



UNIVERSITY
OF YORK

**CENTRE FOR HEALTH ECONOMICS
HEALTH ECONOMICS CONSORTIUM**

Changing Medical Practice: A Study of Reflotron use in General Practice

by

**Brenda Leese and
John Hutton**

DISCUSSION PAPER 60

**CHANGING MEDICAL PRACTICE: A STUDY OF REFLOTRON USE
IN GENERAL PRACTICE**

by

Brenda Leese

and

John Hutton

September 1989

Authors

Brenda Leese is a Research Fellow, and John Hutton is a Senior Research Fellow in the Centre for Health Economics.

Acknowledgements

The authors would like to thank the GPs and staff in the two study practices. Thanks also to Angela Whelan who contributed to the initial stages of this study, to Roger Jennings of the DHSS and Ann Fiddick of Boehringer for helpful comments, and to Simon Rouse for providing the North Middlesex Hospital data. The study was funded by the Boehringer Corporation (London) Ltd.

Further Copies

Further copies are available (at price £4.00 to cover the costs of publication, postage and packing) from:

The Secretary,
Centre for Health Economics,
University of York,
Heslington,
York, Y01 5DD.

Please make cheques payable to the University of York. Details of other Discussion Papers can be obtained from the same address, or telephone (0904) 433648 or 433646.

ABSTRACT

This paper presents the results of a study of the use by two general practices of the Reflotron dry chemistry analyser. The Reflotron is a desk top system which can perform diagnostic tests using a drop of blood, for components such as haemoglobin, glucose and cholesterol, and produces results within minutes. The doctors and nurses who used the Reflotron gave generally favourable responses, and had found the equipment useful but not essential to practice organisation. They felt that patients would benefit most if the practices were to purchase a Reflotron.

The Reflotron was not used to a great extent during the study weeks. Blood samples requiring multiple tests, of which only some were available on the Reflotron, were likely to be sent to the hospital laboratory for all tests. The nurses had found the Reflotron particularly useful in antenatal and diabetic clinics and had continued to use it after the study had ended. The most useful tests were for haemoglobin, glucose and cholesterol, with electrolytes considered to be the most useful additional test. The 10% variation in comparative figures for some tests was viewed with concern, and it was felt that training of staff with emphasis on quality control was essential.

Practices which as a result of the NHS Review, choose to control their own budgets could find the Reflotron a useful addition to their practice, but this would depend upon the charging policy adopted by the hospital laboratory for diagnostic tests, with GPs choosing the cheapest option.

A Study of Reflotron use in General Practice

	Page
1. Introduction	1
2. Characteristics of the Practices	1
3. Current use of Laboratory Services	3
(a) Practice 1	4
(b) Practice 2	10
4. Potential Role of the Reflotron in General Practice	21
5. Use of the Reflotron	26
(a) Practice 1	26
(b) Practice 2	32
6. GP views on Reflotron Use	37
7. The Costs of having a Reflotron in the Practice	44
8. Discussion	49
Appendix 1 Abbreviations	53

List of Tables

<u>Table</u>	<u>Page</u>
1. Number of tests requested: Practice 1	4
2. Breakdown of tests requested available on Reflotron: Practice 1	5
3. Breakdown of tests requested not available on Reflotron: Practice 1	5
4. Taking of samples	6
5. Receipt of test results	7
6. Therapeutic impact: Practice 1	9
7. Type of tests in Practice 2	11
8. Number of tests requested in Practice 2	12
9. Breakdown of tests requested available on the Reflotron: Practice 2	13
10. Breakdown of blood tests requested not available on Reflotron: Practice 2	14
11. Number of times each test available to Practice 2 was requested	16
12. Receipt of test results by Practice 2 broken down by type of test	18
13. Therapeutic impact: Practice 2	19
14. Combined table: therapeutic impact	20
15. All tests requested from the North Middlesex Hospital during the study period	24
16. GP tests which could have been done on the Reflotron	24
17. Test requests for 11 months during 1987 (July excluded) which could have been done on the Reflotron	25
18. Number of tests requested by Practice 1 during each of the 2 Reflotron study weeks	27
19. Type of non-blood tests sent to the hospital laboratory during the Reflotron study week in Practice 1	27

<u>Table</u>	<u>Page</u>
20. Blood tests requested from the hospital laboratory by Practice 1 during the Reflotron study weeks	29
21. Type of tests requested by Practice 2 during the Reflotron study week	32
22. Type of tests requested by Practice 2 during the Reflotron study week, including those done on the Reflotron	33
23. Number of tests requested - Practice 2 Reflotron study week	33
24. Number and type of non-blood samples sent to the hospital laboratory by Practice 2 during the Reflotron study week	34
25. Breakdown of blood tests analysed by the laboratory only, and those analysed by the Reflotron, by Practice 2 during the Reflotron study week	35
26. Which tests did you find the Reflotron most useful for?	37
27. Which additional tests would you like to see available on the Reflotron?	38
28. If the practice were given a Reflotron, would you use it?	39
29. Would you expect the introduction of on-site testing on a long-term basis to contribute to any of the following?	40
30. Who would benefit most from the use of the Reflotron?	42
31. Summary of costs and savings of having a Reflotron in the Practice	49
Figure 1 Comparison of Reflotron and Laboratory Haemoglobin Results	47

1. Introduction

The study, which was designed to assess the impact of the introduction of the Reflotron laboratory analyser on general practice in the UK, was divided into two stages. The first stage involved the assessment of the current utilisation of laboratory testing by general practitioners, in terms of resource use and impact on clinical decisions, and the identification of circumstances in which the Reflotron analyser might be most useful to GPs (see Section 3). The second stage involved the monitoring and analysis of the actual impact of the equipment on the practices, when installed (see Section 5). Section 2 describes the characteristics of the two practices involved in the study and Section 7 attempts to assess the cost to the practices of having a Reflotron. The views of the doctors on the Reflotron are set out in Sections 4 and 6.

The tests available on the Reflotron at the time of the study were haemoglobin, glucose, cholesterol, urea, amylase, uric acid, triglycerides, GGT (gamma glutamyl transferase), GOT (glutamate - oxaloacetate transaminase), and GPT (glutamate - pyruvate transaminase).

2. Characteristics of the Practices

Practice 1 is located in a village near a medium sized town on the edge of the Pennines. The practice population extends to the surrounding rural and mining communities. The practice has a list size of approximately 11,000 patients with six doctors,

including one trainee, who see patients at the main premises and at two branch surgeries. Patients are seen at morning and evening surgeries on weekdays and on Saturday mornings. Special clinics are held for ante-natal care, cervical cytology, immunisation and baby-care.

The main premises are a spacious, older property on the main street of the village. The practice has a computer and ECG machine, and uses some standard items of medical equipment. The main hospital services called on by the practice are pathology, radiology and physiotherapy. Laboratory services are used at two nearby General Hospitals, depending on the patient's residential location.

The occupational classification of the patients is mainly working class with 55% of heads of households in skilled-manual, partly-skilled, or unskilled jobs. The principal cause of death for patients in the practice is heart and circulatory disease (33%) closely followed by respiratory disease (31%) with cancers in third place (19%).

Practice 2 contrasts with Practice 1 in that it is situated in a desirable suburban area of a large northern city. Housing tenure is predominantly owner occupied (78.4%) and it has the lowest proportion of council housing in the city (4%). Car ownership is the second highest in the city and uptake of further education is high.

This practice, with approximately 12000 patients, also has six partners, and a part-time associate. The practice is located on a single site in recently opened cost rented premises. There is a full time practice administrator and patients are seen from 8.30 a.m. to 6 p.m. on weekdays and for emergencies only on Saturday mornings. There are 3 part-time practice nurses who hold their own clinics, by appointment, from 9.30 a.m. - 5.30 p.m. on weekdays. There is also a well baby clinic twice a week, and five antenatal clinics per week as well as a developmental screening clinic. The practice also has a counsellor, two health visitors and a patient participation group. This practice is also a training practice and currently has a trainee. The premises are used by district nurses. Laboratory services are used at the nearby teaching hospital, although a certain amount of private work is contracted to a private laboratory.

