Is there duplication of diagnostic test results ?

By D. B. Rix, MD and Gregory Stump*

Conventional wisdom has it that there is considerable duplication of diagnostic tests prior to hospitalization and during the first week following admission to hospital. This study, funded by the Greater Vancouver Regional Hospital District, investigates the facts.

The idea that diagnostic services in a community area are unnecessarily duplicated when patients are admitted to hospital has long been proclaimed by politicians, hospital officials and even some members of the medical profession. Yet, there has been no major control study confirming this thought.

A recent recommendation in the November 1973 Inter-Laboratory Cooperation Committee report to the professional advisory committee of the Greater Vancouver Regional Hospital District suggested that a study should be conducted to investigate this subject and, if warranted, recommendations should be made.

On reviewing information available at the Greater Vancouver Regional Hospital District, which showed that a high proportion of people in the area were admitted to their local hospital if hospitalization were required, North Vancouver, with Lion's Gate Hospital as a base hospital, was selected as the study area.

The hospital charts of 1189 patients hospitalized during 1972 and the first half of 1973 were examined for all diagnostic work performed in the first week of hospitalization and then compared with diagnostic work done on the same patients 1 week prior to admission to hospital. Any duplicated tests during these periods were carefully examined with the necessary information by the authors and if necessary the appropriate consultant, to see whether unnecessary duplication had occurred.

This study did not confirm the presence of unnecessary duplication of any significant degree.

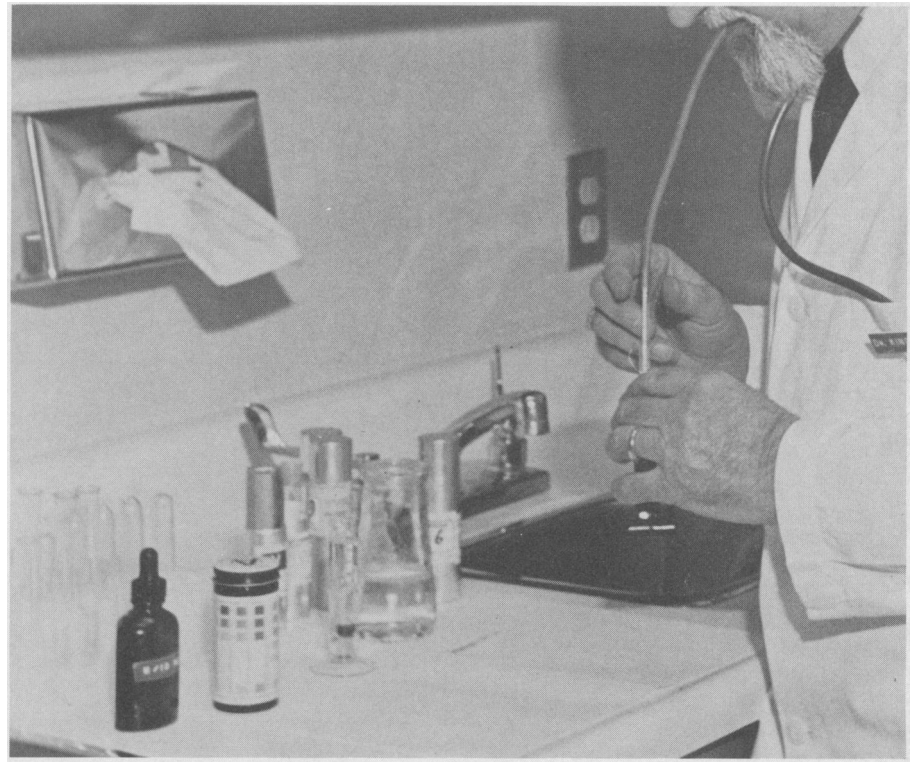
The findings were as follows:

	Unnecessary Duplication
Laboratory tests	0.6%
X-ray tests	1.1%
ECGs	0.0%

Methods

In order to have sufficient numbers of patients to make the study statistically significant and to be able to determine whether any seasonal variation existed in duplication of services, data from consecutive admissions in six 1-week periods between March 1972 and March 1973 were gathered. The periods chosen were as follows: Mar. 12-18, 1972; June 2-8, 1972; Aug. 12-18, 1972; Oct. 22-28, 1972; Jan. 1-7, 1973; Mar. 13-19, 1973.

