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What is the impact of clinical guidelines on imaging costs?

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Abstract:

Inappropriate and irrational use of numerous advanced diagnostic imaging technologies has recently been highlighted in many countries and has gathered the attention of policymakers. This matter has not only increased health costs in countries but also resulted in adverse health results. Various factors are involved in the inappropriate or unnecessary use of advanced medical imaging techniques including patient-related, physician-related, technological, and ultimately radiologist-related factors. This calls for the provision of new guidelines by policymakers to encourage all service providers to make appropriate use of such techniques. One of the main approaches in this regard is the application of clinical guidelines and decision support systems. The present study was a systematized review that conducted in January 2019, and the articles related to palliative care requirements on databases of Web of Science, PubMed, Scopus, ScienceDirect, Ovid, ProQuest, Wiley, and Google Scholar from January 1, 2009, to January 20, 2019, were searched. Strategy for searching and selecting the articles was Preferred Reporting Items for Systematic Reviews and Meta-Analyses Guidelines. Overview of the studies shows that various reasons for the overuse of diagnostic imaging technologies and effects of applying clinical guidelines on reducing diagnostic costs of treatment are investigated in this article with respect to various aspects and viewpoints. Clinical guidelines can be significantly effective in evaluating suitability and quality of referrals for diagnostic imaging, if only adapted properly.

Keywords:

Clinical guideline, diagnostic imaging, health expenditure, Iran, utilization management

Introduction

Imaging is one of the most important and challenging factors in increasing cost of health care.^[1,2] According to the American College of Physicians, surplus imaging imposes a staggering cost of between \$ 200 billion and \$ 250 billion a year on the health-care system.^[3,4] Excessive use of medical imaging can jeopardize its benefit to society due to changes in the balance between results and costs.^[3] Outpatient costs are rising faster with increasing complexity and costly technologies. Concerns about radiation

exposure are increasing day by day due to unnecessary radiology, especially in the case of computed tomography scans. The benefits of using imaging should definitely outweigh the risks associated with radiation exposure.^[5] Unsuccessful tests only impose a heavy economic burden on society, restrict access to patients in need, impose acute risks without providing adequate benefits, and do not increase (or possibly reduce) the quality of health care.^[6,7]

Disadvantages of using medical imaging in medical centers include the cost of diagnostic imaging,^[7] increasing resource constraints

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for use in other potentially effective areas,^[5] inadequate supply of imaging specialists to meet service demand, and Spending their time on unnecessary tests, increasing the risk of litigation due to increasing patients' awareness and strengthening their knowledge about various aspects of their treatment to put them at risk of testing (especially ionizing radiation) without convincing benefits),^[2] additional experiments leading to endangering patients. Their profitability includes the risk of reporting erroneous positive results and failure to provide necessary and appropriate tests leads to inefficient diagnoses and inappropriate treatment, In terms of accountability, inadequate and unnecessary services are a threat to the effective allocation of resources to health care.^[8]

Studies from around the world report that between 10% and 20% of diagnostic images are prescribed by doctors; based on clinical signs, patients are not the most appropriate and best solution. The lack of relevant clinical information has made it difficult for consulting radiologists to participate optimally in more efficient imaging, efficient development of correct diagnoses, and care plan management.^[9] One of the basic methods used to control Costs and adaptations to a competitive environment is utilization management.^[10] The American Medical Institute defines productivity management as follows: a set of methods by buyers of health-care benefits to manage health-care costs by influencing patient care decisions by case-by-case assessment. The occasion of care is used before the provision of that care.^[11] Productivity management is based on the use of protocols, clinical guidelines, and preapproval methods before providing services.^[10] Medical clinical guidelines are the most important tools in productivity management. In fact, clinical guidelines can reduce uncertainty and increase the proper use of radiological experiments by avoiding overuse and underuse of services and preventing the waste of resources.^[3] In this article, by examining the causes and factors of increasing the use of diagnostic tests, it has tried to explain the role and position of clinical guidelines and decision support systems in reducing the costs of medical radiation.

