THE IMPACT OF COST TRANSPARENCY ON THE COST OF CARE DELIVERY: A SYSTEMATIC REVIEW

by

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STATEMENT OF THESIS APPROVAL

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ABSTRACT

Health care costs in the United States are rising at an alarming rate. Although much of the cost of care is dependent on the decisions of care providers, providers remain largely unaware of those costs. Legislators have passed initiatives aimed at increasing cost transparency, but the impact of cost transparency on the cost of care is uncertain.

The purpose of this study was to systematically review trials investigating the impact of cost transparency on the cost of care delivery, identify the factors likely to increase the effectiveness of such interventions, and suggest directions for future research.

We searched the Scopus database for relevant studies published up to November 2014. After identifying potentially relevant studies, we performed additional searches for publications citing or cited by the selected studies. This process was repeated until no additional studies were identified. Key characteristics of relevant studies were extracted for analysis.

We screened a total of 4,906 articles, 23 of which were included in the final analysis. We identified timing (education prior to the decision vs. feedback following the decision) and medium (electronic vs. nonelectronic) of communication as key factors impacting the effectiveness of the cost transparency intervention. One hundred percent (9 of 9) of "postorder feedback" studies resulted in decreased costs, whereas only 54% (7 of 13) of studies in which cost was communicated prior to the clinical decision ("pre-order education" studies) lowered the cost of care delivery. Eighty-eight percent (14 of

16) of nonelectronic studies reduced costs; 29% (2 of 7) of electronic studies reduced costs.

Cost transparency can be an effective strategy to reduce utilization of expensive tests or therapies. Intervention strategies that employ nonelectronic media for communication of financial information to providers and that communicate postdecision feedback may be most likely to succeed. The trend in current publications suggests that health care providers may be moving toward the less effective methods of cost transparency, which could hamper cost containment efforts. The strength of these observations is limited by the absence of prospective studies that directly compare the effectiveness of various cost transparency intervention methods. Future studies are needed to verify these findings and to determine the impact of cost transparency in new cost-centric organizations and incentive structures.

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BACKGROUND

Rapidly rising health care costs are one of the major challenges facing the United States. Factors including consumer insulation from direct costs and a fee-for-service provider reimbursement structure have driven costs to 18% of the U.S. gross domestic product.[1] Costs associated with care delivery are, in general, poorly understood. Physicians remain largely unaware of costs even in situations where the cost is uncomplicated, such as the price of medications.[2] In an effort to slow the rate of cost increases, legislators have put forth initiatives to increase cost transparency, which, presumably, would provide clinicians with the information necessary to ensure that only high value care is delivered to the patient.[3,4] The effects of cost transparency interventions on resource utilization and the cost of care delivery are unclear. The most recent systematic review[5] on the topic was published in 1997 and included only six studies, all of which were determined to have significantly altered provider behavior and reduced the cost of care. Since that time, additional studies have been published with mixed results. Investigators have pointed out some of the differences in the studies, such as setting or the object of the cost (e.g., laboratory test, pharmaceuticals, etc.), that may have led to the differing outcomes, but no clear pattern has emerged to explain why cost transparency reduces the cost of care in some instances but has no impact in others. The objective of our present study was to examine the impact of cost transparency on the cost of care delivery, identify factors that contribute to effective cost containment, and suggest

directions for future research. A description of our systematic review of the medical literature and a summary of our key findings follows.

METHODS

Data source

Due to the interdisciplinary nature of our research topic, which covers clinical medicine, economics, and behavioral sciences, we selected Scopus as the database for our literature search. In collaboration with an experienced librarian, we searched the Scopus database for terms related to the following concepts: health care cost; cost control; health care provider; provider practice patterns. The exact search strategy used is provided in Appendix 1. Search results were limited to primary research articles published in the English language. The latest search was performed on November 5, 2014.

Inclusion and exclusion criteria

We defined cost transparency as any communication to the health care provider of actual or relative costs (i.e., costs incurred by or charged to the provider, payer, or patient) associated with patient care. Our inclusion criteria were as follows: peer-reviewed primary manuscript; evaluation of the impact of cost transparency on the cost of care delivery or utilization; performed in a real-world clinical setting (as opposed to using written case studies or standardized patients); targeted licensed practitioners for the intervention. We excluded studies that were not published in the English language or used surrogate measures (e.g., length of hospital stay) for cost transparency. We also chose to exclude any study in which cost transparency was only part of a broader intervention in which clinical guidance was communicated in addition to financial

information and the effects of the cost-related communication could not be distinguished from those of other aspects of the intervention.

