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# Agency Characteristics and Changes in Home Health Quality After Home Health Compare

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Kyoungrae Jung, PhD<sup>1</sup>, Dennis Shea, PhD<sup>1</sup>,  
and Candy Warner, MBA<sup>1</sup>

## Abstract

**Objective:** This study examines the association between home health agency characteristics and quality improvement in home health care after Home Health Compare (HHC), a public-reporting initiative in the Medicare program. **Method:** We examined the changes in seven quality measures reported in HHC from 2003 to 2007. We used a linear regression model to examine whether quality changes over time differed by agency characteristics.

**Results:** We found improvements in quality after HHC in the indicators that measure patients' ability to independently manage daily activities; however, the use of emergent care did not change, and hospitalization rates increased during the study period. Agencies with low quality at baseline, not-for-profit or hospital-based agencies, and agencies with longer Medicare tenure showed greater improvement for some quality measures than their counterparts.

**Discussion:** There was large variation in the degree of quality improvement after HHC by quality indicators and by agency characteristics.

## Keywords

public reporting, home health compare, home health care quality, quality improvement

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<sup>1</sup>Pennsylvania State University, University Park

## Corresponding Author:

Kyoungrae Jung, Department of Health Policy and Administration, Pennsylvania State University, 604 Ford Building, University Park, PA 16802

Email: [kuj11@psu.edu](mailto:kuj11@psu.edu)

Home health care is an important source of postacute follow-up care for the elderly. Home health care spending was about US\$52 billion in 2006 and is projected to reach US\$120 billion by 2016 (Centers for Medicare and Medicaid Services [CMS], 2007). The number of Medicare beneficiaries who receive home health services increased at an annual rate of 5.6% between 2002 and 2005, and the number of agencies that participate in the Medicare program has significantly increased in recent years (Medicare Payment Advisory Commission [MedPAC], 2008). The demand for home health care is expected to continue to grow rapidly as the population ages and health care costs increase because home health care is viewed as preferable to costly facility-based care by policy makers and consumers. As home health services become increasingly important, ensuring high-quality home care is a priority.

The Center for Medicare and Medicaid Service (CMS) has taken several initiatives to improve home health care quality during the past decade. The first step was to establish quality measurements in home health care. The CMS developed a standardized patient assessment tool, known as Outcome and Assessment Information System (OASIS), in the late 1990s. The OASIS items were intended to provide comprehensive patient health status information, including both home health care outcomes and risk factors that affect those outcomes. The CMS has been collecting OASIS data from Medicare-certified home health agencies since 1999. The development of these outcome-based quality measures and annual collection of the data was a key step to subsequent efforts to improve home health quality.

As part of its recent quality initiatives in home health care, the CMS implemented Home Health Compare (HHC), which releases a subset of OASIS-based performance measures of each agency to the public. Disclosure of quality information has been adopted in many health care settings in recent years, as an essential mechanism to improve quality. The rationale behind this approach is compelling. Economic theory suggests that if consumers cannot identify differences in products or services, providers will not have an incentive to invest in quality, and thus, only poor quality products ("lemons") will remain in the market (Akerlof, 1970). Consumers' uncertainty about service quality has long been identified as a problem in health care (Arrow, 1963), and thus it has been argued that relevant information should be publicly released to mitigate any quality problems associated with imperfect information. It is expected that if quality information is disclosed, it will help consumers choose their providers based on quality, which will in turn motivate providers to improve quality. Furthermore, some suggest that public reporting directly influences providers to change their practice or improve quality, even in the absence of evidence that consumers use the quality information (Dranove,

Kessler, McClellan, & Satterthwaite, 2003; Werner, Asch, & Polsky, 2005): If providers are informed about their quality performance compared with their competitors, they may be motivated to improve quality out of professional responsibility using best performance available as their benchmark. With these expectations, public reporting is rapidly expanding, and the CMS has initiated disclosure programs for almost all Medicare-participating providers, including hospitals, managed care plans, and nursing homes. This movement arrived in home health care in 2003.

However, despite its rapid diffusion, empirical findings about whether information disclosure improved quality are mixed. Early qualitative or case-study research in hospital settings documented that hospitals implemented quality control activities responding to public-reporting programs and that those actions led to quality improvements (Chassin, 2002; Hannan, Kilburn, Racz, Shields, & Chassin, 1994; Longo et al., 1997; Rosenthal, Quinn, & Harper, 1997). Recent studies improved on methods and examined diverse settings, including health plans and nursing homes (Jung, 2007; Mukamel, Weimer, Spector, Ladd, & Zinn, 2008; Werner et al., 2009). Although these studies reported positive impacts of public reporting on quality in general, they found that the improvement was not universal across all quality measures. Furthermore, recent research in the hospital setting showed that public-reporting programs brought in a distorted incentive that hospitals turned away sick patients, fearing they might harm quality scores (Dranove et al., 2003; Werner et al., 2005). This suggests that the positive finding in the prior work may be due to treating healthier patients after public reporting. Although no evidence has been reported yet, it is also possible that providers may have changed data recoding practice to inflate quality scores after reporting programs.

