



Original article

How to save costs by reducing unnecessary testing: Lean thinking in clinical practice

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ABSTRACT

Background: The burden of health care expenditure on national budgets has increased dramatically over the past decade. A pilot study in our hospital demonstrated that many unnecessary diagnostic tests were performed routinely. The aim of this study was to reduce the costs of unnecessary diagnostic tests.

Methods: All diagnostic costs between 2006 and 2008 of the internal medicine department of the VU University Centre were evaluated. A target was set to reduce diagnostic expenditure by 7.5% in 2009 compared to 2008. A few interventions were introduced including introducing posters and pocket cards detailing the costs of diagnostic tests, six weekly feedback on diagnostics costs, mentorship of junior doctors, unbundling panel tests and increasing protocol adherence. Main outcome measures were the reduction in the total diagnostic costs and the total number of laboratory tests performed in the internal medicine department in 2009.

Results: In 2009, we achieved a 13% reduction in the total diagnostic costs compared to 2008. The department of internal medicine spent 2.80 million euro and 2.45 million euro on the diagnostic tests in 2008 and 2009 respectively and thereby saved 350,000 euro in 2009. The largest reduction was achieved by reducing the number of laboratory tests performed.

Conclusion: Introduction of a few simple measures to improve awareness among the physicians led to a significant reduction in the diagnostic costs in the department of internal medicine. Extending these measures to the entire hospital and even entire country will in our opinion lead to significant reduction in the health care costs.

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1. Introduction

In western countries the burden of health care expenditure on the national budgets has increased dramatically in the last few years, forcing the national governments to make hard choices on their spending [1]. For example, in the Netherlands the gross national product (GNP) spent on healthcare increased from 8.3% to 9.9% between 2001 and 2008 [2,3]. Due to the financial crisis and its slow recovery, spending on healthcare is expected to rise to 10.5% of GDP by 2014 [4]. Currently 15% of the population in the Netherlands is above 65 years of age. This percentage will increase almost up to 26% in 2040 [5], causing a shift towards chronic care with a resultant increase in health care consumption [6]. In addition, technological innovations are leading to new and expensive diagnostic and therapeutic options which will cause comparatively greater rise in

expenditure in the healthcare sector than in other sectors such as energy, housing and education [1,4].

Hospital care consumes one of the largest parts of the total healthcare costs. A considerable proportion of the money in hospitals is spent on diagnostic tools such as laboratory and radiological tests. Nevertheless, diagnostic testing is an expanding field. The utilization of laboratory testing and diagnostic imaging, especially computed tomography, has been increasing the last several decades throughout the world [7–10]. Inappropriate laboratory testing by physicians [9,11–13], as well as unnecessary diagnostic imaging, contribute to this expansion. It has been estimated that 30% of computed tomography tests may be unnecessary [10].

In November 2008, a small survey was performed in the outpatients department (OD) and the inpatient clinic of the internal medicine department of our hospital, to estimate the occurrence of inappropriate testing. This survey confirmed that a significant portion of the laboratory and radiology diagnostics was performed routinely without any indication, especially by the junior residents. It was also evident that national protocols were poorly followed leading to frequent and unnecessary laboratory testing. In an extreme case, a total of thirty LDL-cholesterol measurements in 4 years were

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performed in one hypertensive patient without a clear reason (this patient used statins and had a very low LDL-cholesterol level). We therefore decided to design an intervention in 2008 with the aim of reducing the costs of unnecessary diagnostic tests in both the inpatient clinic and in the OPD of the internal medical department in our hospital. This paper describes the results of this project.

2. Methods

2.1. Setting

The VU University Medical Centre in Amsterdam is an academic hospital with large number of secondary and tertiary referrals (approximately 26,000 hospital admissions and 320,000 outpatient clinic visits per year). The out patients department (OPD) of the internal medicine in our hospital treats about 4000 new patients with a total of 30,000 patient contacts annually. In the OPD of the Internal Medicine Department, four junior residents performed most of the consultations under the supervision of eight medical specialists.

The inpatients clinic of the internal medical department had about 900 admissions per year and was run mostly by five junior residents under the supervision of medical specialists. The total staff of the department consisted of around 40 residents and 20 specialists, which did not change markedly between 2006 and 2009. Both specialists and junior residents were interchangeable between the OPD and the inpatient clinic. The patient mix seen in OPD and inpatients clinic of the internal medicine department was stable over the years. Between 2006 and 2009, the top five diagnoses for the OPD were osteoporosis, metabolic diseases, diabetes mellitus, hypertension and tiredness. During the same period, the most frequent diseases in the inpatient clinic were diseases of the respiratory tract, cardiovascular diseases, metabolic diseases and infectious diseases.