Study selection

Two authors independently reviewed the titles and abstracts of the identified studies and labelled each as "potentially relevant" or "irrelevant" based on the inclusion and exclusion criteria. The same two authors then performed additional database searches for articles that cited or were cited by potentially relevant studies. They repeated this process until no additional studies were deemed to be potentially relevant, after which they independently reviewed the full text of all potentially relevant studies. We measured interrater agreement using Cohen's unweighted κ statistic. Disagreements between reviewers were resolved by discussion.

Data extraction

Two authors independently reviewed the full text of selected manuscripts and extracted information on trial design, intervention medium, intervention timing, and outcome. The options for each category were, respectively: experimental vs. quasi-experimental; electronic vs. nonelectronic; pre-order education vs. postorder feedback; decreased costs vs. no effect.

We used the definition of trial designs found in the textbook *Foundations of Clinical Research : Applications to Practice*[6] to categorize the studies included in this review. Accordingly, we categorized as "experimental" any study in which subjects were randomly assigned to at least two comparison groups. We categorized as "quasi-experimental" those studies that lacked either random assignment at the subject level or lacked comparison groups entirely.

Our decision to include the category of intervention medium reflects our interests, as informaticists, in exploring the impact of electronic tools on clinical care. We categorized as "electronic" any intervention in which the primary communication of cost-related information was presented electronically. We included in the "nonelectronic" category studies in which the cost-associated information was presented in a nonelectronic format (e.g., lecture, printed price lists, etc.).

We included intervention timing in our analysis because it is considered to be one of the key factors contributing to the effectiveness of clinical decision support[7,8]. We categorized as "pre-order education" any study in which the content of the intervention consisted of generalized cost information (e.g., the price of drug irrespective of whether or not it had been ordered by the provider). We categorized as "postorder feedback" any intervention consisting of information reflecting costs associated with actual decisions by a provider or group of providers.

We measured interrater agreement for each category using Cohen's unweighted κ statistic. The reviewers resolved disagreements by discussion. Any remaining uncertainty was resolved through consensus of all authors.

Data analysis

We assessed the relationship between each explanatory variable and the outcome (defined as the primary measure of the study or, if the primary measure was not explicitly stated, significant decrease in cost or utilization of at least 50% of the items studied) by calculating binomial proportion confidence intervals using the Wilson score interval approach for individual success rates and the two-sample t test with equal variances

method for differences in success rates. We performed the calculations using Stata[9] release 13.1 (StataCorp, College Station, TX).

RESULTS

Our literature search resulted in a total of 4,906 unique references. After screening titles and abstracts, we reviewed 41 full-text articles, of which 23 met all of our inclusion and exclusion criteria (Figure 1).[10-32] Interrater agreements were satisfactory for study selection and data abstraction (Table 1).

Date of publication

Most (52%) of the studies included in our final analysis were published during or after 1999.[14-19,23,25,27-30] The earliest study was published in 1982.[13] The number of publications over time maintained a steady trend, with the exception of a gap from the years 2003 to 2009. Only one of the articles that were excluded during full-text review was published during this time period.

Study design

Seventy percent (16/23) of the studies employed quasi-experimental designs[12,13,15,17-20,22-28,30,32], lacking the randomization or comparison groups that are characteristic of experimental designs.[6] The most common of these was the one-group pretest-posttest design, used by 6 of the 23 studies that were included in the final analysis.[18,20,23,28,30,32] Only 30% (7 of 23) of the included studies utilized true experimental designs.[10,11,14,16,21,29,31] Four studies were classic randomized controlled trials,[14,16,21,31] in which investigators established a baseline rate prior to the intervention,

