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ORIGINAL ARTICLE

TEST ORDERING PATTERN AT THE CHEMICAL PATHOLOGY LABORATORY, HOSPITAL UNIVERSITI SAINS MALAYSIA

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The utilization of the chemical laboratory resources at the Hospital Sains Malaysia was evaluated. More than 100,000 test requests received and performed over a 12-month period, were analyzed retrospectively. The analysis conducted included the abnormal results obtained, the degree of duplication of tests, and the extent of test-panel ordering. It was found that a relatively moderate degree of over-ordering was evident. The findings suggested that the main reasons for over-ordering were the use of panel tests of ordering, in addition to a small, yet significant degree of duplication. Strategies for cutting down the test ordering have been reviewed and discussed.

Key words *: over-ordering, panel test, individual test, test duplication.*

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Introduction

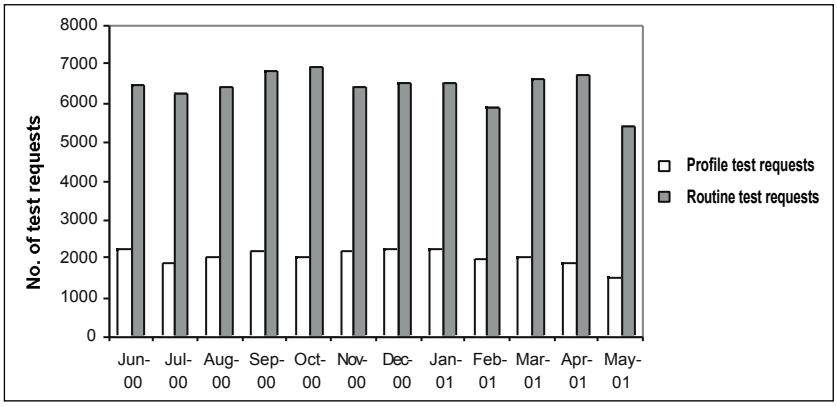
The efficient use of laboratory resources is of great concern to the patient and to the medical staff, both from the health point of view and from the economical point of view. Requests for medical services have been on the increase for a number of reasons, including the increased complexity of medicine, as well as the improved patients' expectations. Many previous studies have claimed that laboratory tests are being over-ordered especially in teaching hospitals resulting in a rise in the expenses of the medical care (1-5). Further studies have shown that over-ordering of laboratory tests may not always provide valuable clinical information or are of low diagnostic value or therapeutic yield leading to new therapies (6-8). Reducing the numbers of laboratory tests ordered by physicians in organized clinical laboratory studies have been claimed not to exert adverse effects on the quality of medical care (9-11). On the contrary, increased testing may occasionally have detrimental effects on care, causing physicians to miss the important findings because they are obscured in a mass of test results (12 ,13).

Presented here is a retrospective study of a 12-month period extending from June 2000 until May 2001. The study was designed to evaluate the incoming requests for routine tests and profile tests in the chemical pathology laboratory of the Hospital Universiti Sains Malaysia. Over 100,000 test requests ordered during the study period were analyzed. It was found that orders containing panels of tests largely dominated over orders containing individual test requests. In addition, the rate of duplications were found to be low. The percentages of abnormal results among the profile tests were variable, but fell within acceptable standards. The possible strategies that could further improve the use of the laboratory have been discussed.

Materials and methods

The utilization of the test requests was started from the records of the results of routine and profile test requests performed over 12 months, extending from June 2000 to May 2001. The total numbers of requests and the abnormal results were calculated. In addition, a count of the numbers of individual and the test-panel orders was also performed.

Figure 1. The total number of Profile and routine test requests over the 12-month period from June 2000 to May 2001.



Routine tests include estimations of serum electrolytes, urea, calcium, chloride, glucose, total bilirubin and amylase. Organ-profile tests include liver function tests (LFTs), cardiac enzymes, renal function tests (RFTs), bone markers and lipid profile tests. LFTs include total protein, albumin, globulin, albumin/globulin (A/G) ratio (calculated), total bilirubin, direct and indirect bilirubin, alkaline phosphatase (ALP), alanine aminotransferase (ALT) and aspartate aminotransferase (AST). The cardiac enzymes include creatine kinase (CK) and lactate dehydrogenase (LDH). RFTs include creatinine and uric acid. Bone markers include calcium (Ca) and phosphate (P), whereas the lipid profile tests include Cholesterol (Chol) and triglycerides (TG). Thus urea and serum electrolytes are requested among routine tests, whereas calcium appears in both forms, the routine tests request, and the organ-profile tests requests Excluding the A/G ratio, the total number of individual tests in a complete organ-profile is sixteen tests. The average number of individual tests per request was estimated by counting the total number of tests in 1,000 requests, selected randomly, divided by 1,000. Tests are carried out on discrete auto-analyzers, i.e. laboratory instruments that are able to perform either single tests or a panel of tests.

