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Hospital Practice

Improving laboratory usage: a review

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Summary: Influencing the ordering of laboratory investigations, and in particular reducing unnecessary ones, is a vital concern to many hospitals. An account of the reasons why control is necessary is presented. The different methods evaluated are reviewed, including rationing, form design, resource management (budget control), education, protocols and decision support systems, incentives, feedback and case note appraisal.

Methods of controlling the requesting of investigations are likely to be ineffective unless they take place in the correct environment. Elements of this include correct attitude and commitment by senior staff, a long term strategy, and different approaches for different groups of doctors.

Introduction

Overuse of investigations

There is ample evidence that many investigations requested are not necessary.[1–7] Repeat investigations are a common cause of unnecessary requests. In one study 30% of the patients had a normal biochemical profile on admission; nevertheless most of these patients received two additional profiles during their hospital stay. In none of the cases did this provide additional evidence necessary for diagnosis or management. Similar results were found for electrolyte determinations.[1]

Another study on repeat investigations judged that approximately 50% of LDH requests and 60% of serum calcium estimations were inappropriate according to explicit criteria.[2]

Over-investigation is not limited to the laboratories. One study showed that up to 65% of laboratory requests, 11% of chest X-rays, and 26% of nursing services could not be justified.[5] There is no reason to suppose that the over-ordering of investigations is restricted to just these accounts. It is likely that there is a general problem in the use of all hospital services. Hence any solution for the problem of over-ordering of investigations should be seen as part of the general issue of effective use of resources.

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Which investigations are necessary?

The most stringent criterion for necessity is did the test make any difference to the management? Audits of medical records have shown that frequently tests are ignored by doctors.[7] Stilwell[8] found that only 1%–5% of clinical chemistry tests and 1%–3% of haematological tests resulted in action. One effect of restricting the number of investigations allowed per patient per day[1] was to increase the proportion which resulted in action from 5% to 23%. The evidence suggests there is considerable scope for reducing the number of tests requested.

Why reduce the number of tests requested?

The commonest reason advocated for reducing the number of requests is to save money. It was pointed out by Fraser & Woodford[9] that the scope of saving significant sums of money in this way is small. In 1985/86 pathology services at a cost of £299 million formed 3.3% of total expenditure on the hospital and community services in England and Wales.[10] However, a 5% saving of this expenditure would generate almost £15 million. More importantly, the attitudes engendered by cost savings should influence other areas of the service providing further economies.

It is also possible to argue that costly care is inefficient and of poor quality.[11,12] The real aim of

improving laboratory usage should be to improve the quality of care rather than to save money.

Review of cost containment strategies

Earlier reviews on controlling laboratory investigations are available.[3,7,9,13–15] A resumé is given here of the main methods tried. Each is reviewed according to the underlying idea, a brief account of the results and a comment.

Rationing

The belief that control by rules and regulations is the most effective form of bringing about a change leads to the introduction of test rationing. Dixon,[1] on assessing a randomly selected set of patients' notes, found that only 5% of the laboratory test results appeared to influence management. A limit of eight tests per day per patient was introduced. This resulted in the number of tests per patient per day falling from six to two, and the daily workload of the laboratory falling by 25%. It was found that 23% of the test results now affected patient management. Further attempts to introduce this system[7] were abandoned as being too difficult to maintain.

It seems unlikely that such draconian methods could be successful in the long run. Laboratories cannot reasonably refuse to perform tests which clinicians say are indicated. In Dixon's system, should the necessity have arisen, then extra tests were allowable.

Form design

Physicians may need guidance in selecting appropriate investigations. This guidance is most conveniently given on the actual requesting form.

Wong and colleagues[16,17] redesigned the request form for thyroid function tests so that it changed from a simple list of tests to groupings relevant for clinical states such as hyperthyroidism, hypothyroidism, thyroid function screen and other thyroid tests. This change led to a fall of 38% in the number of T3 assay requests and 62% of the TSH studies. The method is useful only where a particular test or tests are either diagnostic or confirmatory for a disease. The widespread adoption of this method will lead to a great proliferation of different requesting forms. This could pose administrative problems.