Methods

The present study was a systematized review of publications relating to the Role of Clinical Guidelines of Medical Imaging in Controlling Health Expenditures. The study performed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and Critical Appraisal Skills Program (CASP).^[12]

Search strategy

This study was conducted during January 2019 to review the English and Persian language published papers in the field of Clinical Guidelines of Medical Imaging

in Controlling Health Expenditures. For this purpose, we studied databases including ISI Web of Science, PubMed, Scopus, ScienceDirect, Ovid, ProQuest, Wiley, and Google Scholar from January 1, 2000, to January 20, 2019. The search keywords included "clinical guideline," "diagnostic imaging" "utilization management," "health expenditure," and "Iran,". Using OR and AND, keywords were combined and written in the search box of databases. All synonyms of the keywords were searched using MESH strategies.

Selection of articles and document

Independent reviewers (EM and MH) screened abstracts and titles for eligibility. When the reviewers felt that the abstract or title was potentially useful, full copies of the article were retrieved and considered for eligibility by both the reviewers. If discrepancies occurred between reviewers, the reasons were identified and a final decision was made based on the third reviewer (AJ) agreement. Two authors assessed the methodological quality and grade of evidence of included studies with the CASP tools.^[13] The CASP tools uses a systematic approach to appraise different studies designs from the following domains: study validity, methodology quality, presentation of results, and external validity, and each of the items from the checklists was judged with yes (low risk of bias, score 1), no (high risk of bias), or cannot tell (unclear or unknown risk of bias, score 0). Total scores were used to grade the methodological quality of each study assessed.^[13]

Inclusion and exclusion criteria

We searched papers that (1) mentioned to Role of Clinical Guidelines of Medical Imaging in Controlling Health Expenditures, (2) evaluation of CASP criteria in terms of methodology was corrected, (3) article is to English or Persian language, (4) articles have a perfect structure, (5) internal article has been printed in scientific and research journals, and (6) published papers in the years of 2000 and after.

Study quality assessment

Quality assessment of the included studies was done using the CASP tools. The score of quantitative studies ranged from 2 to 9. Majority of quantitative studies did not provide any ethical statement, study design, sampling, and reflexivity related to the research process. In this study, seven articles were used appropriate methods, and also, the majority of them did not consider important confounding factors accounted.

Results

Database search

The initial electronic database search of the literature resulted in a total of 3075 articles. At the next step, duplicate articles were eliminated and the number

decreased to 1504 articles. Using systematic screening, we reviewed the titles to find those related to the Role of Clinical Guidelines of Medical Imaging in Controlling Health Expenditures and selected 218 articles. In the next step, abstracts of the articles were studied and 40 articles were selected to be fully reviewed. After that, all of the selected articles were completely read, and on the basis of the inclusion criteria, only 15 articles were selected. Figure 1 shows the strategy for searching and selecting the articles in accordance with the PRISMA Guidelines, and Table 1 shows article information used in the study.

Main results

Findings reported strength points of medical tourism in Iran that derived with four main criteria including (1) factors effecting increased use of diagnostic imaging tests, (2) approaches for reducing the application of diagnostic imaging, (3) effects of using clinical guidelines in utilization management of diagnostic imaging, and (4) examples of application of clinical guidelines in diagnostic imaging.

