

# Interventions to Reduce Overuse of Coronary Artery Disease Cares: A Systematic Review

Nariman Moradi <sup>1</sup>, Mehdi Jafari <sup>2,3\*</sup>, Abbas Vosoogh Moghaddam <sup>4,5</sup>, Hamid Ravaghi <sup>6</sup>

<sup>1</sup> PhD. Department of Health Services Management, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran. <sup>2</sup> Professor. Department of Health Services Management, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran. <sup>3</sup> Health Managers Development Institute (HMDI), Ministry of Health and Medical Education, Tehran, Iran. <sup>4</sup> MD-FFPH. Assistant Professor, Society and health policy group, Secretariat of Supreme Council for Health and Food Security, Ministry of Health and Medical Education, Tehran, Iran. <sup>5</sup> Leadership and governance scientific group, Health Managers Development Institute (HMDI), Ministry of Health and Medical Education, Tehran, Iran. <sup>6</sup> Associate Professor. Department of Health Services Management, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran.

## Abstract

Coronary artery disease is the leading cause of death and disability around the world and care of this disease is at risk of overuse. The present study objective is to identify articles that have provided tested interventions to reduce the overuse of services in coronary artery cares. In this systematic review, the search method included all elements of the PRISMA checklist for systematic review. PubMed and Web of Science databases were used in this regard. After searching, two researchers reviewed the titles and then the abstracts of the articles and excluded the non-relevant articles based on the previously-defined inclusion and exclusion criteria. Some articles were also added through manual searching of the reference articles. After ranking the articles, the most relevant articles were selected. Initially, 530 articles were selected and by considering the inclusion and exclusion criteria, 12 articles were selected based on their authenticity, methodology quality, and number of the individuals who were potentially affected. These articles had provided tested interventions to reduce the overuse of coronary artery cares. The strategies found in this study included the dissemination of appropriate use criteria and training based on them and their inclusion in decision support tools. Also, using prior probability and risk classification of patients, feedback for unnecessary cases, lack of repayment for unnecessary cases, using less invasive measures as gatekeepers for more invasive measures, using certificate of need rules, giving information for patients and informing them on the benefits and risks of interventions, giving decision aid tools to patients. Anyway To design strategies to reduce unnecessary services, both the patient and the physician role in providing unnecessary services should be considered and interventions must be designed to influence their beliefs and attitudes toward the benefits and risks of diagnostic and therapeutic interventions and make better decisions, and eventually, adopt appropriate behaviors by encouraging and punishing them.

**Keywords:** Overuse, Low-value Cares, Unnecessary Services, Coronary Artery Diseases

## INTRODUCTION

Coronary artery disease is the leading cause of death and disability around the world. Treatment of cardiovascular diseases has been associated with significant technological advances in the second half of the last century. However, there is much evidence that suggests coronary artery disease care technologies are at risk of overuse <sup>[1, 2]</sup>. Overuse is defined as care in which potential care harms are more than potential benefits <sup>[3, 4]</sup>. In a broader definition, overuse is used to describe services that may be unscientific, duplicate, and unnecessary or harmful <sup>[5]</sup>. Overuse also includes diagnoses and treatments that are more costly, more complicated, and time-consuming compared to their standard alternatives <sup>[6]</sup>. Overuse is divided into three areas: 1. Overuse of tests that can lead into over-diagnosis of the diseases that will never cause symptoms or death 2) Over-treatment, which includes providing treatment that does not have indication or is inappropriate 3) Treatment of diseases diagnosed through over-diagnosis <sup>[3]</sup>. The most important reason to avoid

overuse of these services is that these services are harmful. However, unnecessary care provision that is not directly harmful should also be avoided as these services lead to higher costs <sup>[7]</sup>. Overuse is a major cause of non-stability of

**Address for correspondence:** Dr. Mehdi Jafari, Department of Health Services Management, School of Health Management and Information Sciences, Rashid Yasemi Street, Valiasr Avenue, Tehran, Iran.  
Email: mjafari@iums.ac.ir

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high health care costs and due to restriction in resources; overuse may be indirectly involved in inappropriate distribution of resources and lead to the displacement of resources from valuable cares<sup>[8]</sup>. Complications of over-diagnosis include the negative effects of viewing healthy individuals as ill individuals and labeling<sup>[9]</sup>. Also, in some cases, tests have higher rate of false positive results than true positive results and these tests do not reassure the patient and cause anxiety in the patient and may lead to potentially harmful tests and invasive treatments<sup>[10]</sup>. However, increasing use of health care has not improved clinical outcomes and it has been associated with poor clinical outcomes, such as high mortality and decreased patient satisfaction<sup>[11]</sup>. The present study was conducted to identify the interventions to reduce the use of unnecessary services in coronary heart disease care. Identification and implementation of these interventions can reduce harm to patients and cut the costs imposed to health system.