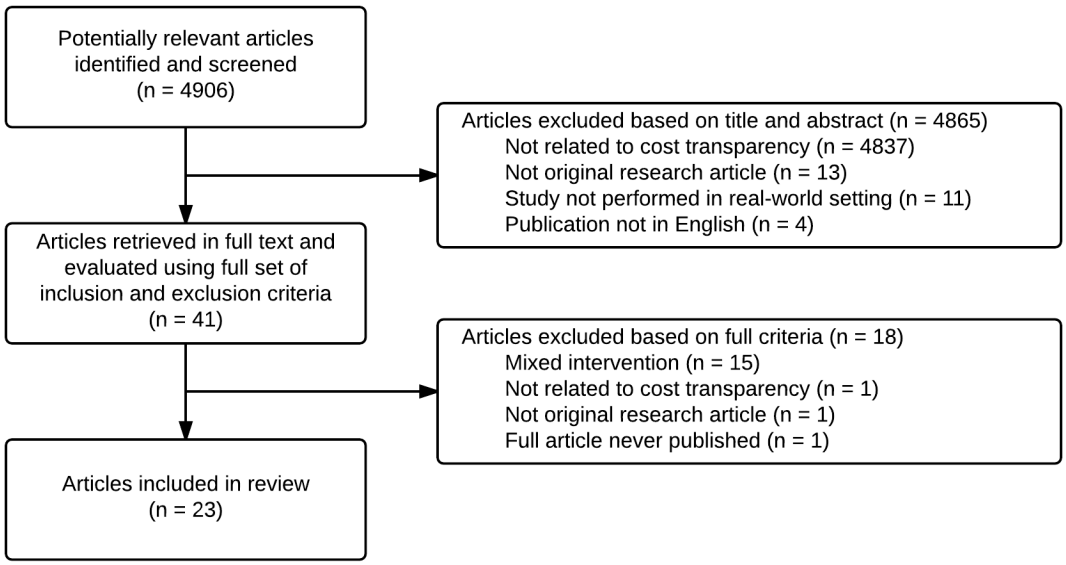

Figure 1, Study Selection Flow Chart

Table 1

Interrater Agreement for Study Selection and Data Abstraction

Decision evaluated	Raw agreement (%)	Cohen's κ (%)
Study meets all inclusion and exclusion criteria based on examination of full text	99.9	91.6
Study implemented true randomization	91.3	81.0
Financial information was presented electronically	100.0	100.0
Financial information was presented prior to order placement	100.0	100.0
Cost transparency resulted in cost reduction	100.0	100.0

calculated the difference between pretest and posttest measurements for each group, and compared the calculated differences of the intervention and control groups. The other three experimental studies used posttest-only control group designs.[10,11,29]

Medium of communication

In most (70%) of the studies, financial information was presented nonelectronically.[11-13,15,17,18,20-22,24-30] Nonelectronic media included lecture, information posted in common areas, written reference material provided to individuals, information listed on prescription forms, printed results that were collected via information systems, and personal communication. Thirty percent of the studies utilized electronic computerized physician order entry (CPOE) systems to display financial information next to orders for tests or therapies.[10,14,16,19,23,31,32]

Timing of communication

Financial information was presented prior to the placement of the clinical order ("pre-order education") in 59% (13 of 22) of the studies.[10,14-20,23,25,27,28,32] The timing of pre-order education varied from weeks prior to an order to simultaneous presentation at the time of the order. Forty-one percent (9 of 22) of studies presented financial information following placement of an order ("postorder feedback").[11-13,21,22,24,26,30,31] Timing of postorder feedback ranged from immediate feedback via computerized interface to one week following the placement of an order. One study employed both pre-order education and postorder feedback communication methods in the intervention groups and was excluded from statistical analysis.[29] That study showed no significant decrease in costs due to the intervention.

Impact on cost

The majority of studies (70%; 16 of 23) demonstrated that cost transparency resulted in a decrease in cost and/or utilization.[11-13,15-18,21,22,24-28,30,31] Thirty percent (7 of 23) of the trials did not significantly lower cost or utilization.[10,14,19,20,23,29,32] Our assessment differed from the conclusion of only one study.[19] In that study, the authors performed separate statistical analysis for each of the 27 tests included in their investigation. Five tests (19%) of the tests showed a statistically significant decrease in costs, while the remaining 22 tests showed no significant change from the control group. We categorized this result as "no effect" as per our criteria.

Relationship between explanatory variable and cost

Table 2 summarizes the success rates of cost transparency interventions, categorized by each explanatory variable. The largest rate difference between success rates was seen between media for communication (Figure 2). The vast majority (87.5%) of interventions that utilized nonelectronic methods for communicating cost information to providers reduced costs, whereas only 28.6% of studies providing cost information via a computerized physician order entry (CPOE) system showed a similar result (rate difference 58.9% (0.22-0.96; $p = 0.0031$)). Remarkably, 100% of interventions in which financial information was provided as feedback after the clinical action resulted in decreased costs and/or utilization (Figure 3). In contrast, only 53.8% of cost transparency strategies that presented financial information prior to the placement of an order decreased costs (rate difference 46.2% (0.098-0.83; $p = 0.015$)).