After obtaining flow sheet data from the medical records department of Lion's Gate Hospital pertaining to admissions, diagnosis and diagnostic services on patients admitted during these six periods, the paid history files of the British Columbia Medical Plan, CU&C (Credit Union and Co.) and Medical Services Association were searched to obtain information on diagnostic tests performed 1 week prior to admission on the same patients. These files revealed only the fact that a service



Of 1315 hemoglobin determinations, 13 were unnecessary duplications

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had been completed at a specific time and place in the community. The results of the various tests were obviously necessary in some cases and this information was obtained, with the permission of the laboratory directors, by examining the reports on various patients from community laboratories in the North Vancouver area.

To establish duplication of diagnostic services, the two sets of data were correlated and compared. The simple criteria for gross duplication were that a service had been undertaken 1 week before admission and had been repeated within the first week of hospitalization.

Following the establishment of the extent of gross duplication of diagnostic services we used the following format to obtain the degree of unnecessary duplication of these services in an unbiased manner.

Table I—Comparison of the total tests duplicated with the total number of tests completed in hospital in six 1-week periods

	Tests completed in hospital		Tests duplicated one week prior to admission	
	First week of admission	First day of admission	Total duplication	Unnecessary duplication
Laboratory Duplication — 1,189 patients				
Clinical blood tests (hematology department)				
Hemoglobin value	1277	662	38	13
Leukocyte count	602	252	21	7
Erythrocyte count	10	4	—	—
Packed-cell volume	1342	607	—	—
Secondary calculations	1335	599	—	—
Sedimentation rate	295	111	4	2
Differential cell count	572	247	19	7
Form and structure	497	209	1	—
Platelet count	25	11	1	—
Prothrombin time	77	27	2	—
Other	50	13	—	—
Total	**6082**	**2742**	**86**	**29**
Chemistry values and levels, chemically determined (chemistry department)				
Plasma glucose	254	73	1	—
Blood urea nitrogen	300	94	1	—
Alkaline phosphatase	67	9	1	—
Electrolytes	104	20	—	—
Bilirubin total	55	17	1	—
Bilirubin direct & total	15	10	—	—
Amylase	30	8	—	—
Proteins, total and albumin	56	10	—	—
Phosphorus	22	1	1	1
Calcium	29	1	1	—
Uric acid	20	—	1	—
Creatinine	23	—	1	1
Creatinine phosphokinase	85	12	—	—
Lactate dehydrogenase	100	10	1	—
Glutamic-oxalacetic transaminase	99	14	1	—
CSF examinations	12	4	—	—
Occult blood	26	1	—	—
Blood gases	50	13	—	—
Cholesterol	11	—	—	—
Others	98	12	—	—
Total	**1456**	**309**	**10**	**2**
Total urinalysis	**1066**	**200**	**36**	**19**
Total cultures	**357**	**28**	**7**	**2**
Grand total laboratory	**8961**	**3279**	**139**	**52**
X-ray Duplication — 453 patients				
Xray films and services (radiology department)				
Chest	240	84	11	5
Head	55	21	—	—
Spine	56	12	2	1
Upper & lower extremities	86	35	4	—
Pyelograms	78	14	—	—
Abdomen	57	24	2	1
Gall bladder	33	4	—	—
Barium meal	28	2	1	—
Cholangiogram	6	1	—	—
Barium enema	12	1	—	—
Other	17	5	—	—
Total	**668**	**203**	**20**	**7**
Cardiology Duplication — 166 patients				
Electrocardiograms	224	66	4	—

All the duplicated tests during these set periods, along with the relevant data such as admitting history, progress notes and discharge and billing card diagnosis were separated and filed to the corresponding individual patient. Then the data on each patient were split into three separate areas of expertise, namely, pathology, radiology, and cardiology (ECG).

In pathology, the following method was used to examine the information: the authors reviewed all the material on each patient; in obvious cases of unnecessary duplication, the tests were placed in the unnecessary duplication file; in borderline cases an opinion was sought from an uninvolved expert in the appropriate field, for example, interested in diabetes but not practising in the North Vancouver area, and this opinion was always accepted.

One of the authors was a former general practitioner and his previous experience was very helpful in establishing unnecessary duplication. However, despite this asset, the authors were extremely careful in their judgements, tending to classify the case as unnecessary duplication or refer the case to the appropriate consultant unless the case was clearcut.

Duplicated tests in radiology were treated as follows: one of us (G.S.) presented all the material on each patient to a radiologist suggested by the section of radiology of the British Columbia Medical Association.

Dr. G. E. Trueman, radiologist, Vancouver General Hospital, was selected and he reviewed each individual case in which duplication had occurred. Following his examination of the data a decision was made whether the duplication was necessary or not and these figures were given to the authors.