Factors effecting increased use of diagnostic imaging tests

Studies have found various reasons for the over-referrals to diagnostic imaging tests. For example, referral patterns are related to physician’s judgment of themselves. Furthermore, physician–patient interaction and social factors seem to have significant effects on referrals for later diagnosis.^[1] Technological advances, aging population, accessibility of technology, and increase in the number of radiologists are also among other factors affecting the increased use of imaging techniques.^[4,15] When a new imaging technology emerges, it may be used for indications for which there exit no or not many evidences of effectiveness or cost-effectiveness, and

therefore, diagnostic imaging techniques are used inappropriately.^[13] Doctor referrals play the main role in how diagnostic services are applied and many factors effect prescription behavior of physicians regarding tests including professional uncertainty, consequent stresses of uncertainty and time limitations, and self-referrals of physicians, i.e., owning advanced imaging equipment by physicians creates financial motivation for increasing use of imaging services despite being redundant. Radiologists also play a role in the inappropriate use of imaging equipment by encouraging physicians to prescribe unnecessary imaging diagnosis. Defensive medicine is also another reason which occurs when physicians feel that they are at risk of being prosecuted judicially by patients. Patient expectations and preferences also increase the use of imaging procedures. This is the result of patients’ increased knowledge regarding advanced imaging techniques through social media and direct marketing, the Internet, and self-guide books which causes patients to seek imaging evaluations when faced with clinical problems.^[15-17]

Another major reason for increased use of imaging technology is the payment system. In other words, payments to physicians, hospitals, and other health-care providers are granted in such a way that they are encouraged to provide more services, without considering its cost-effectiveness and the reasons for fee for service systems. In fee for service systems, procedures or visiting sessions are refunded for each test and medical systems, which lack integrity and encourage the use of unnecessary tests and overdiagnosis.^[4,12,15] The importance of such factors is variant in different organizational structures and various countries throughout the globe.^[5]

Approaches for reducing application of diagnostic imaging

Value-based imaging is undoubtedly preferred to number-based imaging techniques.^[4] Various efforts have been made to improve cost-effectiveness and efficiency of referrals for diagnostic imaging tests,^[1] and payers have applied different tools for cost control, such as issuing prepermits for use of nonurgent and costly methods, which weighs requests for executing a certain method with respect to clinical guidelines provided for that method. In some countries, health program managers meet with business representatives, consumers, medical organizations, and hospitals, and health-care systems.^[7] This task force provides payers and other beneficiaries with recommendations and guidelines regarding type of service or technology needed such that the recommendation is nonbinding. In another program, when radiologists are faced with the question of whether the selected imaging procedure is suitable or not, they call for a meeting with the corresponding physicians who referred patients for

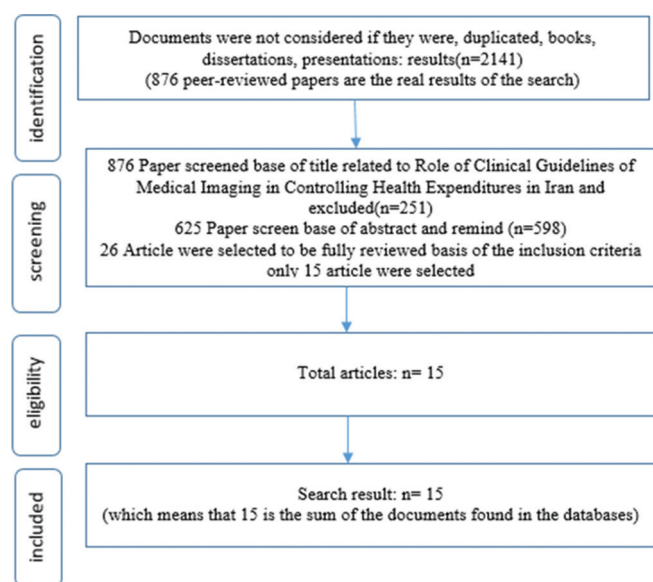


Figure 1: Flow diagram showing selection of articles reviewed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guideline