Resource management

There is a view that giving doctors, nurses and other managers budgets and financial targets will result in increased efficiency. The reorganization of the National Health Service to include the general management function was taken as an opportunity to make clinicians more financially accountable. It was hoped to improve resource usage by giving users of services financial limits.

Four pilot schemes were chosen for an experiment. A report on their activities[18] showed this view to be over-optimistic. There were doubts about the relevance of the information produced, and the information needs of the doctors and nurses were not fully appreciated. A review of this initial experience has led to the concept of resource management with more emphasis on the users' information requirement, plus an encouragement of local ownership of the problem.[18] An account of the effectiveness of this approach in influencing laboratory requests is awaited. This method has an impact beyond laboratory test requesting and its introduction will involve a major change in how hospitals are run.

Financial unbundling

In a 'fee for item' system the actual pricing structure may influence the ordering of investigations. Golden *et al.*[19] reported on the effects of charging for individual tests rather than having panels of investigations covered by one fee. In their initial system a chemistry 19 panel, consisting of 19 separate tests, was $30 as opposed to $308 for the tests if charged separately. This panel covered urea, electrolytes, liver function tests, lipids, calcium and uric acid. There were two further panels of tests available. One covered electrolytes, creatinine and glucose and one just electrolytes. After amending the fee schedule so that individual tests were charged but with a reduced unit cost per test as the number requested increased, there was a decline of 61% in the number of chemistry panel 19 ordered. This was partially compensated for by an increase in the other two panels. These changes were still present after one year.

This method can only work in a 'fee for item' system. It more likely indicates an initial inefficient pricing policy rather than a genuine improvement in test utilization.

Education relating to test requesting

A possible cause of over-requesting is uncertainty over the appropriate tests for a given clinical situation. Areas of uncertainty include better or cheaper alternatives, potential effect on patient management, the risks to the patient, the specificity and sensitivity of the test and so on. An

educational programme to reduce doubt should improve test requesting.

A variety of methods were used including lectures,[5] seminars,[20] distribution of manuals with information on testing.[15] Topics covered included specificity and sensitivity of particular tests, decision theory,[21] clinical decision making,[6] and health economics.[21] The effects of these various educational programmes were mixed.

An educational programme,[16] including staff meetings to discuss cost containment and written guidance to the requestors, had no impact, neither did a study directed at reducing the repeat requesting of LDH estimations.[2] A 6-week educational programme on the use of prothrombin tests resulted in a 45% reduction in requesting over 6 months. However, the number of requests gradually increased to its pre-intervention level.[22] A course of lectures covering topics such as cost and the over-use of hospital services, ethical and policy aspects of health care costs, and iatrogenic risks were given over 4 weeks to resident staff. The course did not affect the level of requesting.[5]

The best results reported were the effects of a long term commitment to reducing test requesting using a variety of methods including rules, education, feedback and review within a hospital clearly committed to efficient practice.[20]

It is generally recognized in educational psychology that a stimulus has to be repeated if the effect is to persist. Many of the educational interventions were of short term, typically one hour, seminar or lecture per week for 4 weeks.[5] Both knowledge and attitudes have an effect on laboratory test requesting. The majority of educational programmes reported attempted to correct only knowledge. These factors may explain why they were relatively unsuccessful or only successful for a short time.

Education about costs

It is commonly believed that accurate knowledge of test costs, the financial implications for the patient and the hospital will influence requestors when considering which, if any, test to order.

Cost education is given to ensure that doctors appreciate the financial effects of their actions. However, even in countries where health care has a strong and visible financial component, knowledge of test costs is slight.[14,25] Methods used include distribution of cost containment news letters,[24] charges of common tests[24] and manuals stressing the cost of tests.[25] Some methods to increase this knowledge have not affected test ordering,[26] others have. (For a fuller discussion see Grossman.[14]) Spitzer[27] surveyed attitudes to cost information and found that approximately one-third of medical students, interns and residents, had within the previous week discussed cost implications of laboratory tests, and over 80% of them within the past 6 months, but overall about 50% of all laboratory requests were made without considering the cost. He concluded that cost education had little influence on the requesting policies of physicians and that cost consciousness was only a minor factor in test ordering strategies.