Patients' registration numbers (R/N) were recorded. The R/N and dates were downloaded on the computer Microsoft-word, and the search was carried out for those tests duplicated on the same day and those duplicated on the following day. The data sheet for each patient was given the computer number to allow easy access to the results of the laboratory tests. All the data obtained was counted. The counting included the total numbers of individual or panel requests, and the total numbers of abnormal results. The duplicated requests were counted, but were not included in calculating the

Figure 2. The total numbers of organ profile test requests and the number of abnormal results. LFTs: liver function tests, Card-enz: cardiac enzymes, RFTs: renal function tests,P+Ca: phosphorus and calcium, TG+Chol: triglycerides and cholesterol.

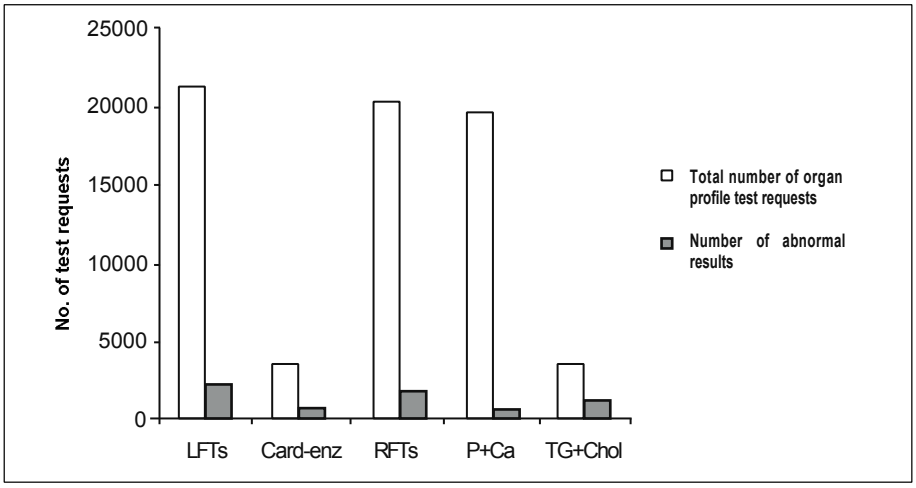
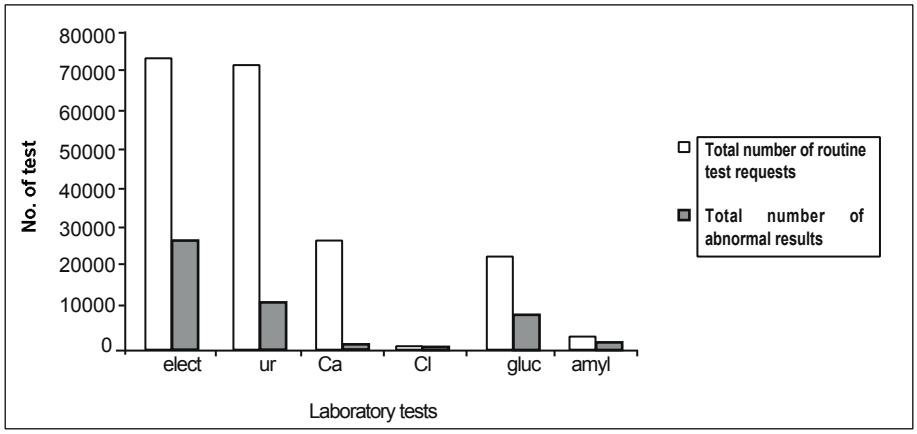


Figure 3. The total numbers of routine test requests and the total numbers of abnormalresults. Elect: electrolytes, ur: urea, Ca: calcium,



percentages of abnormal test results. Tests that were not performed or repeated because of technical reasons, insufficient sample, or unsuitable sample due to lysed blood, were excluded from the study.

The data obtained were analyzed by calculating the percentages and comparing those with relevant published figures. The outcomes were presented graphically as tables and pie charts using Microsoft Excel Programme.

Results

The total number of tests.

The number of requests received monthly averaged 2000 for organ-profile panels, and 6,400 for routine panels (figure 1). The number of requests included in this study over the 12-month study period was found to be 24,309 requests for organ-profile tests, and 76,937 requests in the routine tests. The total number of tests performed is the number of requests multiplied by the number of tests per request. In the organ-profile requests, the average number of tests per request is 11, and in the routine requests, 4. This gave a total number of 267,399 individual organ-profile tests and 307,748 individual routine tests.

Calculation of abnormal results.