In home health care, a recent MedPAC report presented changes in national average scores of the quality measures included in HHC (MedPAC, 2008). During the initial years after the introduction of HHC, most indicators showed steady improvements in their quality, but some quality measures remained stable. However, these aggregate data do not show us whether the improvement (or lack of improvement) occurred in all agencies or whether there was variability in the changes of home health quality across agencies. Complementing this report, our study conducts an exploratory analysis to examine the association between agency characteristics and the changes in home health quality. Despite the growing importance of home health care and continuing efforts to improve its quality, empirical studies about home health quality have been limited. By looking at what agency characteristics are related to improvement (or lack of improvement) in home health quality after a public-reporting initiative, this study provides information that could be useful for the development of strategies to improve quality.

## HHC Quality Measures

In the fall 2003, CMS began to post quality information of all Medicare-certified home health agencies on its Web site (<http://www.medicare.gov/HHCompare/Home.asp>). Once a consumer specifies a service area (zip code) that they live in (or are interested in), a comparison table pops up and presents quality information of all agencies that serve that zip code. Each agency's quality performance is compared with the state average, the national average, and the performance of all other agencies in that area. To promote awareness of this program among patients, the CMS publicized the information about this initiative in late 2003 through advertisements in the country's major newspapers covering all 50 states.

The original quality information disclosed consisted of 10 outcome quality measures that are obtained from OASIS data. The quality measures reported have been revised over time, and currently 12 outcome measures are posted. Since the goal of home health care is to assist patients in reaching the maximum achievable level of independence in daily activities, most quality measures focus on how well patients perform important activities to live independently in their homes. These outcome measures are calculated as a change in patient condition during an "episode," which is a care period between admission to an agency and discharge from the agency (either to home or to an inpatient facility). A few measures that are related to patients' use of medical services are also included, as a potential sign of poor quality (these measures include use of emergent care and hospitalization). Quality scores are updated quarterly, representing prior 12 months of data. Since the set of quality measures has been revised over years, this study uses seven quality indicators that have been included in all years since 2003. These measures are

1. percentage of patients who get better at bathing (bathing)
2. percentage of patients who get better at getting in and out of bed (transferring to bed)
3. percentage of patients who get better at taking their oral medicines correctly (managing oral medications)
4. percentage of patients who have less pain when moving around (less pain)
5. percentage of patients who get better at walking or moving around in a wheelchair safely (walking)
6. percentage of patients who need urgent, unplanned medical care (emergent care use)
7. percentage of patients who had to be admitted to a hospital (hospitalization)

Since the activities captured in these indicators are some of the main targets of home health care services, better performance in the measures may imply efforts by home health staff to improve patients' health and independence. However, since those measures represent patient health outcomes, they also depend on patients' health risk factors, which may be independent of the agency staff's efforts. Therefore, for the comparison of performances across agencies, differences in health risk of patients served by different agencies should be controlled. The CMS currently use risk-adjustment models that control for comprehensive risk factors, including socioeconomic characteristics, clinical health status, and health-related behaviors (Shaughnessy & Hittle, 2002). A specific risk-adjustment model is used for each OASIS-based outcome measure, and the HHC performance indicators posted on the CMS Web site are all risk-adjusted quality scores.

Although a wide range of adjusters are used in the current system, a risk-adjustment model is hardly perfect; a model cannot completely capture all risk factors affecting health outcomes. Furthermore, the current system is developed based on a data-driven stepwise approach, which best fits the model to the sample data that were used for the development of the model (Murtaugh, Peng, Aykan, & Maduro, 2007). Therefore, some important risk-factors may be excluded from the current model, if they had relatively weak explanatory power in the original model with the sample data. For example, patient race, which may be an important predictor of some health outcomes, is not included in the current system. Omitting these variables leave a potential for agencies to selectively avoid patients who are expected to produce poor outcomes based on those factors that are not measured. In addition, as health outcome scores are constructed from assessment data collected by agency staff, the adjustment system is also subject to agencies' incentives to change their coding practice. Although limited, the adjusted scores posted by the CMS may be best ones available, and this study uses the risk-adjusted scores obtained from HHC Web sites to examine whether changes in quality after public reporting differ by agency characteristics.

## **Method**

### ***Data Source***

The main data source of the study is publicly available HHC data set. We downloaded the first 5 reporting years of HHC data (2003-2007) from the CMS Web site (<http://www.cms.hhs.gov/HomeHealthQualityInits/>). This data set provides the information about quality performance of each agency as well as agency characteristics, including profit-status, the number of years that an

agency has been Medicare certified, and the state where an agency is located (we constructed the census region variable from this state information).

The HHC data were merged with the Provider of Service (POS) file, from which we obtained additional information about agency characteristics, including whether an agency is hospital based, whether an agency is part of a branch, and the number of full-time-equivalent (FTE) registered nurses (RNs) of an agency.

As we examine changes in quality over time controlling for baseline scores, our analysis includes agencies with at least 2 years of HHC data during the study period. The number of home health agencies that reported HHC data in 2003 is 7,025 (after excluding agencies in Puerto Rico and Virgin Island), and it increased to 8,659 in 2007. The total number of unique agencies in the data is 9,470, and among them, 92% of agencies (8,678) had 2 years of data. The unit of observation in the analysis is an agency-year, and the total number of observations was 29,347 (agency-years). We use the data from the 2nd reporting year of an agency because quality of the 1st reporting year of the agency (baseline score) is included in the model as an explanatory variable. Although all agencies submitted information about agency characteristics each year, agencies are not required to report quality scores for any measures that they have less than 20 cases. Thus, the number of observations used in our analysis varies between 21,694 and 25,391 agency-years, depending on the quality measure used for analysis.