As expected, quasi-experimental studies were slightly more likely to succeed than experimental studies, but the difference did not reach statistical significance (rate

Table 2

Success Rate by Study Feature

Study feature	Feature prevalence (%)	Success rate with feature (95% CI)	Success rate without feature (95% CI)	Rate difference (95% CI)	Two-sample t test with equal variances
Quasi-experimental (vs. Experimental)	69.6	75.0 (50.5-89.8)	57.1 (25.0-84.2)	17.9 (-0.27-0.63)	p = 0.4149
Nonelectronic (vs. Electronic)	69.6	87.5 (64.0-96.5)	28.6 (8.2-64.1)	58.9 (0.22-0.96)	p = 0.0031
Postorder feedback (vs. Pre-order education) * One trial used both and was unsuccessful	40.9	100.0 (70.1-100.0)	53.8 (29.1-76.8)	46.2 (0.098-0.83)	p = 0.0154

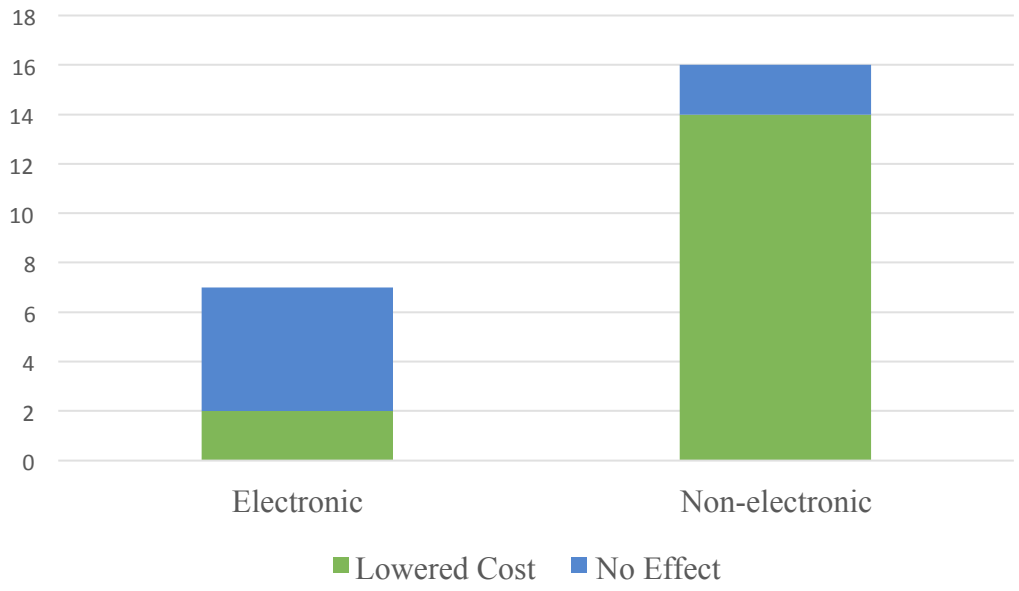

Figure 2, Result by Medium of Communication

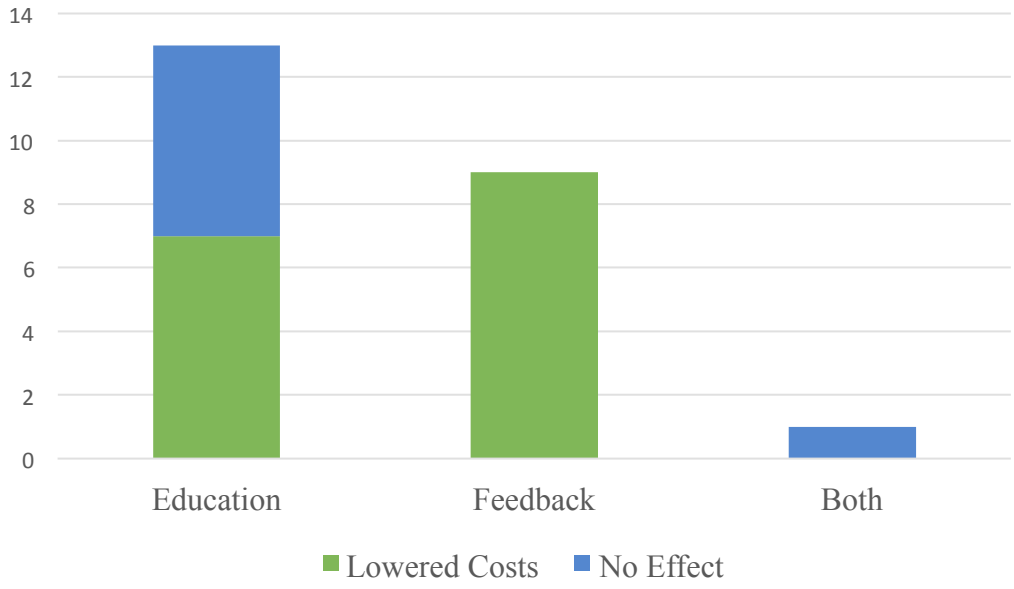

Figure 3, Result by Timing of Communication

difference 17% (-0.27-0.63; p = 0.41)). Further analysis revealed a clear trend toward pre-order education strategies for cost transparency over time (Figure 4). All of the studies published prior to 1990 (4 of 4) used a postorder feedback method for communication of cost information. A majority of the studies (55.6%, 5 of 9) published between 1990 and 1999, and 90% of studies published after 1999 utilized a pre-order education strategy, although one of the studies published after 1999 also incorporated a postorder feedback method in addition to the pre-order education.

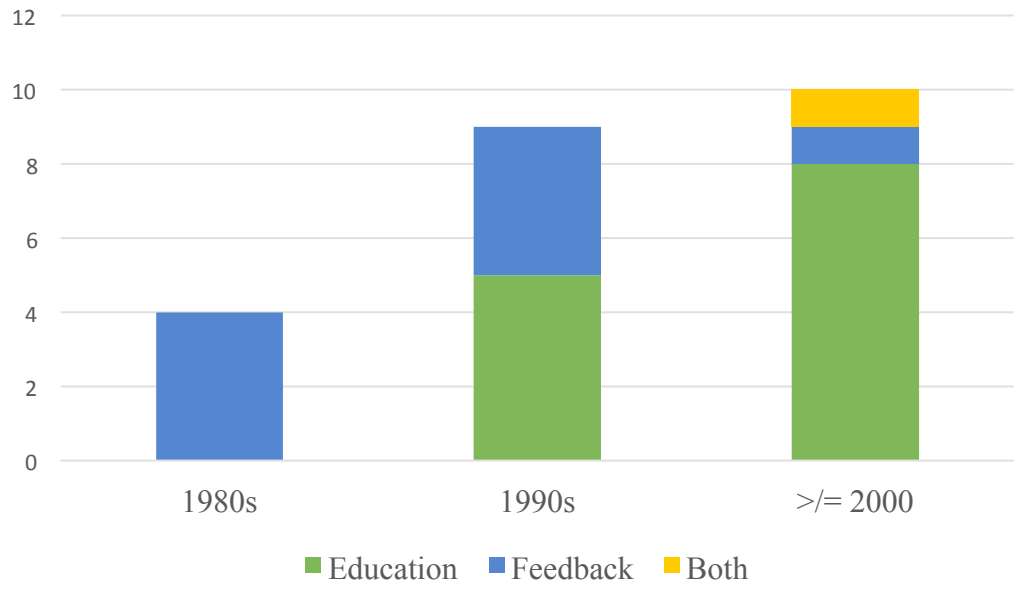

Figure 4, “Timing” Category Over Time

DISCUSSION

We systematically reviewed the medical literature to determine the impact of cost transparency on provider behavior and the cost of care. We specifically considered the effect of two characteristics of the cost transparency interventions: timing and medium of communication. We discovered that interventions in which communication occurred as feedback after the clinical decision had been made were significantly more likely to succeed than interventions that relied on education prior to the clinical decision. Importantly, we observed a clear shift from postorder feedback to pre-order education strategies over time, which, according to our results, indicates a shift from a more effective method to a less effective method of cost communication.

We also found that communication via nonelectronic media was more likely to reduce cost than communication via electronic CPOE. It is important to note that all of the studies included in our analysis that utilized "electronic" media did so through CPOE. The inefficacy of electronic communication, therefore, cannot be extended to other electronic media such as physician access to automatically generated reports or communication of financial outcomes via email.

We find it noteworthy that the only study using electronic communication for a postorder feedback approach (by displaying the cost information in the CPOE immediately following the clinical decision) was one of only two "electronic" studies that were successful at reducing costs. Although six of the seven "electronic" studies

employed a pre-order education approach, the success rate of "electronic" studies is lower than that of "pre-order education" studies, suggesting a possible combination of unfavorable factors.

