

RESPONSE TO REGULATORY STRINGENCY: THE CASE OF ANTIPSYCHOTIC MEDICATION USE IN NURSING HOMES

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SUMMARY

This paper studies the impact of regulatory stringency, as measured by the statewide deficiency citation rate over the past year, on the quality of care provided in a national sample of nursing homes from 2000 to 2005. The quality measure used is the proportion of residents who are using antipsychotic medication. Although the changing case-mix of nursing home residents accounts for some of the increase in the use of antipsychotics, we find that the use of antipsychotics by nursing homes is responsive to state regulatory enforcement in a manner consistent with the multitasking incentive problem. Specifically, the effect of the regulations is dependent on the degree of complementarity between the regulatory deficiency and the use of antipsychotics. Copyright © 2011 John Wiley & Sons, Ltd.

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1. INTRODUCTION

The quality of care provided by nursing homes has been a recurring concern for consumers, health care professionals, and policymakers. States and the federal government have attempted to regulate nursing home quality through multiple mechanisms (Walshe, 2001; Wiener, 2003). One regulatory mechanism used is the annual recertification survey for participation in Medicare and Medicaid programs conducted by states to determine if a nursing home is compliant with federally mandated standards of care. Those facilities that do not meet these standards are given deficiency citations by state surveyors to indicate noncompliance (Spector and Drugovich, 1989). A review of these state nursing home enforcement systems can be found in Harrington *et al.* (2004).

Multiple studies have looked at the relationship between the quality of care provided and the number of deficiencies received by a nursing home. Studies that focus on nursing staff as a quality measure find that facilities with lower staffing levels are more likely to receive a deficiency and receive more deficiencies (see Harrington *et al.*, 2000; Konetzka *et al.*, 2004; Kim *et al.*, 2009). Additionally, facilities with poor quality in one dimension also are more likely to receive a deficiency in that dimension. For example, Graber and Sloane (1995) find that facilities with more physically restrained residents are more likely to receive a physical restraint deficiency, whereas Castle and Engberg (2007) find similar results for medication-related deficiencies.

Although past research finds an association between deficiency citations and quality, many of these studies only measure the contemporaneous relationship between deficiencies and quality. Although contemporaneous measures can be used to determine if deficiencies are correlated with quality, they do not measure the impact of these deficiencies on future quality. Furthermore, there is significant variation

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in the application and enforcement of nursing home standards across states, as measured by the number and type of deficiencies issued (Harrington and Carrillo, 1999; Harrington *et al.*, 2006), and facilities may change care practices in an anticipatory fashion, responding to the overall regulatory climate in the state. Prior studies have not addressed how this regulatory stringency impacts the quality of care provided by nursing homes.

This paper studies the impact of regulatory stringency, as measured by the statewide deficiency citation rate over the past year, on the quality of care provided by nursing homes from 2000 to 2005. The quality measure studied is the proportion of residents who are using antipsychotic medication. Antipsychotics are studied because the widespread reliance on these medications has been a long-standing issue in nursing home quality. Furthermore, there is significant variation in the use of antipsychotics across states, and their use grew rapidly, from 16.0% of nursing home residents in 1996 to over 27.6% by 2001 (Office of Inspector General, 2001; Briesacher *et al.*, 2005). Although multiple factors explain the increased use of antipsychotics, states exercise considerable discretion in the number and type of deficiency citations they impose on nursing homes. We study how these deficiencies impact the use of antipsychotic medications by nursing homes.

2. ANTIPSYCHOTIC USE IN NURSING HOMES

Congress passed nursing home reform legislation as part of the federal Omnibus Budget Reconciliation Act (OBRA) of 1987. Part of this legislation focused on the overuse of psychoactive medications as a form of 'chemical restraint' and mandated the establishment of guidelines to be used in sanctioning nursing homes for unnecessary drug use (Office of Inspector General, 2001). The proportion of nursing home residents receiving antipsychotic medications declined after the passage of the legislation and as antipsychotic guidelines were developed through the early 1990s (Shorr *et al.*, 1994; McKenzie *et al.*, 1999).

Shortly after the passage of OBRA, the Food and Drug Administration (FDA) approved a new generation of antipsychotics called atypical antipsychotics. Although the first of these drugs had serious side effects, the perception of a greater safety profile of atypical antipsychotics accelerated a shift from conventional antipsychotic medications. Although schizophrenia and bipolar disorder were the principal conditions for which FDA indications were approved for use of these drugs, the perceived safety profile of these new atypical antipsychotics led to their wide use for 'off-label' purposes (Crystal *et al.*, 2009). In particular, nursing homes often used atypical antipsychotics to manage behavioral symptoms associated with dementia (Briesacher *et al.*, 2005; Kim and Whall, 2006). For residents without schizophrenia or bipolar disorder, unless the resident has symptoms of psychosis or certain persistent and severe behavioral symptoms of dementia (e.g. aggressive behavior), antipsychotic use is inconsistent with federal interpretive guidelines promulgated to guide nursing facilities' practices and surveyors' assessments (Centers for Medicare and Medicaid Services [CMS], 2004).

With the rapid increase in the use of atypical antipsychotics, evidence accumulated that risks for this class of medications were greater than initially perceived. Atypical antipsychotics were found to be associated with the adverse side effects of weight gain, hyperlipidemia, and diabetes (Lund *et al.*, 2001; Gianfrancesco *et al.*, 2002; Koro *et al.*, 2002). For elderly patients with dementia, who make up a large percentage of nursing home residents, the evidence of risks associated with taking antipsychotics is mounting (Crystal *et al.*, 2009; Trufuro *et al.*, 2009). Using a meta-analysis of randomized clinical trials, Schneider *et al.* (2005) found that the absolute mortality risk for nursing home residents with dementia is about 2% higher for residents treated 8–12 weeks with an antipsychotic compared with a placebo. This led the FDA to issue a public health advisory on 11 April 2005 that cautioned that atypical antipsychotics were associated with increased risk of death for persons with dementia. In 2008, this warning was extended to all antipsychotics.

3. CONCEPTUAL MODEL OF DEFICIENCY CITATIONS AND THEIR IMPACT ON ANTIPSYCHOTIC USE

Nursing homes are faced with the challenge of providing residents high-quality care while also providing that care in a cost-effective manner. Given the complexity of providing care, the nursing home needs to find the best mix of inputs and care practices to provide high quality and to achieve their objectives. The ability of facilities to achieve high quality is determined by the inputs of production a nursing home uses (i.e. staffing levels and physical plant), but the ability of the nursing home to use these inputs to improve quality is mitigated by the payer-mix and case-mix of their residents.