### *Empirical Model*

To examine whether changes in quality after HHC are associated with agency attributes, we estimate a linear regression model for each quality measure. The empirical model is written as

$$\text{QUAL}_{it} = \beta_0 + \beta_1 T_t + \beta_2 \text{BASE}_{i0} + \beta_3 X_{it} + \beta_4 T_t * \text{BASE}_{i0} + \beta_5 T_t * X_{it} + \varepsilon_{it}. \quad (1)$$

$\text{QUAL}_{it}$  is the  $i$ th agency's quality score at year  $t$ .  $T_t$  and  $\text{BASE}_{i0}$  represent year and the  $i$ th agency's baseline quality score, respectively.  $X_{it}$  is a vector of all other explanatory variables.  $T_t * \text{BASE}_{i0}$  represents interaction between year and baseline quality, and  $T_t * X_{it}$  are interaction terms between year and all explanatory variables. The coefficients of these interaction terms are our main interest as they capture differences in changes in quality by agency characteristics or baseline scores. Standard errors are adjusted for clustering

within an agency in all models. We use StataSE 10 for all statistical analysis and estimation (StataCorp, College Station, TX).

Our longitudinal analysis uses information from all agencies with a minimum 2 years of HHC data, including agencies that entered or exited the market during the study period. It is possible that agencies with poor performance may have discontinued services during the study period. It is also possible that new entrants may not respond to HHC as quickly as continuing agencies, leading to a relatively small degree of quality improvement over years. Thus, our results may capture the effect of market entry or exit on quality as well as changes in quality after HHC due to the impact of HHC on market exits by poor quality agencies. We examine this possibility as sensitivity analyses in two ways: First, we conduct an analysis limiting our sample to agencies that continued their services during the study period (i.e., agencies with all 5 years of data). Second, we examine whether quality improvement among agencies with less than 2 years of Medicare tenure ("new entrants") differs from that among continuing agencies.

### *Explanatory Variables and Measurements*

Explanatory variables used in our model include a year variable, an agency's baseline score, agency characteristics, a region variable, and interaction terms between year and all other explanatory variables. First, the year variable reflects time-trend in home health quality during the study period (2003-2007). We rescaled the calendar years (2003-2007), assigning 0 to the baseline year (2003) and increasing the value of subsequent years by 1. The year variable thus takes a value between 0 and 4.

Second, the baseline quality variable examines whether quality scores in subsequent years depend on the initial performance. Prior studies showed that greater quality improvement after public-reporting initiatives was found among initially poor performers than among providers with high quality at baseline (Cutler, Huckman, & Landrum, 2004; Jung, 2007). We use scores of the 1st reporting year of each agency as its baseline quality.

Third, regarding agency characteristics to use, prior literature provides little guidance about what agency factors would be associated with outcome-based home health care quality. Thus, we use agency attributes that have been shown to be related to the provision of home health services and conduct an exploratory analysis. As home health outcomes are a result of home health services received, agency attributes related to the service provision are likely to be associated with home health outcomes quality. Furthermore, a recent study in nursing homes showed that those characteristics are related to

nursing home quality (Zinn, Spector, Hsieh, & Mukamel, 2005). Prior work in home health care has examined the association between agency attributes and home health service provisions after payment policy changes. Similar to payment policies, public reporting is expected to motivate providers to change their practice through incentives (financial or reputational incentives). Thus, the agency characteristics assessed in the literature are likely to be relevant for our study that examines agencies' responses to HHC. These agency attributes include (a) agency ownership (Brega, Jordan, & Schlenker, 2003; FitzGerald et al., 2006; Han, Remsburg, Lubitz, & Goulding, 2004; Jette, Smith, & McDermontt, 1996; McCall, Petersons, Moore, & Korb, 2003; Murkosky, Phillips, McCarthy, Davis, & Hamel, 2003), (b) whether an agency is hospital-based (Brega et al., 2003; Han, McAuley, & Remsburg, 2007; Jette et al., 1996; Porell, Liu, & Brungo, 2006; Williams, 1994), and (c) Medicare tenure—the number of years an agency has been Medicare-certified (Brega et al., 2003; Porell et al., 2006).

To measure these characteristics, first, we use three categories—government, for profit, and not for profit—to capture agency ownership and use a binary variable to indicate whether an agency is hospital based or not (0 or 1, respectively). For Medicare tenure, we classified agencies into three groups based on the distribution of the variable; agencies with Medicare tenure less than or equal to 5 years (the bottom quartile), agencies with the tenure between 6 and 20 years (the second and third quartiles), and agencies with Medicare tenure more than 20 years (the upper quartile). This three-category variable is used in all primary analysis. For sensitivity analysis, we refine this variable and add another category representing “new entrants.” We divide the agencies in the first category (the bottom quartile) into two groups: agencies *t* with Medicare tenure less than or equal to 2 years and agencies with Medicare tenure between 3 and 5 years. Using this four-category variable, the sensitivity analysis examines whether new entrants have a smaller degree of quality improvement compared with continuing agencies.

As additional agency attributes, we include the number of FTE RNs of an agency and whether an agency is part of a branch (either the agency operates a branch or it is operated by a branch). We use the number of RNs as a proxy for the size of an agency because large agencies may be more efficient than small ones in organizing quality-related activities. Similarly, branch agencies may have a mechanism to share information about how to improve performance of organizational activities, structure, and decision-making process. To measure the number of RNs, we create a categorical variable as follows; an agency is categorized as small if the agency is in the lowest quartile of the distribution of the RN number (less than 3), medium if the agency is in the



second and third quartiles (3-10 RNs), and large for the agencies in the highest quartile (more than 10 RNs). Branch affiliation is measured as a dichotomous variable (0 or 1).