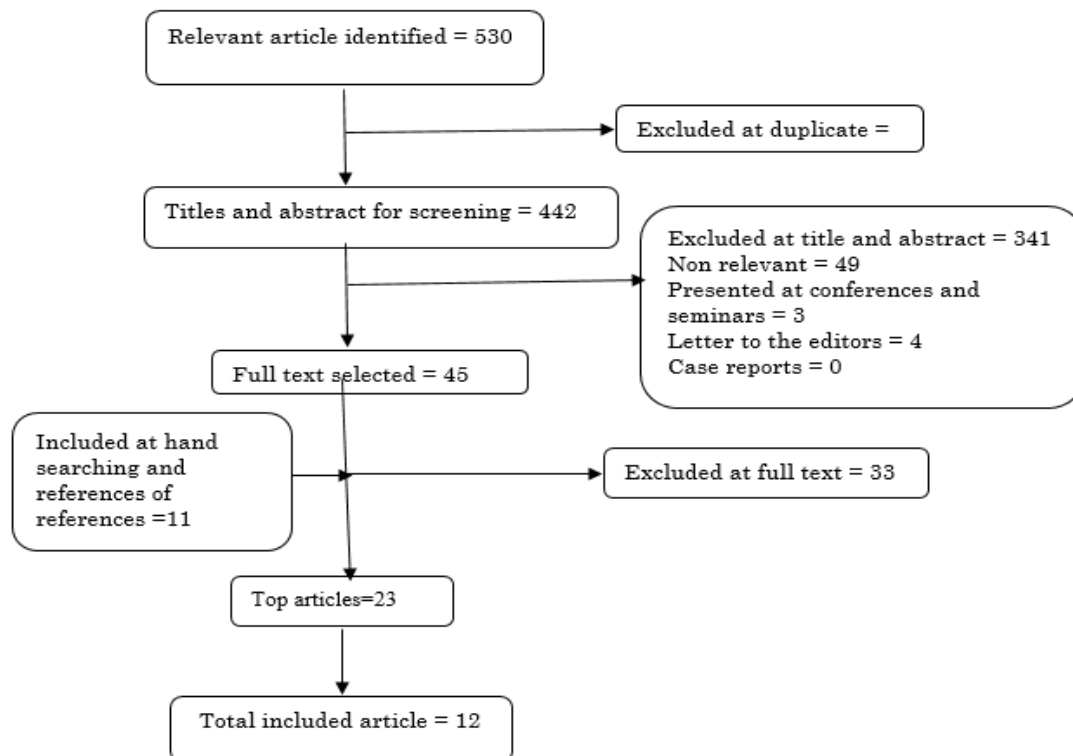
## METHODOLOGY

The present study is a systematic review. The search method included all elements required for PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) checklist for a systematic review. The keywords of unnecessary procedures, low value, overuse, overtreatment, over-diagnosis, inappropriate were combined with the words of coronary artery diseases and coronary arteriosclerosis through the connector of “and” and the search was limited to English and human studies, but there was no restriction with regard to time of studies. The searching procedure of this

study completed in the fall of 2019. The search strategy included manual searching of journals, grey literature, and article sources. The initial protocol for the search included all articles related to low-value services, inappropriate services, and overuse of services related to coronary artery disease. Duplicate articles were excluded through Endnotes software. Then, two researchers reviewed the titles and excluded unrelated articles based on inclusion and exclusion criteria. Inclusion criterion was the articles that provided tested interventions to reduce unnecessary services, and exclusion criteria included the articles presented in congress, letters to the editor, case reports, and public articles that were related to the subject of low-value services. The procedures used for reviewing the titles were also used in reviewing the abstracts. The remaining articles were ranked as the most relevant studies by one author based on the quality of the methodology, clinical impact factor, and number of patients who had been potentially influenced. Among the articles obtained the highest ranks, 12 articles of the most relevant studies were selected by agreement among of the authors. A number of articles with only public opinions were used to explain the introduction.

## RESULTS

A total of 530 articles were obtained by electronic search. After screening the titles, 442 articles were selected and their abstracts were reviewed. Among them, 45 articles were reviewed, and finally, 12 of the most relevant articles were included in the study (Figure 1).