Table 1: Article information used in the study

Title	Author	Year	Findings
Diagnostic imaging pathways: development, dissemination, implementation, and evaluation ^[14]	Bairstow <i>et al.</i>	2006	Technological advances, ageing population, accessibility of technology, and increase in number of radiologists are also amongst other factors affecting the increased use of imaging techniques
Strategies for managing imaging utilization	Bernardy, Mark	2009	Radiologists play a role in the inappropriate use of imaging equipment by encouraging physicians to prescribe unnecessary imaging diagnosis
Effectiveness of clinical decision support in controlling inappropriate imaging ^[2]	Blackmore <i>et al.</i>	2011	Patient expectations and preferences increase the use of imaging procedures. This is the result of patients increased knowledge regarding advanced imaging techniques through social media and direct marketing, the internet, and self-guide books which causes patients to seek imaging evaluations when faced with clinical problems
Utilization and utility of diagnostic imaging: Quantitative studies and normative considerations ^[9]	Lysdahl	2011	various imaging utilization management systems, in various forms, have been applied by different insurance companies and RBM companies focusing on tests costs, overall quality, and guidelines with various levels of success
The sharp reductions in Medicare payments for noninvasive diagnostic imaging in recent years: Will they satisfy the federal policymakers? ^[11]	Levin <i>et al.</i>	2012	The evidence-based imaging paradigm is based on the principle that a physician cannot make an error-free diagnosis of the best practice by only relying on personal experience
Accountable care and value-based imaging: Challenges and opportunities ^[4]	Shrestha	2013	Deciding on creating, distributing, and implementing clinical guidelines must be based on precise evaluation of costs and benefits of changes in distribution and implementation of these guidelines for patient care
What causes increasing and unnecessary use of radiological investigations? A survey of radiologists' perceptions ^[15]	Lysdahl and Hofmann	2009	only 2.4% of specialists applied the appropriate criteria provided by American College of Radiology
Addressing "waste" in diagnostic imaging: some implications of comparative effectiveness research ^[13]	Elshaug <i>et al.</i>	2010	In fee for service systems, procedures or visiting sessions are refunded for each test and medical systems, which lack integrity encourage the use of unnecessary tests and over-diagnosis
Strategies for managing imaging utilization ^[16]	Bernardy <i>et al.</i>	2009	Clinical guidelines can be evaluated from two main aspects: utilization evaluation and evaluation of benefits and effects of guidelines along with consideration of users of these guidelines and how much they are actually being used
Integrating evidence-based imaging into the radiology core clerkship: a proposed teaching tool of imaging strategies ^[17]	Nadgir and Slanetz	2010	Clinical guidelines define the optimum level for patient care with a means to reduce differences in clinical practices applied by physicians or medical teams. Ergo, the increase in care standards
Comparing cost effects of two quality strategies to improve test ordering in primary care: a randomized trial ^[18]	Verstappen <i>et al.</i>	2004	Value-based imaging requires a culture towards continuous improvement of safety, performance, and outputs in order to sustain its current place in the rapidly changing and competitive field of healthcare services
the guideline for the management of patients with peripheral artery disease ^[19]	Rooke <i>et al.</i>	2011	Clinical guidelines are in fact practical evidence-based radiology tools rooted in moral necessities for preventing unnecessary damages, providing benefits for patients, and fair action through removal of redundancy
Identification of the health-care services with potential induced demand ^[6]	Khorasani <i>et al.</i>	2015	providers have applied different tools for cost control, such as: issuing prepermits for use of nonurgent and costly methods, which weighs requests for executing a certain method with respect to clinical guidelines provided for that method
Use of diagnostic imaging studies and associated radiation exposure for patients enrolled in large integrated health-care systems ^[20]	Smith-Bindman <i>et al.</i>	2012	Clinical guidelines are in fact practical evidence-based radiology tools rooted in moral necessities for preventing unnecessary damages, providing benefits for patients, and fair action through removal of redundancy
Adherence of mexican physicians to clinical guidelines in the management of breast cancer: Effect of the national catastrophic health expenditure Fund ^[21]	Ventura-Alfaro <i>et al.</i>	-2019	Doctor referrals play the main role in how diagnostic services are applied and many factors effect prescription behavior of physicians regarding tests including: professional uncertainty, consequent stresses of uncertainty and time limitations, and self-referrals of physicians, i.e.
An evidence-based clinical guideline for the diagnosis and treatment of degenerative lumbar spinal stenosis ^[22]	Kreiner <i>et al.</i>	2013	major reason is payment systems; in fact, there is a tendency for doctors, hospitals, and other medical care providers to make payments that encourage them to provide more services

