Published in final edited form as:

Ann Intern Med. 2010 May 18; 152(10): 649–654. doi:10.1059/0003-4819-152-10-201005180-00005.

The Impact of Different Attribution Rules on Individual Physician Cost Profiles

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Abstract

Background—Health plans are profiling physicians on their relative costs and using these profiles to assign physicians to cost categories. Physician groups have questioned whether the costs category assigned to a physician is driven by the manner in which costs are attributed to physicians.

Objective—To evaluate the impact on physician cost profiles of 12 different attribution rules.

Setting—Massachusetts

Patients—1.1 million adults continuously enrolled in 4 commercial health plans in 2004 and 2005

Design—Using an aggregated database of claims from the 4 health plans, we created different cost profiles for each physician using 12 different attribution rules. The attribution rules differ on the unit of analysis (patient versus episode of care); signal for responsibility (costs versus visits); number of physicians that can be assigned responsibility; and threshold for assigning responsibility.

Measurements—Under each rule, we calculated the percentage of episodes assigned to any physician, calculated the percentage of costs billed by a physician included in his or her own profiles, and placed each physician into high cost, average cost, low cost, or low sample size categories. Compared to a commonly used default rule, we calculated what fraction of physicians are assigned to a different cost category using one of the other 11 attribution rules.

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Reproducible Research Statement

Protocol: Available to interested readers by contacting Dr. Mehrotra at mehrotra@rand.org

Statistical Code: Available to interested readers by contacting Dr. Mehrotra at mehrotra@rand.org

Data: Available through written agreements with the authors, Massachusetts Health Quality Partners, and the health plans who provided the data

None of the authors have any other financial interest in or a financial conflict with the subject matter or materials discussed in this manuscript.

Results—Across the 12 different rules there was substantial variation in the percentage of episodes that could be assigned to a physician (range 20%–69%) and the mean percentage of costs billed by the physician that were included in the physician’s own cost profile (range 13%–60%). Compared to their cost category under the default rule, 17 to 61% of physicians would be assigned a different category across the 11 alternate attribution rules.

Limitations—Results might differ if data from another state or Medicare were used.

Conclusions—The choice of attribution rule affects how costs are assigned to a physician and can have a substantial impact on the cost category to which a physician is assigned.

INTRODUCTION

Health plan administrators and government payers are using the cost profiles of individual physicians for a variety of applications, including physician “report cards” and categorizing physicians into tiered products.(1) These applications are intended to generate incentives for physicians to decrease health care costs. Yet medical societies(2) and a state attorney general(3–5) have questioned the methodology used to create cost profiles, which compare a physician to his or her peers in terms of expenditures incurred.

One methodologic issue in creating the scores is how to determine which physician is responsible for a patient’s care when the patient sees multiple physicians.(6) Because there is no predetermined assignment of responsibility in most cases, analysts have developed algorithms to attribute responsibility on the basis of patterns of utilization found in data derived from health care claims. These algorithms are broadly referred to as attribution rules. One attribution rule, for example, assigns the care for a patient to the physician who accounted for the highest percentage of *patient visits*.(7,8) Another rule assigns the care to the physician who accounted for the highest percentage of the *expenses* incurred in caring for the patient.(2,9,10)

Various attribution rules have been proposed or used for physician cost profiling,(8,11) but little research has been conducted on the key question of whether the choice of attribution rule changes the cost profiles of individual providers.(12–15) To answer this question, we applied 12 different attribution rules (one default rule and 11 alternate rules) to an aggregated database of claims submitted to 4 commercial health plans in Massachusetts. Compared to the default rule, we assessed the impact of the alternate rules on (1) the fraction of care assigned to each physician, (2) whose care is assigned to the physician (care provided by the physician vs. care provided by his or her colleagues), and (3) the cost category (e.g. high cost, average cost) that the physician is assigned.