Before 2006, the supervision of the residents in the OPD of the internal medicine was performed by different individual specialists. Consequently, the continuity of the supervision was lacking. The continuity was improved in 2006 by linking two experienced medical specialists for each resident in the OPD for mentorship. In the OPD, the residents discussed all their patients with their designated mentor before starting the consulting hours. Furthermore, residents could consult their mentor again between or after the patient visit. Diagnostic dilemmas and treatment strategies were discussed. Although specialists and residents had already paid much attention to expensive tests, it was noticed that little emphasis was paid to (unnecessary) laboratory costs. As a consequence, a senior management consultant evaluated all diagnostic costs between 2006 and 2008. The specialists and the residents were informed of these statistics in December 2008 and we decided to declare the year 2009 as the year of "reduction of unnecessary diagnostic costs." Diagnostic tests included radiology, laboratory tests, microbiology, nuclear medicine and pathology. We then set a target to reduce diagnostic costs by 7.5% in 2009 compared to 2008.

2.2. Interventions

The intervention consisted of several steps. First, in order to reduce the number of unnecessary laboratory tests, the supervising consultants were instructed to pay as much attention to the laboratory tests performed as to the diagnostic and therapeutic dilemmas. Second, laboratory orders were constrained by unbundling panel tests such as liver enzyme tests [alanine aminotransferase (ALAT) and aspartate aminotransferase (ASAT)], electrolytes (sodium and potassium), and kidney function (creatinine and urea/BUN). Indications for other frequently used tests such as glucose, calcium, albumine and phosphate were also strictly regulated. Third, the national protocols on the management of chronic diseases were included in a central electronic database, to create more awareness and to make it easier

for clinicians to consult them. The doctors were strictly instructed to follow these national guidelines of the Dutch physicians society with regard to the recommended frequency of the various diagnostic tests in a given chronic disease state. In addition, we printed posters and pocket cards with the cost prices of the laboratory tests and distributed them to all the doctors for reference. Finally, we presented six weekly overviews of the ordered laboratory tests during the morning report. The project was implemented only in the department of internal medicine and we used the performance of the rest of the units in the hospital as the control group.

2.3. Control group and quality of care

To gain insight into the quality of care during the interventions, a few end points including mortality, re-admissions (admission within 28 days after discharge) and Hba1c levels in 2006 until 2009 were reviewed. Hba1c levels were chosen as a parameter because of the high number of diabetic patients in the OPD and in the inpatients department.

2.4. Statistics and calculation of outcome measures

Data were extracted from the central hospital database called Cognos, a program containing detailed information about the number of patients seen, number of tests performed in the hospital and the total costs in all departments. All costs for diagnostic analysis made by the internal medicine department in 2006 until 2009 were reviewed. The expenses from the year 2006 to 2009 were evaluated so that the reduction in the expenses between 2006 and 2007, and 2007 and 2008 could be used to compare the magnitude of the reduction between 2008 and 2009.

The price level changed over the years and more patients were treated in 2009 than in 2006. In order to make an equal comparison, the amount of money spent during each year was adjusted for price level and the amount of work performed in the hospital due to the increased number of patients treated. The factor representing the increase of work and inflation was derived from the federal government budget allocation for 2009 compared to 2006, 2007 and 2008 [14]. The budget allocation took into account the expected increase in the number of patients treated and the inflation factor.