Decision support systems

Another way to correct uncertainty is to give guidelines, doctors knowing exactly how to proceed in a given situation will reduce, by definition, the number of unnecessary tests.

To aid doctors and taking advantage of modern information technology, decision support systems have been developed and tried.[28] Such systems have three parts, a medical record consisting of data peculiar to the patient, a set of criteria for action, i.e. in this situation do serum potassium, and some way of bringing these two together so that for an individual patient a list of suggestions is generated on how to proceed.

Three systems[29–31] based on these principles have been developed and tested. All were effective in reducing the number of unnecessary tests. Young produced a simple problem-orientated system in which the management for 79 common medical problems was given. The doctor entered the patient's clinical problem into the system and was given an information sheet which contained suggestions on investigations and treatments. The evaluation of this system over a limited number of doctors showed that the number of unnecessary investigations per patient when using the system fell from 0.65 to 0.14.

A computer-based medical record and audit system was developed by Thomas.[30] It was evaluated on out-patients suffering with diabetes. The clinician for the test group was given a list of management suggestions produced by the programme which had scanned the patient's record and according to pre-specified protocols, produced them. These suggestions numbered three per visit per patient and were with the doctor when the patient was seen.

After one year it was found that 50.25% of the computer suggestions were followed, whereas in the control group only 37.3% of the potential suggestions were followed. The major difference between the two groups was a reduction in the number of in-patient stays for the experimental group, thus reducing costs for this group.

At the Regenstrief Institute a system was tried

which looked at two areas of medical care. Firstly, the monitoring of medications, i.e. patients on drugs excreted through the kidneys should have renal function tests taken from time to time. Secondly, for patients taking drugs which could have adverse effects, i.e. regular serum potassium estimations are indicated in patients taking amiloride to detect possible hyperkalaemia.

MacDonald[31] compared the actions of physicians given computer generated reminders to those without. It was found that in the first situation the required test was done for 36% of the experimental group, when the computer suggestions were available, and 11% of the controls. For the second area, 28% of the computer suggestions were adhered to with the indicated action occurring in 13% of the control group.

Decision support systems work but they require great technical support, medical supervision to keep the protocols up-to-date and a willingness on the part of doctors to use the outputs from these systems. These qualities are not commonly found together.

Protocols

Written instructions are another way of delivering guidelines. The principles underlining this method are the same as for the decision support systems.

Guidelines consisting of short advisory statements for the nine commonest medical emergencies (myocardial infarction, overdose, haematemesis, pneumonia, CCF, etc.) were developed by consultant staff.[32] Junior staff were given copies of these guidelines and encouraged to use them; however, it was emphasized that they were only advisory and clinical judgement was paramount. In association, a weekly review of patients discharged the previous week was carried out to detect unnecessary investigations. There was an immediate reduction in the average number of haematological tests (64%) and biochemical tests (64%).

This study combined both the use of protocols with a review of the notes. In these circumstances it is difficult to be sure which is having the desired effect. Protocols used in other studies in combination with other methods have had less favourable effects.

Personal incentives

If it is believed that doctors know how to act but for unspecified reasons do not do so correctly, then incentives may be effective.

Modest financial incentives[33] were unsuccessful. The study involved first year residents. Incentives were $150 or $225 to be spent on medically relevant materials. The amount depended on the degree of reduction of tests ordered. It was found they performed less well than the control group in both the intervention and follow-up phases of the study.

This method is the only one in which a clear cut answer has been obtained, though this may just reflect the limited amount of work done using this method.

Feedback

Feedback systems assume that the requestor has policies on test ordering but are unclear as to how well they adhere to these policies. Information on their actions enables them to better keep to these strategies. The other assumption, based on social consideration, is that individuals prefer to act in a similar way to their peers and not be seen to be too far from the average. Information giving the ranking of doctors with respect of their colleagues should help in getting the high volume requestors to reduce their test requests.