METHODS

Data Sources and Study Population

We obtained all claims (professional, facility, pharmaceutical, other) from four health plans in Massachusetts for 2004–2005. We used two years of data based on the recommendation of previous reports,(12,13) and we aggregated data across health plans to capture a larger share of each physicians’ practice. The dataset includes claims from managed care, preferred provider organization, and indemnity products. We estimate that together the dataset included more than 80% of people with commercial health insurance in Massachusetts. Our analyses focused on the 1.1 million enrollees between the ages of 18 and 65 years who were continuously enrolled for the 2 years. More details on our criteria are available elsewhere. (16)

We included all Massachusetts physicians who submitted at least one claim to one or more of the health plans during the study period. To link data from the four health plans at the physician level, we used a physician identifier previously created by Massachusetts Health Quality Partners.(17) We excluded pediatricians and geriatricians (to be consistent with our patient sample), physicians who did not have a specialty assigned, or were in a specialty without direct patient contact.

Physician Cost profiles and Physician Categories

Our methods for constructing physician cost profiles and physician categories were designed to closely follow or replicate the methods commonly used by health plans. Our methods are described in detail elsewhere.(16) The steps are briefly outlined below.

Creation of standardized prices—For each service (visit, laboratory test, hospitalization, or prescribed drug), we examined the distribution of prices (reimbursement plus co-payment) across the 4 plans. We set all prices below the 2.5th percentile to the price at the 2.5th percentile of the distribution, and we set all prices above the 97.5th percentile to the price at the 97.5th percentile of the distribution, a process called Winsorizing.(18) We then calculated the mean price for each service and assigned this standardized price to each service.

Construction of episodes of care—Each episode of care included the clinically related services (e.g., visits, laboratory tests, hospitalizations, prescriptions) delivered to a patient with a specific condition over a defined time period. To aggregate each patient's claims into episodes of care, we used Episode Treatment Groups (ETG) ® (Ingenix, Version 6.0, Eden Prairie, Minnesota) which is a commercial product commonly used by health plans to group claims into episodes. We chose this commercial program over others because it is used by most Massachusetts health plans.(9) It is also commonly used nationally.(19)

The method by which the ETG grouper creates episodes is described in depth in previous publications.(20) Briefly, the grouper takes all claims and places them into mutually exclusive and exhaustive categories. Each episode is marked with an ETG number. There are about 600 different types of episodes (ETGs) and examples include “hypo-functioning thyroid gland”, “viral meningitis”, and “cataract with surgery”. Only certain types of claims can trigger an episode (e.g., evaluation and management visits, surgeries, hospitalizations).

We assigned episodes to a different comorbidity level using Episode Risk Groups (ERG) (Ingenix, Version 6.0, Eden Prairie, Minnesota). Under this system a patient's episode is assigned to a discrete risk level based on a retrospective risk-adjustment score based on patient demographics and co-morbidities. The number of risk levels varies by episode type and depends on the relationship between co-morbidities and costs observed among patients in the ERG development database.

Calculation of observed cost for each episode—We calculated the total cost of each episode (observed cost) by summing the standardized cost of each service multiplied by the number of times the service was provided within the episode.

Assignment of responsibility for care to physicians—We tested 12 different rules for assigning responsibility for patients or episodes of care, as described in detail below.

Calculation of the expected cost for each episode—For each episode, we calculated an expected cost which was the mean cost for all episodes attributed to physicians

of the same specialty (including those with low sample size) for patients with the same condition (ETG) and level of comorbidity.

Construction of composite cost profiles—We profiled physicians if they had 30 or more assigned episodes of care as previously recommended by the National Committee for Quality Assurance.(21) For each physician their cost profile score was the total observed costs across all assigned episodes divided by the total expected costs. Therefore, the score is 1 if the observed costs equal the expected costs and it is >1 if the observed costs exceed the expected costs.

