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Reducing costs with computerised order entry

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The cost of laboratory and radiological tests represents a significant proportion of health care expenditure. Computerised order entry provides several opportunities for significant cost reduction. There is no evidence that the cost reduction comes at the expense of failure to order tests which were indicated.

1. Introduction

Laboratory and radiological testing costs represent a significant proportion of the expenditure of most health care providers. In Australia, the rise in costs of diagnostic testing in pathology and radiology is second only to the rise in cost of pharmaceutical prescriptions.[1] While the cost of individual tests may be relatively fixed, the order entry system provides an opportunity for controlling those costs.

Systems for computerised order entry for laboratory and radiological tests have been in use for many years. The literature supports the claim that such systems, in the context of appropriate education and wider policy setting [2], can reduce the cost of testing. Tierney, Miller, et al. conducted a randomised, controlled trial to assess the effects on resource utilisation of computerised order entry. The computerised order entry group generated charges that were 12.7% lower than the control group ($p = 0.02$). Significant reductions ($p < 0.05\%$) were generated separately for bed charges, diagnostic test charges and drug charges.[3]

In this paper, we examine the approaches to cost reduction at the point of order entry. Section 2 considers some of the issues behind over-utilisation and shows where solutions are likely to lie. Section 3 examines the successful approaches to cost reduction: policy measures, educa-

tion, and feedback. Finally, in Section 4 we consider the important issue of whether reducing test ordering means important tests are never performed.

2. Systemic issues

There is no single, clear cause behind over-utilisation of laboratory and radiological tests. The issue is largely a systemic one:

- Junior staff often order tests liberally to avoid missing an important one, or follow overly simplistic protocols.[1]
- More senior staff often order by conventions accumulated over time rather than through evidence, or sensitivity to medicolegal concerns.[1]
- New laboratory tests are made available with a minimum of education for doctors.

Hospitals often have no clear policy to serve as a guide for users of the testing services. Grantham and Weinstein found a range of common modes of misuse of laboratory testing:

- Duplicate ordering of identical tests due to poor communication
- Tests repeated too frequently
- More involved (and hence expensive) tests ordered when a simpler test was actually indicated.[4]

In some settings, over 30% of ordered tests are inappropriate, and over 20% of results are never used.

Several studies have highlighted tests where the results are never used. In a review of medical records, Rafeh and el-Tobgi found that 31.4% of tests ordered were inappropriate, and 20.1% of results were not used in clinical decision making.[5] These inappropriate tests accounted for 22.6% of the total annual budget for the hospital's laboratory. Some individual tests fare even worse. Kelly found that a mere 1.6% of all blood cultures taken in an Emergency Department setting actually resulted in changes in patient management.[6]

3. Cost reduction measures

3.1. Policy measures

Policy-level interventions have certainly been shown to be effective in reduction of utilisation, but in some respects they are a fairly blunt instrument. Three main interventions have been studied:

- Deletion of particular ‘routine’ tests from a laboratory's services
- Restrictions on ordering of particular tests
- Implementation of protocols or criteria for the ordering of particular tests.

In the order presented above, the measures are decreasingly drastic, but increasingly difficult to implement well and on an ongoing basis.

Deletion of tests essentially refers to removal of tests which are done as ‘routine’ rather than for a specific purpose. (For example, ordering a complete blood examination on admission whether warranted or not.) In a prospective study to examine whether such a measure would

produce a cost saving, Groopman and Powers observed a $US 20,000 annual cost saving with the deletion of a single 'routine' test (coagulation profile). They found no patients untested for whom the test would have been indicated.[7]

Burnett and Sugerman conducted a retrospective review of 142,000 pathology test orders. They found that restrictions on a particular class of tests reduced the overall cost of biochemical testing.[8] Similar results were observed by Lyon, Greenway, et al.[9]

The use of protocols or criteria for ordering laboratory tests has been extensively studied. Of course, there is a certain amount of overlap with this measure and the educational approach described in Section 3.2 below. The consensus is that the use of protocols can reduce the usage, and hence the cost, of laboratory testing.[10, 11] Wachtel and O'Sullivan conducted a study to compare test use before and after the implementation of practice guidelines for fourteen medical problems in hospitalised patients. Participating doctors were able to achieve substantial and significant reductions in testing without any demonstrable adverse effect on quality of care, and without any demonstrable shifting of resources from the inpatient to the outpatient setting.[12] Novich, Gillis, et al. trialled a program of requiring a written justification for certain tests at order entry time. They found reductions in test ordering such as anticoagulation profiles (44%, $p < 0.001$) and differential leucocyte counts (35%, $p < 0.001$).[13] Other studies have found similar usage and cost reductions are possible.[14–16]

Stuart, Crooks, et al. implemented a three-level protocol for restricting test ordering in an emergency department setting.[17] Pathology and radiology tests were categorised into:

- Unrestricted tests (e.g., routine haematology and biochemistry, chest X-rays)
- Tests with ordering criteria, and for which follow-up must be arranged (e.g., coagulation studies, serum drug levels)
- Tests which were completely restricted (e.g., endocrine tests, sputum cultures).

Savings of over $A 1,000,000 were made with a simple protocol-based system in a small emergency department.