The abnormal results obtained in each panel in both organ-profile and routine tests were selected and calculated separately over the period of study. For each test panel, the total annual number along with the number of abnormal results were plotted in a histogram for organ-profile test panels (figure 2) and for routine tests (figure 3).

The percentages of abnormal results were

Figure 4. The percentages of the abnormal results among the various organ-profile testsand routine tests. LFTs: liver function tests, card-enz: cardiac enzymes, RFTs: renal function tests, Ca-P: calcium and phosphorus, TG-Cho: trilgycerides and cholesterol,elect: electrolytes, ur: urea, Ca: calcium, Cl: chloride, gluc: glucose, amyl: amylase.

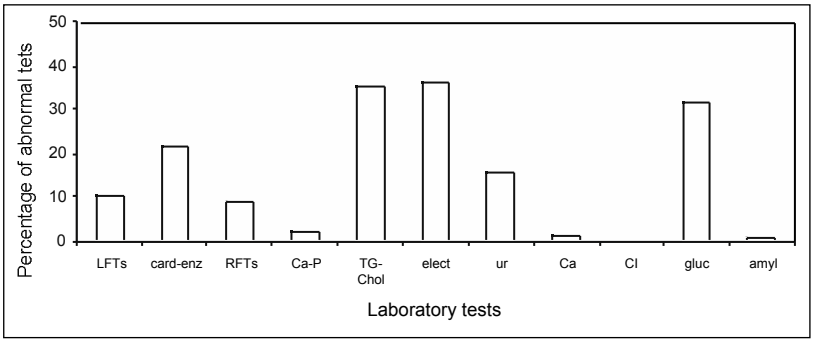
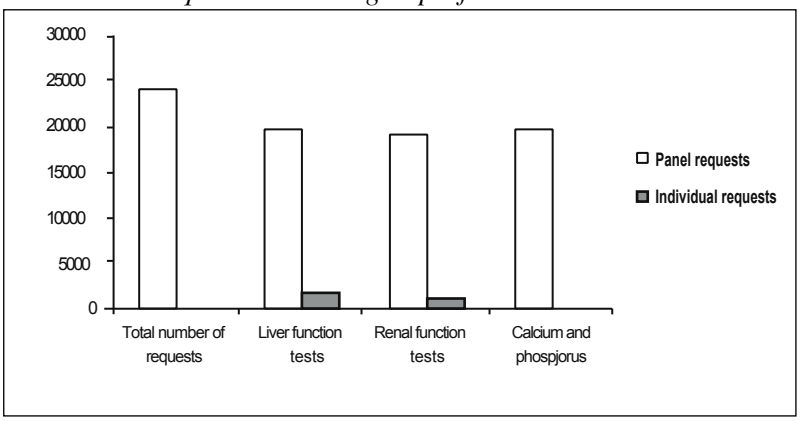


Figure 5. Total number of panel test requests and individual test requests within organ-profile tests.



calculated and plotted in figure 4. Abnormal test results are those that contained abnormal findings in one or more of the parameters in that panel. It was not possible to calculate precisely the average number of abnormal parameters per panel. As depicted from figures 2 and 3, LFTs, RFTs and Ca+P comprised the bulk of organ-profile test requests, with total numbers of 21237, 20395 and 19818, respectively. This meant that 2 or 3 of these panels are requested simultaneously in most of the cases. The percentages of abnormal results were found to be 10.3 for LFTs, 9.0 for RFTs and 2.0 for Ca and P.

Electrolytes and urea were always requested together, totaling 74529 requests, and the percentages of abnormal results were 36.1 and 15.4, respectively. Calcium results appeared among both routine test results and organ-profile test results. The percentage of abnormal results of calcium in routine tests was 1.46. Ca and P in profile tests had 2% of abnormal results. Cardiac enzymes, lipid profiles and glucose were ordered less frequently with percentages of abnormal findings of 21.7, 35.1 and 31.5, respectively. Chloride and amylase were rarely requested, a total of 52 requests for chloride and 2192 requests for amylase, with corresponding percentages of abnormal test results of 0.0 and 1.0 (figure 4).