Placement of physicians into cost categories—We placed physicians into four categories: low cost, average cost, high cost, or low sample size (<30 episodes). Consistent with the method used by health plans,(22) we examined the distribution of cost profile scores of physicians with 30 or more episodes and categorized physicians below the 25th percentile as low cost, those between the 25th and 75th percentile as average cost, and those above the 75th percentile as high cost. This was done separately for each specialty. In a sensitivity analysis we categorized the physicians using an alternative method, testing whether a physician's cost profile was statistically different from the average physician within the same specialty.(23)

Description of Attribution Rules

We created 12 different attribution algorithms that reflect the current range of rules being used or considered by payers (Table 1). Each rule is a combination of choices in the following four domains: unit of analysis (patient versus episode of care); signal for responsibility (professional costs versus number of evaluation and management visits); number of physicians that can be assigned responsibility (single physician versus multiple); and minimum threshold for assigning responsibility (majority of visits or costs versus plurality of visits or costs).

The first choice is whether to consider the costs incurred for all of a patient's care(8,24) or for each care episode.(2,10,25,26) The patient-based rule would assign all of the patient's costs to a single physician. The episode-based (condition-specific) rule assigns costs separately for each of the patient's conditions to a different physician.

The second choice is whether to assign costs to the physician who accounts for the largest percentage of the total professional costs(2,10,25,26) or to the physician who accounts for the largest percentage of evaluation and management visits.(8,24,27) Based on convention we assigned costs based on only physician professional costs (e.g. reimbursement for visits or procedures) and therefore excluded testing or facility costs. The third choice is whether costs are assigned to a single physician(10,25,26) or to multiple physicians.(8,13) The fourth choice concerns the minimum percentage of costs or visits that needs to be reached before a physician is assigned the costs of care. If a 50% cutoff (majority) is used,(2,22,27) the costs of care are assigned to a single physician. If a 30% cutoff is used,(8,22) the costs are assigned to the physician with the largest percentage and at least 30% costs or visits (plurality) or to all physicians with at least 30% (multiple physician rules).

Because it is commonly used by health plans,(22) we designated the episode-based costs plurality rule as the default rule.

Analyses

The analyses used descriptive statistics to compare the results of applying 12 different attribution rules (Table 1). For each patient, we used data from the two-year period to

calculate the costs and number of physicians involved. Similarly, for each episode, we used data from that episode to calculate the costs and number of physicians involved. For each rule, we calculated the percentage of episodes that could be assigned to physicians. We also calculated the percentage of physicians who met the threshold for cost profiling (≥ 30 episodes).

To address whose costs are assigned to a physician, we examined the professional costs billed by each physician and calculated the percentage of that cost incorporated into the physician's own cost profile under each of the 12 rules. We also looked at the converse—the percentage of professional costs included in each physician's profile that were actually billed by that physician. Across all physicians we calculated the mean percentage and standard deviation.

For each attribution rule, we used the results to assign each physician to 1 of 4 categories: low-cost, average-cost, high-cost, or low sample size (< 30 episodes). We compared the default rule to each of the 11 alternate rules to determine the percentage of physicians for whom the rules disagreed on the cost category assigned. For this analysis we excluded physicians who were not assigned ≥ 30 episodes of care under *any* of the 12 attribution rules.

The funders had no role in the design and conduct of the study; the collection, management, analysis, and interpretation of the data; or the preparation, review, or approval of the manuscript.

RESULTS

Our study sample included 13,761 physicians who delivered 5,602,652 episodes of care for 1.1 million patients. The care of most patients and most episodes involved multiple physicians. Among patients, 91% saw multiple physicians over the two-year study period, and 61% saw five or more physicians. Among episodes, 54% involved multiple physicians, and 9% involved five or more physicians.

Across the 12 different attribution rules, percentage of episodes that could be assigned to physicians varied from 20–69%, and percentage of physicians with low sample size (≥ 30 episodes) from 39–66%. The mean percentage of a physician's billed professional costs that were included in the physician's own cost profile ranged from 13–60% and the mean percentage of professional costs included in a physician's cost profile that were actually billed by the physician range from 37% to 73%. (Table 2).