The main results of this study are summarized in Table 1.

**Table 1.** Description of the selected studies selected

ID	Country	Setting	Study design	Study period	Participants	Intervention	Related outcomes
Desai NR, et al. <sup>[12]</sup>	USA	hospitals continuously participating in the National Cardiovascular Data Registry CathPCI registry	Multicenter, longitudinal, cross-sectional analysis	2009-2014	patients undergoing PCI	AUC publications	<p>The volume of PCI for patients with asymptomatic and acute conditions without symptoms or for those with mild symptoms decreased from 89704 in 2010 to 59375 in 2014</p> <p>The proportion of this measure in patients with non-acute conditions that were classified as inappropriate decreased from 26.2% to 13.3% after AUC publication.</p> <p>Since the publication of the AUC for Coronary Revascularization in 2009, a significant reduction in the volume of inappropriate PCIs occurred.</p>
Bhatia RS, et al. <sup>[13]</sup>	USA, Massachusetts	academic medical center in Boston	randomized control trial	from August 1, 2012, to April 30, 2013	physicians-in-training	The effect of an educational intervention based on appropriate use criteria and feedback on the administration of echocardiography in outpatients	<p>The proportion of inappropriate echocardiography was significantly lower in the intervention group than that in the control group (13% vs. 34%).</p> <p>Also, the proportion of appropriate echocardiography prescribed by the intervention group was significantly higher than that in the control group (81% versus 58%). Trained physicians generally administered lower echocardiographies</p>
Bhatia RS, et al. <sup>[14]</sup>	USA	teaching general medicine service at the Massachusetts General Hospital	time series analysis	February 23, 2012, to June 24, 2012	all medical house staff	<p>Using AUC and its training includes: 1) Lectures for staff about AUC, 2) Pocket cards where AUC was used for routine clinical practice</p> <p>3) Feedback as two-week emails about echocardiography prescribing behaviors.</p>	<p>There was a 26 percent reduction in the number of echocardiographies prescribed. Also the proportion of inappropriate echocardiographies decreased significantly during the study period (13% vs 5%,</p> <p>Also, the proportion of inappropriate echocardiographies decreased significantly during the study period (13% vs. 5%, <math>p &lt; 0.001</math>) and appropriate cases increased.</p>
Hannan EL, et al. <sup>[15]</sup>	USA, New York	New York hospitals	Before-After	before (2010 through 2011) and after (2012 through 2014)	patients without acute coronary syndrome	Quality improvement efforts resulting from the publication of the AUC; reporting the performance to the hospital on the rate of their inappropriate angioplasties; lack of re-payment for inappropriate cases	The number of angioplasties decreased from 2956 in 2010 to 911 in 2014, that is, a 69% reduction.
Lin FY, et al. <sup>[16]</sup>	USA	patients insured by 1 large private payer	prospective multicenter cohort	Between June 2010 and January 2011	One hundred physicians used the AUC-DST	multimodality approach-appropriate use criteria and decision support tools (AUC-DST)	For the tests prescribed in the first two months of use compared to the last two months, appropriate tests increased from 49 percent to 61 percent, while inappropriate tests decreased from 22 percent to 6 percent.

Hess EP, et al. <sup>[19]</sup>	USA	Six emergency departments in the United States	Multicenter pragmatic parallel randomized controlled trial	898 adults with a primary complaint of chest pain who were being considered for admission to an observation unit for cardiac testing and 361 emergency clinicians	2012	Shared decision-making using decision aid	Compared to the control group, patients in the intervention group had higher level of knowledge of their diseases and their choices for care; patients in the intervention group were more involved in decision-making (18.3% vs. 7.9%) and lower tendency towards using cardiac tests (37% vs. 52%), No serious heart attack due to intervention was observed
Rothberg MB, et al. <sup>[18]</sup>	USA		randomized trial	1257 adults older than 50 years living in the general community recruited using the Internet	2012	Three scenarios were suggested to improve patients' belief that angioplasty does not prevent heart attack: Participants did not receive information about the effect of angioplasty on cardiac arrest. 2) Participants were briefly explained that angioplasty does not reduce the risk of cardiac arrest 3) It was explained for participants why angioplasty does not reduce the risk of cardiac arrest	Patients' belief that angioplasty prevented heart attack was 71, 38.7, and 30.6, respectively, in scenarios 1, 2 and 3, and the probability of choosing angioplasty in scenarios 1, 2, and 3, respectively, was 69.4, 48.7, and 45.7%. Agreement with drug therapy in scenarios 1, 2 and 3 were 83.1, 87.4 and 92.3%, respectively. Hence, giving information could affect people beliefs and prevent unnecessary angioplasties.
Chinnaiyan KM,et al. <sup>[17]</sup>	USA, Michigan	Michigan hospitals	Before-After	pre-intervention (July 2007 to June 2008), intervention (July 2008 to June 2010)		Using a managerial approach of continuous quality improvement and provision of continuous training for physicians and systematic feedback	25387 patients were enrolled In the Advanced Cardiovascular Imaging Consortium Compared to pre-intervention period, there was a 23.4% increase in use of appropriate cases and a 60.3% decrease in inappropriate cases.