RBM=Radiology benefits management

imaging. Therefore, in to aid radiologists, physicians provide further details in referral forms regarding whether imaging tests are appropriate or not. In another program, accurate preference standards are established for imaging equipment. Obligatory accreditation, clinical decision support systems, and provider support systems are among other solutions for this problem.^[5,7,11] In fact, various imaging utilization management systems, in various forms, have been applied by different insurance companies and radiology benefit management (RBM) companies focusing on test costs, overall quality, and guidelines with various levels of success.^[9] According to radiologists, the most important reason for increased diagnostic imaging procedures is the expansion of medical probabilities and supply and demand services. This is an indicator of the need for having specific tools for effecting supply and demand services to manage the growth of diagnostic imaging investigations, especially decision support systems for physicians.^[13]

Application and development of decision support systems have been introduced as a specific strategy for appropriately determining the need for diagnostic tests.^[7] Evidence-based practice is determined as the assimilation of foremost scientific evidence with clinical experience and patient expectations regarding certain clinical problems.^[16] The evidence-based imaging paradigm is based on the principle that a physician cannot make an error-free diagnosis of the best practice by only relying on personal experience.^[17] Just as evidence-based medicine and patient safety programs grow, guidelines for the best practice, which are used in certain regions, move toward data directing algorithms based on compliance. Such standard systems allow physicians to learn during prescription and provide tools for prescribing appropriate tests for existing clinical complaints, without the need for a big body of experience regarding imaging techniques and sensitivity and expertise in clinical scenarios.^[19] Clinical guidelines are in fact practical evidence-based radiology tools rooted in moral necessities for preventing unnecessary damages, providing benefits for patients, and fair action through removal of redundancy.^[3]

Effects of using clinical guidelines in utilization management of diagnostic imaging

Due to limitations in health-care resources, it is necessary to evaluate both cost-effectiveness of treatment methods and care procedures along with cost-effectiveness of all recent strategies for improving quality of health-care services.^[18] The main advantage of clinical guidelines is the promotion of patient care services. Although more precise evaluations have shown that clinical guidelines can in fact improve service quality, it is not evident whether this objective (increase in quality) is achieved on a daily basis. This is partly due to the variety in

how patients, physicians, payers, and managers define the quality of service, and studies regarding cost-effectiveness of clinical guidelines are scarce.^[17] Deciding on creating, distributing, and implementing clinical guidelines must be based on precise evaluation of costs and benefits of changes in the distribution and implementation of these guidelines for patient care.^[19] Clinical guidelines can be evaluated from two main aspects: utilization evaluation and evaluation of benefits and effects of guidelines along with consideration of users of these guidelines and how much they are actually being used.^[21] A quantity adherence study of clinical guidelines reported that only 2.4% of specialists applied the appropriate criteria provided by the American College of Radiology (ACR).^[15] Clinical guidelines and well-defined criteria in the form of evidence-based medicine are ultimately result in the benefit of patients, physicians, radiologists, and other parties and result in the steep reduction of costs while promoting quality of care services. Considering the exponential growth of costs, radiology has been the main focus of utilization management.^[10] Clinical guidelines define the optimum level for patient care with a means to reduce differences in clinical practices applied by physicians or medical teams. Furthermore, clinical guidelines aid physicians and other health-care providers in managing large amounts of information from scientific communities, journal articles, and personal clinical experience.^[20] Avoiding intensive applications can have a positive effect on radiologists' line of work and "increase cost-effectiveness through using appropriate tests at the appropriate time." Clinical guidelines also assure patients that prescribed tests and treatments are completely free of any personal judgment on part of the physicians.^[3]