To adjust for regional differences in home health care practice, we use a variable for the census region of an agency. Previous studies have shown that there is huge variation in home health care practices across regions (FitzGerald et al., 2006; Han et al., 2004, 2007; Jette et al., 1996; McCall et al., 2003). Four census regions (Northeast, Midwest, West, and South) are used to indicate the region where an agency operates.

Finally, our model includes interaction terms between year and all other explanatory variables. The coefficients of these interaction terms represent differences in quality improvement over years by baseline scores, agency characteristics, or geographic regions.

## Results

Table 1 presents scores for seven quality measures in 2003 by agency characteristics. Higher scores imply better performance for the first 5 quality indicators that measure independence in managing daily activities. Low scores represent good quality for the last two utilization measures. The average scores are high in bathing activity (55.4%) and pain measures (55.6%). Relatively low scores are found in the measures of managing oral medication (33.5%) and ability to walk around (32.9%). The standard deviations of the scores were about 10 percentage points in all measures. The quality scores varied substantially across individual agencies, ranging from the lowest 5 percentage points to about 90 percentage points in most measures (Table 1).

Quality scores in 2003 varied by agency characteristics but the differences were relatively small, ranging between 3.6% and 11.3% of the mean, depending on measure. The largest difference was shown in the measure of transferring to (and from) bed. Table 1 shows the results of *t* tests that examine if quality scores in the 1st year of HHC (2003) are significantly different between different agency characteristics. For the characteristics with more than two categories, each category is compared with the reference group. First, government agencies had poorer performance than for-profit agencies in most measures. Not-for-profit agencies were better than for-profit agencies in the measures of emergent care use and hospitalization. For-profit agencies performed the best in the measures of bathing and managing oral medications. Second, hospital-based agencies or agencies with a large number of RNs generally had better quality scores than their counterparts. There was no consistent pattern in quality differences by Medicare tenure.

**Table I.** Mean Quality Scores in 2003 by Home Health Agency Characteristics

Agency characteristics	Agencies with characteristic N = 7,025 (%)	Quality measures						
		Bathing <sup>a</sup>	Transferring to bed <sup>a</sup>	Managing oral meds <sup>a</sup>	Less pain <sup>a</sup>	Walking <sup>a</sup>	Emergent care use <sup>b</sup>	Hospitalization <sup>b</sup>
No. of agencies		5,486	5,236	5,108	5,333	5,473	5,672	5,890
Mean scores for all agencies (SD)		55.4 (9.8)	47.3 (11.8)	33.6 (9.4)	55.5 (12.1)	32.9 (7.9)	23.9 (9.4)	30.2 (10.2)
Minimum score		9.0	5.0	5.0	5.0	6.0	5.0	5.0
Maximum score		95.0	94.0	87.0	95.0	77.0	92.0	91.0
Ownership								
For profit (ref)	3,849 (54.8)	55.7	46.1	34.5	55.8	32.9	24.1	31.2
Public	967 (13.8)	54.1***	48.0***	32.1***	53.0***	32.2*	25.0*	30.9
Not for profit	2,209 (31.4)	55.6	48.7***	32.9***	56.0	33.2	23.2***	28.5***
Hospital based								
Yes	1,768 (25.2)	55.6	49.1***	32.6***	55.2	33.2*	22.7***	28.0***
No (ref)	5,257 (74.8)	55.3	46.5	34.0	55.6	32.8	24.4	31.1
Branch affiliation								
Yes	1,133 (16.1)	55.3	47.6	33.8	53.8***	33.1	23.7	31.1***
No (ref)	5,892 (83.9)	55.5	47.2	33.5	55.9	32.9	24.0	30.0
RN number (FTE)								
Small (ref)	1,959 (27.9)	55.4	44.9	33.2	54.6	32.2	24.6	30.3
Medium	3,146 (44.8)	55.0	47.3***	33.0	54.8	32.6	24.2	30.5
Large	1,920 (27.3)	56.0	48.6***	34.5**	56.9***	33.8***	23.0***	29.6

(continued)

Table 1. (continued)

Agency characteristics	Agencies with characteristic N = 7,025 (%)	Quality measures						
		Bathing <sup>a</sup>	Transferring to bed <sup>a</sup>	Managing oral meds <sup>a</sup>	Less pain <sup>a</sup>	Walking <sup>a</sup>	Emergent care use <sup>b</sup>	Hospitalization <sup>b</sup>
Years Medicare certified								
0-5 years (ref)	1,347 (19.5)	55.9	43.7	34.9	57.3	32.6	24.5	30.3
6-20 years	3,650 (52.9)	55.8	47.3***	33.5**	55.2**	32.9	23.9	30.3
More than 20 years	1,902 (27.6)	54.6*	48.5***	33.2***	55.3**	33.0	23.7	30.0
Region								
South (ref)	3,090 (44.0)	55.2	47.1	34.4	54.7	33.3	23.5	31.3
Northeast	816 (11.6)	53.6***	47.5	32.9***	58.4***	32.1***	26.1***	33.1***
Midwest	1,950 (27.8)	54.2**	47.3	31.9***	54.6	32.1***	25.0***	30.3**
West	1,169 (16.6)	59.2***	47.6	34.3	56.7***	33.6	21.3***	24.6***

a. Higher scores represent better quality.

b. Lower scores represent better quality.