Nursing home regulators have the ability to prioritize which aspects of quality and mix of care practices employed by nursing homes need improvement through the use of regulatory sanctions called deficiency citations. Deficiencies are issued by state surveyors as part of the required annual CMS recertification process that evaluates whether the nursing home is meeting minimum regulatory standards. The standards of care for which deficiencies are assigned are set at the federal level, but how states interpret, implement, and enforce these regulations (i.e. regulatory stringency) can be different for each state.

Regulators are capable of influencing the aspects of quality in which nursing homes should expend quality improvement efforts by varying the type and number of deficiency citations they issue. For example, if a large number of facilities in the state receive a specific deficiency, nursing homes may devote resources to improving quality related to that deficiency in anticipation that regulators will focus on that aspect of quality when the facility is recertified. This implies that regulatory stringency can improve quality through an anticipatory effect. That is, because there is significant variation in the number and type of deficiency citations given by each state (Harrington and Carrillo, 1999; Harrington *et al.*, 2006), facilities observe peer institutions receiving deficiencies and change their behavior.

However, a high level of regulatory stringency causes the nursing home to face a multitask incentive problem (Holmström and Milgrom, 1991; Laffont and Tirole, 1991; Hart *et al.*, 1997). That is, nursing home managers must allocate their attention among multiple activities, and this allocation is determined by the relative benefits they derive from each task. The amount of effort depends on the complementarity or substitutability of the task (Dewatripont *et al.*, 2000). If regulators are concerned about and signal a need to improve one aspect of quality, they can encourage firms to put more effort into improving that aspect of quality through the use of specific negative feedback (fines/citations). However, if regulators focus on one aspect of quality, they can crowd out efforts to improve other aspects of quality.

Similarly, in the nursing home industry, the effect of regulatory stringency on quality depends on the degree of complementarity or substitutability between the quality improvement effort the regulators are promoting and the quality measure. For example, states that use deficiency citations to emphasize reducing the use of physical restraints may cause facilities in those states to reduce their use of physical restraints, but this could lead to increases in the use of substitutes for physical restraints, such as antipsychotic medications. In this case, the physical restraint deficiency is incongruent with the use of antipsychotics, and we expect that there would be an increase in the use of these medications. In contrast, if the regulatory deficiency is complementary to the use of antipsychotics, we would expect facilities to reduce the use of these medications.

The deficiencies for physical and chemical restraints can affect the use of antipsychotics. Federal guidelines state that 'physical or chemical restraints' are inappropriate when used for the purpose of 'discipline or convenience, and not required to treat the resident's medical symptoms'. If a facility is found to be violating this regulation by using physical restraints, deficiency F221 is given; if the violation is for 'chemical restraints' then deficiency F222 is given. In both cases, if regulators are assigning a high number of F221 or F222 deficiencies, a facility could believe that regulators are targeting the use of a specific type of restraint. Because physical restraints are a potential substitute for antipsychotic medications, facilities in a state that issues a high number of physical restraint deficiencies are expected to increase the use of antipsychotics. In contrast, high use of the F222 deficiency, which directly relates to the chemical restraint property associated with antipsychotics, should lead to lower use of these antipsychotic medications.

The deficiency F319 (receipt of mental health services for mental or psychosocial adjustment difficulty) is given if a resident with psychosocial or mental adjustment difficulty does not receive mental health treatment or services for his or her conditions. Residents who have problems in adjustment are required to receive a psychiatric evaluation and appropriate medical interventions. Deficiency citations in this area may reflect antipsychotics being used to treat residents with adjustment difficulty without proper evaluation. For this deficiency, antipsychotic use is viewed as a complement and should be associated with lower antipsychotic use.

A final set of specific regulatory deficiencies (F329, F330, and F331) pertains to the overuse and misuse of medications. In particular, CMS guidelines related to deficiency F329 (unnecessary drug use) require that each resident's drug regimen be free from all unnecessary drug use, whereas deficiencies F330 (free from antipsychotic use without approved conditions) and F331 (efforts to reduce dosage and discontinue antipsychotics) specifically address antipsychotics (CMS, 2004). Deficiency F330 requires that the resident be free from antipsychotic use without approved conditions, whereas F331 requires there be a tapering of dosage when antipsychotics are used. Each of these deficiencies either directly or indirectly address the inappropriate use of medications, and each is expected to be associated with reduced use of antipsychotics.

In addition to specific deficiencies, the total number of deficiencies issued by the state could impact the amount of antipsychotic use. By issuing a high number of regulatory deficiencies, the regulator is indicating that there are multiple aspects of quality that are of concern; nursing homes, faced with limited resources and the multitask incentive problem, may find it hard to determine which aspects of quality to focus their quality improvement efforts. The net result is that nursing homes might only focus on the aspects of quality that were a concern in the past or might spread scarce resources thinly to try to improve multiple dimensions of quality. Because quality improvement efforts in the nursing home industry have focused on reducing the use of physical restraints, we expect that facilities in states that issue a high number of deficiencies would not necessarily decrease their use of antipsychotics.

Another way deficiencies can impact quality through an anticipatory effect is when a nursing home has received a deficiency in their prior recertification survey. These deficiencies indicate to the facility that it is providing care below minimum standards. Because regulators use past deficiencies as a guide during the facility's next survey, nursing homes have the incentive to improve quality in the areas that they received deficiencies in the past. It is expected that the direction of the effect on antipsychotic use is the same for facility-specific and statewide deficiencies, but the size of the effects and which deficiencies are the most effective can be different. Furthermore, whereas regulatory stringency is likely exogenous because statewide deficiency rates are determined by variation in enforcement across states, there is a possibility that deficiencies received by a specific facility may not be strictly exogenous because they reflect that the facility provided care below standards in the past. Therefore, the empirical model includes both state-level and facility deficiency measures, but our results and discussion focus to a greater extent on the state-level deficiency measures.

4. ECONOMETRIC METHODS

4.1. Data sources

The data source used in this analysis is the Online Survey Certification and Reporting (OSCAR) System. OSCAR is a uniform database of state nursing home regulatory reviews for all CMS certified facilities as part of a yearly recertification review process. Data are validated during on-site surveys completed by state surveyors, operating under CMS oversight, every 9–15 months with an average period of 12 months between surveys. OSCAR is the only national source for information on deficiencies for the period studied. Although some aspects of the OSCAR data have been criticized, and some studies have preferred to use cost reports, many studies have found that OSCAR measures are appropriate for research (Feng *et al.*, 2005; Intrator *et al.*, 2005; Harrington *et al.*, 2006).