It seems to us that a common element exists between postorder feedback and nonelectronic intervention strategies. That common element is personal involvement. Nonelectronic communication often involved personal communication. Even in the cases in which communication was not directly personal, it may be that information printed on paper suggests personal involvement more so than information presented on a computer screen. Similarly, postorder feedback suggests that another person has seen and potentially evaluated the information as part of the communication process, whereas pre-order education does not.

We conjecture that personal involvement in cost transparency interventions has, historically, been the key factor in the success of the intervention because it has provided an incentive to use the financial information that is made available. Without personal involvement, that motivation may not exist. Health care providers are not trained to consider financial information in making clinical decisions, and many believe that it is inappropriate to do so. In addition, it is widely recognized that the fee-for-service payment structure incentivizes utilization to maximize revenue, despite evidence of overutilization in many areas of care. Personal involvement conveys accountability for costs incurred, thereby encouraging providers to consider costs when making decisions. This, of course, is a driving factor behind the formation of accountable care organizations. We support the idea that health care providers should work together with patients to determine the best course of action for each patient, taking into account

financial information, clinical evidence, and personal goals of the patient, sharing accountability with the patient for the ultimate outcome.

Strengths and limitations of our study

Our study has several strengths. First, our literature search was very thorough, with no constraints on the date of publication and including screens of reference lists and articles citing every publication that we identified as potentially relevant based. Second, we used two reviewers to increase the reliability of study selection and data abstraction. Third, we provided a quantitative analysis to assess the impact of each selected intervention characteristic on the probability of success.

One limitation of our study is the narrow focus on cost transparency, which excluded broad interventions that involved communication of other information that is useful for decision-making, such as quality or outcomes data. We believe that this limitation was necessary to isolate the effects of financial information on the cost of care delivery. We considered the possibility that limitation may have selectively excluded recent publications in which more sophisticated information systems were used to deliver both quality and financial information, thereby explaining the shift from postorder feedback to pre-order education methods over time, but our analysis revealed that most of the studies involving mixed interventions were published in the 1990s.

Another limitation of our study is the use of binomial outcome measures, precluding analysis of effect size. We believe that binomial analysis was appropriate in this case considering the relative scarcity and heterogeneity of cost transparency research. The lack of homogeneity also precluded valid meta-analysis.

Finally, our analysis relied on statistical correlation and may therefore have identified factors related to, but not causative of, decreased costs of care delivery. For example, we did not take into account changes in billing practices, perception of malpractice risk, patient expectations, or other cultural changes that may have occurred over the course of time.

Future directions

The literature describing the effects of cost transparency is sparse. Rigorous randomized control trials are necessary to corroborate our findings and determine the optimal medium and timing of communication of cost information to health care providers. Additionally, studies assessing the impact of nonCPOE electronic methods of cost transparency are needed. Finally, additional research should investigate the effectiveness of cost transparency in the context of accountable care organizations or other environments in which providers are incented to reduce the cost of care delivery.

APPENDIX

Cost Transparency Search Strategy (Scopus)

((TITLE-ABS-KEY(("health care" cost*) OR ("health care" fee) OR ("health care" economic*) OR ("health care" charge*) OR ("health care" expenditur*) OR (healthcare cost*) OR (healthcare fee) OR (healthcare economic*) OR (healthcare charge*) OR (healthcare expenditur*) OR (hospital cost*) OR (hospital fee) OR (hospital economic*) OR (hospital charge*) OR (hospital expenditur*)) AND (TITLE-ABS-KEY(control* OR reduc* OR decreas* OR saving OR transparenc* OR cutting OR analy*)) AND (TITLE-ABS-KEY(physician* OR clinician* OR doctor* OR provider*)) AND (TITLE-ABS-KEY(("practice pattern") OR behavio* OR attitud* OR decision* OR awareness* OR knowledg*))) ()) AND (LIMIT-TO(SUBJAREA, "MEDI")) AND (LIMIT-TO(DOCTYPE, "ar")) AND (LIMIT-TO(LANGUAGE, "English")) AND (LIMIT-TO(EXACTKEYWORD, "Physician's Practice Patterns") OR LIMIT-TO(EXACTKEYWORD, "Physician attitude") OR LIMIT-TO(EXACTKEYWORD, "Physician's Role"))

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