Revisiting the relationship between nurse staffing and quality of care in nursing homes: An instrumental variables approach

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ABSTRACT

This paper revisits the relationship between nurse staffing and quality of care in nursing homes using an instrumental variables approach. Most prior studies rely on cross-sectional evidence, which renders causal inference problematic and policy recommendations inappropriate. We exploit legislation changes regarding minimum staffing requirements in eight states between 2000 and 2001 as exogenous shocks to nurse staffing levels. We find that registered nurse staffing has a large and significant impact on quality of care, and that there is no evidence of a significant association between nurse aide staffing and quality of care. A comparison of the IV estimation to the OLS estimation of the first-difference model suggests that ignoring endogeneity would lead to an underestimation of how nurse staffing affects quality of care in nursing homes.

1. Introduction

Considerable research has been devoted to examining the relationship between nurse staffing and quality of care in nursing homes (see Bostick et al., 2006; Collier and Harrington, 2008 for a review). Understanding this relationship is crucial for guiding policy interventions in order to improve quality of care and maintain cost efficiency. The past decade has seen an increase in calls to mandate minimum staffing requirements as a policy instrument to help solve the problem of quality deterioration in nursing homes nationwide (Institute of Medicine, 1986; U.S. Office of the Inspector General Department of Health and Human Services, 1999; U.S. General Accounting Office, 2003; U.S. Government Accountability Office, 2007, 2009a,b). By 2010, 41 states, including Washington D.C., had implemented minimum staffing mandates (Harrington, 2010).

Despite the large amount of literature on nurse staffing and the tremendous advocacy aimed at increasing minimum staffing requirements, existing studies have not yet reached definitive conclusions on how nurse staffing affects quality of care. For example, a large number of studies find that increases in registered nurse (RN) staffing improve health outcomes as measured by an array

of quality indicators (e.g., Cohen and Spector, 1996; Castle, 2000; Harrington et al., 2000b; Zhang and Grabowski, 2004; Castle and Myers, 2006; Decker, 2006; Castle and Anderson, 2011). Other studies, however, find no evidence to support such a direct relationship (e.g., Zinn et al., 1993; Porell et al., 1998; Intrator et al., 1999; Arling et al., 2007). Still other studies, including a well-designed study by Zimmerman et al. (2002), find some evidence of a negative association between RN staffing and quality of care. Research on the staffing of other types of nurses, such as licensed nurses (LNs) and nurse aids (NAs), is even more mixed (e.g., Cohen and Spector, 1996; Castle, 2000; Harrington et al., 2000b; Castle and Myers, 2006).

The lack of conclusive findings in the existing literature is not surprising. Most prior studies rely on cross-sectional evidence, which renders causal inference problematic and policy recommendations inappropriate. One threat to causal inference is omitted variable bias. It is likely that nursing homes with a higher level of staffing also have relatively higher levels of other inputs that affect quality of care, such as advanced medical equipment and efficient care management. Cross-sectional analyses lacking controls for these factors would lead to overestimates of the effect of nurse staffing on quality of care. Another threat involves endogeneity between staffing and quality of care. As Konetzka et al. (2008) show, staffing decisions are inherently endogenous. Nursing homes make structural decisions about staffing and quality of care subject to a set of constraints such as regulation, limited budget, and patient case mix. For example, a higher level of staffing might reflect

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an increased acuity level on the part of patients. Since patient case mix is difficult to control, one might expect an underestimate of the association between nurse staffing and quality of care. Analysis using longitudinal data has the advantage of accounting for time-invariant unobserved heterogeneity. However, the identification issue remains if there is time-variant unobserved heterogeneity that complicates the causal relationship between nurse staffing and quality of care.

To establish a causal relationship between nurse staffing and quality of care, this paper takes advantage of legislation changes regarding minimum staffing requirements, which we argue serve as exogenous shocks to nurse staffing levels. During 2000 and 2001, eight states (with separate requirements for RN and NA staffing) altered their mandates, which significantly impacted RN and NA staffing levels in nursing homes in those states. These legislation changes provide a great opportunity for examining the causal relationship between nurse staffing and quality of care using an IV approach.[1] Our identification relies on the assumption that changes in minimum staffing requirements affect quality of care only through nurse staffing. We argue that this assumption is likely valid given the crucial roles that nurses play in nursing home care production. We also provide additional evidence in support of the exclusion restriction of our IV approach through an empirical examination of possibilities for input substitution between labor and material and through an over-identification test. Furthermore, we address the complications caused by the implementation in 2003 of tort legislation changes in three states, which could potentially threaten our identification.