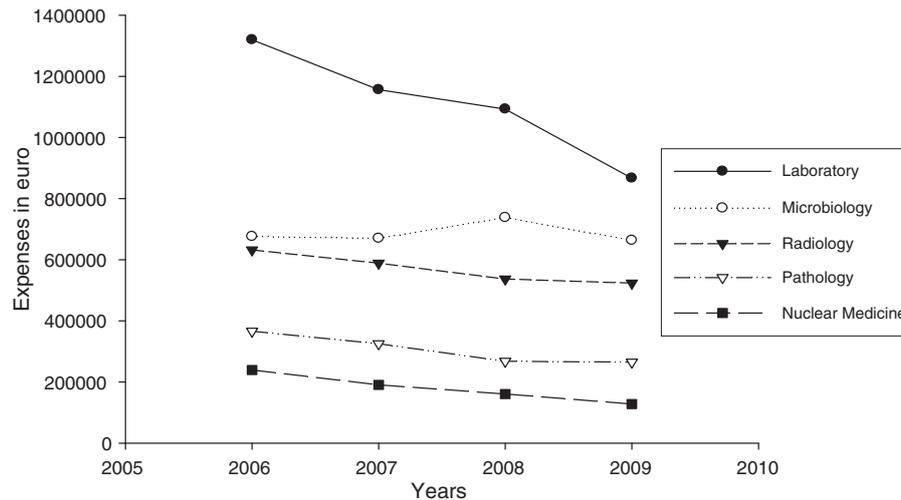
To compare, the difference between the magnitude of total diagnostic cost and laboratory cost reduction in the department of internal medicine and the rest of the hospital, the difference in the percentage cost reduction for each month between 2009 and 2008 was calculated. Thereafter, the paired *T*-tests were used to test this difference statistically.

3. Results

We investigated the proportion of the total budget of internal medicine department spent on diagnostic costs (radiology, laboratory tests, microbiology, nuclear medicine and pathology). In 2009 the internal medicine department spent altogether 23% of the budget on diagnostics.

After introduction of the interventions to reduce unnecessary testing in 2009, the expenditure on diagnostics by the internal medicine department declined from 2.80 million euro in 2008 to 2.45 million euro in 2009, saving 350,000 euro in 2009 (13% reduction) (Fig. 1). In the rest of the hospital (internal medicine department excluded), the expenditure on the diagnostics was 29.54 million euro in 2008 declining to 28.61 million euro in 2009, saving 930,000 euro in 2009 (3.1% reduction) (Fig. 2). The difference between the cost reduction in the internal medical department and the rest of the hospital was statistically significant ($p < 0.001$).

The largest cost reductions by the internal medicine department were made on laboratory expenses (Fig. 1). These costs declined from 1.1 million euro in 2008 to 870,000 euro in 2009, saving 230,000 euro

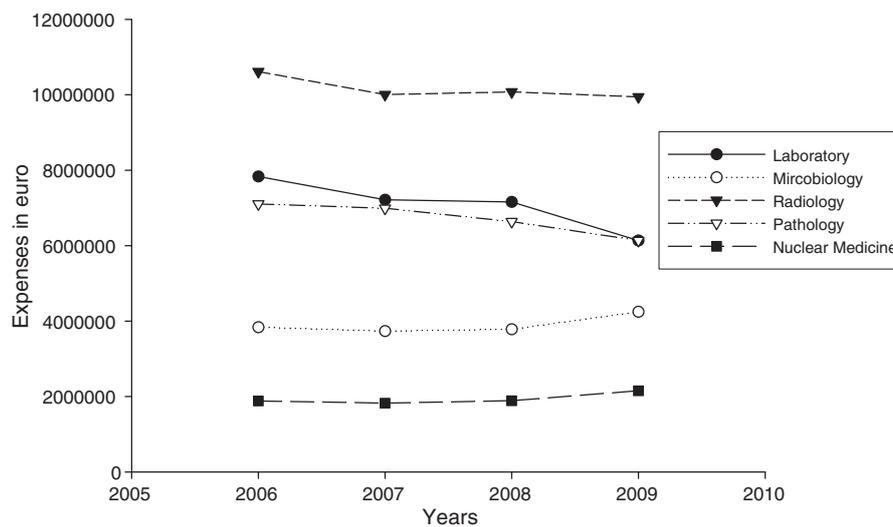


	2006	2007	2008	2009
Laboratory	€ 1.319.710	€ 1.156.495	€ 1.092.731	€ 866.612
Microbiology	€ 675.863	€ 670.037	€ 737.900	€ 663.191
Radiology	€ 632.134	€ 588.699	€ 536.902	€ 523.451
Pathology	€ 366.083	€ 324.849	€ 267.651	€ 264.948
Nuclear Medicine	€ 239.178	€ 190.556	€ 160.514	€ 127.803
Total	€ 3.232.967	€ 2.930.636	€ 2.795.699	€ 2.446.005

Fig. 1. Total costs spent by internal medicine department on the diagnostics in 2006–2009.

in 2009 (21% reduction). The rest of the hospital (excluding the Internal Medicine Department) spent 7.16 million euro on laboratory costs in 2008, which declined to 6.14 million euro in 2009, saving 1.02 million euro in 2009 (14% reduction) (Fig. 2). The difference between the laboratory cost reduction in the internal medical department and the rest of the hospital was statistically significant ($p < 0.02$).