The OSCAR system allows for construction of a panel dataset with the nursing home facility as the unit of observation. To construct the sample used in the analysis, all standard OSCAR surveys at least 180 days apart for US non-hospital-based nursing homes in the 48 contiguous states that occurred between 1 January 1999 and 31 December 2005 are obtained ($N=94680$). Because regulatory variables are measured using data from all the surveys in each prior year, the regressions are performed on the years of 2000–2005. Additionally, the regression method accounts for serial correlation. This method causes the first observation of each facility to be dropped from the sample and requires each included facility to have at least three surveys in the study period. The resulting sample contains 14743 unique nursing facilities with the average time between surveys being slightly over 365 days ($N=64711$). These restrictions are unlikely to lead to any significant selection bias because most of the observations that are dropped are from 1999 or reflect the first observation of a facility in the dataset after 1999.

OSCAR is merged with data on the state Medicaid reimbursement rates and the state minimum nursing direct care staffing requirements. State Medicaid reimbursement rates are obtained from Grabowski *et al.* (2004a, 2004b, 2008) and are adjusted for inflation to 2005 dollars using the Consumer Price Index (CPI-U). The minimum required state nursing direct care hours per resident day (HPRD) are constructed from multiple sources. First, information on nurse staffing requirements are obtained from Harrington (2001, 2008). These sources only provide a cross-sectional perspective of minimum staffing rates. State statutes and regulations on state websites are reviewed with follow-up phone calls to state agencies/associations to identify and confirm required minimum staffing rates for each specific year from 1999 to 2005.

4.2. Variables

The dependent variable used in the regression is the proportion of residents in the facility who are receiving an antipsychotic medication. This proportion is calculated as the total number of residents that are receiving an antipsychotic medication at the time of the survey divided by the total number of residents in the facility. The total number of residents receiving antipsychotics is from the Minimum Data Set, which uses clinical records of each patient, and this measure is not risk adjusted. The remaining discussion in this section describes the construction of regulatory deficiency and control variables included in the model.

4.2.1. Regulatory deficiency variables. Deficiency citations are a measure of how facilities are achieving minimum quality standards. The guidelines used to determine if a facility should receive a deficiency are set by the federal government, but the actual on-site surveys of compliance by nursing facilities are performed by state surveyors within particular survey regions. Because of this, there is significant variation in the number and types of deficiencies issued to facilities (see Table I for rates in 1999). This variation in the number and type of deficiencies found in the OSCAR system reflects variation in state and local survey region regulatory stringency.

Deficiencies can be measured either in terms of the total number of deficiencies or in terms of specific types of deficiencies. To capture state regulatory enforcement effort, both total deficiencies and specific deficiencies that could impact antipsychotic use are included in the model. The specific deficiencies used include F221 (free from physical restraint), F222 (free from chemical restraint), F319 (receipt of mental health services for mental or psychosocial adjustment difficulty), F329 (unnecessary drug use), F330 (free from antipsychotic use without approved conditions), and F331 (efforts to reduce dosage and discontinue antipsychotics). F329 citations reflect a broader measure of regulatory activity related to medication use and are not limited to antipsychotic use.

State-level regulatory deficiency variables capture how a facility responds to overall regulatory stringency as reflected in the statewide rate of deficiency citations. If a facility observes that other facilities in the state are receiving certain deficiencies, the facility may be induced to focus on that aspect of care. Furthermore, the use of state-level variables captures variation in enforcement efforts by states. For total number of deficiencies, the state-level deficiency variable is the statewide average number of deficiency citations for

Table I. Antipsychotic use rates and state deficiency rates

State	Antipsychotic use rate ^a			Proportion of facilities with deficiency ^b						Average number of deficiencies ^c
	2000	2005	Change	F221	F222	F319	F329	F330	F331	
Alabama	16.90	28.41	11.51	11.24	0.00	1.12	11.24	2.81	1.69	7.64
Arizona	16.60	23.30	6.70	18.06	0.00	2.78	9.72	1.39	1.39	7.90
Arkansas	25.11	29.55	4.44	25.87	0.00	1.00	9.95	9.45	9.45	8.65
California	20.97	26.24	5.26	23.86	1.02	5.28	30.15	1.32	1.83	12.47
Colorado	20.05	25.54	5.49	9.85	0.00	0.99	11.82	0.99	1.97	3.23
Connecticut	24.43	30.32	5.89	7.38	0.00	0.41	3.69	0.00	0.41	3.98
Delaware	18.55	28.08	9.53	21.88	0.00	3.13	6.25	0.00	0.00	7.66
Florida	17.71	24.47	6.76	9.95	0.31	3.98	12.40	1.07	1.23	6.86
Georgia	24.37	32.89	8.52	6.92	0.35	2.42	2.08	0.00	0.35	4.76
Idaho	15.50	23.59	8.08	14.29	0.00	0.00	32.14	1.79	0.00	7.89
Illinois	24.61	30.46	5.85	12.31	0.26	2.72	6.74	0.39	1.30	6.56
Indiana	23.39	27.10	3.71	15.56	3.94	2.90	10.79	2.49	1.56	7.91
Iowa	15.40	22.96	7.57	1.56	0.00	0.00	7.27	0.78	2.86	4.41
Kansas	23.42	29.75	6.33	16.13	0.00	1.76	17.30	1.17	1.47	7.23
Kentucky	22.72	27.56	4.84	14.80	0.00	1.79	14.35	1.35	0.00	7.99
Louisiana	28.89	33.89	5.00	2.70	0.68	1.01	6.76	0.00	0.00	5.07
Maine	20.92	28.52	7.60	5.36	0.00	0.89	5.36	0.00	0.00	3.56
Maryland	21.18	24.56	3.38	9.32	0.00	0.85	6.78	0.00	0.00	4.10
Massachusetts	25.41	31.26	5.85	12.56	0.22	3.81	7.40	0.00	0.45	4.26
Michigan	17.56	19.27	1.71	18.78	0.53	4.50	31.22	0.26	2.12	10.38
Minnesota	20.33	25.36	5.03	2.49	0.00	0.83	8.86	0.55	1.66	3.69
Mississippi	25.17	32.71	7.54	12.50	0.00	2.94	10.29	2.21	0.74	6.44
Missouri	21.33	28.29	6.96	6.41	0.00	6.20	6.41	0.21	0.64	5.65
Montana	18.87	26.52	7.66	16.07	0.00	3.57	17.86	0.00	0.00	5.71
Nebraska	16.94	25.11	8.17	7.29	0.00	3.13	7.81	2.08	1.04	3.52
Nevada	18.25	23.60	5.35	29.03	3.23	6.45	3.23	0.00	0.00	14.03
New Hampshire	18.65	26.14	7.50	3.23	0.00	0.00	9.68	0.00	0.00	3.98
New Jersey	17.91	22.59	4.69	5.44	0.00	1.02	5.78	0.34	0.34	3.56
New Mexico	18.14	24.65	6.51	13.89	0.00	1.39	9.72	0.00	1.39	5.14
New York	20.29	26.56	6.27	10.35	0.00	4.88	5.08	0.00	0.59	3.52
North Carolina	18.29	25.51	7.22	8.19	0.00	0.58	25.44	0.29	1.17	6.27
North Dakota	19.71	23.93	4.21	1.49	0.00	1.49	19.40	1.49	0.00	4.97
Ohio	23.97	29.79	5.83	10.20	0.26	3.79	6.54	0.78	0.65	5.77
Oklahoma	22.70	31.79	9.09	24.23	0.31	0.31	0.92	0.92	0.00	5.18
Oregon	19.74	23.77	4.03	16.15	1.54	6.15	16.92	2.31	0.77	7.24
Pennsylvania	19.12	24.77	5.66	11.26	0.73	4.09	15.79	0.15	0.00	4.58
Rhode Island	22.57	27.25	4.67	14.89	0.00	0.00	3.19	0.00	0.00	3.41
South Carolina	16.70	24.06	7.36	17.19	0.00	1.56	15.63	0.00	2.34	8.83
South Dakota	19.19	23.05	3.86	25.00	0.00	0.00	8.82	0.00	0.00	4.37
Tennessee	23.84	33.12	9.28	3.34	0.00	6.35	13.38	0.00	1.34	5.28
Texas	24.79	29.83	5.04	9.36	0.82	2.27	8.00	0.73	0.64	5.24
Utah	25.00	31.99	6.99	1.64	0.00	0.00	9.84	0.00	0.00	4.44
Vermont	23.20	28.59	5.39	4.55	0.00	2.27	6.82	0.00	2.27	2.36
Virginia	20.59	25.33	4.75	12.86	0.41	1.66	6.64	0.41	0.00	3.94
Washington	18.06	23.32	5.26	19.43	0.40	4.45	19.43	0.40	2.02	10.10
West Virginia	19.90	24.82	4.92	16.35	0.00	1.92	12.50	0.96	0.96	6.31
Wisconsin	18.47	22.68	4.21	12.20	0.27	1.06	12.47	0.53	1.86	3.44
Wyoming	18.82	26.34	7.52	34.78	0.00	0.00	13.04	0.00	0.00	5.96
Average	20.71	26.86	6.14	12.67	0.32	2.29	11.31	0.83	1.01	5.95
Minimum	15.40	19.27	1.71	1.49	0.00	0.00	0.92	0.00	0.00	2.36
Maximum	28.89	33.89	11.51	34.78	3.94	6.45	32.14	9.45	9.45	14.03