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ ; for comparison between subgroup and reference (ref) subgroup.

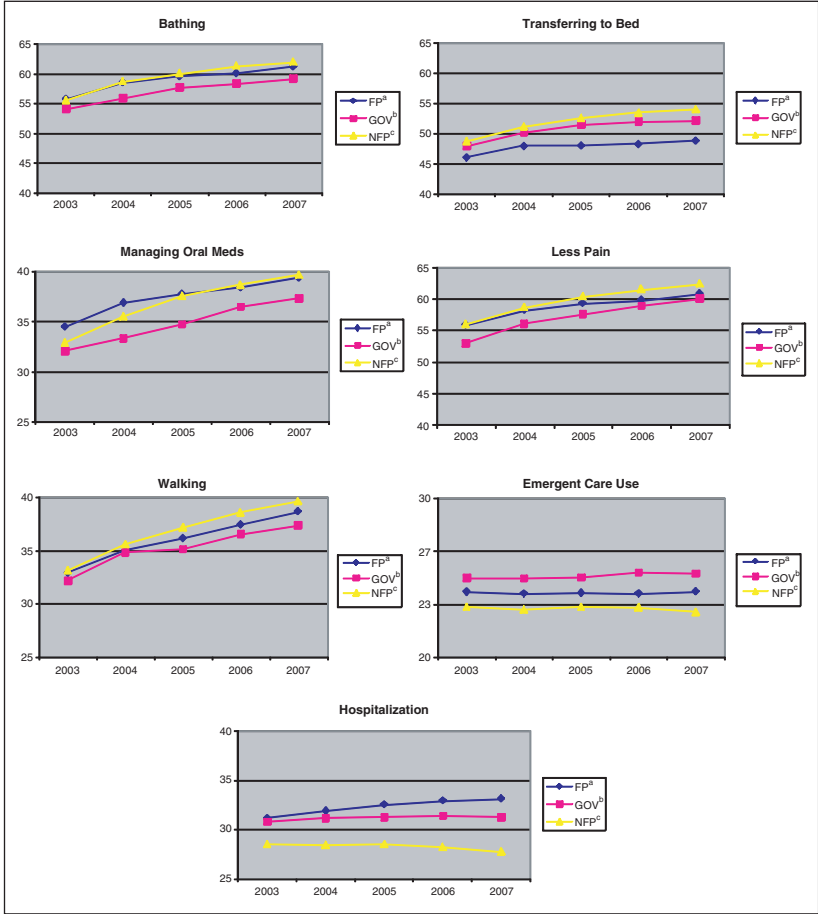
Regarding regional differences, agencies in the West region reported higher quality scores than agencies in any other regions, and agencies in the Northeast region offered relatively low quality compared with other regions, except for the pain control measure.

We next examined the changes in average quality scores over time (data not shown). We found improvements in quality after HHC in all five indicators related to the management of daily activities; however, the score of the emergent care use measure did not change over years (23.9%), and the average hospitalization rate increased (worsened) during the study period (from 30.2% in 2003 to 31.5% in 2007). Among the indicators measuring the performance in activities in daily life (ADL), the degree of the improvement differed by quality measure, ranging from 7.1% above the baseline percentage (3.4 percentage points; transferring to bed) to 18.9% (5.7 percentage points; ability to walk around). There was also large variability in the level of quality change across individual agencies: some agencies did show decreases in quality scores of daily activities, and some showed improvements in the use of emergent care or hospitalization rates. Depending on measure, about 27% to 45% of the agencies had poorer performance in later years than at baseline during their reporting period (Table 2).

We then looked at quality changes by agency characteristics. Consistent with the trend in overall average score, quality scores generally improved in all types of agencies. There was some variation in the degree of quality improvement by agency attributes, and we present the trend in quality scores over time by agency profit-status in Figure 1. Although for-profit agencies had higher scores in 2003 than nonprofit agencies for some measures, nonprofit agencies improved over time and had better performances in 2007 than for-profit agencies for all measures. Although the difference is not large, the improvement is greater among nonprofit agencies than for-profit agencies consistently across all measures. This trend is particularly clear in the hospitalization measure, widening the gap in the quality of that indicator over time between nonprofit and for-profit agencies. Hospitalization rates decreased by 0.7 percentage points among nonprofit agencies (from 28.5% to 27.7%), but they increased by 2.0 percentage points among for-profit agencies (from 31.1% to 33.1%). The net difference in the change between the two types of agencies is thus 2.7 percentage points. This magnitude may appear to be small; however, about 5 million episodes were provided in 2007 (we do not have information on the number of episodes by type of agencies). Thus, if for-profit agencies had matched the performance of nonprofit agencies, assuming that each type of agencies treats the same number of the episodes, there would have been 67,500 fewer hospital admissions among Medicare home health patients.