The analyses to determine disagreement in cost categories (Table 3) included the 9,741 physicians (71% of physicians in our sample) who had ≥ 30 episodes under *any* of the 12 rules. Rate of disagreement between the default rule and alternate rules ranged from 17% to 61%. In general, the highest disagreement rates were associated with patient-based rules (47–61% range of disagreement) and multiple-physician rules (35–53%).

We tested the sensitivity of these conclusions to the manner in which disagreement was measured and to the method of cost category assignment (Appendix). With one exception there was only fair to moderate agreement across the different attribution rules when we used a weighted kappa to measure agreement. Under this method we assigned different weights to different levels of disagreement. When using statistical testing to assign physicians to low and high-cost categories, disagreement rates were lower (11–50%) than shown in Table 3 but still notable.

DISCUSSION

In creating profiles of the relative costs of care delivered by physicians, a number of methodological decisions must be made. We explored whether the choice of a rule for assigning costs to physicians affected the cost category to which physicians were assigned. We found that, compared to the most common rule used, 17% to 61% of physicians would be assigned a different category under an alternate attribution rule. Practically this means that if two health plans in a region chose different attribution rules, a physician will frequently be assigned a different cost category by the two health plans even if his or her care pattern was identical.⁽²²⁾ Our findings are consistent with previous work that found that attribution rules applied to Medicare patients could affect the results of pay-for-performance programs.⁽⁸⁾ This result, however, diverges from what has been found in evaluating methods used to measure physician quality. In that literature, choice of attribution method has a relatively small effect on physicians' quality profiles.^(28,29)

Our results help to explain why some physicians question cost profile attribution rules. No more than 60% of physicians' billed costs were included in cost profiles under any rule. And of the physician costs assigned to a physician, up to two-thirds, were billed by other physicians. These findings might make physicians less responsive to efforts to use cost profiles to decrease spending. A related issue is what care assigned to a physician is truly "controllable" versus those costs that are driven by patient factors.⁽³⁰⁾ To date, cut-offs such as 30% of the spending within an episode have been used as a method of determining assignment or control, but any such percentage cut-off is arbitrary and the appropriate cut-off may vary based on the condition being treated or the clinical scenario.

Given that the choice of attribution rule will lead to different conclusions being drawn about physicians' cost performance, which rule is the best one? Unfortunately, there is no clear or simple answer to this question because "best" depends on what is important to each stakeholder and those perspectives vary. To illustrate this point we consider the views that might be held by a purchaser (health plan), a physician, and a patient. The purchaser is primarily interested in driving a change in the cost-related decisions of physicians, which will be easiest if the maximum number of physicians can be included in the profiling program. Using that criterion, the best rules include those that assign care to multiple physicians under which up to 66% of physicians having at least 30 episodes assigned.

From the physician perspective, the rule should accurately reflect what the physician is doing in practice. That means physicians might prefer profiles that capture a large proportion of their billed services and that reflect the care they billed rather than that billed by other providers. The best performing rule under the first criteria is the episode-based cost rule for multiple physicians which included on average 60% of a physician's own costs in the profile. The best performing rule under the second criteria, that the profile does not include other physician's care, is the episode-based, majority of costs, single physician rule in which 73% of the professional costs billed on average were by the physician being profiled.

From the patient perspective, the profiles should produce trustworthy information that is aligned with the decision the patient is being asked to make. Trust in the information will be undermined if the health plans in a region use different methods and different data because the different health plans will publicly report disparate results. Thus, patients are likely to be best served by efforts in which health plans pool their data and use consistent methods. Beyond that requirement, we might imagine two different types of choices being made by patients: choosing a primary care physician and choosing a specialist for consultation. In the case of choosing a primary care physician, the patient-based rules are most consistent with

the decision being made. When a patient chooses a primary care physician they are in some sense choosing that physician and his or her referral network. Under a patient-based rule the physician assigned a patient's costs is also assigned the costs provided by all the physicians caring for the patient. Alternatively, when choosing a specialist for a discrete reason, the episode-based rules are most consistent with the choice as the content of the profile is likely to be dominated by the types of services typically provided by those specialists.