3. Current Use of Laboratory Services

To monitor the current use of laboratory services by the two practices, specific surveys were carried out. Neither practice routinely recorded the number of tests ordered, so there was no historical data-base. Using a questionnaire, a one week study was undertaken in Practice 1 from 10 to 16 August 1987, and a similar study in the Practice 2 from 5 to 11 October 1987. All the practice partners were present during the respective study weeks.

(a) Practice 1

During the study week, Practice 1 ordered 96 tests for a total of 66 patients. Tables 1, 2 and 3 show the types of test requested, whether they could have been done on the Reflotron, and the frequency of multiple testing. In aggregate, 40% of the tests could have been done on the Reflotron. Although many patients required multiple testing, 21 patients (32%) could have been completely diagnosed in the surgery with the Reflotron.

46% of the samples were taken by doctors at the surgery, with a slightly smaller percentage requiring hospital attendance for sampling (Table 4). Table 5 shows the distribution of waiting times for results. The average wait was 5.2 days, with a median value of four days. Over 75% of results were received within five days.

Table 1: NUMBER OF TESTS REQUESTED

<u>Practice 1</u>					
No. of tests per Patient	No. of Patients	No. of Tests	No. of Tests possible on Reflotron	%	
4	2	8	4	50	
3	4	12	7	58	
2	16*	32	15	47	
1	44	44	13	29	
TOTAL	66	96	39	40	

* 1 patient both tests possible on Reflotron
2 patients neither test possible on Reflotron

Table 2: BREAKDOWN OF TESTS REQUESTED AVAILABLE ON REFLOTRON

Practice 1

Haemoglobin	22
Glucose	13
Uric Acid	1
Urea	1
GOT	1
GPT	1
<hr/>	
TOTAL	39
<hr/>	

Table 3: BREAKDOWN OF TESTS REQUESTED NOT AVAILABLE ON REFLOTRON

Practice 1

ESR	13
Urea and Electrolytes	8
Cervical Smear	4
MSU	3
Pregnancy	2
Thyroid function	2
Micro - C & S	2
Full Blood Count and Differential	2
Stool Culture	2
Others	19
<hr/>	
TOTAL	57
<hr/>	

Table 4: TAKING OF SAMPLES

Sample taken by:	<u>Practice 1</u>		<u>Practice 2</u>	
	No	%	No	%
Doctor	44	45.8	17	13.1
Hospital	41	42.7	10	7.7
Practice Nurse	0	0	87	66.9
Midwife	0	0	5	3.8
Patient	0	0	1	0.8
N/A	11	11.5	10	7.7
TOTAL	96	100	130	100

Table 5: RECEIPT OF TEST RESULTS

After no. of days	No. Tests		Comments
	<u>Practice 1</u>	<u>Practice 2</u>	
same day	3	1	
1	1	1	
2	9	23	
3	8	14	
4	26	8	
5	15	5	
6	6	7	
7	3	7	
8	2	6	
9	1	0	
10	3	4	
11	1	2	
12	0	2	
13	0	1	
16	1	1	Cervical Smears
17	2	0	GOT, GPT
18	0	1	Cervical Smear
20	0	2	Cervical Smears
21	0	5	1 Thyroid Func., 3 smears, 1 FBC
22	0	2	Cervical smears
25	0	1	MSU
30	1	1	Cold aggluto (Practice 2) cervical smear (Practice 1)
58	0	2	FBC+plasma viscosity
N/A	14	4	
TOTAL	96	100	
Average time (days)	5.2	8.1	
Median time (days)	4	5	
% available by 5 days	75	52	

NOTE: Practice 2 results exclude the 67 dipstick tests completed the same day.

The impact of the results on clinical decisions is shown in Table 6. For 62 tests the doctor waited for the results before taking any decision. In 41 cases (66%) the eventual decision was that no treatment was necessary. In seven of the remaining 21 such tests, specific action followed from the test results. The apparent inconsistency of the 13 responses of "continue existing treatment" after previously indicating "no decision taken", can be explained by the number of patients on long-term medication e.g. diabetics. In such cases the basic treatment would continue pending receipt of the test results, and would then be maintained or modified. Strictly interpreted for the purposes of this study, such cases should go into the "None/No treatment" cell as the test did not lead to a change of management at any stage. Using the higher figure of 54 this indicates that 56% of tests had no therapeutic impact. When a hospital appointment was considered necessary before the test results were received, the results of the test did not change that decision. In 23 cases drug prescriptions were immediately given, 18 were continued, but three were stopped and two changed after the test results were known. Overall, 12 tests resulted in changes in patient management (shaded in Table 6). 21 patients might have been diagnosed in the surgery if a Reflotron were available. Of these, seven patients had suspected anaemia and nine were possible diabetics. Five other patients also received haemoglobin tests. If the test for haemoglobin for the anaemic patients had been done at the surgery instead of the hospital, five patients need not have gone to the hospital, one would have avoided an initial prescription which was subsequently changed, and one would have been given a new drug immediately.

Table 6 THERAPEUTIC IMPACT PRACTICE 1

IMMEDIATE DECISION \ FINAL DECISION	NO TREATMENT	CONTINUE EXISTING TREATMENT	NEW DRUG PRES.	HOSP. APPT.	OTHER	N/A	ROW TOTAL
NONE	41	13	4	1	2	1	62
HOSP. APPT.	-	3	-	-	-	-	3
DRUG PRES.	3	18	2	-	-	-	23
OTHER	-	-	-	-	-	-	
N/A	4	2	1	1	-	-	8
COLUMN TOTAL	48	36	7	2	2	1	96

Shaded areas indicate where treatment changed after receiving test results i.e. 12 cases.

Of the nine patients with actual or suspected diabetes, two, tested at the hospital, were given no treatment, as were three tested by the GP. If the two tested at the hospital had been tested instead at the surgery, a hospital visit would have been avoided. For the remaining four patients, only one was given a new prescription, the other three continuing with their existing treatment. It took an average of 4.9 days for the results to reach the GP. The five patients diagnosed other than as anaemic or diabetic would have received immediate treatment if they had been tested by the GP.

(b) Practice 2

Practice 2 differed from Practice 1 in the type of tests directly available to it. Practice 2 GPs were not able to request directly the individual liver function tests available on the Reflotron (GGT, GOT, GPT), so none of those tests were requested during the study week. The tests routinely requested by Practice 2 GPs did not always directly correlate with those available on the Reflotron. For example, haemoglobin was part of FBC (full blood count), cholesterol and triglycerides were part of "fasting lipids" and U +E (urea + electrolytes) were available together.

During the study week, the Practice 2 GPs ordered 130 tests on 85 patients. 55 (42.3%) were blood tests, 47 (36.2%) were urine tests and 28 (21.5%) were classified as 'other' (Table 7). For the purposes of analysis all 'dipsticks' have been classified together, e.g. if a patient had dipstick analyses for glucose and

protein, this would count as one dipstick test only, because separate dipstick data was not collected during the study week when the Reflotron was in use. In this first study week, 30 consultations resulted in dipstick testing, although 67 individual dipstick tests were made.

Table 7: TYPE OF TESTS IN PRACTICE 2

	No.	%
On blood	55	42.3
On urine	47	36.2
Other	28	21.5
TOTAL	130	100

From Table 8 it can be seen that 25 or 19.2% of all the tests made could have been done, at first sight, on the Reflotron. However, these 25 tests included 14 FBC tests which would be replaced by haemoglobin alone on the Reflotron. The doctors' view was that haemoglobin alone would be sufficient in some cases, but that in others, full blood count would be needed. A further two of the 25 samples were for U + E (urea and electrolytes) and from the discussion with the GPs it could well be the case that without electrolytes, the Reflotron urea would be insufficient. Two other tests were for fasting lipids, which included cholesterol and triglycerides, and which would be acceptable in this form on the Reflotron.