**Table 2.** The Number of Agencies by the Status of Changes in Quality Scores

Changes in quality scores	Quality measures					
	Bathing	Transferring to bed	Managing oral meds	Less pain	Walking	Emergent care use
Improved (%)	4,661 (61.9)	4,021 (54.9)	4,296 (59.8)	4,249 (57.2)	4,680 (62.1)	3,265 (41.5)
No change (%)	810 (10.8)	789 (10.8)	854 (11.9)	850 (11.5)	837 (11.1)	1,053 (13.4)
Worsened (%)	2,060 (27.4)	2,515 (34.3)	2,035 (28.3)	2,325 (31.3)	2,015 (26.8)	3,558 (45.2)
Total (%)	7,531 (100.0)	7,325 (100.0)	7,185 (100.0)	7,424 (100.0)	7,532 (100.0)	7,876 (100.0)
						3,798 (47.2)
						962 (12.0)
						3,284 (40.8)
						8,044 (100.0)



**Figure 1.** Changes in quality scores by agency ownership type  
a. For profit.  
b. Government.  
c. Not for profit.

Table 3 presents the results of multiple regression models to examine the association between agency characteristics and quality change. First, for the year variable, the positive and significant coefficient of the variable in the first 5 models confirms the quality-improving trend shown in the descriptive analysis. For the last two utilization measures, the positive coefficient suggests quality of these two indicators worsened over time. As we note in

the discussion section, the differences in quality trends between ADL and utilization measures may partially reflect a trend in coding practice; if agency staff intends to inflate quality scores, they can relatively easily change evaluation criteria for ADL measures compared with utilization measures; or, the utilization may capture a decreasing trend in quality for other unreported quality indicators.

Second, regarding the baseline variable, baseline quality has a positive relationship with quality scores of later years in all indicators, as expected. The interaction term between baseline scores and year was negative in all models, implying that agencies with low quality at baseline had larger improvement in quality over years than initially high-performing agencies.

Next, turning to agency characteristics, for the ownership variable, the results of the regression analysis are generally consistent with the findings observed in the graphs. Government agencies had poorer performance and showed less improvement than for-profit agencies for some measures. Non-profit agencies had greater improvements than for-profit agencies in the measures of transferring to beds and hospitalizations.

For other agency factors, we found a larger decrease in hospitalizations among hospital-based agencies than agencies that are not hospital based. As hospital-based agencies had lower hospitalization rates at baseline than their counterparts, this finding implies that the difference in the hospitalization rates between the two groups became larger over time. No significant difference is found in the degree of quality improvement based on branch affiliation. We found a positive association between the number of RNs and quality for some measures. Furthermore, we found a greater improvement in some indicators among agencies with a large number of RNs than agencies with a small number of RNs. For the Medicare tenure variable, there was a negative association between Medicare experience and quality for ADL measures; however, agencies with longer Medicare tenure showed larger quality improvement over time than agencies with short Medicare tenure for most measures. This finding partially suggests that new entrants had a smaller degree of quality improvement than continuing agencies.

We found regional differences in quality improvement after HHC. Agencies in the West region had largest improvement for the measures of emergent care use and hospitalizations. For ADL indicators, agencies in Midwest showed smaller improvement than agencies in South.

Finally, the sensitivity analysis that uses only agencies with all 5 years of HHC data produced very similar results with the primary analysis discussed above. Although there were slight differences in the coefficients between the two models, all the findings were qualitatively the same. A distinct difference

**Table 3.** Results of Regression Analysis

Quality measures (variables)	Coefficient (robust standard errors)					
	Bathing <sup>a</sup>	Transferring to bed <sup>a</sup>	Managing oral meds <sup>a</sup>	Less pain <sup>a</sup>	Walking <sup>a</sup>	Emergent care use <sup>b</sup>
No. of observations	23,294	22,460	21,694	22,642	23,363	23,745
Year	2.11*** (0.44)	1.63*** (0.35)	1.69*** (0.32)	2.27*** (0.47)	1.29*** (0.30)	1.75*** (0.20)
Baseline scores	0.52*** (0.02)	0.56*** (0.02)	0.50*** (0.02)	0.51*** (0.02)	0.43*** (0.02)	0.68*** (0.02)
Baseline scores × Year	-0.03*** (0.01)	-0.04*** (0.01)	-0.03*** (0.01)	-0.03*** (0.01)	-0.02* (0.01)	-0.06*** (0.01)
Ownership (for profit)						
Public	-1.38** (0.47)	0.48 (0.60)	-1.88*** (0.54)	-0.82 (0.58)	0.02 (0.47)	0.12 (0.40)
Not for profit	-0.10 (0.36)	0.45 (0.45)	-0.67 (0.40)	-0.42 (0.44)	-0.02 (0.34)	-0.11 (0.32)
Public × Year	0.06 (0.17)	0.14 (0.22)	0.16 (0.21)	0.08 (0.21)	-0.39* (0.18)	0.13 (0.14)
Not for profit × Year	0.19 (0.13)	0.41* (0.16)	0.26 (0.15)	0.32* (0.16)	0.10 (0.13)	-0.19 (0.11)
Hospital based (no)						
Yes	0.78* (0.33)	1.18** (0.43)	-0.29 (0.38)	0.18 (0.41)	1.17*** (0.32)	-0.09 (0.27)
Yes × Year	0.00 (0.12)	0.16 (0.16)	0.31* (0.14)	0.18 (0.15)	-0.25* (0.12)	-0.12 (0.10)
Branch-affiliated (no)						
Yes	-0.10 (0.30)	-0.54 (0.37)	-0.26 (0.34)	-1.22*** (0.38)	0.09 (0.29)	0.44 (0.29)
Yes × Year	-0.03 (0.12)	-0.17 (0.14)	-0.04 (0.13)	-0.16 (0.14)	-0.03 (0.11)	-0.09 (0.10)
RN Number (Small)						
Medium	-0.24 (0.50)	-0.75 (0.60)	1.07 (0.55)	0.10 (0.61)	0.17 (0.44)	-0.08 (0.41)
Large	-0.22 (0.50)	-0.56 (0.62)	1.72** (0.56)	0.45 (0.63)	0.13 (0.46)	-1.00* (0.41)
Medium × Year	0.11 (0.18)	0.21 (0.21)	-0.14 (0.20)	0.14 (0.22)	0.19 (0.16)	0.00 (0.14)
Large × Year	0.47** (0.18)	0.41 (0.22)	0.09 (0.20)	0.29 (0.23)	0.46** (0.17)	0.01 (0.14)
Years Medicare certified (0-5 years)						
(6-20 years)	-1.84*** (0.48)	-1.58** (0.58)	-2.15*** (0.55)	-1.83** (0.61)	-1.21** (0.45)	1.63*** (0.44)