Larochelle MR, et al. [20]	USA, Maryland	academic medical center in Baltimore	Interrupted times series	Preintervention (January 2009 through July 2011) post-intervention from November 2011 through all adult patients admitted to Johns Hopkins Bayview Medical Center from 1 January 2009 through 31 October 2012	multimodal interventions including publishing organizational guidelines and modifications to computerize the prescription entry system for provider, to improve evidence-based prescription of cardiac biomarkers in the diagnosis of acute coronary syndrome	guideline-concordant ordering increased from 57.1% to 95.5%, an increase of 38.4%. A 66% reduction in the number of tests prescribed was observed, and this reduction in the number of tests had no effect on the early diagnosis of acute coronary syndrome.	
Kline JA, et al. [21]	USA	ED at Carolinas Medical Center in Charlotte	Randomized controlled trial	45 days	patients with chest pain paired with their clinicians	The use of prior probability	The use of prior probability was associated with a statistically significant reduction in patient exposure to radiation, increased patient satisfaction with physician explanations, Reduced return to the emergency unit during 7 days, no delay or failure to diagnose acute coronary syndrome. Providing prior probability safely reduced the use of unnecessary resources in patients with chest pain and low risk in the emergency unit reduced the ability of physicians to correct test prescribing behavior.
Litt HL, et al. [22]	USA	Five emergency department	randomized, controlled, multicenter trial		1370 low-to-intermediate-risk patients presenting with possible acute coronary	Use of CT angiography as the first imaging test	50% of patients who had been assessed using CT angiography strategy were discharged from the emergency department that it was more than twice the number of patients treated with traditional therapy and no one died or was affected by cardiac arrest within thirty days of follow-up. This strategy leads to safe discharge of patients, increased discharge and reduced hospital stay
Popescu I, et al. [23]	USA	4587 US hospitals	cohort	2000-2003	1139792 patients with acute myocardial infarction	Using certificate of need and lack of using it and its impact on the rate of revascularization and mortality after a heart attack	The probability of hospital admission for revascularization was 51.5% in a state that had these rules and it was 62.8% in a state that had no these rules Also, the rate of re-vascularization in these states was 26.1% versus 31.8%, and the mortality rates were similar in both states.

According to Table 1, interventions to reduce unnecessary services were introduced. One of the interventions is to publish appropriate use criteria. Appropriate use criteria were formulated in response to concerns on growing use of services by American Cardiac College (ACC) and American Heart Association (AHA) and with the participation of other specialized communities. Publishing these criteria can be helpful in informing physicians about unnecessary cases and it leads to appropriate use of services. Thus, training of physicians on the basis of appropriate use criteria can lead to more appropriate diagnoses and treatments. Also, to facilitate the use of these criteria, they can also be integrated to decision support tools. For example, the inclusion of appropriate use

criteria in smartphone applications and computerized prescriptions systems can inform the physician on unnecessary prescriptions by giving alarms, leading to reduced unnecessary services [12-16].

Other interventions include assessing the performance of physicians and hospitals and giving them feedback and comparing their performance with the performance of those who have been more successful in reducing unnecessary services. This measure will encourage them to provide appropriate services. However, feedback should not be limited to reporting unnecessary services, but it should include appropriate models and training to reduce these

services. Repeated feedbacks and attaching educational messages to them increase their effectiveness [13-15, 17]. The use of appropriate payment methods, and non-repayment to the provider for cases of unnecessary service identified after performance assessment can reduce unnecessary services [15]. Another intervention identified through review of studies is the use of less invasive measures as gatekeeper for more invasive measures in the path of diagnosis and treatment. For example, despite the availability of non-invasive imaging, invasive angiography is commonly used initially to diagnose suspected coronary artery disease. However, approximately 60% of invasive angiographies do not show an evidence of coronary artery disease. Taking an appropriate medical history of patients and categorizing them based on prior probability and providing services according to this classification before any diagnostic or therapeutic intervention can lead to a reduction in unnecessary services. Also, the use of certificate of need rules can prevent the uncontrolled expansion of equipment and facilities and ultimately lead to the rational use of services [21-23].