Table 8: NUMBER OF TESTS REQUESTED - PRACTICE 2

No. tests/ patient	No. patients	No. tests	No. possible on Reflotron	%
8	1	8	5 ¹	62.5
6	2	12	4 ²	33.3
5	0	0	0	0
4	0	0	0	0
3	7	21	5 ³	23.8
2	14	28	3 ⁴	10.7
1	61	61	8 ⁵	13.1
TOTAL	85	130	25	19.2

NOTES:

1. Includes 2 FBC + 1 U + E
2. Includes 3 FBC
3. 4 FBC + 1 U + E
4. 2 FBC
5. 3 FBC + 2 fasting lipids

The most frequently requested tests which were available on the Reflotron were haemoglobin and glucose, as predicted by the doctors (see Table 9). Blood tests requested and not available on the Reflotron are listed in Table 10. FBC appears on both Tables 9 and 10. Excluding this, the most frequently requested tests not available on the Reflotron, were for thyroid function and plasma viscosity.

Practice 2 differed markedly from Practice 1 in who was responsible for taking the samples. Whereas in Practice 1 most were taken by the doctors or at the hospital, 67% in Practice 2 were taken by the practice nurse and only 13% by the doctors

Table 9: BREAKDOWN OF TESTS REQUESTED AVAILABLE ON THE REFLOTRON

Tests	<u>Practice 2</u>	
	On Reflotron	No. Tests
Glucose	Glucose	6
Uric acid	Uric acid	1
Full blood count	Haemoglobin	14
Fasting lipids)	Cholesterol	2
Fasting lipids)	Triglycerides	
U + E	Urea	2
TOTAL		25

Notes:

- (1) Hb available to Practice 1 as part of full blood count. Would Hb alone be sufficient?
- (2) Urea is part of U + E. Would urea alone be acceptable?

Table 10: BREAKDOWN OF BLOOD TESTS REQUESTED NOT AVAILABLE ON
REFLOTRON

Practice 2

TEST	NO. TESTS
Full blood count	14 (but Hb is part of this)
Plasma viscosity	6
Serum B12	2
Serum Folate	2
U + E	2 (but urea is available)
LFT	3
HbA ₁	1
Thyroid Function	7
WR	2
Prothrombin	1
Rh factor	1
Other	5
<hr/>	
TOTAL	46
<hr/>	

themselves (Table 4).

Table 11 lists the number of times each test available to the Practice 2 GPs was requested. There were 67 urine dipstick tests in 30 consultations, which accounted for 23% (30/130) of the 130 tests requested during the week. These tests are not available on the Reflotron but they do, like the Reflotron, provide rapid results which may be the reason for their widespread use. Excluding the dipstick tests, the most frequently requested tests were, as expected, for FBC, MSU (mid stream urine) and cervical smears. Table 5 compares the waiting time for test results for each practice. Practice 2 results took on average 2.9 days longer and only 52% were available by five days, compared with 75% of the Practice 1 results. Of the tests available on the Reflotron, FBC took an average of five days (if the anomalous 58 day sample is excluded), urea + electrolytes 6.5 days, uric acid two days, fasting lipids 12 days and glucose three days. (Table 12).

Table 13 shows the impact of Practice 2 results on clinical decisions. In 142 cases results were awaited before a decision on treatment was made (line 1 in Table 13). In 101 (71.1%) of these cases, no action was subsequently taken. In 16 of the remaining cases in this group, specific action followed receipt of the results. In the remaining 12 cases, where no action was initially taken and the subsequent action is not available, none of the tests could have been done on the Reflotron in any case. Neither could the three samples in Box 6, Table 13, in which both initial and final actions were unavailable.

Table 11: NUMBER OF TIMES EACH TEST AVAILABLE TO PRACTICE 2 WAS REQUESTED

BLOOD TESTS		URINE TESTS		OTHER TESTS	
FBC	14			Cervical Smear	12
Plasma viscosity	6			Swab	11
Monospot	0	"dipsticks"	30	ECG	1
Serum B12	2	MSU	14	X-ray	1
Serum Folate	2	preg.test	2	Ultrasound	0
U + E	2	Other	1	faecal culture	3
LFT	3			Histology	0
Ca	0			Other	0
Uric Acid	1				
Fasting lipids	2				
Glucose	6				
HbA ₁	1				
Thyroid	7				
WR	2				
Rubella	0				
Blood group	0				
Prothrombin	1				
Rhesus Factor	1				
Antinuclear factor	0				
Other	5				

"Dipsticks" were made up of 29 glucose tests; 30 protein tests; and 8 blood-in-urine tests.

If the 13 cases in which the same prescription was continued after receipt of the test results are added to the 101 cases, there were 114 cases (or 68.3%) where the tests results did not change patient management.

In 22 cases (the ones shaded in Table 13, excluding the 12 not available), changes were made after the test results were known (13.2%). Of these 22 cases, eight were blood tests, one of which (glucose) could have been done on the Reflotron. In this case, no action was taken initially, then when the test result was known, the patient's prescription was changed.

Table 14 combines data for both practices in percentage form. Here, in 47 or 17.9% of the tests, (shaded in Table 14) treatment had changed after the test results were available. This included 13 tests (4.9%), the 12 from Practice 2 discussed above, and one from Practice 1, in which the final decision was not available.

Table 12: RECEIPT OF TEST RESULTS BY PRACTICE 2 BROKEN DOWN BY TYPE OF TEST (excludes dipstick results and those N/A)

TEST	Average time taken (days)	No. tests	Range (days)	On Reflotron?
A. <u>BLOOD</u>				
FBC	* 9	14	2-58	Partly
Plasma Visc.	* 14	5	2-58	No
Serum B.12	2	2	2	No
Serum Folate	2	2	2	No
U + E	6.5	2	3-10	Partly
LFT	3	3	3-4	No
Uric acid	2	1	2	Yes
Fasting lipids	12	2	11-13	Partly
Glucose	3	6	2-8	Yes
Hba ₁	8	1	8	?
Thyroid Funct.	11	7	6-21	No
WR	8	2	6-10	No
Prothrombin	12	1	12	No
Rhesus Factor	5	1	5	No
Other	9	5	2-30	No
B. <u>URINE</u>				
MSU	5	14	2-25	No
Pregnancy test	3	2	1-4	No
C. <u>OTHER</u>				
ECG	same day	1	-	No
X-ray	2	1	-	No
Faecal culture	7	3	4-10	No
Swab	6	10	3-8	No
Cervical smear	19	9	10-22	No

* 5 days for FBC and 3 days for plasma viscosity if the 58 day sample excluded.

Table 13: THERAPEUTIC IMPACT PRACTICE 2

FINAL DECISION

Final Imm	No Treatment	Continue existing treatment	New Prescript.	Hosp. appt.	Other	N/A	TOTAL	
None	101	13	10	-	6	12	142	1
Hosp. Appt	1	-	2	-	-	-	1	2
Prescription	4	10	2	-	-	1	17	3
Nurse → GP	1	-	-	-	-	-	-	4
Other	3	-	-	-	-	-	3	5
N/A	-	-	-	-	-	3	3	6
TOTAL	110	23	12	0	6	16	167	

Shaded areas indicate where treatment had changed after receiving test results i.e. 34 cases inc. 12 where final result is not known.