Examples of application of clinical guidelines in diagnostic imaging

During 1990, ACR initiated a large-scale project for determining national clinical guidelines for appropriate use of diagnostic imaging technology. The product of this project was ACR Appropriateness Criteria. These clinical guidelines propose certain criteria regarding why, when, and how to use imaging technologies.^[23] However, these criteria were not well accepted by physicians. Payers applied numerous methods for utilization control, among which RBM is the most common. Decision support systems for clinical decisions are one of the solutions of RBM.^[24] Imaging experts at Royal Perth Hospital, Western Australia, created certain guidelines and instructions for diagnostic imaging (Diagnostic Imaging Pathways) in 1992 and disposed them to hospital physicians as a means to aid physicians in requesting appropriate tests under normal and common conditions. After later reconsiderations of the guidelines, it became evident that there is a need to fill the gap between evidence and clinical practice along with a need for an appropriate

electronic environment for easy distribution and continuous updating of guidelines. Moreover, use of these applications must be encouraged and evaluated.^[7] Pursuing excellence in clinical context and academic imaging guidelines and a complex electronic environment for presenting guidelines are not the only requirements for accessing and configuring the relationship between guidelines and applicant's behavior.^[21] It is evident that guidelines must be readily accessible at the time and the place where decisions are being made. For example, in an excursion of patient's bedside or during counseling, there is a need to include clinical guidelines in other information systems commonly used by physicians in a clinical environment value-based imaging which requires a culture toward continuous improvement of safety, performance, and outputs to sustain its current place in the rapidly changing and competitive field of health-care services.^[3]

Discussion

The increasing growth of imaging tests and high costs of diagnostic imaging necessitates the need for paying special attention to utilization management in this field, especially for policymakers.^[2] Prior to recognizing solutions for managing applications of diagnostic imaging, it is essential to determine what reasons drive the inappropriate use of such technologies and further impose unnecessary costs so as to propose proper solutions by investigating fundamental causes.^[25] In a study investigating the utilization of imaging services accompanied by magnetic resonance in patients covered by medical insurance at Esfahan, Iran, it is stated that application of magnetic resonance imaging (MRI) services is following an increasing trend which itself is due to the increase in new MRI centers and contracts with physicians for referring patients at Esfahan. On the other hand, certain professional groups prescribe these services more than others which is a result of Esfahan's special epidemiological status.^[26] Another main reason for irregular use of various diagnostic techniques is induced demand. A study on induced demand stated that insurance companies must endure further unnecessary costs due to induced demand which results in increased debt.^[8] On the other hand, induced demand proposes serious challenges for health system including fraud through irregular treatment methods, loss of equity in health, reduced productivity of the health system, reduced service quality, excessive expansion of new technologies, financial consequences for the health system, challenges of accessibility, inappropriate allocation of resources, increased service demand, and distortion in public's opinion on medicine. Patients also be burdened with consequences of induced demand including social, cultural, and financial challenges along with medical complications.^[26] Thus, the management

of resource utilization and application of approaches for evidence-based use of various diagnostic imaging techniques are of utmost importance. Evidence-based services are among recommended approaches for confronting induced demand.^[20]

Physician referrals also play a key role in how diagnostic services are used, and many factors influence physicians "behavior in prescribing tests, including professional uncertainty, stress caused by uncertainty and time constraints, and physicians' self-references."^[25] This means that the ownership of advanced imaging equipment by physicians creates economic incentives to increase the use of imaging. In addition, radiologists can be one of the main reasons for the increase in inappropriate use of imaging because unnecessary extra imaging is recommended by doctors. Defense medicine is another reason why it happens when doctors use Judicial litigation is dangerous for patients. Patient expectations and preferences also increase the use of imaging. This is due to the increase in patients' awareness of advanced imaging through the media and direct marketing for patients, the Internet, and self-help books, which leads patients to request imaging assessments for their clinical problems.^[11,20,25]