The data is calculated for non-hospital-based facilities in contiguous U.S. from standard Online Survey Certification and Reporting (OSCAR) surveys in the calendar year. States are reported in alphabetical order. Deficiencies codes are: F221 - free from physical restraint, F222 - free from chemical restraint, F319 - receipt of mental health services for mental or psychosocial adjustment difficulty, F329 - unnecessary drug use, F330 - free from antipsychotic use without approved conditions, and F331 - efforts to reduce dosage and discontinue antipsychotics

^aThe antipsychotic use rate is calculated as the average of the proportion of residents in the facility using antipsychotics.

^bDeficiencies are the proportion of OSCAR surveys in calendar year 1999 that received a deficiency.

^cAverage number of deficiencies is based on OSCAR surveys in calendar year 1999.

all regulatory reviews in the prior 12-month period. For the state-level specific deficiency variables, the regulatory variable is the proportion of all statewide regulatory reviews with the specific deficiency in the prior 12-month period.

This construction makes the state-level regulatory deficiency variable different for each month. To illustrate, if an OSCAR survey occurs in January 2000, the state-level regulatory variable measures the regulatory environment from January 1999 to December 1999; if the OSCAR survey occurred in February 2004, then the state-level regulatory variable measures the regulatory environment from February 2003 to January 2004.

As discussed in the conceptual framework, a regulator that issues a deficiency to a facility is indicating that the facility is providing care below standards. Because a facility may react differently to receiving a deficiency than to the overall statewide deficiency rate, deficiencies specific to the facility are included in the model. Facility-specific regulatory deficiency variables include the total number of deficiencies received in the facility's prior regulatory review and an indicator variable for receiving a specific deficiency in the prior regulatory review.

4.2.2. Control variables. To completely model the impact of regulation on nursing homes' antipsychotic use, it is important to account for other characteristics that may affect the use of antipsychotics. Control variables include a set of time dummies, facility-specific heterogeneity, and time-varying controls. The time dummies are indicator variables for each calendar year. The facility-specific heterogeneity accounts for facility-specific variables that are constant over time and may impact antipsychotic use. Both observable (e.g. state indicators, facility bed size) and unobservable (e.g. floor plan, unobservable care practices) facility-specific heterogeneity are controlled in the regression model by using a fixed effects estimation technique that is discussed further in the next section. Finally, time-varying control variables are included in the model to capture changes in facilities over time that could impact the use of antipsychotics. These time-varying control variables are broken into five groups/categories.

Physical restraints are the first group of time-varying controls. Physical restraints are any physical or mechanical device that restricts the freedom of movement and are an input that nursing homes may use to avoid harm to the resident or other persons. Although there may be justification for restraining select residents for short periods in a limited set of circumstances, reducing the use of physical restraints has been a priority since the passage of OBRA. Therefore, some nursing homes may have reduced the use of physical restraints only to be substituted by an increased use of antipsychotic medications. The use of physical restraints is included as a control variable and is measured as the proportion of residents who are physically restrained in the prior regulatory review. Three different regressions are estimated, one focusing on restraint use among all residents, another that focuses on facility-acquired restraint use among residents who did not have orders for restraints prior to admission, and one that excludes the physical restraint variable.

The second set of time-varying control variables are facility operational characteristics. These operational characteristics of the nursing home include payer-mix and occupancy rate. The reimbursement facilities received for providing care varies significantly by source. For example, Medicaid has consistently paid low reimbursement rates, and facilities that are more dependent on Medicaid have been found to provide lower quality of care (Cohen and Spector, 1996; Grabowski, 2004). Payer mix categories include the proportion of residents funded by Medicaid and the proportion of residents paid for by Medicare, with the reference category as the proportion of residents paid for by all other sources (e.g. self-pay, private insurance). Finally, occupancy rate is included as a control variable as it has important influence on treatment patterns; for example, a facility with a low proportion of occupied beds may not have enough revenue to cover the fixed costs of production.