Using panel data from the federal On-Line Survey Certification and Reporting System (OSCAR), we find that RN staffing has a large and significant impact on quality of care, as measured by the count of deficiencies and a score measure that accounts for differentials in the scope and severity of violation for each deficiency.[2] More specifically, we find that increasing RN staffing by 0.3 hours per resident day (one standard deviation in the data) increases quality by more than 16%, which is equivalent to lowering the number of deficiencies from the average of 7.4 in the data to 6.2. We also find that NA staffing does not have a significant impact on quality of care. Our IV estimation of the first-difference model contrasts significantly with the OLS estimation, which is likely prone to bias due to time-variant unobserved heterogeneity. Our results are robust to alternative quality measures, the inclusion of a third nurse type (licensed practical nurse, LPN), a nonlinear relationship between nurse staffing and quality of care, alternative choices of study years, and alternative selections of states for analysis.

This paper contributes to the large amount of literature on the relationship between nurse staffing and quality of care in nursing homes.[3] To the best of our knowledge, most of the existing literature is non-causal. One important exception is a study by Konetzka et al. (2008). They utilize the introduction of a prospective payment system for Medicare in nursing homes in 1998 to serve as an exogenous financial shock to RN staffing. Using data from five states between 1997 and 2000, they find that higher RN staffing reduces adverse outcomes including pressure sores and urinary tract infections. Another exception is a paper by Zhang and Grabowski (2004), which exploits the establishment of federal minimum staffing mandates as a result of the passage of the Nursing Home Reform Act (NHRA) in 1987. This paper finds a positive association between RN staffing and quality of care, but only for cases in which nursing homes had particularly deficient staffing prior to the NHRA. Our paper differs from these two studies in several important ways. First, our identification exploits policy changes at the state instead of the national level, which enables us to produce a more precise estimation of the association between staffing and quality of care. Moreover, the richness in state policy variation allows us to conduct additional tests in support of the validity of the exclusion restriction of our IV approach, which is not used by Zhang and Grabowski (2004) and remains untested by Konetzka et al. (2008). Second, we explicitly study RN and NA staffing (and LPN staffing in a supplemental analysis) and separately identify their impact on quality of care. Lastly, we provide additional evidence by using deficiencies as proxies for overall quality of care.

Additionally, this paper closely relates to the literature on hospital nurse staffing and quality of care (e.g., Aiken et al., 2002; Kovner et al., 2002; Needleman et al., 2002; Mark et al., 2004; Blegen et al., 2011; Needleman et al., 2011). Within this large literature, the following two studies using hospital discharge data from California are worth noting. Evans and Kim (2006) exploit variation in Friday/Saturday admission to hospitals to identify whether a large shock of increased admission leads to adverse outcomes for patients admitted on Thursdays. They find evidence of some small effects. Cook et al. (2012) directly examine the association between hospital nurse staffing and patient outcomes using the failure to rescue rate and rate of decubitus ulcers. They find no evidence of a causal impact of nurse staffing on quality of care. Note that their identification relies on the mandates for minimum nurse staffing levels in California implemented in 2004. Our empirical strategies adapt those used in Cook et al. (2012).

2. Background and study design

2.1. Roles of different types of nurses and their potential impact on quality of care

Following the literature, we distinguish between three types of nurses: registered nurses (RNs), licensed practical nurses (LPNs), and nurse aids (NAs). We also refer to licensed nurses (LNs) as the combination of RNs and LPNs. RNs include registered nurses and directors of nursing. RNs mainly play supervisory roles: they supervise other nurses, assess residents' health conditions, develop treatment plans, and administer medications. RNs are also responsible for assigning nurses' work schedules. LPNs primarily carry out medication management and tasks such as taking patients' vital signs (e.g., blood pressure and temperature). NAs include certified nursing assistants and nursing assistants, who provide direct nursing care to help residents with daily living activities such as bathing, dressing, using the toilet, and taking medication.

Conceptually, RN staffing is vital to the quality of care provided in nursing homes. RNs' clinical knowledge, care coordination, and professional oversight make them likely to be crucial factors in determining the quality of nursing home care (Castle and Anderson, 2011). NAs also appear essential given that they deliver 80–90% of direct care to patients (Institute of Medicine, 1996). LPNs might have a lesser influence on quality of care given the narrow range of duties that they conduct as compared to RNs and NAs (Castle

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[1] The construction of our instrumental variables follows the idea that the extent to which a nursing home changes its staffing levels correlates with its initial distance from the newly imposed standards. More specifically, we create two distance variables for RN and NA staffing. We also include their squared terms and an interaction term of the two distance variables. We provide more details in Section 3.3.

[2] Quality measures using data on deficiency have been widely used in the literature. See Section 3.2 for more discussion. Alternative quality measures based on patient outcomes have delivered consistent results, which are covered in Section 5.2.

[3] Some related studies directly examine the policy impact of imposing minimum staffing requirements in nursing homes, such as Park and Stearns (2009) and Matsudaira (2014).