In the years before the interventions, expenditure on diagnostics by the internal medicine department only declined by 300,000 euro between 2006 and 2007 (9% reduction), and by 135,000 euro between 2007 and 2008 (5%) (Fig. 1). Costs spent on laboratory tests by the internal medicine department declined by 300,000 euro between 2006 and 2007 (12% reduction) (Fig. 2).



	2006	2007	2008	2009
Laboratory	€ 7.831.395	€ 7.217.414	€ 7.157.238	€ 6.136.014
Microbiology	€ 3.837.308	€ 3.734.900	€ 3.780.824	€ 4.244.522
Radiology	€ 10.614.554	€ 10.004.443	€ 10.074.859	€ 9.943.544
Pathology	€ 7.105.393	€ 6.988.004	€ 6.635.556	€ 6.137.097
Nuclear Medicine	€ 1.882.726	€ 1.822.335	€ 1.889.889	€ 2.150.789
Total	€ 31.271.376	€ 29.767.096	€ 29.538.366	€ 28.611.947

Fig. 2. Total costs spent in the whole hospital (internal medicine excluded) on various diagnostics in 2006–2009.

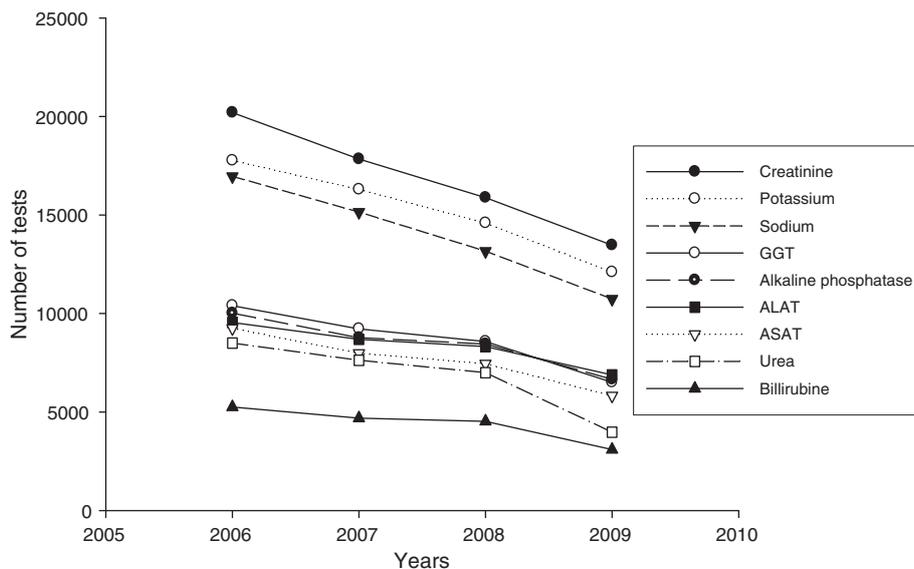


Fig. 3. Number of tests for various electrolytes, kidney function and liver enzymes performed in 2006–2009. GGT: gamma-glutamyl transferase. ALAT: alanine transaminase. ASAT: aspartate transaminase.

The number of orders performed by the internal medicine department declined for several tests but the most reduction was seen between 2008 and 2009. Figs. 3 and 4 show the number of orders for liver enzyme tests, electrolytes, kidney function, cholesterol and other frequently ordered tests.

3.1. Quality of care

No evident changes occurred for mortality and hospital re-admissions between 2006 and 2009 in the internal medical department (Figs. 5 and 6). In addition, the average values for HbA1c did not change between 2006 and 2009. In 2006 until 2009 the average HbA1c values were 7.76% (*n*: unknown), 7.85% (*n*: 4800), 7.71% (*n*: 4647) and 7.63% (*n*: 4358) respectively.

4. Discussion

We have demonstrated that the introduction of a few simple measures in the in and out patients departments of internal medicine in our university hospital, led to a statistically significant reduction

in unnecessary diagnostic testing. Thereby we achieved a major reduction in the costs. Increasing the awareness among the clinicians about these costs was mainly responsible for this decline.

