suggested Rx			Clinician Rx		
RE	-0.75 = $-0.25$ ax 133	20/20		-0.75 = $-0.50$ ax 135	20/20
LE	-0.62	20/15		-0.50 = $-0.25$ ax 60	20/20
ADD	+1.25			+0.75	

*Remarks:* The right eye findings are in excellent agreement, as are those of the left, having the same equivalent sphere. This agreement is surprising since this patient was not very precise in his responses. The generated add may be too high to prescribe since the patient is not wearing any and is not complaining of presbyopia. The clinician found a slightly lesser add for a greater working distance which supports the basic finding.

61.	May 17	#9991	Age 26	Sex M	Rating G
Computer-suggested Rx			Clinician Rx		
RE	-2.37	20/20		-3.00 = $-0.25$ ax 75	20/20
LE	-2.50 = $-0.25$ ax 33	20/15		-2.50 = $-0.25$ ax 20	20/20

*Remarks:* Less concave sphere was found by the system on the right eye which appears desirable because of good acuity. The left eye prescriptions were identical except for a  $13^\circ$  axis difference which is not significant for a quarter diopter.

62.	May 17	#7208	Age 47	Sex M	Rating U-UE/G
Computer-suggested Rx			Clinician Rx		
RE	-4.75 = $-0.25$ ax 7	20/40		-4.25 = $-2.25$ ax 167	20/20
LE	-3.12 = $-1.00$ ax 2	20/15		-3.25 = $-1.25$ ax 173	20/20
ADD	+1.50			+1.75	

*Remarks:* The visual acuity with the computer's finding for the right eye is 20/40 compared with the clinician's 20/20 which indicates an unsatisfactory computer correction. The problem appears to be with undercorrection of the cylinder, the difference being 2 D. The left eye powers are in good agreement although a  $9^\circ$  axis difference could be significant despite excellent acuity. The presbyopic adds are in good agreement.

63.	May 17	#8497	Age 32	Sex M	Rating G
Computer-suggested Rx			Clinician Rx		
RE	-3.12	20/20		-3.25	20/20
LE	-2.62	20/15		-3.00	20/20

*Remarks:* Agreement is good. The convex lens bias designed in the system is evident.

64.	May 13	#0000	Age 13	Sex M	Rating G
Computer-suggested Rx			Clinician Rx		
RE	+0.37 = $-0.50$ ax 99	20/15		plano = $-0.50$ ax 90	20/20
LE	+0.37 = $-0.50$ ax 74	20/15		plano = $-0.50$ ax 75	20/20

*Remarks:* The cylinders are in excellent agreement (with the exception of a  $9^\circ$  axis difference for the RE), but the system finds more convex sphere which is supported by good acuity. This 13-year-old boy did well and appeared to enjoy the experience.