(continued)



Table 3. (continued)

Quality measures (variables)	Coefficient (robust standard errors)					
	Bathing <sup>a</sup>	Transferring to bed <sup>a</sup>	Managing oral meds <sup>a</sup>	Less pain <sup>a</sup>	Walking <sup>a</sup>	Emergent care use <sup>b</sup>
(More than 20 years)	-2.41*** (0.51)	-1.61** (0.62)	-2.00*** (0.58)	-2.40*** (0.65)	-1.30** (0.49)	1.65*** (0.46)
(6-20 years) × Year	0.49** (0.16)	0.73*** (0.18)	0.58*** (0.17)	0.30 (0.20)	0.56*** (0.15)	-0.02 (0.14)
(More than 20 years) × Year	0.77*** (0.17)	0.85*** (0.20)	0.73*** (0.19)	0.77*** (0.21)	0.75*** (0.17)	-0.14 (0.15)
Region (south)						
Northeast	-1.03** (0.39)	0.04 (0.49)	-0.09 (0.43)	1.01* (0.48)	-0.47 (0.38)	1.06** (0.39)
Midwest	-0.19 (0.35)	0.78 (0.43)	0.14 (0.39)	1.03* (0.44)	-0.10 (0.33)	-0.12 (0.31)
West	2.00*** (0.41)	0.81 (0.48)	1.55*** (0.44)	0.74 (0.48)	0.44 (0.38)	-0.88** (0.33)
Northeast × Year	-0.15 (0.14)	0.21 (0.18)	-0.21 (0.16)	-0.28 (0.18)	-0.24 (0.15)	-0.10 (0.14)
Midwest × Year	-0.35** (0.13)	-0.09 (0.15)	-0.57*** (0.14)	-0.42** (0.15)	-0.40*** (0.12)	-0.31** (0.11)
West × Year	-0.08 (0.14)	0.23 (0.16)	-0.62*** (0.15)	-0.10 (0.17)	-0.27* (0.13)	-0.01 (0.11)
R <sup>2</sup>	.2295	.2343	.1872	.2065	.1511	.2939
						.5242

Note: Reference groups for categorical variables are in parentheses. Standard errors are adjusted for clustering within an agency.

a. Positive coefficients represent positive effects on quality.

b. Negative coefficients represent positive effects on quality.

\*p < .05. \*\*p < .01. \*\*\*p < .001.

was found in the coefficient of the year variable: the coefficient was twice as large in the sensitivity analysis. This implies that agencies that entered or exited the market may have had smaller improvements in quality than continuing agencies.

We also found similar results in the analysis that uses the four-category Medicare tenure variable: 0 to 2 years, 3 to 5 years, 6 to 20 years, and more than 20 years. We used new entrants (agencies with 0-2 years of Medicare experience) as a reference group. In this analysis, the coefficients of the year variable were all significant and smaller than those from the primary analysis. The interaction terms between year and the categories capturing long Medicare tenure (6-20 years and more than 20 years) had significant and larger coefficients than those from the primary model; however, the coefficient of the category representing agencies with 3 to 5 years of experience was not significant or was marginally significant in most models. These findings suggest that quality improvement was smaller among new entrants than among continuing agencies with longer than 5 years of experience.

## Discussion

As demand for home health care is increasing, it is important to provide high-quality services in home health care, and the CMS has been implementing programs to improve home health care quality. However, there have been few studies that examine the impact of those initiatives or factors associated with home health care quality. Our analysis is the first study that examines the association between agency characteristics and quality improvement after HHC, a recent public-reporting program. We found significant improvements in quality after HHC for all indicators related to managing daily activities; however, the use of emergent care did not change, and hospitalization rates actually increased. We also found that there was variability in the degree of quality improvement across individual agencies or by agency characteristics.

It has been reported that agency characteristics, such as profit-status or hospital-affiliation, are associated with differences in the provision of home health services, and our study shows that those characteristics are also related to outcome-based home health quality. This result is consistent with the literature in nursing home care, which reported associations between facility attributes and nursing home quality (Zinn et al., 2005). These findings suggest that different types of agencies may organize their quality-related activities in a different way that influences the performance of organizations.