There is no rule that best serves all perspectives. For this reason, transparency with respect to the methods used is critical. Purchasers will need to try and select a rule that balances these different perspectives. For example, in our study, under the episode-based cost multiple-physician rule, a high proportion of physicians were profiled and those profiles included a reasonably high proportion of physicians' own costs.

Our analyses have several key limitations. We used aggregated data from four commercial health plans. Patients from a single health plan typically comprise a small fraction of a physician's care. If we created cost profiles using a single health plan's data, fewer physicians could be profiled. It is also unclear how our results generalize to Medicare beneficiaries who generally receive care from a larger number of providers than commercially insured patients, a difference which could make attribution more difficult.(8) Although we tried to be comprehensive in our examination of attribution rules, there are variations in rules that we have not addressed. For example, some attribution rules use relative-value units rather than visits or costs as a signal for responsibility(22) and cutpoints other than 30% and 50%.(12,13,22) We also did not explore different attribution rules for different types of conditions.(31) It could be argued that the disagreement rates between attribution rules we report are overestimates. As we describe in our supplementary appendix, using statistical testing to categorize physicians results in lower, though still substantial, disagreement rates. Some health plans use two cost categories(22) instead of the three used in our analysis, and using two cost categories will obviously result in lower disagreement rates. Also, in some cases a large fraction of the disagreement between attribution rules occurs because of the difference in the number of physicians with a low sample size (<30 episodes). The cut-off of 30 episodes was based on previous recommendations.(21) If a higher or different threshold is used then our results would be different as fewer physicians would likely be included in any profiling effort.

The use of physician cost profiles has become more common. Our analyses emphasize that the choice of attribution rule affects how costs are assigned to physicians and that moving from one rule to another rule can make a difference in the cost category to which physicians are assigned. It is critical for health plans and others who create physician cost profiles to be transparent about how they assign costs to a physician. We hope these results prompt and inform a dialogue among stakeholders on which attribution rule should be used for different applications of cost profiles.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Primary Funding Source: Department of Labor

Dr. Mehrotra had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. We thank Barbra Rabson and Jan Singer of Massachusetts Health Quality Partners, who facilitated our access to the data sets used in this study.

Grant Support:

Ann Intern Med. Author manuscript; available in PMC 2010 November 24.

The research was supported by a contract from the U.S. Department of Labor (J-9-P-2-0033). Dr Mehrotra's salary was supported by a career development award (KL2 RR024154-03) from the National Center for Research Resources, a component of the National Institutes of Health, and Dr. Thomas's participation in this research was also supported by Grant #60517 from the Robert Wood Johnson Foundation's Health Care Financing and Organization program.

Dr. Thomas has received consulting support on the topic of physician cost profiling from Agency for Healthcare Research and Quality, American Board of Medical Specialties, American Medical Association, Arkansas Medical Association, Blue Cross Blue Shield of Michigan, CIGNA Healthcare, Integrated Healthcare Association, Massachusetts Medical Society, Pacific Business Group on Health, Wisconsin Collaborative for Healthcare Quality, and the Wisconsin Medical Association. The authors have received a grant from the Massachusetts Medical Society and the American Medical Association to study other aspects of physician cost profiling.