The types of feedback used include (a) information on test requesting and utilization.[4,6,19,27,34] (b) Information on the cost of investigations either in total or by patient.[4,21,24,26,35,36] (c) Ranking positions according either to the numbers of tests requested or costs of tests.[4,26,35]

From the data of 10 to 15 patients for each of 33 faculty internists, mean annual laboratory, drug, combined costs were produced.[35] The doctors were ranked in order of increasing costs of laboratory and drug usage and combined costs. These rankings were circulated to the doctors, their own position in the list being clearly identified. An overall reduction of 29.2% in laboratory costs occurred. The high cost doctors reduced the most.

The repeat requesting of serum calcium and LDH estimations was examined.[2] If three or more investigations in a week were ordered, the set was reviewed to see if they were justified according to explicit criteria previously decided by experts. When the tests were judged unnecessary, the requesting physicians were informed. Though this feedback was combined with a simple educational programme of discussing the indications for LDH tests, assessment showed no significant change in test ordering.

Another study which was unsuccessful involved weekly returns listing the tests ordered and the cost per patient to the first year residents who ordered them.[24] A successful study[25] involved the distribution every two weeks of a computer printout which showed the number of patients reviewed

and the amount spent on diagnostic tests, plus similar data for the other 56 house officers in the study. A marked decrease from 1.49 to 1.09 test per patient per visit was noted. Another group in the same study were given a reference manual with information on testing. Their average number of requests per patient fell from 1.31 to 1.03.

Feedback methods have had a variable success in reducing the number of investigations requested. Simple methods of sending back short reports on test utilization and their costs is not very effective.[2,4,6,24,36] When the information is made more specific to the individual by providing a ranking of his test ordering and cost relative to his peers, this seems to make a difference.[4,25,35] In one study, just one return giving the ranking of mean annual laboratory, drug and combined costs had a marked effect on test and drug usage.[36]

The conditions for success seem to be that the information should be specific to the doctor, that is, he should know exactly his position, particularly with respect to his peers. The information should be timely and recent enough for the doctor to appreciate and understand the information fed back to him. Normally this means data on patients under care within the previous 4 weeks. Absence of these conditions is likely to mean that feedback will not be successful.

Review of patient notes

The junior doctor is most likely to pay attention to, and be influenced by, examples drawn from patients under his care, particularly if the review is conducted by one of his seniors. The senior doctor leads a discussion, which includes a commentary and analysis of the investigations requested, their usefulness, possible alternatives and the use to which the information might be put. This is the most powerful form of feedback.

Once a week for 4 weeks the requesting doctor met the senior to review one set of notes for a patient under his care.[33] Each test was reviewed and ruled as necessary or unnecessary.

Other related matters were discussed. Assessment showed that the number of tests per in-patient fell from 107 to 57 and this improvement was maintained. Over a 5-month period, every 2 weeks a random set of five notes was reviewed and used as a basis to discuss decision making for laboratory tests under the related topics.[24] These reviews were associated with the cost and numbers of tests performed in the previous two weeks. Results showed a fall in total tests ordered by 15%. Most of the studies have been done on in-patients, a study reported by Everett[37] showed that there was a carry-over effect from in-patients to out-patients. The number of tests requested on out-patients fell as those requested on in-patients fell. However, the effect was temporary and the previous testing pattern reverted back within a few weeks.

A weekly review of medical records by a senior doctor,[32] in combination with guidelines on the use of tests for the nine commonest medical emergencies, produced a 64% reduction in both biochemistry and haematology requests.[32]

Notes review is a combination of feedback, education, increasing motivation and attitude creating. A personal approach by a senior is the most effective way of introducing a change.

Not all were successful. In one study,[5] both a course of lectures and a review of the patient records only minimally reduced the ordering of investigations. The conclusion was that in the absence of other cost containing incentives, physician education alone is not an effective hospital cost containment strategy. This study apart, this method intuitively seems to be the most effective. Involvement of senior staff gives authority as well as an opportunity for the lessons of experience to be passed to those more junior.