The rationale for the categorisation centred on feasability of follow-up. For example, a sputum culture which may take several days to yield a result is of no immediate benefit to the emergency management of a patient. The appropriate place to order such a test is either at the primary care level, or as an inpatient. Following intervention, there was a 40% decrease in the ordering of tests in the emergency department, with test utilisation falling from a mean of $A 39.32 per patient to $A 23.72 per patient. Reductions were similar for both laboratory and imaging tests, and were sustained after the intervention period. The overall saving over an 18 month period was $A 1,008,197 (in a department seeing 42,500 patients annually). No adverse patient outcomes relating to underutilisation of investigations attributable to the protocol were identified.[17]

3.2. Education

Many studies have examined the role of education in managing overutilisation of laboratory services, and it has often been found to be a successful strategy.[18] Some work has examined the use of online educational material to promote the appropriate use of radiological tests.[19] Martin, Wolf, et al. showed that an educational program worked better than even financial incentives in reducing laboratory test ordering.[20] Sucov, Bazarian, et al. found that significant cost savings can be made by decreasing test ordering through educational programs.[21] Other studies have replicated these results.[22–24]

Some studies have suggested that education alone is not the optimum strategy.[25] Education is often combined with other measures, such as provision of feedback. (Feedback will be discussed extensively in Section 3.3.) In a retrospective, controlled study examining the effects of interventions including education and feedback, Isouard found the number of inappropriate tests ordered was reduced during the interventions ($p < 0.01$).[26] Dowling, Alfonsi, et al. conducted a prospective, observational study looking at the test ordering patterns for two simple blood tests: the complete blood examination (CBE) and thyroid stimulating hormone (TSH) assay. The intervention included provision of education and an audit feedback system. They observed a significant reduction in the ordering of TSH ($p < 0.0001$) and CBE ($p < 0.05$).[27]

3.3. Feedback

Providing feedback to doctors has proven to be an effective cost reduction strategy. The main types of feedback are:

Cost — The actual cost of a test is provided to the doctor, usually at the time of order entry, but in some cases retrospectively. Alternatively, the cost of a doctor's overall usage could be provided.

Usage — Some aspect of a doctor's usage pattern is provided. This could be the overall number of tests ordered in a time period, the number of orders for a specific test, or the number of orders for a specific patient.

Other types of feedback have been used, and we will consider them at the end of this section.

Simply providing an indication of how much a test costs can reduce its usage.

Cost feedback is an obvious, direct measure of a doctor's laboratory utilisation. In a randomised, controlled trial examining the effect of daily cost feedback on expenditure, Pugh, Frazier, et al. found a highly significant reduction in diagnostic testing (20%), but also accommodation charges (18%) and length of stay (18%).[28] Hampers, Cha, et al. conducted a prospective, controlled trial to determine whether presentation of cost information at the time of ordering affected the use of laboratory tests. They found that simply providing price information was associated with a significant reduction in charges for tests ordered, and found no difference in subjective outcomes or family satisfaction.[29] In a year-long, prospective, controlled trial to examine the effect of cost feedback on outpatient laboratory test orders, Gama, Nightingale, et al. found reductions in both the number of tests ordered and overall laboratory costs.[30] Gortmaker, Bickford, et al. studied a series of interventions including feedback on costs. They found reduction in the number of tests ordered per patient ($p < 0.0005$) and a reduction in overall laboratory costs ($p < 0.02$).[31]

Feedback on system usage is an indirect measure of the cost of a doctor's ordering patterns. Gama, Nightingale, et al. found that such feedback at the time of order entry can reduce laboratory utilisation.[32] Spiegel, Shapiro, et al. conducted a time series study to examine the feasibility of reducing laboratory utilisation by developing criteria for the usage of a set of tests, and incorporating usage feedback. They found that order rates for several tests (including radiology and pathology) decreased by between 23 and 46%, and the reduction persisted after the intervention.[33]

Other feedback approaches have also been studied. In a randomised, controlled trial, Tierney, McDonald, et al. showed that presenting doctors with previous test results at the time of order entry reduced the ordering of those tests by at least 13%.[34] Bates, Teich, et al. conducted a randomised, controlled trial to determine the impact of giving doctors computerised reminders about apparently redundant clinical laboratory tests. About 70% of tests were cancelled

in response to reminders, giving an estimated annual cost saving of $US 35,000 for this laboratory.

Two studies have described the interesting approach of providing probabilistic information as feedback at order entry time. Tierney, McDonald, et al. performed a randomised, controlled trial to determine whether computer display of the likelihood of a normal test result for a given test would influence ordering behaviour. They observed a cost reduction of 8.8%.[36] In a prospective cohort study, Solomon, Shmerling, et al. examined the display of post-test probability estimates at order entry time. In this study, 11% of intervention orders were canceled, compared to only one out of 236 controls.[37]

4. Avoiding underutilisation

There is no evidence that cost reduction measures have any adverse effect on patient outcomes.

Having considered a range of measures for reducing laboratory utilisation, a reasonable question arises: 'Is there a risk of underutilisation—are patients missing out on tests they should be having?' The literature suggests that the answer is a definite 'no.' Groopman and Powers, in the study referred to in Section 3.1 above, found that no patients were untested when a test would have been indicated.[7] Again in Section 3.1 above, Wachtel and O'Sullivan found reductions in testing without any demonstrable effect on quality of care.[12] In Section 3.3 we referred to the study by Gortmaker, Bickford, et al. in which there was no evidence of reduction in the ordering of essential tests.[31] Kroenke, Hanley, et al. conducted a study addressing whether programs to reduce testing lead to a higher proportion of clinically indicated tests, and whether underutilisation is an adverse outcome. Using both education and policy restrictions, the authors found that test underutilisation was no worse during the intervention compared to nine months post-intervention.[38]

5. Conclusion

Computerised order entry presents several opportunities for cost savings. Used to implement the measures described in this paper, the savings can be significant and persistent. Most importantly, though, the reduction in laboratory utilisation has not been shown to involve the underutilisation of appropriate or indicated tests.

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