Table 14: COMBINED TABLE: THERAPEUTIC IMPACT

PRACTICES 1 & 2

FINAL DECISION

Final Imm	No Treatment	Continue existing treatment	New Prescript.	Hosp. appt.	Other	N/A	TOTAL
None	54.0	9.9	5.3	0.4	3.0	4.9	77.6
Hosp. Appt	0.4	1.1	-	-	-	-	1.5
Prescription	2.7	10.6	1.5	-	-	-	15.2
Nurse → GP	0.4	-	-	-	-	-	0.4
Other	1.1	-	-	-	-	-	1.1
N/A	1.5	0.8	0.4	0.4	-	1.1	4.2
TOTAL	60.1	22.4	7.2	0.8	3.0	6.5	100

Figures are % of total number of tests for both practices.

Shaded areas indicated where treatment had changed after receiving tests results, i.e. 17.9% (47) of total tests. This included 13 tests in which final decision was N/A.

Total tests = 263

4. Potential Role of the Reflotron in General Practice

The monitoring of actual use of tests was supported by a survey of doctors' opinions on and attitude to the use of the Reflotron analyser.

Interviews were carried out before the monitoring results were known. The responses from Practice 1 are discussed here.

The doctors' impression that haemoglobin and glucose were the most frequently requested tests proved correct. Of those not available on Reflotron, electrolytes, thyroid tests, and ESR were thought to be the most common. During the survey week thyroid testing was not frequent but the other two were.

If the Reflotron were available, increased use of haemoglobin and glucose tests was predicted, the latter probably stimulating the establishment of a specific diabetic clinic. Specific clinics for other conditions, such as monitoring those at risk of heart disease, were unlikely to be set up.

There was unanimous agreement that when multiple tests were needed, and not all were available on Reflotron, the sample would be sent to the hospital for all the tests to be done there. Only in the case of monitoring glucose levels for diabetics did the doctors feel that the use of Reflotron in their practice was likely to produce immediate improvements in the quality of care. In such circumstances the need for hospitalisation could be more speedily determined, leading to faster therapeutic intervention,

or the avoidance of an unnecessary hospital visit.

The doctors did not perceive any great efficiency improvements which might stem from the use of Reflotron. Sample-taking in the practice is done by the doctors, so decisions on the organisation of the use of the Reflotron could have a significant effect on the use of their time. What they were sure of was the increased convenience for patients of surgery-based testing (or home-based for the elderly?). The situation of the practice between two urban areas meant that hospital visits for tests, particularly using public transport, could be very time consuming.

For comparative purposes, an analysis was carried out of data from the North Middlesex Hospital, on GP test requesting patterns to the hospital laboratory for 11 months during 1987 (July excluded). The data are summarised in Tables 15-17. At the North Middlesex Hospital Laboratory, 12.7% of all the tests requested were from GPs (Table 15), and of the total GP requests 19.7% could have been done on the Reflotron (Table 16). Table 17 gives the breakdown of tests from all sources which could have been done on the Reflotron, and shows that 12.7% of these requests were from GPs. However, it is possible that some of the potential Reflotron tests not done by GPs could have been done away from the hospital laboratory if suitable equipment was available elsewhere in the hospital. During the 11 months of the study, a total of 922,682 tests were performed by the hospital laboratory, and of these, 23,152 (or 2.5%) could have been done by GPs using the Reflotron.

During the study period in Practice 1, 40% of the total number of tests performed could have been done on the Reflotron. The corresponding figure for Practice 2 was 19%, reflecting their high use of urine dipsticks. If the 67 urine dipstick analyses are excluded, since they would not have been included in the requests to the North Middlesex Hospital laboratory, then 25% of the 100 tests requested in Leeds could have been done on the Reflotron. These figures should be compared with that of 19.7% for the GP test requests to the North Middlesex Hospital.

Judging by Practice 1, the potential role of Reflotron, with its current range of tests, seems quite limited. However, indications from Practice 2 are that, in different geographic and social circumstances, the scope is much wider. The use of the Reflotron in connection with special clinics, e.g. to try to prevent heart disease, was regarded as an obvious possibility. Practices undertaking health screening work for private industry could also see a use for the equipment, and also a possible way around the financial constraints. The practices took a sceptical view of the likelihood of the NHS funding them to use equipment such as the Reflotron in the near future.

Table 15: ALL TESTS REQUESTED FROM THE NORTH MIDDLESEX
HOSPITAL DURING THE STUDY PERIOD

Specialty	Total tests requested	GP tests requested	% from GPs
Biochemistry	507382	52494	10.3
Referred biochemistry	2348	294	12.5
Haematology	412932	64622	15.6
Total	922662	117410	12.7

Table 16: GP TESTS WHICH COULD HAVE BEEN DONE ON THE
REFLOTRON

No. all tests requested from GPs	No. GP requests which could have been done on Reflotron	% of all GP requests which could have been done on Reflotron
117410	23152	19.7

Table 17: TEST REQUESTS FOR 11 MONTHS DURING 1987 (JULY EXCLUDED) WHICH COULD HAVE BEEN DONE ON THE REFLOTRON

Test	GP as % of total	Total no. requests	No. GP requests
ALT (GPT)	0	0	0
Amylase	3.4	1248	43
AST (GOT)	9.6	20873	2021
Cholesterol	40.8	2160	882
Glucose	11.6	23401	2728
GGT	9.2	1828	170
Triglycerides	41.0	2154	885
Uric acid	28.3	2189	620
Urea	6.9	44731	3110
Haemoglobin	15.2	83206	12693
Total	12.7	181790	23152

5. Use of the Reflotron

After receipt of the Reflotron, Practice 1 undertook two separate study weeks, during which the use of the Reflotron was monitored. The first week took place from 11th to 15th July 1988, and the second week from 26th to 30th September 1988. The study was carried out for two separate weeks rather than just one because, after the first week, two falsely low haemoglobin results had been obtained on the Reflotron, so it was decided to have a second study week, and during this week, all samples analysed on the Reflotron would also be sent to the hospital laboratory for comparison. During the first study week there was no comparison of the Reflotron results with the hospital laboratory results. For Practice 2, the local ethics committee had insisted that, during the study week, all samples analysed by the Reflotron should also be analysed by the hospital laboratory for comparison. There was only one study week for Practice 2, from 7th to 11th November 1988.

(a) Practice 1

First study week with the Reflotron

During this week five of the six doctors were present. The doctors had been able to practice using the Reflotron for two weeks before the study week commenced. The practice made use of 96 tests for a total of 18 patients (see Table 18).

Of the non-blood tests, 29 urine tests were done in the surgery, and a further 34 non-blood samples were sent to the

hospital laboratory for analysis. The breakdown of these tests is shown in Table 19. The remaining 33 tests out of the total of 96 were blood tests (Table 18).

Table 18: NUMBER OF TESTS REQUESTED BY PRACTICE 1 DURING EACH OF THE 2 REFLOTRON STUDY WEEKS

<u>Test</u>	<u>1st week</u> (no.)	<u>2nd week</u> (no.)
Non-blood tests requested from hospital laboratory.	34	25
Urine tests done in the surgery.	29	25
Blood tests requested from hospital laboratory.	23	40
Blood tests on Reflotron.	10	10
Total	96	100

Table 19: TYPE OF NON BLOOD TESTS SENT TO THE HOSPITAL LABORATORY DURING THE REFLOTRON STUDY WEEKS IN PRACTICE 1

<u>Test</u>	<u>1st week</u> (no.)	<u>2nd week</u> (no.)
MSU	18	7
Stool	3	0
Gravidex	3	2
Swab	1	2
Sputum	1	0
X-ray	7	8
ECG	1	1
IV pylorogram	0	1
Barium meal	0	1
Ultra sound scan	0	2
HVS (high vaginal swab)	0	1
Total	34	25

The 33 blood tests out of a total of 96 samples taken during this week should be compared with the 39 tests potentially available on the Reflotron, of the total of 96 tests ordered during the study week before the Reflotron was installed.