65. May 12 #3011 Age 29 Sex M Rating G  
 Computer-suggested Rx Clinician Rx  
 RE plano = -0.25 ax 178 20/15 plano 20/20  
 LE -0.37 20/70 -0.50 20/40 amblyopia  
*Remarks:* The refractive findings are in excellent agreement. The only discrepancy is a difference in the visual acuity of the left amblyopic eye, 20/40 by the clinician and 20/70 by the system. Without lenses the latter found 20/60 which tends to support the clinician's acuity finding as more accurate.
66. May 12 #7766 Age 30 Sex M Rating G  
 Computer-suggested Rx Clinician Rx  
 RE -3.37 = -2.00 ax 7 20/15 -2.75 = -2.25 ax 5 20/20  
 LE -3.62 = -1.50 ax 2 20/15 -3.25 = -1.75 ax 2 20/20  
*Remarks:* The cylinder axes and powers are in good agreement. The system shows more concave spherical power in both eyes by 0.37 D but may also show slightly better acuity.
67. May 12 #3595 Age 24 Sex M Rating G  
 Computer-suggested Rx Clinician Rx  
 RE -0.12 20/30 plano = -0.25 ax 180 20/20  
 LE +0.12 20/20 plano 20/20  
*Remarks:* The refractions are in excellent agreement, that is, within 0.12 D equivalent sphere which is well within the usual error of clinical measurements. The automatically recorded visual acuity with Rx came out too low for the RE, 20/30, as may be seen from the automatically recorded acuity without Rx which was 20/20 for no lens.
68. May 12 #1199 Age 44 Sex M Rating G  
 Computer-suggested Rx Clinician Rx  
 RE +0.75 = -0.25 ax 122 20/10 plano = -0.25 ax 120 20/20  
 LE +0.75 = -0.25 ax 7 20/20 plano = -0.25 ax 35 20/20  
*Remarks:* Computer finds +0.75 more convex lens which is good if the visual acuities are valid. The right cylinders are in good agreement, but the left axes differ by 28 degrees which may be tolerable for 0.25 cylinder.
69. May 12 #2071 Age 24 Sex M Rating A  
 Computer-suggested Rx Clinician Rx  
 RE -2.62 = -1.00 ax 24 20/20 -2.00 = -1.00 ax 35 20/20  
 LE -4.00 = -0.75 ax 134 20/20 -3.75 = -0.75 ax 155 20/20  
*Remarks:* The cylindrical powers are in good agreement, but the differences in axes may be of clinical significance, especially that of the LE. The system RE sphere is 0.62 more concave for the same acuity which can be considered an error. Although the LE has the same tendency, the difference is probably negligible.
70. May 10 #8103 Age 45 Sex M Rating G/U-AE  
 Computer-suggested Rx Clinician Rx  
 RE +1.12 20/15 +0.75 20/20  
 LE +0.37 20/15 +0.25 20/20  
 ADD see remarks +2.00  
*Remarks:* The distance refractions are in good agreement, with the system finding slightly more convex lens with good acuity. The computer did not generate an add because of an unusual circumstance which was not anticipated in the flow chart. On any patient 40 years or older the system measures the negative and positive relative accommodations through the empirical add. This is the assumed add according to the age of the patient which is based on a very high correlation. This patient was expected to have about a +0.75 add but actually required an extraordinary +2.00 add. As a result, the target was blurred initially, the relative accommodations could not be measured, and there was no suggested add generated. The flow chart and program have been modified to anticipate and provide for this unlikely contingency in the future.
71. May 7 #1157 Age 47 Sex F Rating U-FE/NA  
 Computer-suggested Rx Clinician Rx  
 RE -2.50 = -0.75 ax 124 20/200 -0.25 20/20  
 LE -0.12 20/20 plano 20/20  
 ADD see remarks +2.00  
*Remarks:* The patient did not accept the automated examination. She was upset and confused. Apparently

as a result her right eye was highly overcorrected with concave lens as was evident from the earlier measurement of 20/30 with no lens. However, the left eye shows good agreement. No add was generated because of the RE error.

72.	May 7	#6456	Age 26	Sex M	Rating G
Computer-suggested Rx					
RE	-0.12		20/15	plano	20/20
LE	-0.12		20/15	plano	20/20

*Remarks:* Good agreement.

73.	May 7	#9520	Age 19	Sex F	Rating A
Computer-suggested Rx					
RE	-0.37		20/15	+0.25	20/20
LE	-0.37		20/15	+0.25	20/20

*Remarks:* Here the system appears to have a concave lens bias as confirmed by the printout showing 20/15 vision with plano each eye. A new program to be added will prevent this.

74.	May 5	#8459	Age 28	Sex F	Rating G
Computer-suggested Rx					
RE	-0.12		20/15	plano	20/20
LE	+0.12		20/15	plano = -0.25 ax 45	20/20

*Remarks:* Good agreement.

75.	May 5	#0742	Age 19	Sex M	Rating U-AE
Computer-suggested Rx					
RE	-1.87 = -0.25 ax 86		20/20	-0.75 = -0.50 ax 90	20/20
LE	-2.00		20/15	-1.25 = -0.25 ax 105	20/20

*Remarks:* The system suggests too much concave lens. Two points are made. First, looking at the record the error is obvious since the acuity through the old Rx (which is close to that of the clinician) was 20/15 in each eye. Second, a new flow chart is being programmed to prevent too much concave lens in the future.

76.	May 5	#9404	Age 20	Sex M	Rating A
Computer-suggested Rx					
RE	-0.37		20/15	-0.25	20/20
LE	-0.62		20/15	plano = -0.25 ax 70	20/20

*Remarks:* Right eye acceptable compared to that of the clinician, but left may have too much concave lens as confirmed by the computer acuity without lenses being 20/15.

77.	April 4	#9581	Age 32	Sex M	Rating G
Computer-suggested Rx					
RE	-0.75 = -0.25 ax 148		20/20	-0.75 = -0.25 ax 170	20/20
LE	-0.87		20/15	-0.75 = -0.25 ax 20	20/20

*Remarks:* Good agreement.

78.	March 8	#1819	Age 12	Sex M	Rating G
Computer-suggested Rx					
RE	-0.25 = -0.25 ax 100		20/25	-0.50 = -0.25 ax 90	20/20
LE	-0.25 = -0.25 ax 52		20/25	-0.25 = -0.25 ax 80	20/20

*Remarks:* Good agreement. This seventh grade student had no difficulty following the instructions.