The general quality-improving trend after HHC in the measures capturing the ability to manage daily activities is encouraging. This does not necessarily

imply a positive effect of HHC on home health quality because our analysis is based on only post-HHC data, which are publicly available; however, it is suggestive that public reporting of quality information may provide agencies with motives to improve quality. Although the overall trend in quality is positive, it should be noted that the degree of improvement varied by quality indicators. Among those measures related to daily activities, large improvements were shown in the measures that had relatively low scores at baseline. This is an expected consequence of public reporting because agencies may achieve large improvements in the measures with initially low scores for a relatively low level of efforts. It may also be that agencies pay more attention to those measures than others if they are concerned about being flagged as a poor quality agency due to the scores of those measures. This finding has been reported in prior studies examining similar initiatives in other settings (Cutler et al., 2004; Jung, 2007).

For the utilization measures, there was no improvement in the use of emergent care, and the hospitalization rates increased during the study period. This is somewhat less encouraging because these two measures may represent changes in patients' health outcomes that are not captured by other HHC quality indicators. Longer term efforts may be required for meaningful changes in these two measures than other indicators; however, this finding suggests a possibility that agencies may have strategically targeted publicly reported measures in their quality efforts rather than investing in the improvement of overall quality. An examination of the changes in quality for unreported measures will help assess whether there has been this "strategic resource reallocation" motive after HHC and, if any, to what extent. This is an important question to address but is beyond the scope of this study, and we leave it to future research.

We found that the degree of quality improvement after HHC varied largely across individual agencies, depending on their initial quality scores or organizational types. In general, agencies with low quality at baseline had large improvement; this is consistent with the anticipation that public-reporting initiatives motivate providers, particularly who are behind at baseline, to improve quality using others' quality scores as their benchmark. For agency attributes, we found agency types that were associated with high quality at baseline often had larger improvements. For example, for the measure of hospitalizations, agencies with a large number of RNs or long Medicare tenure, not-for-profit agencies, and hospital-based agencies showed greater improvement than their counterparts, after controlling for initial scores. This implies that the gaps in quality across different agency types became larger over time in some cases. Although we do not claim that our finding represents a causal relationship, this

finding suggests that certain agencies may be better structured or more committed to improving quality than others.

A few caveats should be noted in interpreting these results. First, it is possible that the trend of quality improvement may be due to the changes in the patient composition of an agency rather than a result of quality improvement efforts. Since patients' health risk influences health outcomes of home health services, if agencies treat healthier patients after HHC than before, it results in high-quality scores after HHC without agencies' investments for quality. Similarly, the differences in quality improvement across agency types may be because the composition of patients in terms of health risk differed by agency characteristics. Although risk-adjusted quality scores (based on an extensive set of risk factors) are used in HHC, a risk-adjustment system is hardly perfect, and it is likely that providers have additional information about patients' health status that is not captured in the adjustment system. This implies that providers may treat healthy patients who respond favorably to quality scores as a response to public-reporting programs. This type of selection incentives is particularly likely when outcome-based quality measures are disclosed because health outcomes are affected by many other risk factors, which are not readily captured in risk-adjustment systems. This undesirable effect has been shown in hospital markets where mortality rates after cardiac procedures of each hospital were released to the public: After the reporting program, hospitals avoided treating sick or minority patients who were perceived to produce poor health outcomes (Dranove et al., 2003; Werner et al., 2005).

Second, it is also possible that the quality improvement observed is due to a change in record-keeping practice after HHC. A potential consequence of public reporting is that agencies may change their coding practices to inflate quality scores (reporting creep). Similar incentives were observed in hospitals after the introduction of the prospective payment system (PPS): hospitals tended to up-code patients' clinical categories to receive high payments after PPS (Carter, Newhouse, & Relles, 1990). This incentive is likely in home health care because the OASIS data, from which HHC quality scores are derived, are collected by home health agency staff. ADL measures are particularly subject to this up-coding incentive because they are relatively hard to verify and agency staff can easily change assessment criteria for those measures. This may have contributed to the differential trend in quality between ADL and utilization measures. This possibility of changes in coding practice or evaluation criteria is not considered in our study.

Third, our study identified important agency characteristics that are associated with quality based on the literature; however, the measurements are limited to data availability, and they represent a small set of agency attributes that are

potentially related to home health quality. For example, we used the number of RNs, as a proxy for agency size; however, agency size would be better represented if the measurement is based on the volume of services that an agency offers.

The number of RNs probably represents a variety of factors, including the severity mix of patients of an agency, the level of quality of care that the agency desires to provide, the cost of RNs and other types of home health workers, and other factors. To the extent that this variable captures unmeasured factors or is correlated with other omitted variables, the level of association between agency traits and quality found in our study may be biased.

Our study also has limited information about characteristics of markets that an agency serves. Although we included the census region variable to address geographical variation in home health care practice, it does not capture micro-market environments that an agency faces, such as market demand or competition. Agencies in markets with intense competition or high demand for home health quality may have incentives to improve quality after their quality information is publicly disclosed. Furthermore, these market variables may interact with agency characteristics, and certain types of agency may perform better under specific market circumstances. However, these possibilities are not considered in our analysis. Studies on the associations among market characteristics, agency traits, and home health quality will provide information that could be used to develop policies about public reporting and quality improvement in home health care.

Finally, beyond assessing the trend in quality, it is important to identify mechanisms by which agencies improve quality. Considering the finding that there was large variability in quality improvement by agency types and across individual agencies, some agencies may have been successful in developing and implementing initiatives that resulted in quality improvements under HHC, whereas some may have failed to find effective actions despite their efforts. Identifying approaches that successfully lead to quality improvements is important to further explore effective strategies to improve quality, and this highlights the need for future research that investigates in detail how some agencies achieved large quality improvements.

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