A recent study reported a major success in reducing laboratory expenditure after stimulating the cost consciousness of the physicians [15]. Often clinicians tend to pay much attention to prevent unnecessary and expensive diagnostic tests. However, little attention is paid to inexpensive diagnostic tests, which make up a significant part of the costs because they are performed frequently [16–18]. Larsson et al. calculated that 5% of total costs in clinical chemistry in Sweden could be saved on seven of the most frequently used tests [12].

In our study most savings were also obtained by reducing frequent ordered tests. This reduction was achieved in spite of the fact that the number of patients treated by the internal medicine department increased during the test period. Moreover, we achieved a reduction of 13% in 2009 compared to 2008 although our aim was only 7.5% reduction. In the control group there was also a reduction of diagnostic expenditure between 2008 and 2009, though only 3.1%, suggesting a generalized trend towards cost reduction in our hospital.

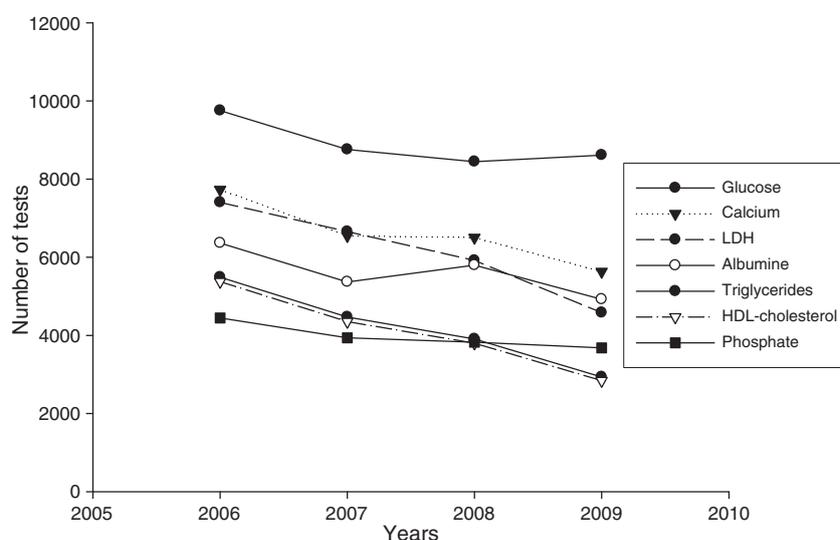


Fig. 4. Number of other frequently ordered laboratory tests in 2006–2009. LDH: lactate dehydrogenase.

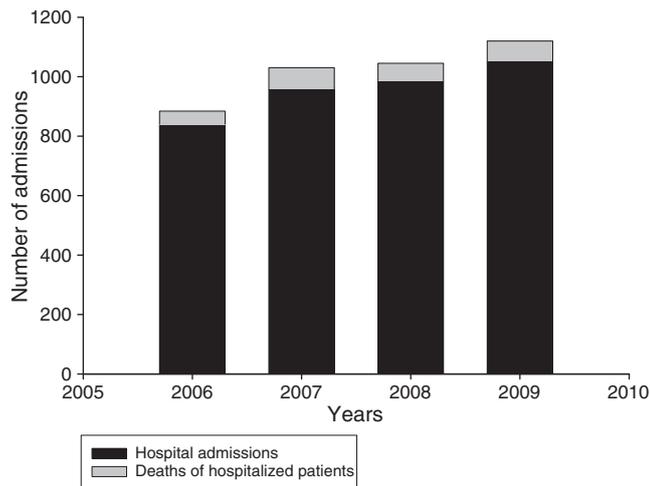


Fig. 5. Hospital admissions and number of deaths of the hospitalized patients for the internal medicine department in 2006–2009.

There was a uniform decrease in the costs spent on the diagnostics in all sub-departments except the microbiology department. This was due to the epidemic of H1N1 influenza in 2009, which led to an increase use of molecular diagnostic tests.

We believe that the generalized cost saving trend was caused by the fact that the whole hospital was facing budget cuts. Although other departments did not systematically implement rules for diagnostic costs, it is likely that there was more awareness about expenditure and that departments tended to be more thoughtful about their spending. However, the statistical analysis clearly showed that the difference between the magnitude of cost reduction in internal medical department was significantly more than the rest of the hospital.