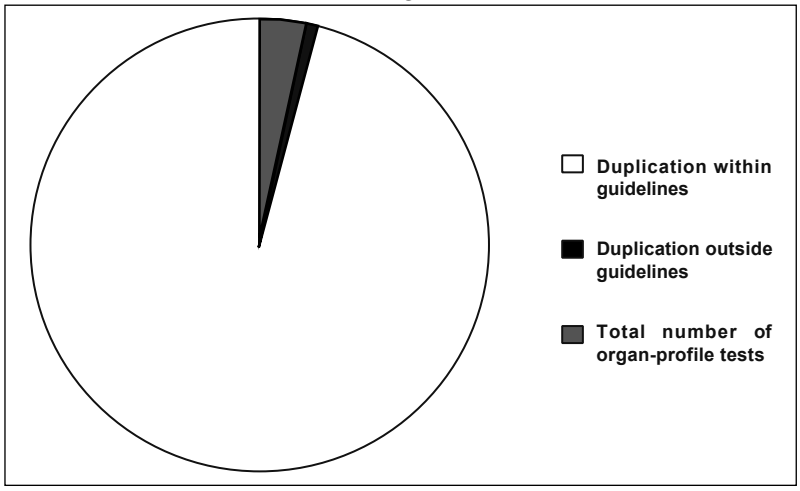
Test panel ordering.

The numbers of panels of tests as opposed to individually selected test requests for LFTs, for RFTs and for Ca and P were shown in figure 5. There were 19382 LFT panel tests orders, and 1855 individual tests within the LFT panel. There were 18978 RFT panel test orders and 1417 individual tests from the same panel. There were also 19818 orders for bone markers, all containing both Ca and P.

Test order duplication.

Among all the organ-profile test requests over periods not exceeding 7 days, 1121 requests were found to be duplicated (4.6%). Of these, 846 requests

Figure 6. Duplication of organ profile test requests with reference to the recommended guidelines.



(3.46%) were found within the limits recommended by the guidelines of test ordering, and 278 (1.14%) requests exceeded the limits of these guidelines (figure 6).

Discussion.

The large number of laboratory tests at the chemical pathology laboratory, Hospital-USM demanded that this study be carried out to outline the pattern of test ordering. The abnormal results obtained were found to vary widely among the various profile tests and routine tests, ranging from 1.46% for Ca and P to over 30% for glucose, lipid profile tests and electrolytes (figure 4). Such wide variations in the percentages of abnormal test results have appeared in previous reports, ranging from 12 to 53% of the total numbers of test orders (14-16). It was also found that the frequency of request duplication outside the guidelines limits did not exceed 1.1%, totaling 247 requests of panel tests in 12 months, which is in excess of 2,500 individual tests. Similar and even higher duplication rates have been reported (14). Reference guidelines for such duplications have been reported previously showing the maximum recommended frequency of duplication of tests per day and per week, for normal and for abnormal results (17,18).

The total number of organ profile tests in the Chemical Pathology Laboratory H-USM is 16. This means that the total number of individual profile tests performed annually sums to hundreds of thousands. Should there be a general reduction in these numbers of tests, by avoiding unnecessary duplication, and referring more to individual testing instead of panel ordering, savings in expenses may turn out to be unexpectedly high. Furthermore, there would be an accompanying reduction in the use of manpower and a possible similar reduction in human and technical errors. However, any reduction in test ordering should not be at the expense of the quality of the medical care. Reduction would be greater should similar situations existed in other service departments.

The problem of over-ordering tests has been the point of discussion for years in western medical practice, especially in teaching hospitals. The idea behind over-ordering is to improve the health care facility, yet at the same time, the disadvantages of over-ordering have been highlighted frequently (1-5). Panel-ordering aims very occasionally at case-finding in asymptomatic individuals (8,19). The most commonly discovered cases in this way are those of hyperlipidaemia, occasional cases of diabetes as well as thyroid and hepatic disorders (20,21). In this study, it was found that the least ordered panel with nearly the highest percentage of abnormal results is that of lipid profile, TG and CHO (table 4). Kelantan state harbors a high prevalence of hyperlipidaemia and diabetes (22).

In conclusion, the chemical pathology laboratory performs a large number of tests. Although high-scale over-ordering was not found, it still exists in the form of panel-testing, and it may be possible to cut down the number of tests. The suggested strategies for optimizing the number of tests without having negative effects on the medical care would be reviewing the request forms to allow individual selection of tests rather than panels to promote a discriminative pattern of test ordering. This was previously reviewed and it was found that panel testing requests is a cause of excessive tests ordering (10,11). Informing clinicians on the cost per test of all laboratory tests performed should be encouraged. This has previously shown to be effective in cutting down test orders by clinicians (24,25,26). Introducing of medical education programs to junior and trainee medical doctors on the utilization of lab services, have proved to be valuable in previous trials (23,24). Reviewing the reliability and validity of all laboratory tests and selecting and offering only the tests that are most cost-effective and reliable. The use of AST has been claimed to show no special significance in the diagnosis of liver disease, and trials to abandon requesting it have started in some countries (27). It's use as a cardiac marker has been shown to be of low diagnostic value (28). Finally computerization of the test ordering and test results reporting which can detect test duplication, many perhaps solve many problems of communication (29).

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