The focus of policies on reducing the use of unnecessary services in areas leading to a change in physicians' behavior is due to given the role of decision-making to physicians in health care. However, patients' enthusiasm and their ability to make decisions about their own care are increasing. Giving information for patients and making them aware of the risk of diagnostic and treatment services can result in reduced use of services. Also, decision aid tool can be used to help patients make decision and give them a stronger role in decision-making [18, 19]. Finally, the interventions obtained from the study can be classified into two dimensions of service provider interventions and service applicant interventions based on Table 2.

**Table 2.** Classification of interventions based on service provider interventions and service applicant interventions

Service provider	Service applicant
<ul style="list-style-type: none"> <li>•Publishing appropriate use criteria and training of physicians based on these criteria and informing them of unnecessary services.</li> <li>•Inclusion of appropriate use criteria in decision support tools to empower physicians at prescribing time</li> <li>•Feedback from unnecessary cases done by provider</li> <li>• Lack of payment for unnecessary cases</li> <li>• Using comparative studies to identify more appropriate measures and using less invasive measures as a gatekeeper for more invasive measures.</li> <li>•Taking an appropriate medical history and using prior probability and risk-based classification of patients to</li> </ul>	<ul style="list-style-type: none"> <li>• Providing information to patients and informing them of the benefits and risks of diagnostic and therapeutic measures</li> <li>• Using decision aid tools to empower the patient in shared decision-making</li> </ul>

- provide appropriate services to each patient
- Formulating clinical guidelines and incorporating them into the computerized data entry system
- Using the rules of certificate of need

## DISCUSSION

Overuse of services is considered as the biggest problem of modern medicine or modern health care [24]. Because of overuse of services and an emphasis on increasing the value of coronary heart disease care, the overuse of services has drawn the attention of experts and an investment to reduce them is essential. In the present study, the articles that recommended methods to reduce overuse of services were reviewed. To reduce unnecessary services, the first challenge is to identify unnecessary services. Sometimes, physicians are overconfident in tests due to their lack of knowledge of the harms of cares, and sometimes, the existence of a great number of studies can confuse the physicians and disable them to make a distinction between good and bad studies. These reasons indicate the necessity of appropriate use criteria (AUC). Also, to inform the physicians of unnecessary services cases, training them based on appropriate use criteria is essential. To facilitate the use of physicians, these criteria can also be included in decision support tools to identify an unnecessary service at prescription time.

The expansion of using highly sensitive tests and technologies has resulted in accidentally identifying of less important abnormal cases [25]. Prescription of electrocardiogram, stress test, angiography, CT angiography, or any screening test in patients at low risk and non-symptom patients are unnecessary, while more than 45% of screening is performed at low risk and non-symptom patients. Performing a stress test or any other advanced non-invasive imaging test annually as part of routine follow-up in patients without symptoms is unnecessary and it does not make a significant difference in the management of patient treatment [26].

Physicians must be aware that physical and psychological symptoms occur together and approximately 75% of symptoms resolve after several weeks and months, so physicians should be alert of using diagnostic tests to diagnose diseases with no prior probability because most diseases can be diagnosed with taking a complete medical history and skill in physical examinations [27]. Sometimes, physicians before clinical evaluation prescribe tests that may be unnecessary [28]. For these reasons, taking an appropriate medical history and risk-based classifying of patients using prior probability and providing services according to this classification before any diagnostic or therapeutic intervention are essential.

Various studies have revealed a significant relationship between over-supply of health services and unnecessary use of these services. Thus, using a certificate of need program to control high-cost and unnecessary provision of services can



be useful in this regard and result in reduced use of unnecessary services.

Financial factors are also an important factor for overuse of service. There is particular concern on the fee-for-service payment model because it provides financial incentives to deliver tests and treatments, despite patient benefits, and it rewarding volume of services rather than value. This payment model causes time limitation during consultation and makes it difficult to make common decisions and describe the complexity of diagnoses and treatments for the patient. Also, insurance coverage encourages patients to seek health care services and may reduce physicians' concern about the financial burden of over-treatment.<sup>[29]</sup> For this purpose, modifying payment method and using appropriate payment methods and lack of payment for provider for unnecessary services can reduce unnecessary services by sharing the service provider in risk.