The third set of time-varying control variables captures resident case-mix. Antipsychotics are indicated for residents with schizophrenia and bipolar disorder but also are used 'off-label' to manage behavioral symptoms of dementia. It is important to account for the increase in the number of residents that may have these and other relevant medical conditions, but a limitation of OSCAR is it only provides broad measures of mental health case-mix: the proportion of residents in the facility with dementia, depression, developmental

disability, and psychiatric illness other than dementia or depression. The level of dependence and use of special medical procedures of the residents in the facility, or facility acuity level, is measured using the Acuindex (Cowles, 2002).

Nurse staffing is the largest input cost of nursing homes and, staffing variables are included as control variables. Nurse staffing variables are measured in terms of the level and composition of staffing by each type of nurse and an indicator variable reflecting whether the facility had any staff specializing in mental health services. Nurse staffing categories include registered nurses, licensed practical nurses, and certified nurse aides. Each type of nursing staff is included in the regression and is measured in terms of staffing HPRD to standardize across facilities of various sizes. To identify and correct for occasional improbable values in the HPRD that may be recording errors, we identified observations for each nurse staff type that were unreliable based on the following criteria: (i) more than 24 hours of staffing; (ii) zero staffing; and (iii) among facilities that do not fall into the first two categories, those that are outside three standard deviations of the mean. Unlike other studies that have dropped these observations (Banaszak-Holl *et al.*, 2002; Harrington *et al.*, 2006; Kash *et al.*, 2007), no observations are dropped, but instead indicator variables are created to identify which observations have unreliable staffing records (Bowblis, 2011).

Because staffing levels are an input that nursing homes can change in response to regulatory factors, staffing changes and the antipsychotic use rate could be jointly determined because of substitution of inputs (Cawley *et al.*, 2006). This could lead to endogeneity bias. To assess the size of this potential bias, we estimate the model with contemporaneous, lagged, and without staffing variables. We also estimated the model using instrumental variables using lagged staffing variables as exclusion restrictions. The coefficient estimates of the regulatory variables are statistically indistinguishable for all model specifications. Therefore, we only present the results that treat staffing as exogenous, and any causal inference of the staffing variables should be interpreted with caution.

The final set of time-varying control variables includes the average state Medicaid reimbursement rate adjusted for inflation using the CPI-U and the state minimum nursing staff requirement. The impact of Medicaid reimbursement on quality is mixed and depends on the level of excess demand (Nyman, 1985; Gertler, 1989, 1992; Grabowski, 2001). The average state Medicaid reimbursement rate is the average per diem reimbursement for Medicaid nursing home residents in the state. This variable is only available by calendar year, and the reimbursement rate for the prior calendar year is used in the regression. The minimum nurse staffing rate is defined as the minimum number of direct care nursing HPRD required by state regulation. To keep this variable consistent across all states and years, data for all states that reported requirements in terms of nurses-per-resident or nurses-per-bed were converted to HPRD. In addition, some states have different staffing requirements based on the number of residents; therefore, we standardized the minimum direct care staffing ratio used in the analysis based on 100 residents (Harrington, 2001, 2008). The effective date of the state minimum nurse staffing level is known for all states, and the minimum staffing level variable is based on the minimum staffing requirement in effect 365 days before the current regulatory review. A series of robustness checks use contemporaneous Medicaid reimbursement rates, contemporaneous state minimum staffing rates, and a squared term for Medicaid reimbursement rates. The parameter estimates for the regulatory variables are similar for all regressions.

4.3. General model specification

The empirical model uses a reduced form relationship between antipsychotic use and regulatory deficiency variables to determine how state regulatory stringency impacts the use of antipsychotics in nursing homes. The dependent variable for facility i in state s observed in year t is the proportion of residents using antipsychotics (AP_{ist}). The empirical model to be estimated includes the explanatory variables of facility-specific regulatory deficiency variables (R_{ist-1}^i), state-level regulatory deficiency variables that impact all facilities in the state (R_{st-1}^s), other time-varying control variables and time dummies (X_{ist}), and facility-specific heterogeneity (δ_i). Facility-specific regulatory variables measure the regulatory deficiencies received by each facility in the prior

regulatory review. State-level regulatory variables measure the regulatory environment in the state in the previous 12 months and are different depending on the month and year the OSCAR survey occurred. The facility-specific heterogeneity is treated as a fixed effect and captures both observed and unobserved differences across facilities that are constant over time. The following reduced form model is estimated for years 2000–2005:

$$AP_{ist} = a_1 R_{ist-1}^i + a_2 R_{st-1}^s + \beta X_{ist} + \delta_i + u_{ist}$$

where $u_{ist} = \rho \varepsilon_{ist-1} + \varepsilon_{ist}$. By assuming that ε_{ist} is independent and identically distributed, the preceding equation can be estimated by the technique described by Baltagi and Wu (1999). Hausman tests find that a fixed effect and serial correlation are consistent with the data.

5. RESULTS

The percentage of nursing home residents receiving antipsychotic medication by state is reported in Table I for the years 2000 and 2005. Across the 48 states in the sample, the average increase in the proportion of nursing home residents using antipsychotic medications is 6.14 percentage points over the 5-year period, from 20.71% of residents in 2000 to 26.86% of residents in 2005. We found wide variation across the states in the change in the antipsychotic use rate from 2000 to 2005, and increases are noted in every state. Michigan had the smallest increase in the proportion of residents using antipsychotics with a 1.71 percentage point increase, whereas Alabama had the largest increase with 11.51 percentage points. Also reported in Table I is the proportion of facilities that received specific deficiencies in 1999. There is significant variation in the number and type of deficiencies used by regulators.

The summary statistics are presented in column 1 of Table II. In this same table, we present regression results for four different model specifications. Regression model 1 reports the full regression results and will be the base model used to discuss the results. The remaining columns of Table II report results of alternative specifications. In the first regression model, the physical restraint measure is excluded from the regression. The second and third regressions include the proportion of all residents who are physically restrained. The coefficient estimate for physical restraint use is found to be negative but is not statistically significant. The third model uses the proportion of residents who have facility-acquired physical restraints (restrained without orders on admission) because the physical restraint measure does not account for people that are ordered to be physically restrained upon admission. This measure of physical restraint use has a coefficient estimate that is negative and statistically significant. The fourth specification excludes the facility-specific regulatory deficiency variables because these facility-specific deficiencies may not be exogenously determined. All of these alternative specifications have similar coefficient estimates.

The regression results for the state-level and facility-specific deficiency variables suggest that nursing homes strategically change their use of antipsychotics in response to certain types of deficiency citations. The first set of deficiency citations is for the use of physical and chemical restraints. Antipsychotic use rates were not significantly associated with physical restraint citation rates, suggesting that facilities do not respond to these citations by shifting to antipsychotic use. Chemical restraint citations, although highly specific to antipsychotic use, are used relatively infrequently (less than 0.4% of regulatory reviews in this sample resulted in this deficiency), resulting in limited power.