Framework for the control of test requesting

There have been mixed results with virtually all methods used to control requesting of investigations. Clearly there are other issues which have to be taken into account when devising systems to influence test requesting. These include the following.

Attitude

There is some evidence[5,24,36,38] that the attitudes of senior doctors are critical for the success of any of these methods. If senior medical staff are indifferent to the concept of cost reduction, then the likelihood of any initiative succeeding is much less. If, on the other hand, they are enthusiastic and insistent then the initiatives are likely to succeed.

An outstanding example of this was given by Cohen *et al.*[36] They studied the effects of feeding back cost information on laboratory tests to two teams of physicians and similar data on X-ray requesting to two further teams. Surprisingly, it was the teams receiving the X-ray information who showed the greatest decrease in laboratory test cost, whilst also reducing the X-ray costs. The other team showed no change for either laboratory or X-ray costs.

On investigation, it was found that the firm

leaders of both the teams receiving X-ray data took a great interest in the study in contrast to the leaders of the other two teams. It was felt that this difference explained the results. A similar conclusion was reached by Everett[38] who concluded that test utilization was strongly influenced by attitude and where favourable attitudes were present laboratory testing could be reduced by several different strategies.

Suitable attitudes can be encouraged if the reasons for engaging in laboratory test reduction are clearly understood. On the whole, it is of little interest to participants to state that cost containment is an end in itself. The key reasons for cost containment are (a) improved patient care in that patients get just those investigations which their condition warrants; (b) efficient use of resources releases monies which can be used for other purposes, hopefully better patient care in other areas, and (c) intellectual satisfaction in doing the best for a particular circumstance. This should improve morale and further contribute to good care.

Framework

Reducing test ordering should be seen as an ongoing concern of the hospital and part of the culture of the institutions. Many of the studies reviewed, particularly those involving education or peer review, were only done for a relatively short time, four weeks in some instances. If initiatives are perceived as short term measures only, then they are likely to be regarded as experimental or only of interest to other people and not relevant to the care of patients.

When it is accepted that cost containment, like good prescribing habits, is part of the hospital's ethos, then it is likely to be taken seriously. This kind of framework should support other aspects of hospital resource usage, including decisions for admitting patients, treatments, length of stay and other aspects of care. The overriding criterion is what is in the best patient interest and are we spending just the resources that his condition requires. It seems clear that the appropriate culture depends on correct attitudes and the right framework for these activities.

The key figure is the doctor delivering care. He should appreciate his responsibility in the effective use of laboratories, pharmacy, etc. A laboratory manager's role is to allow him to achieve these aims, by providing him with information on usage.

The effect of sustained interest

The most successful reported means of reducing test ordering from one hospital involved a wide variety of methods over a number of years.[20] The methods used included 7 hours of lectures for residents on various features of test ordering, including the cost of laboratory investigations, the supervision of house staff by senior residents, reviews with house staff on good laboratory practice and teaching rounds to look critically at the use of laboratory tests by residents and others. Other methods included distribution of hospital bills for each patient given to the resident in charge, a manual of charges on each ward and continual research projects on the use of laboratories within the hospital.

This multifactorial approach within a framework of commitment by hospital authorities has been effective and continually effective.

Different strategies for different groups

Whilst a global strategy of cost containment which will apply to all groups for all times is a happy thought, a more realistic approach is to consider why different groups of doctors order investigations. It appears that the older and more experienced practitioners order less tests than their junior colleagues. The broader prospectives of long experience bring a greater appreciation of the clinical assessment. However, on some occasions the strategies of test ordering may not be the most modern.[39,40] Educational programmes to present more up-to-date views on the best tests might be helpful.

Junior doctors place great reliance on tests. Strategies aimed at them should set the role of investigation within the context of an accurate clinical assessment. A common fault is excessive repeat testing. Measures such as the feedback of testing statistics might reduce these repeat investigations.

Other determinants of test requesting are attitudes to risk, teaching hospitals *vs* non-teaching hospitals, environments, availability of investigations, and nearness of expert opinions.[40] A successful strategy or test control needs to consider all these factors.

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