23 blood tests for 10 patients were requested from the hospital laboratory. These are listed in Table 20. Of the 23 tests, three were available on the Reflotron (one glucose and two haemoglobins), but were sent to the hospital because the patients concerned also required other tests not available on the Reflotron. Three urea + electrolyte tests were also requested from the laboratory, although urea alone is available on the Reflotron. In the three latter cases, other tests, also not available on the Reflotron, were requested from the hospital laboratory.

Ten tests were performed on the Reflotron for eight patients during the study week. Seven were for haemoglobin, two for glucose and one for cholesterol. Immediate decisions made by the doctor for the eight patients were various. In two cases, the decision was not known, and for three patients, no treatment was considered necessary. One patient had further hospital tests requested; another had a drug prescription and a follow-up GP appointment, and another had a GP and a hospital appointment with possible hospital admission.

In the pre-Reflotron study week 39 tests requested were available on the Reflotron (Table 2), but it was calculated that only 21 patients could have been completely diagnosed in the

Table 20: BLOOD TESTS REQUESTED ONLY FROM THE HOSPITAL LABORATORY BY PRACTICE 1 DURING THE REFLOTTRON STUDY WEEKS

Test	1st week Number	2nd week Number	Available on Reflotron?
BUN	0	1	No
FSH	0	1	No
GOT	0	1	Yes
LH	0	1	No
GPT	0	1	Yes
testosterone	0	1	No
cortisol	0	1	No
procreatine	0	1	No
fructosamine	0	1	No
urea	0	1	Yes
TFT	2	5	No
Hb	2	11	Yes
ESR	3	4	No
RAT	1	1	No
cardiac enzymes	1	0	No
LFT	1	2	No
white cell count	1	0	No
FBC	5	1	No
monospot	1	0	No
serum fibrinogen	0	1	No
urea + electrolytes	3	1	No
uric acid	0	1	Yes
Rh. factor	0	1	No
glucose	1	1	Yes
occult blood	1	0	No
creatinine	0	1	No
serum ferritin	1	0	No
Total	23	40	

surgery using the Reflotron. These figures are higher than those in the first Reflotron study week, but in this latter week, only five of the six doctors were present. The tests requested and available on the Reflotron during the pre-Reflotron study week and the first Reflotron study week differed in number and type. In both cases, haemoglobin was the most frequently requested test; 22 (56.4% of the total possible Reflotron tests) in the pre-Reflotron study week and seven (70%) in the first Reflotron study week, closely followed by glucose - 13 tests (33.3%) in the pre-Reflotron week, and two (20%) in the first Reflotron week. Other tests in the pre-Reflotron study week were one each of uric acid, urea, GOT and GPT; and in the first Reflotron week, one request for cholesterol. These figures include those for patients who also had additional tests which were not available on the Reflotron.

Second study week with the Reflotron

During the second Reflotron study week in Practice 1, all six doctors were present. Between the first and second study weeks, two falsely low haemoglobin results had been obtained from the Reflotron, so it was decided that, for the second Reflotron study week, all samples analysed on the Reflotron should also be sent to the hospital laboratory for comparison.

During the second Reflotron study week, the practice requested 100 tests for a total of 22 patients (Table 18). During this week, 25 urine tests were done in the surgery and a further 25 non-blood samples were sent to the hospital laboratory for analysis (Table 19). The remaining 50 tests, from the total

of 100, were blood tests (Table 20), and 10 of these (20%) were performed on the Reflotron. The Reflotron tests were confirmed by the laboratory and there were no discrepancies.

40 blood tests were requested from the hospital laboratory only. These are listed in Table 20. Of the 40 tests, 16 were available on the Reflotron (11 haemoglobin, and one each of GOT, GPT, urea, uric acid, and glucose). In all cases except two, these tests were not done on the Reflotron because other tests, not available on the Reflotron, were also required. In the remaining two cases, one glucose test sample was taken at a branch surgery where the Reflotron was not available and one haemoglobin was considered by the GP to be non-urgent, and was sent to the hospital laboratory. Test results took from one to ten days to be received from the laboratory.

Ten tests were carried out on the Reflotron only, for six patients: four tests were for haemoglobin, two for glucose and one each for cholesterol, GGT, GOT and GPT. Immediate decisions on the six patients following Reflotron testing were, "no treatment necessary" in three cases, one hospital appointment, one follow-up appointment, and one decision for other tests to be done at the hospital. By using the Reflotron, six follow-up appointments to receive the results had been avoided.

If all the tests utilised and available on the Reflotron (including those which were actually analysed at the hospital because other tests not available on the Reflotron were also requested) are included, haemoglobin remains the most frequently

requested test.

(b) Practice 2

Reflotron study week

During their single Reflotron study week, Practice 2 ordered 169 tests on 93 patients (note that some patients may have been seen more than once during the study week so that 93 is effectively the number of consultations resulting in at least one test). 84 of the tests (49.7%) were blood tests, 53 (31.4%) were urine tests and 32 (18.9%) were classified as 'other' (see Table 21). These figures were similar to those in Table 7 which were before the Reflotron was in use. Table 22 shows data similar to that in Table 21, but indicating the number of tests analysed on the Reflotron.

Table 21: TYPE OF TESTS REQUESTED BY THE PRACTICE 2 DURING THE REFLOTRON STUDY WEEK

Type	Number	%
on blood	84	49.7
on urine	53	31.4
other	32	18.9
TOTAL	169	100

Table 22: TYPE OF TESTS REQUESTED BY PRACTICE 2 DURING THE REFLOTTRON STUDY WEEK, INCLUDING THOSE DONE ON THE REFLOTTRON

Type	Number	%
non-blood sent to hospital lab	55	32.5
urine done in surgery	30	17.8
bloods done in hospital lab	55	32.5
bloods on Reflotron (& confirmed by lab)	29	17.2
TOTAL	169	100

Reflotron tests constituted 17.2% of all the tests requested. A similar proportion (19.2%) was estimated from the study week before the Reflotron was installed (see Table 8). Table 23 sets out the results obtained in the Reflotron study week in the same format as Table 8, indicating the number and proportion of tests carried out in the Reflotron.

Table 23: NUMBER OF TESTS REQUESTED - PRACTICE 2 REFLOTTRON STUDY WEEK

No. tests/ patient	No. patients	No. tests	No. on Reflotron	% on Reflotron
6	1	6	0	0
5	3	15	3	20
4	4	16	4	25
3	13	39	15	38.5
2	21	42	7	16.7
1	51	51	0	0
TOTAL	93	169	29	17.2

Table 24 shows a breakdown of the non-blood samples sent to the hospital laboratory during the Reflotron study week. In addition, there were 30 urine dipstick tests performed in the surgery. It should be noted here that for the pre-Reflotron study week "dipsticking" was divided into three groups - for glucose, protein and blood - but for the second study week with the Reflotron, the category on the form was "dipsticking" only. In the latter week, dipsticking may have been carried out more than once in a single consultation, although it would appear only once on the form. Results in both study weeks have been taken as a simple dipstick test per consultation, to aid comparisons.

Table 24: NUMBER AND TYPE OF NON-BLOOD SAMPLES SENT TO THE HOSPITAL LABORATORY BY PRACTICE 2 DURING THE REFLOTRON STUDY WEEK

Test	Number
MSU	19
cervical smear	17
swab	7
pregnancy test	3
faeces culture	3
X-ray	2
cytology	1
nail clippings	2
ECG	1
TOTAL	55

During the Reflotron study week, the most frequently requested Reflotron test was haemoglobin, followed by urea and then glucose, cholesterol and triglycerides. During this week, and excluding FBC requests, the most requested blood tests not available on the Reflotron were plasma viscosity, TFT, U+E and LFT (Table 25). As in the first study week, the most frequently requested of all tests were found to be FBC/haemoglobin, MSU, and cervical smears, followed by plasma viscosity and TFT.