In cardiology the same format was used to examine the case of duplicated ECGs. Dr. John Osborne, head of the department of cardiology, Vancouver General Hospital, reviewed all material on each patient. Because of the opinion that no duplication existed, Dr. R. B. Kerr, then head of the department of medicine, Vancouver General Hospital, again reviewed all the data and concurred completely with Dr. Osborne's opinion.

During the six 1-week periods which were stipulated, 1752 patients were admitted to hospital. The number of patients, however, included in this study was 1189, or 67% of the original sample, since patients who had no laboratory work in hospital or for whom sufficient data from the medical plans were not available were eliminated.

Each of the 1189 patients had a minimum of one test and a maximum of 44 tests during the first week of

hospitalization. The average is eight tests per patient per week.

Contrary to the author's expectations, the separation of the laboratory tests by date failed to show significant seasonal variation.

A laboratory performs a wide range of individual tests and its tests are more commonly used in medical practice than x-rays or ECGs. Therefore, it is not surprising to note that, of the 1189 patients in the series, only 453 had any x-ray films taken and, similarly, only 166 patients had one or more ECGs performed on them during the first week of hospitalization.

Analysis of the extent of duplication required a calculation of both the total number of tests completed in hospital 1 week after admission and the number of tests duplicated 1 week before (Table I). These two sets of data were then compared. This analysis was chosen because we were interested in gross duplication of the number of diagnostic services. It would be futile to report that 13 hemoglobin determinations were duplicated unnecessarily 1 week prior to admission if that could not be related to the total tests undertaken on the same segment of patients after hospitalization. For example, of the 1277 hemoglobin determinations completed on 1189 patients during the first week of hospitalization 38 were duplicated during the week prior to admission.

Table I also includes, for comparison, the total tests completed on the days of admission. Generally, about one half the total tests done during 1 week after admission were completed on the first day.

Of the 140 laboratory tests duplicated, 52 were found unnecessary. hemoglobin determinations and urinalyses making up the bulk of the unnecessary work. This is to be expected because both tests are routinely done on admission.

Table II—Comparison of the total tests completed 1 week before admission to the total tests duplicated 1 week later

Department	Total tests one week after admission	Total duplication one week prior to admission	Total unnecessary duplication	Percent unnecessary duplication
Laboratory	8961	140	50	0.6
Radiology	668	20	7	1.1
Cardiology	244	5	0	0
Grand total	9873	165	57	0.6

The determination of the extent of urinalysis duplication was made difficult because a single urinalysis in the hospital could comprise a number of tests. Outside hospital a urinalysis was billed as routine, microscopic or diagnostic. A single duplication in the study involves the matching up of similar work inside and out of hospital. Often however, a single duplication consists of only a portion of what was termed a single urinalysis in hospital.

The department that apparently suffered the greatest abuse of testing was hematology. However, when related to the bulk of work within the hospital, this misuse of lab tests is rather small.

The two tests duplicated in chemistry were performed on the same patient and results of the tests were necessary in order to determine the extent of this duplication. The misuse of these tests can safely be considered negligible.

Although the number of tests duplicated in bacteriology was small, the relative duplication is as high as that in hematology. The determination of the degree of duplication of cultures was wrought with similar problems as those associated with urinalyses. The two duplications of cultures turned up by the survey included only a single sensitivity and identification whereas the cultures done in the hospital almost invariably include both sensitivity and identification.

Table II summarizes the total diagnostic work completed at the end of 1 week in hospital, the gross duplication and the unnecessary duplication 1 week prior to admission. The overall unnecessary duplication of all diagnostic work was found to be a meagre 0.6% based on total laboratory tests done before and after admission to hospital.

Table III shows the cost of unnecessary duplication of diagnostic services. On the basis of the data establishing the duplication and applying the then-current BCMA fee schedule, the cost of unnecessary duplication can be ascertained as: laboratory, $86.40; radiology, $66.60; ECG, nil.

It is obvious the cost of this unnecessary duplication is minimal.

To give another perspective, if the data were expanded to an annual basis (there were 15 056 admissions from July 1972 to June 1973) and our previous figures applied, the total annual cost for unnecessary duplication would be: laboratory, $1094, radiology, $843.

It would be extremely difficult to establish the total annual cost for diagnostic services in the North Vancouver area; however, considering the extent of the services in that area, it would not be unreasonable to consider $500-000 or more. This sum, of course, makes the figures of $1094 and $843 quite insignificant.

One of the terms of reference of this study was to look for any evidence of communication of results of diagnostic services between community-based and hospital diagnostic services. The findings are reviewed in Table IV.