Similarly, the F319 citation (deficiency in provision of mental health services for mental or psychosocial adjustment difficulty) was relatively rarely used; receipt of this citation type was significantly and negatively associated with antipsychotic use at the state-level but not statistically significant at the facility level. A 10-percentage point increase in the proportion of facilities in the state that receive the F319 deficiency would be estimated to decrease antipsychotic use in a facility by 1.03 percentage points. These results are suggestive of pre-emptive change in facility behavior based on the deficiency experience of peer facilities.

Table II. Summary statistics and regressions for antipsychotic use

	Summary statistics	Model (1)	Model (2)	Model (3)	Model (4)
<i>Dependent variable</i>					
% of residents using antipsychotics	25.120 (14.000)				
<i>Facility physical restraint use (prior survey)</i>					
% of residents with restraints	9.879 (11.262)		-0.005 (0.004)		
% of residents with facility-acquired restraints	7.224 (9.094)			-0.010** (0.004)	
<i>Facility operation characteristics</i>					
% of residents with Medicaid	65.281 (21.164)	0.012*** (0.004)	0.012*** (0.004)	0.012*** (0.004)	0.014*** (0.004)
% of residents with Medicare	10.504 (11.598)	-0.032*** (0.005)	-0.032*** (0.005)	-0.032*** (0.005)	-0.033*** (0.005)
Occupancy rate	83.519 (16.118)	-0.000 (0.004)	-0.000 (0.004)	-0.000 (0.004)	0.001 (0.004)
<i>Facility mental and physical acuity measures</i>					
% of residents with dementia	45.804 (18.260)	0.031*** (0.002)	0.031*** (0.002)	0.031*** (0.002)	0.032*** (0.002)
% of residents with psychiatric diagnosis	18.835 (16.537)	0.077*** (0.003)	0.077*** (0.003)	0.077*** (0.003)	0.078*** (0.003)
% of residents with depression	43.434 (21.078)	0.034*** (0.002)	0.034*** (0.002)	0.034*** (0.002)	0.034*** (0.002)
% of residents with developmental disability	3.090 (5.859)	0.043*** (0.011)	0.043*** (0.011)	0.043*** (0.011)	0.047*** (0.011)
Facility acuity level	10.138 (1.479)	-0.142*** (0.040)	-0.142*** (0.040)	-0.141*** (0.040)	-0.148*** (0.039)
<i>Facility staff resources</i>					
RN HPRD	0.313 (0.302)	0.163 (0.172)	0.160 (0.172)	0.162 (0.172)	0.123 (0.165)
LPN HPRD	0.693 (0.370)	0.284** (0.125)	0.285** (0.125)	0.284** (0.125)	0.268** (0.121)
CNA HPRD	2.016 (0.747)	0.134** (0.067)	0.135** (0.067)	0.134** (0.067)	0.105 (0.065)
Unreliable RN HPRD	0.025 (0.156)	-0.159 (0.227)	-0.160 (0.227)	-0.159 (0.227)	-0.115 (0.223)
Unreliable LPN HPRD	0.021 (0.143)	-0.281 (0.262)	-0.277 (0.262)	-0.275 (0.262)	-0.428* (0.257)
Unreliable CNA HPRD	0.035 (0.183)	0.075 (0.229)	0.076 (0.229)	0.077 (0.229)	0.043 (0.225)
Presence of mental health staff	0.487 (0.500)	0.228*** (0.081)	0.228*** (0.081)	0.228*** (0.081)	0.209*** (0.079)
<i>Facility deficiencies (prior survey)^a</i>					
Free from physical restraints (F221)	0.106 (0.308)	-0.013 (0.099)	-0.006 (0.099)	-0.004 (0.099)	
Free from chemical restraints (F222)	0.004 (0.063)	-0.250 (0.454)	-0.248 (0.454)	-0.248 (0.454)	
Receipt of mental health services for difficulty (F319) ^b	0.018 (0.132)	-0.032 (0.226)	-0.032 (0.226)	-0.035 (0.226)	
Unnecessary drug use (F329)	0.123 (0.328)	-0.155* (0.094)	-0.154* (0.094)	-0.153 (0.094)	
Free from antipsychotic use without approved conditions (F330)	0.009 (0.094)	-1.005*** (0.303)	-1.002*** (0.303)	-1.001*** (0.303)	
Efforts to reduce dosage and discontinue antipsychotics (F331)	0.011 (0.105)	-0.474* (0.268)	-0.472* (0.268)	-0.470* (0.268)	
Total number of deficiencies	6.267 (5.754)	-0.001 (0.007)	-0.001 (0.007)	-0.001 (0.007)	
<i>State regulatory deficiencies measures (prior year)^c</i>					
Free from physical restraints (F221)	10.402 (5.348)	-0.015 (0.011)	-0.015 (0.011)	-0.015 (0.011)	-0.014 (0.011)

Table II. *Continued*

	Summary statistics	Model (1)	Model (2)	Model (3)	Model (4)
Free from chemical restraints (F222)	0.404 (0.703)	0.002 (0.071)	0.002 (0.071)	0.001 (0.071)	-0.032 (0.069)
Receipt of mental health services for difficulty (F319) ^b	1.898 (1.895)	-0.103*** (0.029)	-0.103*** (0.029)	-0.103*** (0.029)	-0.095*** (0.028)
Unnecessary drug use (F329)	12.300 (7.978)	-0.045*** (0.011)	-0.045*** (0.011)	-0.045*** (0.011)	-0.044*** (0.011)
Free from antipsychotic use without approved conditions (F330)	0.860 (1.453)	0.044 (0.031)	0.045 (0.031)	0.045 (0.031)	0.033 (0.031)
Efforts to reduce dosage and discontinue antipsychotics (F331)	1.147 (1.172)	-0.015 (0.040)	-0.015 (0.040)	-0.015 (0.040)	-0.026 (0.039)
Total number of deficiencies	6.350 (2.092)	0.181*** (0.045)	0.181*** (0.045)	0.181*** (0.045)	0.174*** (0.043)
<i>Other state regulations (prior year)</i>					
Real average state Medicaid reimbursement (10's)	124.848 (26.022)	-0.115** (0.046)	-0.113** (0.046)	-0.113** (0.046)	-0.125*** (0.045)
Minimum state direct care HPRD	1.772 (1.236)	0.219 (0.179)	0.223 (0.179)	0.225 (0.179)	0.253 (0.177)
<i>Year dummies (Reference=2000)</i>					
Year 2001	0.176 (0.380)	-0.089 (0.375)	-0.092 (0.375)	-0.093 (0.375)	0.112 (0.294)
Year 2002	0.179 (0.384)	1.549*** (0.437)	1.546*** (0.437)	1.546*** (0.437)	1.788*** (0.345)
Year 2003	0.164 (0.370)	3.021*** (0.456)	3.016*** (0.456)	3.017*** (0.456)	3.264*** (0.362)
Year 2004	0.169 (0.375)	3.894*** (0.463)	3.884*** (0.463)	3.884*** (0.463)	4.152*** (0.370)
Year 2005	0.158 (0.365)	3.741*** (0.467)	3.726*** (0.467)	3.724*** (0.467)	3.991*** (0.373)
Constant		20.233*** (0.817)	20.264*** (0.817)	20.268*** (0.817)	19.923*** (0.757)
Number of Observations		64711	64711	64711	64711