Moreover, to improve the well-being of the community, there is an interest in the development of technology and innovation in health care, and this has led to a high desire in people to use the latest medical equipment<sup>[30]</sup>. There is a strong belief in health care that "the more is better" and "the new is better" and this is often a factor in overuse of services<sup>[31]</sup>. A strong belief in the benefits of screening in healthy individuals and a belief that early diagnosis and prevention is better than cure have increased the worry of people on non-diagnosis of serious diseases and their fear of delayed diagnosis and their pressure to access a test or treatment<sup>[9]</sup>. Patients believe that drugs are based on definitive knowledge and tests, especially the high-tech ones, are accurate and they have unquestionable trust in physicians<sup>[32]</sup>. Patients' overconfidence in tests is a means for their reassurance. "Just for sure" is what physicians hear during intervention and assessment<sup>[33]</sup>. Individuals also demand for services sometimes because their neighbor, family, or colleague have made measures and achieved good results<sup>[34]</sup>. Patients' expectation that physicians must do an action is an agent for overuse. For most patients, prescribing test or referring to a specialist physician is a sign of quality of service. They believe that physicians who do not make these measures are those who are not skilled in their work<sup>[35]</sup>. In short, it can be stated that inadequate education and knowledge of patients about medical limitations and injuries make patients overestimate the benefits and underestimate harms of prevention and therapeutic interventions. For example, elective angioplasty in patients with stable angina may improve symptoms to some extent and have limited benefits including relief of angina, but it may have an impact on the risk of heart attack or subsequent death. However, since people are unaware of this issue, they have an unnecessary demand in this regard<sup>[36]</sup>. Hence, providing information to patients and informing them of the risk of interventions is necessary and can lead to reduced use of unnecessary services.

Modern medicine operates through a model that considers disease as a deviation from biological variables. Focusing on deviation from biological standards rather than focusing on the patient needs is a factor that reduces the likelihood of the patient participation in decision-making and achieving the therapeutic goals<sup>[37,38]</sup>. Also, patients rarely participate in the collaborative decision-making process even when the process is elective<sup>[39,40]</sup> and even those who wish to use less services make their decision based on cost of information (Do they have time and access to high-quality information?) and cognitive limitations (Do they have the knowledge and ability to understand the complex functional data presented for right choice?)<sup>[41,42]</sup>. Hence, decision aid tool can be used to help patients make decisions and give them a greater role in decision-making.

In general, health care begins with making decision about the patient-physician relationship, and to reduce unnecessary services, a change in patient and physician behavior and influencing the decision made during the relationship is needed. The strategies obtained in this study can be classified according to the behavior model introduced by Solomon et al<sup>[43]</sup>. In this model, different behavior change strategies are classified into three groups. Strategies that aim at changing knowledge or attitudes are classified as predisposing factors, strategies that facilitate specific behavior or reduce barriers for performing it are considered enabling factors, and strategies that encourage or punish a specific behavior are introduced as reinforcing factors. In this study, publication of appropriate use criteria and training based on these criteria and informing physicians of unnecessary cases and giving information to the patient and informing the patient of the risks and benefits of services are classified as predisposing factors. Also, the inclusion of appropriate use criteria in decision support tools and the use of priori probability for physicians and the use of decision aid tools for patients are classified as enabling factors. Giving feedback and lack of payment for unnecessary cases and sharing the physician at risk and patient participation in payment can be classified as reinforcing factors.

## CONCLUSION

This study identified interventions to reduce the use of unnecessary services in the care of coronary artery disease. These interventions refer to role of both patient and the service provider in reducing unnecessary services. Higher focus on policies to reduce the use of unnecessary services in areas that change physicians' behavior is due to key decision-making role of physicians in health care. However, patients' enthusiasm and ability to make decisions about their own care is increasing. Therefore, to design strategies to reduce unnecessary services, both the patient and the physician role in providing unnecessary services must be considered. Additionally, a number of studies have emphasized the importance of using multiple approaches and combining different interventions to reduce the use of unnecessary services and since different factors are involved in using unnecessary services, a combination of interventions as a

comprehensive strategy that can cover the factors of provision of unnecessary services is recommended. Finally, interventions should be designed to influence the beliefs and attitudes of service providers and patients about the benefits and risks of diagnostic and therapeutic measures and help them to make better diagnostic and therapeutic decisions and take appropriate actions to stabilize diagnostic and therapeutic behaviors with incentive and punitive measures.

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