Another major reason is payment systems; in fact, there is a tendency for doctors, hospitals, and other medical care providers to make payments that encourage them to provide more services. Without paying attention to its effectiveness, the reason is the fee for service system based on the service unit (fee for service). It performs a repayment process or visit for each test, as well as medical systems that lack integration, promoting unnecessary tests and overdiagnoses. The importance of these factors varies in organizational structures and different countries.^[22]

In general, the causes investigated in this article can be divided into four categories including reasons related to technology, physicians, patients, and radiologists. Figure 2 shows the causality network for reasons why diagnostic imaging techniques are used inappropriately. As can be seen from this figure, the reasons related to technology include technological advances and consequently increased use of and access to technology, and direct marketing for health-care providers and patients. In regard to patients, considering direct marketing of advanced imaging technologies and increased knowledge of patients about these technologies, patients expect more from their physicians regarding the prescription of new imaging technology. On to physician-related reasons, considering accessibility to advanced technologies and current market of these equipment, owning of such equipment may inspire financial motivation for physicians to take advantage

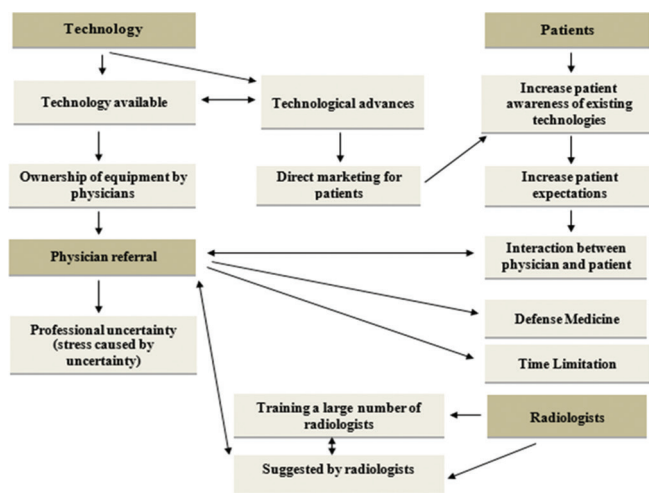


Figure 2: Causality network reasons for improper use of diagnostic imaging

of having a special imaging equipment and prescribe inappropriate tests and other unnecessary procedures for patients. On the other hand, high expectation of patients from physicians can cause prescription of unnecessary diagnostic tests. Lack of adequate training and physician's experience can also result in professional uncertainty and ultimately prescription of inessential tests. Fee for service systems, defensive medicine, and time limitations are among other reasons.

Conclusion

Finally, regarding radiologists, training large numbers of radiologists and their recommendations to physicians both cause increased use of unnecessary imaging procedures. Considering these problems, one of the solutions for utilization management of diagnostic imaging is the use of evidence-based imaging approaches, in which codification of guidelines is strongly recommended. Applying clinical guidelines concomitant to other utilization management approaches including previous licensing (license for prescribing tests before actually executing them in accordance with standards) is also another great commendation. It is also essential to investigate various administrative solutions and their cost-effectiveness before implementing clinical guidelines. Having ready an executive setting and localizing clinical guidelines is essential for its cost-effective and appropriate application.

In short, clinical guidelines can be significantly effective in evaluating suitability and quality of referrals for diagnostic imaging, if only adapted properly.

Strengths and weaknesses of the study

Clinical guidelines are the most important tools in productivity management. In fact, clinical guidelines can reduce uncertainty and increase the proper use of radiological experiments by avoiding overuse and

underuse of services and preventing waste of resources. In this article, by examining the causes and factors of increasing the use of diagnostic visual tests, we tried to explain the role and position of clinical guidelines and decision support systems in reducing the cost of medical radiation. One of the limitations of this study was the lack of access to the full text of some articles.

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Conflicts of interest

There are no conflicts of interest.

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