Regressions use data from the standard OSCAR surveys for all non-hospital-based nursing facilities in the contiguous US between 2000 and 2005. Models 1 – 4 regress the dependent variable of percentage of residents prescribed antipsychotics using facility-specific fixed effects panel regression that controls for serial correlation in the error term. Standard deviations for summary statistics and standard errors for the regression models are reported in parentheses.

CNA, certified nurse aide; HPRD, hours per resident day; LPN, licensed practical nurses; RN, registered nurse.

^aFacility-specific deficiencies are indicator variables for receiving the specific deficiency and the total number of deficiencies in the prior regulatory review.

^bThe full name of the deficiency is “receipt of mental health services for mental or psychosocial adjustment difficulty.”

^cState-level deficiencies are the proportion of regulatory reviews that received the specific deficiency and the average number of deficiencies per regulatory review in the prior 12-month period.

*Significant at 10%; **significant at 5%; ***significant at 1%.

The final set of specific deficiency citations (F329, F330, and F331) is related to the overuse and misuse of medications, whereas deficiency types F330 (free from antipsychotic use without approved conditions) and F331 (efforts to taper dosage and discontinue antipsychotics) are specific to antipsychotic medications. At the state level, the effect of citations for unnecessary drug use was negative and statistically significant. A 10-percentage point increase in the proportion of facilities in the state that received a deficiency for unnecessary drug use would decrease the proportion of residents in a facility that received an antipsychotic by 0.45 percentage points. However, the other two statewide deficiency citation rates are not statistically significant. This may reflect the more frequent use of F329 (12.3% of the sample), in contrast to the infrequent use of deficiency types F330 and F331 (about 1% of the sample).

The coefficient estimates for the three facility-level deficiencies of overuse and misuse of medications are statistically significant. Facilities that received a deficiency for unnecessary drug use (F329) and failure to taper

dosage and discontinue antipsychotics (F331) had a lower average proportion of residents using antipsychotic medications by 0.16 and 0.47 percentage points, respectively, in the next regulatory review period compared with facilities that did not receive the deficiency. The effect for F329 is rather small and may not have had as large an impact on antipsychotics because it can be given for unnecessary use of non-antipsychotic medications. Deficiency F330 (free from antipsychotic use without approved conditions) is specific to antipsychotic medication. Facilities with a F330 deficiency in the prior regulatory review, compared with facilities that did not receive the deficiency, averaged a 1.00-percentage point lower antipsychotic use rate in the next review period. This is a non-trivial effect, given that the average change in the proportion of residents that received an antipsychotic from 2000 to 2005 is 6.14 percentage points.

Although three of the facility-specific deficiency results are statistically significant, caution should be exercised. First, nursing home responses to facility-specific deficiencies are because of the potential for receiving increased monitoring by regulators for not having met standards in the past. This can cause facility-specific deficiency variables to not be strictly exogenous. Second, given the large sample ($n=64,711$), a 10% significance level for two of the three facility-specific deficiencies may imply that the relationship between the deficiency and antipsychotic use is weak.

The final state-level and facility-specific variables are the total number of deficiency citations. The average number of deficiencies per survey assigned by the state in the previous 12 months was significantly associated with *higher* use of antipsychotics by facilities in the state. For each additional deficiency cited statewide, the proportion of residents who used antipsychotic medications in a facility is higher by 0.18 percentage points. This result is consistent with a multitasking incentive problem and reflects a diversion of improvement efforts to other multiple areas of quality concerns when overall state regulatory stringency increases. Interestingly, the facility-specific total deficiency variable has a coefficient estimate near zero and is not statistically significant. This may reflect a pattern of greater response by facilities to specific deficiency types rather than to the total number of deficiencies received.

Although Table II reports three additional specifications, correlations of the state-level deficiency citation rates are rather high. This high co-linearity between the state regulatory variables may cause some of the coefficient estimates to not be statistically significant because of multicollinearity. Table III reports the coefficient estimates for the regulatory variables of various robustness checks. The base model is the regression results from Model 1 in Table II. The alternative models reported in Table III use the same variables as the base model and change only the selection of deficiency variables in the regression. The size of coefficient estimates for state regulatory variables shows little variation, and all variables that had statistically significant coefficients in the base model also had statistically significant coefficients in the alternative specifications. One coefficient estimate that shows some variation by specification is the state-level total number of deficiencies, with some specifications finding an effect that is about half as large as in the base model. The only other noticeable deviation from the base model is in the state-level physical restraint (F221) deficiency variable. In the base model, the coefficient estimate is -0.015 and is not statistically significant. In the robust specification, the coefficient estimate is -0.022 and is statistically significant at the 5% level.

6. CONCLUSION

Modeling nursing home response to regulation is very complex as states vary in many relevant policies and regulatory stringency that may affect treatment patterns, and because the outcomes of responses to regulatory actions are likely to take time. This paper builds on previous research related to regulation and quality of care in nursing homes by using a national panel of nursing homes to examine how facilities respond to state regulations. This paper finds that nursing homes increased their use of antipsychotics but that the rate of increase varied significantly by state, consistent with the general trend in antipsychotic use for the period. Although case-mix partially explains the increase in the use of antipsychotics, an important factor is the variation in the deficiency citation rates across states.