Table 25: BREAKDOWN OF BLOOD TESTS ANALYSED BY THE LABORATORY ONLY, AND THOSE ANALYSED BY THE REFLOTRON, BY PRACTICE 2 DURING THE REFLOTRON STUDY WEEK

<u>Tests analysed only by the laboratory</u>	<u>No.</u>	<u>Test analysed on the Reflotron</u>	<u>No.</u>
Hb	1	Hb	16
FBC	15	glucose	2
plasma viscosity	9	cholesterol	2
monospot	2	triglyceride	2
serum B12	1	uric acid	1
U+E	5	amylase	2
LFT	5	urea	3
TFT	7	GGT	1
HbA ₁	1		
rheumatoid factor	2		
SUA	2	<u>TOTAL</u>	<u>29</u>
Hep. B status	1		
lithium level	1		
alcohol level	1		
platelet aggregation	1		
digoxin	1		
<u>TOTAL</u>	<u>55</u>		

In the Reflotron study week, 36 consultations resulted in blood tests and 12 of these consultations did not involve use of the Reflotron. In total 29 tests were done on the Reflotron, and 55 by the hospital laboratory, making a total of 84 blood tests

in 36 consultations. Of the 55 blood tests sent to the hospital laboratory, 54 were not available on the Reflotron (including the 12 FBC tests which include haemoglobin). The single additional case was a haemoglobin test sent to the hospital, together with a request for FBC in a case of suspected glandular fever.

16 haemoglobin tests were analysed on the Reflotron, and for 11 of these, FBC was also requested from the hospital laboratory. FBC was presumed to be requested in these cases because it contains haemoglobin as well as other tests.

Five consultations resulted in Reflotron tests only. These were two cases of haemoglobin, and one each of haemoglobin, glucose and urea; cholesterol and triglyceride; and cholesterol, triglyceride and GGT.

In terms of the clinical decisions taken for the patients, in most cases, tests not available on the Reflotron had been requested in addition to the Reflotron tests, so the most common initial decision was to "await laboratory results".

In the four cases where Reflotron tests only were done, because confirmation by the laboratory was requested by the ethical committee, three still awaited laboratory results, so the test was not a fair one. In one case, it was decided immediately that no action was required.

6. Results of the Survey on GP Attitudes to the Reflotron

A small study involving the doctors from each of the two practices was undertaken to assess GP attitudes to having a Reflotron in the practice. Views were assessed using a questionnaire.

All of the doctors, or a nurse on their behalf, had used the Reflotron during the study weeks. None of the doctors in Practice 2 had experienced any difficulty in using the Reflotron, but four did not use the machine personally. Two of the Practice 1 GPs had experienced difficulties which were related to the two inaccurate results obtained by this practice, outside the study weeks. When asked whether they had used the Reflotron outside the study weeks, five of the Practice 1 doctors and two from Practice 2, said that they had. Table 26 sets out the tests which the doctors found most useful. These were found to be glucose, haemoglobin and cholesterol.

Table 26: WHICH TESTS DID YOU FIND THE REFLOTRON MOST USEFUL FOR?

	Practice 1	Practice 2	Total
Glucose	6	3	9
Haemoglobin	5	4	9
Cholesterol	4	2	6
Triglycerides	1	1	2
GGT	0	0	0
Uric Acid	1	0	1
Urea	0	0	0
GPT	0	1	1
Amylase	0	1	1
GOT	0	0	0

The doctors were asked whether, if more tests were available on the Reflotron, their use of the machine would increase. Two of the six Practice 1 GPs, and four of the six Practice 2 GPs felt that it would. Four Practice 1 GPs felt that it would not and two Practice 2 GPs were uncertain. Additional tests which the doctors would like to see made available on the Reflotron are listed in Table 27. It can be seen that electrolytes (K+ and Na+) were most often cited, followed by alcohol, liver function and thyroid function tests, and digoxin.

Table 27: WHICH ADDITIONAL TEST WOULD YOU LIKE TO SEE
AVAILABLE ON THE REFLOTRON?

	Practice 1	Practice 2	Total
None/no response	5	1	6
Na+	1	0	1
K+	1	3	4
LFT	0	1	1
Alcohol (ethanol)	0	2	2
Digoxin	0	1	1
Thyroid Function Test	0	1	1

When asked if they would support the purchase of a Reflotron for the practice if the reimbursement system remained unchanged (i.e. no direct reimbursement), three Practice 1 GPs and three Practice 2 GPs were in favour, but three doctors from each practice were against. When asked the same question, but assuming the introduction of reimbursement, the numbers increased to four of the six Practice 1 GPs and all of the Practice 2 GPs being in favour. Table 28 shows the results of the use GPs felt they would make of the Reflotron if they were to be given one for

their practice. This table indicates a generally favourable response.

Table 28: IF THE PRACTICE WERE GIVEN A REFLOTRON, WOULD YOU USE IT?

	Practice 1	Practice 2	Total
Only if more tests were available	0	0	0
A lot	2	3	5
A little	4	3	7
Not at all	0	0	0

An open-ended question was asked on whether, if a Reflotron were available to the practice, it would change the way in which the practice was organised. Four doctors (one in Practice 1, three in Practice 2) mentioned its potential usefulness in diabetic clinics or diabetic care in general. One Practice 1 GP mentioned lipid screening and one in Practice 2 specifically mentioned hypercholesterolaemia screening, but felt that more nurse time would be required. Possible use in a well man clinic was mentioned by one of the Practice 2 GPs, and another mentioned that the blood tests taken at employment medical examinations and currently analysed by a private laboratory could be done on the Reflotron, but this doctor did not see the advantage in routine work since the laboratory would always be cheaper. One Practice 1 GP was positively against the Reflotron in that preventive/anticipatory care was already practised in most consultations and there were no plans for "superfluous" screening clinics.

Since not all of the frequently requested tests are available on the Reflotron, the doctors were asked, if multiple tests were required on the same sample, and if not all were available on the Reflotron, whether they would send samples to the laboratory, for all tests, or whether they would do those available on the Reflotron themselves and have the remainder analysed at the hospital. Five of the Practice 1 and three of the Practice 2 GPs would, in these circumstances, send all of the tests to the laboratory, and only one Practice 1 and three Practice 2 GPs would do some of the tests on Reflotron.

Table 29 sets out the results of asking whether the GPs would expect the introduction of on-site testing on a long term basis to contribute to a list of outcomes. Most felt that patients would receive the most benefits.

Table 29: WOULD YOU EXPECT THE INTRODUCTION OF ON-SITE TESTING ON A LONG-TERM BASIS TO CONTRIBUTE TO ANY OF THE FOLLOWING?

	Practice 1	Practice 2	Total
a) Better use of resources within practice	2	2	4
b) Increased convenience for patients	4	6	10
c) Improved quality of care	2 (+1?)	4	6+1?
d) Increased service provision for patients	4	5	9
e) Increased convenience for the GPs	4	3	7

Doctors were asked to give examples of situations in which on-site testing and immediate results would lead to significant improvements in the effectiveness of therapy. Six doctors specifically mentioned diabetes (five from Practice 1 and one from Practice 2), but one of the Practice 1 GPs pointed out that they already had a glucose meter in the practice. Two Practice 2 GPs included blood sugar, haemoglobin and thyroid function tests. One of these GPs also mentioned glucose measurements when speedy referral might be required, and the other mentioned triglycerides. The usefulness of speedy diagnosis and action was also mentioned by one Practice 2 GP who cited hypo- and hyperglycaemia and kalaemia, and digoxin overdose. Tests, such as thyroid function, which currently took a long time to be analysed by the hospital laboratory, were also mentioned. However, one Practice 2 GP pointed out that the Reflotron might speed up diagnosis and therefore management, but would not necessarily make treatment more effective. Another GP mentioned that the Reflotron would be useful if all electrolytes were available, and also mentioned its usefulness for hypertension and obesity as well as diabetes. One Practice 2 GP listed haemoglobin, thyroid function and serum potassium as well as blood sugar. Only two GPs (one from each practice) responded with a "no" to this question. Four doctors (two from each practice) said that such cases occurred infrequently in their practices. One from Practice 1 mentioned 10% of the time, and one from Practice 2 one or two cases per week. The rest were either unsure or did not respond to the question.