Thirty-nine patients (3.3%) in this study had the results of their diagnostic tests in the community transmitted to the hospital by various means. In all these cases, no cases of unnecessary duplication occurred. Admittedly, one third of these patients were required to supply the hospital with some laboratory results because they were being admitted for either sterilization or abortion; however, the other two thirds were not required to do so. These data certainly suggest that any duplication, no

Table III—Unnecessary duplication and cost

	Unnecessary duplication	Laboratory duplication Cost of each test	Total cost
Hemoglobin determination	13	$0.90	$11.70
Leukocyte count	7	4.50	31.50
Sedimentation rate	2	1.35	2.70
Differential cell count	7	*	—
Phosphorus level	1	4.50	4.50
Creatinine level	1	3.60	3.60
Urinalysis	19	**	22.50
Culture	2	***	9.90
Total laboratory	**52**	—	**86.40**
		Radiology duplication	
Chest	5	9.00	45.00
Spine	1	12.60	12.60
Abdomen	1	9.00	9.00
Total radiology	**7**	—	**66.60**
Grand total	**59**	—	**$153.00**

* Cost included in leukocyte counts
** Cost calculated, micro, routine and diagnostic
***Cost calculated, susceptibility and identification included

Table IV—Number of admissions and types of test results transferred to hospital

Period	Number of admissions with communication	Percent of total admissions	Test results communicated: Urin.	Hb	P	M	Preg. test	Radiograph
1972								
March 12 - 18	2	1.0	2	1	—	—	—	—
June 2 -8	6	2.9	5	2	—	—	1	—
Aug. 12 - 18	5	3.0	4	1	—	—	—	1
Oct. 22 - 28	4	2.3	3	1	—	—	—	—
1973								
Jan. 1 - 7	8	3.8	8	7	—	—	—	—
Mar. 13 - 19	14	6.1	14	10	1	1	—	—
Total	39	3.3	36	22	1	1	1	1

matter how insignificant, that now exists could be further minimized by encouraging this development.

Discussion

The amount and the cost of unnecessary duplication of diagnostic services in the North Vancouver area were minimal. Three reasons are suggested by the authors for these findings:

- Physician education concerning the cost of diagnostic services. The practising physician has literally been bombarded with literature from government bodies, professional associations and hospital committees concerning the cost and the economical use of diagnostic facilities. On reviewing various requisition forms, the authors gained the impression that doctors were making an effort to use the laboratory efficiently by ordering individual tests, instead of batteries, and ordering tests for a specific diagnostic reason, not in a routine fashion. This development cannot help but lead to better utilization of diagnostic facilities and improved medical care due to the increased cooperation between the clinician and the laboratory physician.
- Community diagnostic results in hospitals. In addition to the small number of cases in which the laboratory results were sent to the hospital, the authors noted many cases where the attending physician or consultant had incorporated the diagnostic results into his admitting note, history, progress notes or consultant report. Also it was noted that the report forms from medical laboratories were posted right onto the hospital chart in many cases. It would appear to the authors that this development should be encouraged. Laboratory people should attempt to standardize their methods, arrive at similar normal values and develop universal report forms so that there would be flow of diagnostic information concerning patients. Radiology and cardiology (ECG) should also investigate related problems in their area.
- Time period for the study. The original time frame for the study, namely, 1 week before admission and 1 week of hospitalization was decided upon after considerable discussion with knowledgeable people. However, when the data began to show an insignificant amount of duplication, the authors expanded the period of time to 6 weeks before hospitalization. Despite this extension, the amount of unnecessary duplication was still minimal.

We think this study clearly answers the eternal question in the title of the article with a resounding NO!

Despite the minimal amount of unnecessary duplication that was found in this study, the authors feel that it is worthwhile to explore the feasibility of establishing a mechanism where reports from community laboratories are sent to the hospital when a patient is admitted. Also the reverse can apply, and reports from the hospital can be sent to the community laboratory so that the patient's followup can be accurately assessed. The benefits to the delivery of medical care in the community are quite obvious.

We think efforts can be made to improve the reporting and communicating system so that cumulative current diagnostic information concerning patients would easily be available to the attending physician no matter what the locale of the patient.

However, the tremendous cost of a central data bank facility in an area to record all the diagnostic information on a patient for instant retrieval by the physician or the laboratory whether the patient is in or out of hospital is not supported by this present study.

Costs for and hazards of unnecessary laboratory and radiology services have been of concern to the medical profession for several years, yet the subject of relatively little study. While far from exhaustive, the above report by Rix and Stump clearly does not support the "common knowledge" that 15 to 20% of tests are unnecessary. — Ed.