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Table 1

Description of the 12 Attribution Rules Used in the Analyses

Title of Attribution Rule	Unit of Care Attributed to Physician	Signal for Responsibility of Care^a	Number of Physicians that Can be Assigned Care	Cutoff for Physician Assignment^b
Episode, costs, plurality (Default Rule)	Episode	Professional costs	Single	Physician responsible for plurality of costs
Episode, costs, majority	Episode	Professional costs	Single	Physician responsible for majority of costs
Episode, visits, plurality	Episode	Evaluation and management visits	Single	Physician responsible for plurality of visits
Episode, visits, majority	Episode	Evaluation and management visits	Single	Physician responsible for majority of visits
Patient, costs, plurality	Patient	Professional costs	Single	Physician responsible for plurality of costs
Patient, costs, majority	Patient	Professional costs	Single	Physician responsible for majority of costs
Patient, visits, plurality	Patient	Evaluation and management visits	Single	Physician responsible for plurality of visits
Patient, visits, majority	Patient	Evaluation and management visits	Single	Physician responsible for majority of visits
Episode, costs, multiple physicians	Episode	Professional costs	Multiple	All physicians responsible for $\geq 30\%$ of costs
Episode, visits, multiple physicians	Episode	Evaluation and management visits	Multiple	All physicians responsible for $\geq 30\%$ of visits
Patient, costs, multiple physicians	Patient	Professional costs	Multiple	All physicians responsible for $\geq 30\%$ of costs
Patient, visits, multiple physicians	Patient	Evaluation and management visits	Multiple	All physicians responsible for $\geq 30\%$ of visits

^aThe definitions of professional costs and evaluation and management visits are available in the appendix.

^bMajority is >50%. Plurality is the physician who provides the largest fraction of care and at least 30%.

Table 2

Assignment of Care Under the 12 Different Attribution Rules Used to Calculate Physician Cost Profile Scores

Title of Attribution Rule	Number (%) of Episodes of Care That Could Be Assigned to a Physician^a	Number (%) of Physicians Who Were Assigned at least 30 Episodes of Care^b	Of all professional costs billed by a physician, % included in that physician's cost profile Mean % (SD)^c	Of all professional costs in a physician's cost profile, % billed by the physician profiled Mean % (SD)
Episode, costs, plurality	3,059,348 (55)	8689 (63)	58 (27)	67 (23)
Episode, costs, majority	2,901,069 (52)	8401 (61)	51 (27)	73 (24)
Episode, visits, plurality	2,964,837 (53)	8600 (62)	50 (28)	46 (24)
Episode, visits, majority	2,871,366 (51)	8415 (61)	46 (27)	49 (25)
Patient, costs, plurality	2,293,098 (41)	7474 (54)	23 (22)	52 (31)
Patient, costs, majority	1,140,854 (20)	5567 (40)	13 (17)	55 (37)
Patient, visits, plurality	2,867,732 (51)	6983 (51)	19 (22)	37 (28)
Patient, visits, majority	1,651,251 (29)	5411 (39)	12 (16)	39 (32)
Episode, costs, multiple physicians	3,223,882 (58)	8908 (65)	60 (28)	64 (21)
Episode, visits, multiple physicians	3,015,484 (54)	8928 (65)	54 (29)	42 (21)
Patient, costs, multiple physicians	2,349,405 (42)	7841 (57)	22 (20)	53 (30)
Patient, visits, multiple physicians	3,880,845 (69)	9138 (66)	33 (28)	36 (24)

^aThe total number of episodes was 5,602,652. Percentages are based on this number.

^bThe total number of practicing physicians was 13,761. Percentages are based on this number.

^cStandard Deviation

Table 3Percentage of Physicians Assigned a Different Cost Category when Compared to Default Attribution Rule^a

Attribution Rule	Physicians Assigned a Different Cost Category Using this Attribution Rule %
Episode, costs, majority	17
Episode, visits, plurality	38
Episode, visits, majority	36
Patient, costs, plurality	47
Patient, costs, majority	56
Patient, visits, plurality	54
Patient, visits, majority	61
Episode, costs, multiple physicians	35
Episode, visits, multiple physicians	46
Patient, costs, multiple physicians	46
Patient, visits, multiple physicians	53

^aDefault rule is Episode, Costs, Plurality. The analyses were limited to the 9,741 physicians who could be assigned at least 30 episodes under *any* of the 12 rules. For each attribution rule, the results were used to place individual physicians into 1 of 4 categories: low cost, average cost, high cost, or low sample size (≥ 30 episodes). Disagreement sometimes occurred because the paired rules assigned a physician to 2 different cost categories or because 1 of the rules assigned a physician to a cost category and the other assigned the physician to the low sample size category.