The main drawbacks to the widespread use of the Reflotron in general practice, in the present reimbursement situation, were cited as: cost by five Practice 1 and three Practice 2 GPs; time by two Practice 1 and two Practice 2 doctors; accuracy by one Practice 1 GP, and the temptation to do unnecessary tests by one Practice 2 GP. Table 30 shows the results of asking the GPs whom they felt would benefit most from the use of the Reflotron. Most benefit, it was thought, would be derived by the patients.

Table 30: WHO WOULD BENEFIT MOST FROM THE USE OF THE REFLOTRON?

	Practice 1	Practice 2	Total
Doctors	3	2	5
Patients	6	5	11
Hospital	3	0	3
No one	0	0	0
Other	0	1(DHA)	1

Practice 2 had a delivery service for specimens to be sent to the hospital, but in Practice 1 the methods of transporting samples to the laboratory included not only a delivery service, but also samples being taken by the GPs themselves, or the patient travelling to the hospital. Additional comments about the Reflotron were requested and three doctors responded. One had "enjoyed having it", another said that it was "a good idea" and the third said that was "easy to use".

Conclusions

The results of the questionnaire revealed a generally favourable attitude on the part of the GPs towards the Reflotron. It was notable that seven of the 12 responding GPs had used the Reflotron outside the study weeks. In addition, six of the 12 felt that their use of the Reflotron would increase if more tests were available, although four said it would not, and two were uncertain.

The most useful tests were considered to be glucose, haemoglobin and cholesterol, and the most favoured additional test was for electrolytes. Even if the reimbursement system for equipment were to remain as it is now (i.e. no direct reimbursement), six of the 12 GPs favoured the purchase of a Reflotron by their practice, and this increased to 10 out of 12 if the system were changed to allow reimbursement. In addition, five of the doctors said they would use the Reflotron "a lot" if the practice were given one, and seven would use it "a little".

The Reflotron was thought to be particularly useful in diabetic clinics; and lipid testing was also mentioned, as were its advantages when speedy referral was required. In addition, one GP said the Reflotron would be of advantage over using a private laboratory for non-FPC work.

In spite of these generally favourable reactions to the Reflotron, eight of the 12 GPs would send all tests to the hospital laboratory if some were not available on the Reflotron.

The major drawbacks to the widespread use of the Reflotron were seen to be cost and the reimbursement system (eight out of 12 GPs), followed by time (four out of 12 GPs). It is also clear that an increase in the type of tests available would have a positive effect. This survey was conducted before the NHS Review was published.

The most important factors necessary for the widespread use of the Reflotron in general practice would therefore appear to be:

- (1) availability of more tests
- (2) reliability
- (3) competitive pricing.

The NHS Review, in allowing GPs in larger practices to control their own budgets, may encourage such practices to seek the most economic way of obtaining diagnostic tests. This survey suggests they might well choose a Reflotron (or similar machine) rather than buying some tests from the local hospital.

7. The Cost of having a Reflotron in the Practice

GPs in Practice 2 referred patients needing blood tests to the practice nurse, whether the samples were to be sent to the laboratory or analysed on the Reflotron, so consultations with the GPs were not prolonged. Nursing time was approximately three minutes per venesection (which again would be the same for laboratory or Reflotron tests). Reflotron analysis would take

approximately two minutes. A single test would therefore require five minutes nursing time, with two minutes per additional test, at a cost of £6 per hour in nurse salaries (reduced to £1.80 after 70% reimbursement). The nurses pointed out that most of the additional time which slowed them down during the study week was due to: (a) duplicating tests for the hospital, completing laboratory forms and labelling bottles and; (b) completing the Reflotron study form. Without these hindrances, time taken would be no greater than under the usual system. The practice would not envisage employing extra staff, but Reflotron analysis would be fitted in with existing nursing time. This might change, in view of the White Paper, if the practice were asked to analyse samples from large numbers of patients from other practices wanting "instant" results. But in that situation, the practice would presumably be selling its services and expertise.

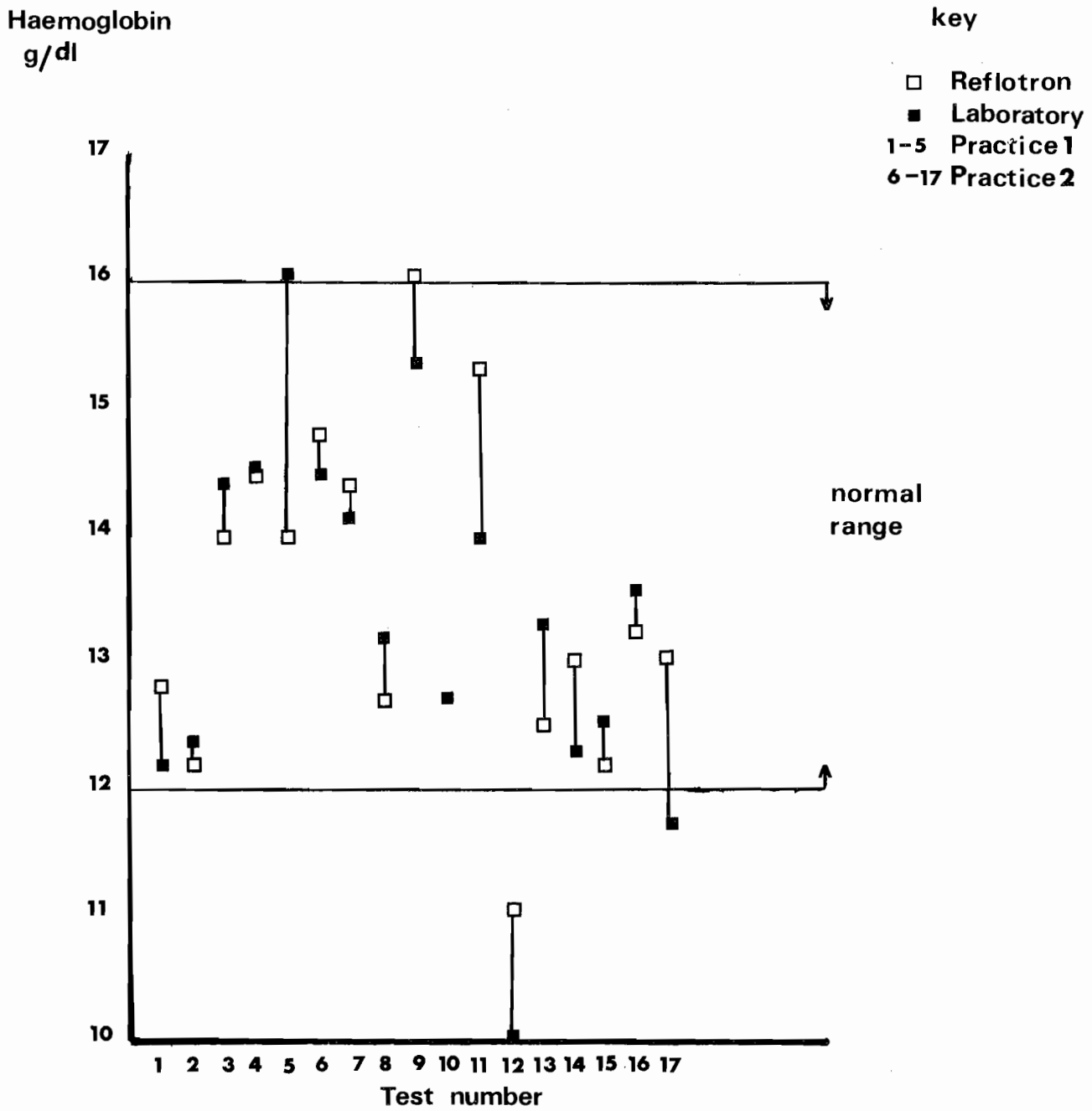
The overall impact of the Reflotron on Practice 2 was discussed with one of the doctors and one of the nurses involved. There was some concern felt by the doctor at the variability in some of the haemoglobin results, plotted in Figure 1, particularly where they differed by 10% or more from the laboratory results, but the differences were not consistently positive or negative and were not statistically significant. The nurse was pleased with the Reflotron results and had continued to use the equipment, though less often, since the study had ended. She had found it particularly useful for haemoglobin measurements in the antenatal clinic and for glucose in the diabetic clinic. The patients at the antenatal clinic had been impressed with receiving their haemoglobin results immediately. The practice had a glucose meter which would be used if only a few tests were