Several interventions to improve physicians testing practices have been described in literature. Adherence and implementation of clinical guidelines can optimize the use of laboratory resources [19,20]. Other strategies include education and feedback of physicians [21,22], patient education, changing order sheets [23] and the use of computer systems [19,24]. All these interventions can reduce laboratory use, but it is likely that multiple behavioral factor interventions are

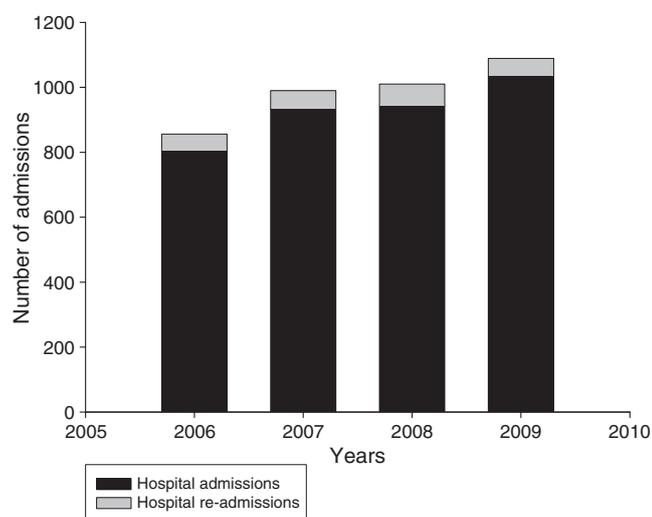


Fig. 6. Hospital admissions and re-admissions (<28 days after discharge) for the internal medicine department in 2006–2009.

more successful than one intervention [25,26]. In this study, reducing the diagnostic costs was also achieved through a multiple approach, which included creating awareness, unbundling laboratory tests, more intensive supervising, better guideline adherence and feedback. Not only residents but also senior doctors were involved in the project.

Despite of the reduced amount of diagnostic tests, the quality of care was probably not affected since mortality and re-admissions did not change over the years. Also the average values for HbA1c did not change significantly during the years. Perhaps, quality of care was improved because unnecessary tests are known to increase patient discomfort and lead to more false-positive results [27,28]. Also, frequent phlebotomies are known to be associated with a drop in hemoglobin levels [29].

In Europe, the costs of laboratory tests represent 0.8% of total healthcare expenditure, according to the European Diagnostic Manufacturers Association (EDMA) [30]. This number of 0.8% might seem low; however the burden of diagnostics on the budgets of hospitals is relatively much higher and more so in teaching hospitals with junior staff performing much of the clinical work. For example, in our internal medical department 23% of the total budget is spent on diagnostics. Therefore, in our opinion efficient and correct use of diagnostics costs on the hospital levels would lead to a significant reduction in the total hospital costs. Furthermore, inappropriate diagnostic tests may lead to more consultations and more false-positive results with additional costs [27,28]. In the United States, it has been estimated that wasted medical spending accounts for one third of the national annual expends of medical care, and inappropriate testing is suggested to account for the largest part of this waste [31]. Because it is expected that the government budget cuts will continue, it is important, in our opinion, to use the diagnostic tools as efficiently as possible and not to waste any money.

5. Conclusions and limitations

Although we have shown a significant reduction in the tests ordered with a large reduction in the costs, we cannot say with certainty whether this led to a reduction in the quality of care. We have demonstrated that there were no significant changes in the mortality and the readmission rate. However these measures would not cover the total quality of care.

In conclusion, we demonstrated that with the introduction of a few simple measures a significant reduction in the diagnostic costs could be achieved in the department of internal medicine in our university hospital. Extending these measures to the entire hospital and even entire country will in our opinion lead to significant reduction in the hospital care costs.

Learning points

- Many unnecessary diagnostic tests are routinely performed in daily practice in hospitals.
- Increasing the awareness among the doctors about the unnecessary diagnostics and increasing the supervision of the junior doctors lead to significant reduction in these unnecessary tests performed.
- While the doctors tend to pay much attention to reduction in the amount of so called expensive tests little attention is paid to cheap tests which are performed frequently. Paying more attention to the indications for these tests leads to significant reductions in the costs. Increasing the adherence to guidelines and protocols leads to significant reduction in diagnostic costs.

Conflict of interest statement

The authors state that they have no conflicts of interest.

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