Table III. Coefficient estimates for state policy variables for alternative specifications

	Alternative specifications											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<i>Facility deficiencies (Prior survey)^a</i>												
Free from physical restraints (F221)	-0.017 (0.099)											
Free from chemical restraints (F222)		-0.289 (0.454)										
Receipt of mental health services for difficulty (F319) ^b			-0.033 (0.226)									
Unnecessary drug use (F329)				-0.171* (0.093)								
Free from antipsychotic use without approved conditions (F330)					-1.049*** (0.302)							
Efforts to reduce dosage and discontinue antipsychotics (F331)						-0.562** (0.268)						
Total number of deficiencies	-0.006 (0.007)	-0.006 (0.006)	-0.006 (0.006)	-0.003 (0.007)	-0.004 (0.006)	-0.005 (0.006)	-0.006 (0.006)	-0.006 (0.006)	-0.006 (0.006)	-0.006 (0.006)	-0.006 (0.006)	-0.006 (0.006)
<i>State regulatory deficiencies measures (Prior year)^c</i>												
Free from physical restraints (F221)	-0.015 (0.011)						-0.022** (0.011)					
Free from chemical restraints (F222)	0.002 (0.071)	-0.066 (0.069)						-0.067 (0.069)				
Receipt of mental health services for difficulty (F319) ^b	-0.103*** (0.029)		-0.123*** (0.028)						-0.123*** (0.028)			

Table III. Continued

	Alternative specifications											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Unnecessary drug use (F329)	-0.045*** (0.011)			-0.051*** (0.010)						-0.052*** (0.010)		
Free from antipsychotic use without approved conditions (F330)	0.044 (0.031)				-0.015 (0.028)						-0.023 (0.028)	
Efforts to reduce dosage and discontinue antipsychotics (F331)	-0.015 (0.040)					-0.040 (0.037)						-0.044 (0.037)
Total number of deficiencies	0.181*** (0.045)	0.093** (0.041)	0.100** (0.040)	0.144*** (0.042)	0.067* (0.039)	0.077* (0.040)	0.093** (0.041)	0.072* (0.039)	0.100** (0.040)	0.146*** (0.042)	0.068* (0.039)	0.078* (0.040)
Other state regulations (Prior year)	-0.115** (0.046)	-0.110** (0.045)	-0.079* (0.045)	-0.132*** (0.045)	-0.103** (0.045)	-0.108** (0.045)	-0.110** (0.045)	-0.100** (0.045)	-0.079* (0.045)	-0.132*** (0.045)	-0.104** (0.045)	-0.107** (0.045)
Real average state Medicaid reimbursement												
Minimum state direct care HPRD	0.219 (0.179)	0.277 (0.179)	0.252 (0.179)	0.235 (0.179)	0.272 (0.179)	0.281 (0.179)	0.280 (0.179)	0.276 (0.179)	0.252 (0.179)	0.236 (0.179)	0.277 (0.179)	0.279 (0.179)

Regressions use data from the standard OSCAR surveys for all non-hospital-based nursing facilities in the contiguous US. between 2000 and 2005. The base model contains the regression results from Model 1 in Table II. All regressions have the dependent variable of percentage of residents prescribed antipsychotics and are regressed using a facility-specific fixed effects panel regression that controls for serial correlation in the error term. The sample size is 64,711 for all specifications. Regressions control for facility operational characteristics, facility mental and physical acuity levels, facility staffing resources, and year dummies. Standard errors for the regression models are reported in parentheses.

^aFacility-specific deficiencies are indicator variables for receiving the specific deficiency and the total number of deficiencies in the prior regulatory review.

^bThe full name of the deficiency is "receipt of mental health services for mental or psychosocial adjustment difficulty."

^cState-level deficiencies are the proportion of regulatory reviews that received the specific deficiency and the average number of deficiencies per regulatory review in the prior 12 month period.

*Significant at 10%; **significant at 5%; ***significant at 1%.

The results of this study indicate that nursing homes are selectively responsive to regulatory deficiencies received by their peer institutions as well as those they receive themselves. This suggests that nursing homes respond in an anticipatory fashion to information that is reflective of regulatory stringency (i.e. the state regulatory environment and likelihood of enforcement). By discerning which deficiencies impact each quality area, policymakers will be better able to target deficiencies to improve specific quality areas. In the case of antipsychotics, we find evidence that high statewide deficiency rates for unnecessary drug use (F329) and the receipt of mental health services for mental or psychosocial adjustment difficulty (F319) influence the antipsychotic prescribing behavior of peer facilities through a 'regulatory stringency' effect. We also find evidence that facilities respond to receiving a deficiency for using antipsychotics without approved conditions (F330), whereas there is a weak association between antipsychotic use and other deficiencies for overuse and misuse of medication (F329 and F331).

Given the considerable risks of antipsychotics in this population documented by the FDA in its black box warning, it is of concern that the categorization of medication-related deficiency citations has become less rather than more specific in recent years. In 2006, federal regulators collapsed the antipsychotic-specific deficiency types F330 and F331 into the generic unnecessary medication use deficiency (F329) and eliminated two deficiency citations that could impact antipsychotic use if they are used more often (CMS, 2006). Although deficiencies F330 and F331 did not have a statistically significant impact on antipsychotic use at the state level, they did impact antipsychotic use at the facility level. By collapsing these deficiencies into F329, the federal government has eliminated the ability of state regulators to target antipsychotic use, and there may be value in reinstating these types of medication-specific deficiencies.

Although the total number of deficiencies received by a facility in the prior regulatory review did not impact the use of antipsychotics in a nursing home, facilities in states that issue more deficiency citations have higher use of antipsychotics. This result seems counter-intuitive because one might expect that state assignment of more deficiencies should lead to quality improvement. However, this result is consistent with the multitasking incentive problem. That is, when regulators attempt to increase facility effort in one aspect of quality, they may crowd out efforts in other areas. If the total number of state-level deficiencies is low, whereas the proportion of facilities that receive a specific deficiency complementary to antipsychotic use is high, regulators are sending a clear signal about which quality area needs improvement, and facilities respond by reducing their use of antipsychotics. However, states that issue a high number of deficiencies statewide are not providing a clear signal to facilities about which quality areas are important to regulators. This could cause facilities to spread their scarce resources for quality improvement across multiple dimensions of quality concern, leading to lower quality in some dimensions.

Although this study cannot distinguish between appropriate and inappropriate use of antipsychotics because OSCAR is limited in its specificity to case-mix, we find that the nursing homes adjust their use of antipsychotics in response to regulatory actions/mechanisms and that these regulations have different impacts. Our results suggest that regulators need to carefully weigh the positive impact of giving specific targeted deficiencies against the negative impact of assigning a high number of deficiencies. Specifically, in the case of antipsychotics, this implies using fewer total numbers of deficiencies, but focusing on the F319, F329, and F330 deficiencies can incentivize nursing homes to reduce their use of antipsychotics in the future. Assigning a high total number of deficiencies could derail facility quality improvement efforts for optimizing antipsychotic use.

Another way to send clearer signals would be to develop a quality measure based on the CMS guidelines to provide more specific guidance to both facilities and surveyors. Recording and reporting of this quality measure at admission and over time would allow surveyors and researchers to identify quality problems that are the result of poor care with more accuracy. This study provides useful insights into the ways in which specific deficiencies impact the quality of care provided by nursing homes, but future research should use longitudinal data that can differentiate between appropriate and inappropriate antipsychotic use and should focus on other aspects of quality.

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