required, but if more were required the Reflotron would be used. Samples were not sent to the hospital laboratory for comparison in these situations. In general, the nurses decided for themselves when to use the Reflotron, and also when to send samples to the laboratory, and it was likely that if tests not available on the Reflotron were requested, as well as those that were, all would be sent to the laboratory.

The practice had a daily collection system for specimens for the hospital laboratory, which meant that samples had to be available by 9.30 a.m. For patients consulting after that time, they had to return the following morning, or the sample was stored in the fridge. The Reflotron was useful there if an urgent result was needed. The doctor pointed out that potassium is the most important missing test for the Reflotron since samples cannot be stored and have to be sent directly to the laboratory.

During the study week, the nurses had done all the Reflotron tests in bulk at the end of the morning, so that patients were not aware of the change. The doctor noted that results were rarely needed immediately and that although the average time taken to receive results from the laboratory was high (8.1 days), if there was an abnormal result, the laboratory would telephone the GP and the GP could also telephone the laboratory if he or she was concerned about a patient.

Figure 1 : Comparison of Reflotron and Laboratory Haemoglobin Results.



The doctor suggested that the Reflotron was "too simple" for nurse use, and a more cost effective method would be to train a receptionist to use it. The nurse, however, had doubts about this. Although agreeing that her skills might be better used elsewhere, she was concerned that, although a receptionist could certainly be trained to use the Reflotron, interpreting results was a different matter and would need very careful training or a nurse on hand to comment. The Reflotron did take up more time. This practice already employed its full complement of ancillary staff allowed under FPC rules, an exception to the national average, so would have to redeploy existing staff if required.

The nurse felt that the Reflotron would be a must if the practice were to control its own budget; the doctor was more circumspect, saying it would depend on costs. The practice would use the cheapest alternative. If this were the Reflotron, one would be purchased; if the hospital laboratory could offer cheaper tests, then the hospital would be used. There was some discussion on which costs would be passed on to the GP - marginal, average or total. The GP commented that commercial laboratory charges for a patient profile were lower than the cost of tests on the Reflotron. It is possible that a hospital laboratory might have differential charges, depending on the customer, perhaps charging marginal cost to patients within the hospital, but total costs to someone from outside.

From figures provided by Boehringer, for a practice doing 30 tests per week, each test would cost £2.07, and if 60 tests per week were done, this would fall to £1.48 per test. These figures

include the cost of the Reflotron, assuming a seven year life-span, the service contact, VAT, all consumables and is based on an average test strip cost of 86p (the actual cost of the strips ranged from 64p for glucose to £1.34 for amylase). The more frequently requested tests tended to be cheaper. Table 31 summarises the potential costs and savings to a practice having a Reflotron.

Table 31: SUMMARY OF COSTS AND SAVINGS OF HAVING A REFLOTRON IN THE PRACTICE

Costs	Savings
1. Extra staff time	1. Avoided hospital visits by patients
2. Staff training	2. Avoided return surgery visits by patients
3. Purchase price and running costs	3. Avoided repeat consultations by GPs
4. Temptation to do unnecessary tests	4. Saved specimen transport costs to laboratory
5. Insufficient types of tests available; need to use multiple sources for results.	5. No waiting for results
	6. Speedier diagnosis and management

8. Discussion

The two practices differed in their organisation, and it was initially felt that the Practice 2, being more geared up to preventive work, might have been more enthusiastic about the

Reflotron than Practice 1. As it turned out, both practices gave similar, generally favourable, responses to the Reflotron.

Practice 1 lost some confidence in the Reflotron with the 2 false readings obtained outside the 2 study weeks, which meant that a patient was sent to the hospital unnecessarily. The Reflotron result had indicated that the patient's haemoglobin level was low, but at the hospital laboratory it was found to be within the normal range. In the second Practice 1 Reflotron study week, when samples were also analysed by the hospital laboratory, there was a tendency for the GPs to wait for the laboratory comparisons before acting on the test results. This was also apparent in Practice 2, where diagnosis awaited the laboratory results when action could have been taken on the Reflotron results alone. It is therefore essential that the Reflotron is seen to be accurate and that the GPs have confidence in it before it can be used to the patients' (and the doctors') advantage by avoiding follow-up appointments to receive and discuss results. The direct comparison of the laboratory and Reflotron results confirmed the previously established accuracy of the machine when correctly operated.

For both practices, the most frequently requested tests available on the Reflotron were haemoglobin and glucose, as predicted by the doctors. GPs would most like to see electrolytes available on the Reflotron. Haemoglobin and glucose testing did not increase when the Reflotron was available, but one doctor did comment on the temptation to do more tests since they were readily available.

Dipstick testing remained the same in Practice 2 in both study weeks, and of the 55 blood tests sent to the laboratory during the Reflotron study week, only one was also available on the Reflotron. Practice 2 could routinely request LFTs from the laboratory but not in the same format as the Reflotron. When these tests became available on the Reflotron, only one (GGT) was carried out on the Reflotron - possibly because the GPs needed longer to become accustomed to their availability in this format?

In general, the doctors and nurses involved in the study had found the Reflotron to be a useful, but not necessary, addition to their practice. In the present situation, where there is no direct reimbursement for equipment costs for GPs, Reflotron use is unlikely to become widespread in general practice. If budget holding by the larger practices becomes a reality, the situation could change. However, given the length of time taken for test results to be received from laboratories use of the Reflotron would be of benefit to the patient who could be treated immediately by the doctor at the initial consultation.

The data from the North Middlesex Hospital suggests that there would be little reduction in demand for laboratory services, if GPs were to do the current proportion of their own tests available on Reflotron. Future developments will be more dependent on relative costs and charging policy.

If laboratories charged average costs at £6.75 (1989/90 prices assuming 7% inflation), as estimated from a literature survey described in another paper in this series, then buying a

Reflotron with tests costing approximately £2.00 would be attractive, but if marginal costs were charged by laboratories, the reverse would be true.

Appendix 1

Abbreviations

BUN	Blood urea nitrogen
Ca	Calcium
ECG	Electrocardiogram
ESR	Erythrocyte sedimentation rate
FBC	Full blood count
FPC	Family Practitioner Committee
FSH	Follicle stimulating hormone
GGT	Gamma glutamyl transferase
GOT (AST)	glutamate-oxaloacetate transaminase (LFT)
GPT (ALT)	glutamate-pyruvate transaminase (LFT)
Hb	Haemoglobin
K ⁺	potassium
LFT	liver function test
LH	luteinising hormone
MSU	mid stream urine
Na ⁺	sodium
RAT	rheumatoid test
Rh. factor	rheumatoid factor
TFT	thyroid function test
U+E	urea and electrolytes
WR	Wassermann Reaction